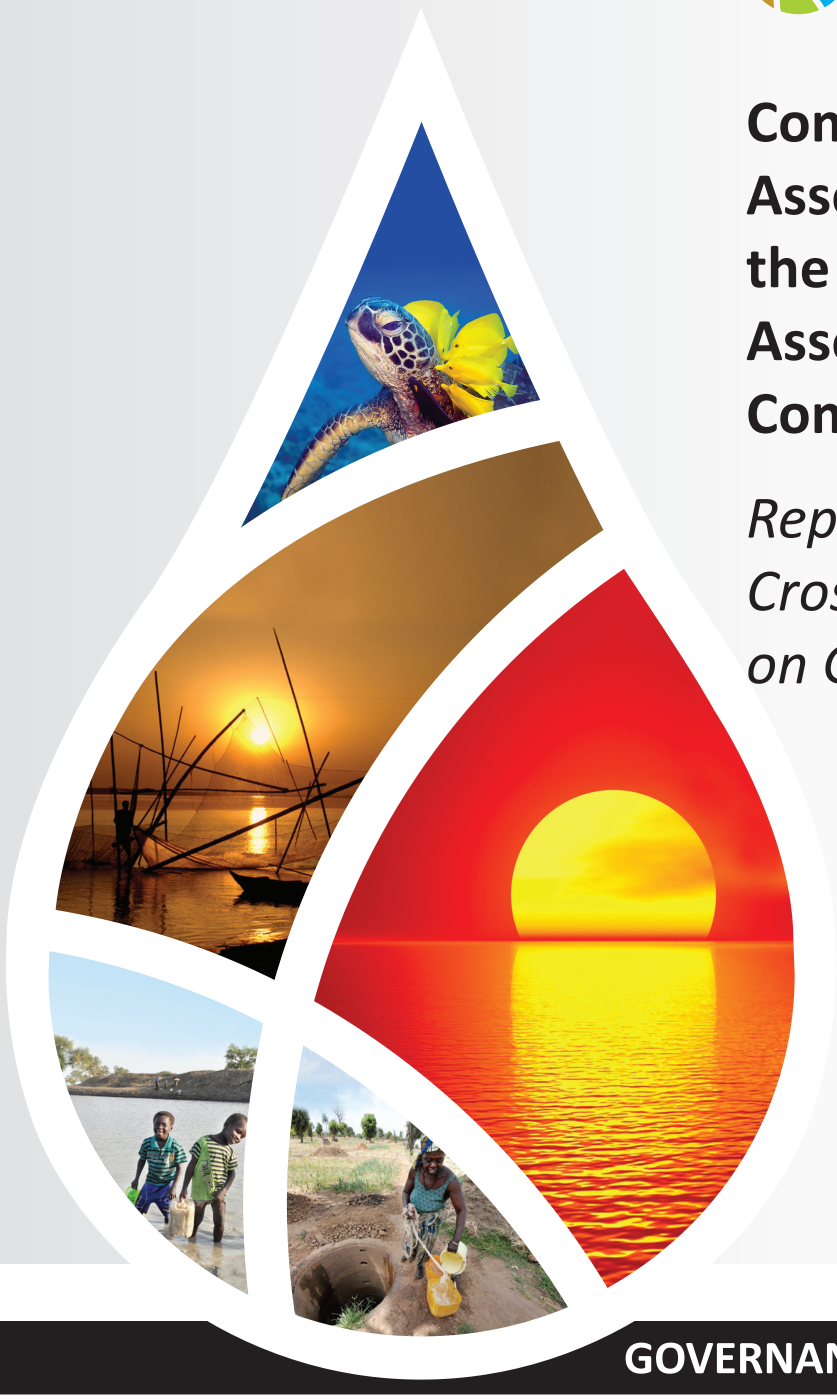
TWAP
TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

Comparison of Governance Assessments Conducted by the Transboundary Waters Assessment Programme Components

Report of the TWAP Crosscutting Working Group on Governance



GOVERNANCE ASSESSMENTS

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Centre on Water and Environment
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Preface

The Global Environment Facility (GEF) approved a Full Size Project (FSP), "A Transboundary Waters Assessment Programme: Aquifers, Lake/Reservoir Basins, River Basins, Large Marine Ecosystems, and Open Ocean to catalyze sound environmental management", in December 2012, following the completion of the Medium Size Project (MSP) "Development of the Methodology and Arrangements for the GEF Transboundary Waters Assessment Programme" in 2011. The TWAP FSP started in 2013, focusing on two major objectives: (1) to carry out the first global-scale assessment of transboundary water systems that will assist the GEF and other international organizations to improve the setting of priorities for funding; and (2) to formalise the partnership with key institutions to ensure that transboundary considerations are incorporated in regular assessment programmes to provide continuing insights on the status and trends of transboundary water systems.

The TWAP FSP was implemented by UNEP as Implementing Agency, UNEP's Division of Early Warning and Assessment (DEWA) as Executing Agency, and the following lead agencies for each of the water system categories: the International Hydrological Programme (IHP) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) for transboundary aquifers including groundwater systems in small island developing states (SIDS); the International Lake Environment Committee Foundation (ILEC) for lake and reservoir basins; the UNEP-DHI Partnership – Centre on Water and Environment (UNEP-DHI) for river basins; and the Intergovernmental Oceanographic Commission (IOC) of UNESCO for large marine ecosystems (LMEs) and the open ocean.

The five water-category specific assessments cover 199 transboundary aquifers and groundwater systems in 43 small island developing states, 204 transboundary lakes and reservoirs, 286 transboundary river basins; 66 large marine ecosystems; and the open ocean, a total of 756 international water systems. The assessment results are organized into five technical reports and a sixth volume that provides a cross-category analysis of status and trends:

Volume 1 – ***Transboundary Aquifers and Groundwater Systems of Small Island Developing States: Status and Trends***
Volume 2 – ***Transboundary Lakes and Reservoirs: Status and Trends***
Volume 3 – ***Transboundary River Basins: Status and Trends***
Volume 4 – ***Large Marine Ecosystems: Status and Trends***
Volume 5 – ***The Open Ocean: Status and Trends***
Volume 6 – ***Transboundary Water Systems: Crosscutting Status and Trends***

A ***Summary for Policy Makers*** accompanies each volume.
The Report of the TWAP Crosscutting Working Group on Governance(CCWG) provides a brief on the overall activities of the CCWG, provide a comparative analysis of the governance assessments carried out for the five water system categories, and briefly examines the governance implications of biophysical linkages among adjacent water systems from different International Waters (IW) water categories. The report is a collaboration of the five independent water-category based TWAP Assessment Teams under the leadership of the Cross-cutting Analysis Working Group on Governance, with support from the TWAP Project Coordinating Unit.

Contents

Figures

Tables

Summary

The water systems of the world, aquifers, lakes, rivers, large marine ecosystems and Open Ocean, provide goods and services that are essential for human well-being. Many of these systems are transboundary. The Global Environment Facility International Waters (GEF IW) focal area is supporting the Transboundary Waters Assessment Programme (GEF TWAP) which is the first global-scale assessment of transboundary waters. The methodologies for this assessment were developed during the TWAP Medium-sized Project (MSP)(2009-2010). The TWAP Full-sized Project updated and implemented these methodologies to conduct the first truly global comparative assessment for the five transboundary water system categories. The TWAP consists of five independent indicator-based assessments.

During the development of the TWAP methodology the five working groups for the water categories developed their approaches to assessing governance. However, these approaches were not as comprehensive as desired, due to the lack of established methods for assessing governance in the literature and also of data on governance. Therefore, it was decided to treat governance as a crosscutting issue and to try and harmonise governance assessment approaches to the extent possible. A crosscutting working group on governance (Governance CCWG) was established to explore a common methodology and to coordinate its application in the FSP. The Governance CCWG developed a methodology which was to be incorporated into the assessment process for each water category. Its role was to harmonise, integrate and synthesise governance assessments across all five water categories to the extent possible by:

- Promoting the application of a common methodology for assessment of governance arrangements;
- Harmonising concepts and terminology to the extent possible
- Assessing selected linked water systems
- Synthesising and comparing governance assessments to the extent possible

The purposes of this document are to:
1. Report briefly on the overall activities of the Governance CCWG,
2. Provide a comparative analysis of the governance assessments carried out for the five water system categories, and
3. Briefly examine the governance implications of biophysical linkages among adjacent water systems from different IW water categories.

An overview of the activities and outputs of the Governance CCWG is provided in Appendix 1. The second and third purposes are addressed below.

Ultimately, after evaluating and testing a proposed crosscutting governance methodology to be used among the five component working groups, its application was deemed too time consuming and too demanding or difficult to obtain data for application by the aquifers, lakes and rivers working groups owing to the large numbers of systems in these water categories. The LMEs and open ocean working groups adapted the proposed methodology and applied it.
The use of different governance approaches by the five working groups precluded a straightforward comparison of results. However, it was agreed by the Governance CCWG that the treatment of governance in such an assessment would be facilitated by the adoption of a common indicator framework, even if the same indicators were not used in each water category.

Possible frameworks were considered and an expanded version of the three-category GEF IW indicator framework was adopted. In addition to the original three indicator categories of governance process, ecosystem pressure and ecosystem state, the expanded framework includes four new indicator categories making a total of seven:
- Governance architecture,
- Governance process,
- Stakeholder engagement,
- Ecosystem pressure,
- Ecosystem state,

- Social justice,
- Human well-being.

Altogether these seven categories were identified as fully covering the range of indicators that are needed to assess whether both ‘good’ and ‘effective’ governance have been achieved. This distinction was considered important with ‘good governance’ indicators (architecture, process, stakeholder engagement) showing whether arrangements and processes are in place and reflect accepted international norms. ‘Effective governance’ indicators (social justice, ecosystem pressure, ecosystem state, human well-being) reflect whether governance has achieved what it set out to achieve.

The indicators used by the TWAP assessments were mapped into the expanded framework. This proved to be challenging in the case of composite indicators that spanned several indicator categories. The mapping showed that there was a preponderance of ecosystem state and ecosystem pressure indicators. There were much fewer ‘good governance’ indicators, particularly governance process and stakeholder engagement. There were no indicators in the social justice category and very few for human well-being. Consequently, it was clear that few key issues in the water systems assessed were covered by a full suite of indicators, although in most cases there were indicators for ecosystem pressure and state across the issue areas of water quality, water quantity, fisheries and biodiversity (where applicable).

The CCWG recommends that in future assessments, whether global or not, the GEF adopt an approach in which all known critical issues for the water system being assessed are covered by a full suite of indicators covering all seven indicator categories in the expanded framework.

The real value of this perspective could be realised most fully by building the use of the framework into GEF IW projects from start to finish. The use of the framework and indicator categories in conducting a Transboundary Diagnostic Analysis (TDA) would reveal the issue-specific gaps in governance architecture and process in all the dimensions shown in Figure 3. It would provide a structured approach to assessing both ‘good governance’ and ‘effective govenance’ that is currently missing from the TDA process. Furthermore, the framework would facilitate the development and implementation of the Strategic Action Programme (SAP) by linking the extent to which the architecture and processes needed for good governance are in place with issue-specific indicators for effectiveness. Ultimately, this approach would facilitate the development of a SAP that would be aimed at filling the gaps found in the framework, and improving associated enabling conditions or mitigating risk factors in order to improve human well-being.

The CCWG recommends that the expanded governance framework be used to improve the TDA-SAP process.

1. Introduction

1.1 Introduction to TWAP

The water systems of the world - aquifers, lakes, rivers, large marine ecosystems, and Open Ocean - support the socioeconomic development and well-being of its population. Many of these systems are shared by two or more nations and these transboundary resources are interlinked by a complex web of environmental, political, economic and security interdependencies. The Global Environment Facility International Waters (GEF IW) focal area is enabling the Transboundary Waters Assessment Programme (GEF TWAP) to provide the first global-scale assessment of transboundary waters, improve knowledge for informed decision-making, raise awareness and foster cooperation among all stakeholders.

The methodologies for conducting a global assessment of the five categories of transboundary water systems were developed during the TWAP Medium-sized Project (MSP)(2009-2010)(Jeftic et al. 2011). The TWAP Full-sized Project (FSP) updated and implemented the methodologies developed in the MSP to conduct the first truly global comparative assessment for the five transboundary water system categories. The project results will assist the GEF and other international organizations in setting priorities for supporting the conservation of transboundary water systems. The TWAP consists of five independent indicator-based assessments, including their socioeconomic and governance-related features.[1]

Governance as envisaged by the CCWG is about interactions among actors or stakeholders, the institutions, whether formal or informal, that provide context for these interactions, and the visions and principles that guide these institutions and interactions. Hence the following definition of governance is a useful one. "Governance is the whole of public as well as private interactions taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them." (Kooiman et al. 2005). Similar perspectives are espoused by most groups working on governance of natural resources (Biermann et al. 2009, Armitage et al. 2008). According to the Science and Implementation Plan of the Earth System Governance Project, their "[...] notion of governance refers here to forms of steering that are less hierarchical than traditional governmental policy-making (even though most modern governance arrangements will also include some degree of hierarchy), rather de-centralized, open to self-organization, and inclusive of non-state actors that range from industry and non-governmental organizations to scientists, indigenous communities, city governments and international organizations" (Biermann et al 2009). Hence the approach taken in this comparative analysis will be based on these broader perspectives of governance.

1.2 Governance assessment in TWAP

During the development of the TWAP methodology, the working group for each of the five IW water categories developed their approaches to assessing governance (Jeftic et al. 2011). In the final MSP Project Steering Committee (PSC) meeting, the working groups noted that they had not been able to include as comprehensive an assessment of governance as they had desired. This was because there were few existing governance indicators that were specific to the sustainability issues of concern in IW systems that could be drawn upon for such an assessment. This is in contrast to the numerous general governance indicators available at country level, such as those developed by the World Bank or Transparency International (Arndt and Oman 2006). It was also noted at the PSC meeting that governance is a crosscutting issue that would benefit from harmonisation of approaches to the extent possible.

1 http://www.geftwap.org/

The PSC established a crosscutting working group on governance (Governance CCWG) to explore the possibility of a common methodology for assessment of governance architecture for the five water categories. The Governance CCWG developed a methodology which was to be incorporated into the assessment process for each water category (Mahon et al. 2011).

The Governance CCWG was also continued into the TWAP Full-size Project (FSP) (2013-2015) to harmonise, integrate and synthesise governance assessments across all five water categories to the extent possible by:

- Promoting the application of common methodology for assessment of governance arrangements;
- Harmonising concepts and terminology to the extent possible
- Assessing selected linked water systems
- Synthesising and comparing governance assessments to the extent possible

1.3 Purpose of this report

The purposes of this document are to:

1. Report briefly on the overall activities of the Governance CCWG and
2. Provide a comparative analysis of the governance assessments carried out for the five water categories, and
3. Briefly examine the governance implications of biophysical linkages among adjacent water systems from different IW water categories.

An overview of the activities and outputs of the Governance CCWG is provided in Appendix 1. The second purpose comprises the bulk of the report and leads to recommendations for improving the approach to governance in GEF IW projects, particularly in Transboundary Diagnostic Analyses (TDAs). There is a preliminary examination of the biophysical linkages which indicates that the implications of these could be substantial.

2 A framework for governance assessment

The comparative analysis of governance assessment among IW water categories will be most easily approached if there is a common framework for discussing governance assessment. This framework would facilitate the development of appropriate indicators for its various parts. There are several frameworks that can be drawn upon, for example, the Institutional Analysis Framework (Ostrom 2009), Interactive Governance Approach (Kooiman et al. 2005), the International Lake Ecosystems Committee (ILEC) six pillars approach (ILEC and RCSE 2014), the LME Governance Framework (Fanning et al. 2007), the TWAP Open Oceans/LME modified DPSIR (IOC-UNESCO and UNEP 2016a, 2016b) and the expanded GEF IW indicator framework developed for the Caribbean Large Marine Ecosystem Project (Mahon et al. 2013). These frameworks range from highly conceptual to operational. They are not mutually exclusive or independent and have many common elements.

In the case of TWAP there is the need to have a practical framework that can be used to operationalize governance assessment. Some desirable characteristics of such a framework include:

- Easy to understand, so that it is clear what the selected indicators cover and what they do not;
- Comprehensive, so that the indicators cover all the aspect of governance that should be addressed;
- Well-grounded in governance thinking and concepts;
- Connected with actions that can be taken to improve governance.

For the comparative analysis of governance assessment in the TWAP, the expanded GEF IW indicator framework was considered to be the most appropriate. It appears to meet the criteria listed above. This framework and its relationship to other frameworks are described and discussed in the next section.

2.1 The expanded GEF indicator framework

The assessment of governance arrangements and their effectiveness is a complex and multifaceted task (Young, 2013). It continues to be a significant subject for discussion among scholars and practitioners alike, particularly in assessing success in the area of integrated coastal and ocean management (Olsen 2003, Stojanovic et al. 2004, IOC 2006, Bille 2007, Tabet and Fanning 2012, Jacobson et al. 2014, Maccarrone et al. 2014, Botero et al. 2016).
To facilitate evaluation, Young (1999) suggests one perspective is to break what governance is expected to achieve into three components:

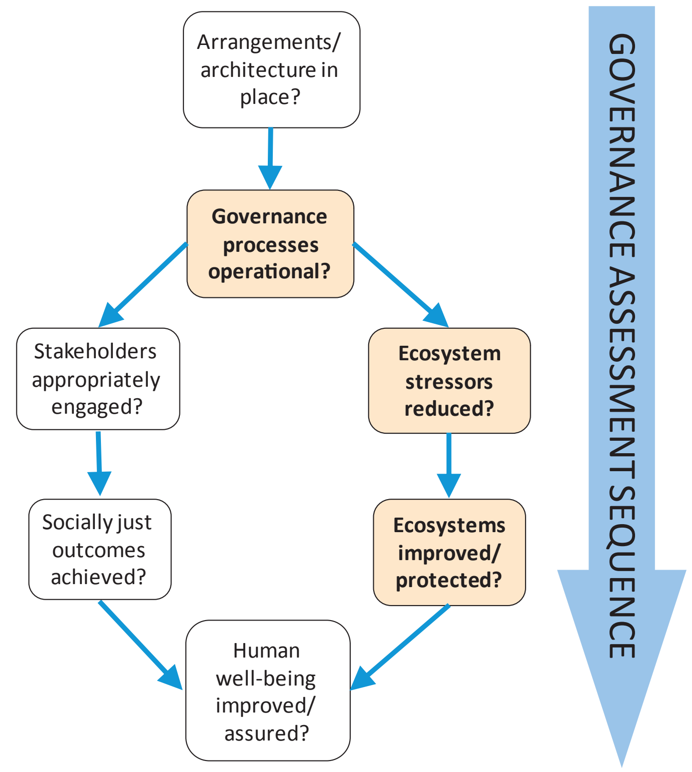
- The first is ‘outputs’, which are the arrangements that are put in place to achieve governance.
- The second is ‘outcomes’ which represents changes in the behaviour of people that are the target of the arrangement.
- The third is ‘impact’ which represents changes in the state of the system that is the target of the arrangement.

The framework developed by Olsen (2003) for integrated coastal management takes a similar approach and like that developed by Ehler (2003) and Hockings et al. (2006) allows for considerations to be made regarding both interventions and the assumptions underlying those actions. In these frameworks, the focus is on the entire management cycle and ensuring that mechanisms are in place within the governance architecture to allow for adaptation, should the desired outcomes not be achieved. For example, Olsen (2003) examines the four orders of outcomes: (1) Enabling conditions; (2) Changes in behaviour; (3) improvements in the system, and (4) sustainability achieved. Similarly IOC (2006) also considers four categories of indicators needed to assess governance of coastal and ocean systems: (1) Inputs; (2) Processes; (3) Outputs; and Outcomes. As noted by Jacobsen et al (2014, p.52), “without coverage across different components of the management cycle, identifying which elements of management to adapt is problematic.”

These components can be assessed separately with appropriate indicators. They should also be assessed in sequence, as it is likely that there will be time lags in changes in them. This perspective is consistent with the formulation of the GEF IW programme approach to evaluation of its projects and interventions, which has been based on three categories of indicators: (1) process indicators, (2) stress reduction indicators and (3) environmental status indicators (Duda 2002).

Mahon et al. (2013) suggested that with the increased understanding of governance over the past decade, the GEF IW evaluative approach should be expanded to include additional categories of indicators that are critical when assessing governance effectiveness for sustainable development. They proposed that, for the indicator scheme to be in accord with current thinking regarding the goal of sustainable development, there should be additional categories of indicators for: (1) governance architecture, (2) stakeholder engagement, (3) social justice and (4) human well-being. The latter three are in tandem with those for environment (Figure 1). The first, governance architecture, is included because assessment of the existing or proposed additional categories of indicators will be dependent upon the institutional structure in place to facilitate decision-making, planning and implementation.

Figure 1: *The expanded GEF IW indicator framework of Mahon et al (2012). The original GEF IW indicator categories (Duda 2002) are shaded. The new indicator categories are unshaded.*



The view that an appropriate governance structure is a necessary but insufficient condition for successfully achieving improved human well-being, led Mahon et al. (2013) to call for the assessment of governance architecture to precede the assessment of governance process. This distinction is considered to be particularly important in the case of multilevel nesting typical of international environmental governance systems (Young 2002, Fanning et al. 2007, Biermann 2007). Indeed, Biermann and Pattberg (2012, p.274) observe that "... increasingly the debate turns toward what we describe as an overarching 'architecture' of global environmental governance, that is, the entire interlocking web of widely shared principles institutions and practices that shape decisions by stakeholders at all levels in this field".
The expanded GEF IW indicator framework provides for the full set of indicators needed for a comprehensive governance assessment (Fig 1). The seven indicator categories cover the two major aspects of such an assessment:

a) Determining if governance arrangements and processes have been set up in a way that is consistent with accepted institutional norms and practices (architecture, process, engagement) - namely whether 'good governance' is in place;
b) Determining if the governance practices have achieved what they were established to do (ecosystem pressure, ecosystem state, social justice, human well-being) – namely whether there has been 'effective governance'.

Ultimately, 'good governance' characteristics might be expected to produce better governance results. However, the state of governance research is such that it is not possible to be definitive about the relationship between 'good governance' characteristics and governance effectiveness. Nonetheless, 'good governance' characteristics are often cited as being desirable attributes of governance architecture and processes in their own right (Lemos and Agrawal 2006, Lockwood et al. 2010).

The indicators categories shown in Fig 1 form an assessment sequence. The indicators in the earlier (upper) categories will be verifiable sooner after implementation than the later (lower) ones. Ecosystems may take decades to respond to reduced pressures; and changes in human well-being is only likely to occur after ecosystem and social justice outcomes have occurred. A further complication is that as one moves down the sequence it will be more difficult to demonstrate cause and effect between interventions, outcomes and impacts. It will often be clear that a process outcome (plan or regulation) has led to a pressure reduction. However, tracking the effects of a pressure reduction on system state or of system state on well-being may be more difficult due to confounding factors that are external to the intervention that is being assessed.

2.2 Using the indicator framework

The use of the term indicators calls for some elaboration. Strictly, an indicator shows if there has been some change in a selected attribute of the system being monitored. The indicator should have directionality so that it shows whether the attribute is improving or deteriorating. Ideally, an indicator should have target or threshold values which are to be aimed for or to be avoided (Caddy and Mahon, Ehler 2003, Shin et al., 2010). However, when the state of an attribute is clearly undesirable, identifying the direction of change needed for improvement may be enough to guide governance action until targets can be determined (Berkes et al. 2001). Furthermore, even when the same indicators may be used in different IW systems or instances within systems situations, the target levels must be situation specific and may differ among instances.

Indicators could be used as a monitoring tool to provide the feedback necessary to identify what has been done and as such measures progress toward stated management goals and objectives. In contrast, indicators used for evaluation provide insight into what should have been done and is therefore a measure of the effectiveness of the stated goals and objectives. (Botero et al. 2016). These assessments are essential to adaptive learning within complex coastal systems as the findings may reveal information leading to a rerouting, rereading and reinterpretation of the stated goals and objectives (Bille 2007).

Table 1. Indicator categories and examples of subcategories

Indicator category	Indicator subcategories (examples)
Governance architecture	Existence and structure of institutions Agreements concluded Mechanisms for linking stages of the policy cycle Mechanisms for integration
Governance process	Existence and structure of institutions Agreements concluded Mechanisms for linking stages of the policy cycle Mechanisms for integration
Ecosystem pressure (relative to some target state or desired direction)	Population changes in basin Use of habitat and biodiversity Fisheries effort or demand Pollution inputs
Ecosystem state (relative to some target state or desired direction)	Habitat/ biodiversity Level of pollution/water quality Fisheries Water quantity
Stakeholder engagement	Evidence of participation Attention to disadvantaged groups and minorities Availability of information Access to capacity building to engage
Social justice	Income equitability Sustainability of traditions
Well-being	Economic benefits Access to social services Access to ecosystem services

In order to ensure that there is comprehensive assessment of both good governance and effective governance within a transboundary water system, it is necessary to ensure that indicators are developed and monitored in each of the seven categories for each issue identified as being of concern in that system. Adequate coverage of an indicator category may require more than one indicator. Consequently, in developing a governance assessment or monitoring programme, it may be necessary to consider subcategories of the indicator for each category. Table 1 provides examples of what some of these subcategories might be.

It must also be emphasised that when applying this framework within or across water categories, indicators in each category will be situation specific. They should be selected to provide the best representation of the critical issues in each indicator category.

2.3 The TWAP Level 1 governance assessment focus and methodology

Strictly, the TWAP transboundary water governance assessments were intended to focus on the first indicator category in Fig 1; governance architecture. The TWAP methodology therefore focussed on the types of structures and processes (architecture) needed to support the other six indicator categories. However, it is important to keep in mind the distinction between (1) assessing (or designing) governance architecture that leads to appropriate processes, covers the important stressors, etc., (good governance) and (2) evaluating how well the governance arrangements have performed (effective governance). Clearly, these are linked in an iterative management cycle in which evaluation of performance should lead to review of architecture. However, the primary intent was for TWAP to focus on current architecture – referred to as the TWAP Level 1 Governance Assessment methodology.
The Level 1 Governance Assessment methodology for transboundary water systems developed for TWAP evaluates two major aspects of governance architecture:
(1) whether all transboundary issues are covered by governance arrangements that have fully-functioning decision-making processes or policy cycles, and
(2) Whether there is integration across the different arrangements.

Several steps are required to determine the governance arrangements in place for a particular water system (Table 2). The whole architecture is considered to be greater than the sum of its parts, especially for integration of governance at the transboundary level. This process, as summarized in Table 2, ultimately provides a picture of:

- The extent to which transboundary governance issues are covered, thereby allowing for gaps to be identified;
- The match between governance arrangements and issues;
- The extent to which arrangements extend outside the system;
- The extent to which issues are covered by multiple arrangements that could result in conflict;
- How well arrangements are clustered or integrated to make the best use of existing institutions and organizations.

In step 3, the approaches to evaluating the arrangements may vary among systems and arrangements, ranging from highly expert judgment-based to being based on extensive desk-top analysis of multilateral agreements, protocols, institutional constitutions and other instruments, supported by sound science and or stakeholder opinion. This allows for considerable flexibility in approach within each system, but will also mean that the final summaries for the systems will be based on widely ranging degrees of analysis. These differences will have to be borne in mind when comparing assessment across water systems and categories.

Table 2. Steps required to assess governance architecture in a system to be governed

Step	Key points
1. Identify system to be governed	Begin with a clear definition of the system to be governed. Geographical boundaries of the system and the countries involved in the transboundary system must be clearly identified.
2. Identify issues to be governed	In some IW systems, the issues will already have been identified through a TDA and may have been further explored through Causal Chain Analysis (CCA). In others, the issues may have to be identified. Issues may have both a topical and a geographical component.
3. Identify /assess arrangements for each issue	Determine the extent to which each issue is covered by an identifiable arrangement that is specific to the issue, whether formal or informal. The aim will be to evaluate the extent to which the arrangement comprises a complete policy cycle with the potential to function in three modes (Kooiman 2003): (1) The meta-mode (articulation of principles, visions and goals); (2) the institutional mode (agreed ways of doing things reflected in plans and organizations; and, (3) the operational mode. It also examines the extent to which these modes may operate at different scale levels within the same arrangement, hence the need for linkages within arrangements.
4 Identify clustering of arrangements within institutions	Examine the way that arrangements are clustered for operational purposes and/or share common institutions/organisations at different levels. Similar issues may be covered by similar arrangements. There may be efficiency in clustering these arrangements. Alternatively, clustering may occur at higher levels for policy setting or institutional efficiency, but be separated at lower levels.
5. Identify linkages	Identify actual and desirable linkages within and among arrangements and clusters.

3 Evaluation of the governance architecture and process indicators used in TWAP

In the first part of this section we review what each water category intended to do (based on their plans at the beginning of the project) and what they actually did. Reasons for variances and experiences in implementing what was done are reviewed in the second and final parts of this section. Ultimately the assessments carried out by some water categories went beyond the assessment of architecture into the assessment of process and/or engagement. Where that was the case, those aspects are included in this comparative analysis of governance assessments.

3.1 Description of approaches

The starting point of the TWAP assessments for the different components was quite different, and this was an additional reason why it was not feasible within the TWAP FSP to fully align the governance assessment between the five components.

3.1.1 Aquifers

The aquifers WG used the methodology described in the aquifers MSP report (UNESCO-IHP, IGRAC, WWAP 2012). Of a total of 20 indicators to be assessed in the groundwater component the methodology comprised four governance related indicators in two categories as shown in table 3.

Table 3. Governance indicators for the aquifers assessment

Indicator	Scoring criteria
Category 1: Enabling environment for transboundary aquifer resources management	
Transboundary legal framework (existence, status and comprehensiveness of a binding agreement on the transboundary aquifer under consideration)	1. Agreement with full scope for TBA management signed by all parties 2. Agreement with limited scope for TBA management signed by all parties 3. Agreement under preparation or available as an unsigned draft 4. No agreement exists, nor under preparation
Transboundary institutional framework (existence, mandate and capabilities of institutions or institutional arrangements for managing the transboundary aquifer under consideration (all types of interventions))	1. Dedicated transboundary institution fully operational 2. Dedicated transboundary institution in place, but not fully operational 3. National/Domestic institution fully operational 4. National/Domestic institution in place, but not fully operational 5. No institution exists for TBA management
Category 2: Implementation of groundwater resources management measures	
Control of groundwater abstraction (current practices on the implementation of measures to control groundwater abstraction)	1. Combination of Regulatory and Suasive measures applied 2. Regulatory/Direct measures applied (licensing) 3 Indirect/suasive measures applied (incentives/discentives) 4. No measures for control applied
Groundwater quality protection (current practices on the implementation of groundwater quality protection)	1. Combination of Regulatory and Suasive measures applied 2. Regulatory/Direct measures applied (licensing) 3 Indirect/suasive measures applied (incentives/discentives) 4. No measures for control applied

In addition to the above indicators, it was agreed during development of the FSP to assess the transboundary governance architecture for 3-5 aquifer systems using the TWAP methodology developed during the MSP (Jeftic et al. 2011).

The TWAP Groundwater component focussed on collecting data to set-up the first global database on transboundary groundwater, rather than on detailed analyses. The process started with the mapping of many of the transboundary aquifer systems (prior to TWAP the exact location of many of the transboundary aquifers was still unknown) and subsequently collecting basic data for the assessment. Given the limited time-span of the TWAP project this process did not allow for collecting and analysing detailed thematic data, which are required to apply the full suite of governance indictors. Lastly, only seven cooperative agreements on transboundary aquifers exist worldwide, which means that a detailed governance assessment would have required assessing and comparing national laws, policies and practices related to the governance of the transboundary groundwater resources. This was beyond the scope of the TWAP groundwater assessment.

3.1.2 Lakes

The approach to assessing governance that was proposed for transboundary lakes in the TWAP MSP was based on the International Lake Environment Committee (ILEC) methodology (ILEC and RCSE - Shiga University 2012,) as stated in the lakes MSP report (ILEC 2011). The initial considerations included the following descriptive indicators.

- Government effectiveness, based on the World Bank indicator (Kauffman 2010)
- Control of corruption, based on the World Bank indicator
- Rule of law, based on World Bank indicator
- Voice and accountability, based on World Bank indicator
- Access to improved sanitation from the World Bank using WHO, UNCF, JMP, GADM, Landscan
- Coverage in literature as an indicator of availability of information for policy
- Gross national income international development support
- National Integrated Water Resource Management (IWRM) plans.

In addition to the above indicators, it was agreed during development of the FSP to assess the transboundary governance architecture for 3-5 lake systems using the TWAP methodology developed during the MSP (Jeftic et al. 2011).

Ultimately, after identifying a final list of 206 transboundary lakes, it was recognised that there were severe data limitations regarding the analyses that had been originally proposed, including use of the above-noted indicators. Accordingly, rather than trying to get an overview of in-lake conditions of the transboundary study lakes, it was decided to evaluate the relative risks to the lakes on the basis of the stresses to them from their surrounding drainage basin, the resulting impairments on the lakes from the stresses, and the possible impacts of these impairments on the sustainability of the ecosystem goods and services they provide to the basin stakeholders (ILEC and UNEP 2016). The basin stresses were grouped under the categories of catchment disturbance, pollution, water resource development, and biotic factors (ILEC and UNEP 2016).

With regard to governance, there are a few examples of well-studied transboundary lakes with various 'agreements' or conventions in place (e.g., North American Great Lakes; Lake Geneva; Lake Titicaca; Lake Victoria; Lake Chad). The governance architecture for these lakes could be examined in some detail, but would provide a rather skewed picture of the governance realities concerning transboundary lakes in general. Further, lakes continue to receive little attention in global water fora and international agreements, in spite of the vast quantities of freshwater they contain and the wide range of ecosystem goods and services they provide. Consequently, it was decided that given the unavailability of data but for a few prominent lakes, no governance indicators were pursued for transboundary lakes. However, ILEC is continuing to refine and apply its Integrated Lake Basin Management (ILBM) Platform process to lakes and reservoirs as a virtual stage for collective stakeholder actions to improve lake basin governance in countries around the world. As a complement to the existing IWRM process, ILBM represents “an approach for achieving sustainable management of lakes and reservoirs through gradual, continuous and holistic improvement of basin governance, including sustained efforts for integration of institutional responsibilities, policy directions, stakeholder participation, scientific and traditional knowledge, technical possibilities, and funding prospects and constraints” (Nakamura and Rast 2014).

3.1.3 Rivers

The governance indicators used for rivers addressed the governance aspects of legal frameworks, resilience to hydro-political tensions and enabling environment (table 3). The indicators complement each other by addressing various aspects of the governance needs and pressures in a transboundary river basin. Effective transboundary river basin management requires robust legal and institutional frameworks at both the transboundary and national levels (Gander 2013). The frameworks are needed to cope with pressures on the basin, such as development and changes in climate (De Stefano et al. 2012). For more information on the transboundary rivers governance assessment, see UNEP-DHI and UNEP 2016.

The Legal Framework indicator is based on the premise that the governance of a transboundary basin is guided by (amongst other things) the legal agreements in place and that these provide a framework for managing the shared water resources of a basin. Principles of international water law have been defined to guide dialogue among riparians for creating effective transboundary water resources management. This assessment maps the presence of widely recognised key international legal principles in transboundary treaties to determine the extent to which the legal framework of the basin is guided by these principles. The indicator assesses the degree of correspondence/alignment of existing transboundary freshwater treaties with the six key legal principles described in table 4 above (ILC 1996, 2004, McCaffrey 2003).[2]

The Hydropolitical Tension indicator maps the risk of potential hydro-political tensions that exist when basins may be ill-equipped to deal with transboundary disputes associated with the development of new water infrastructure.

Table 4. Governance indicators for the rivers assessment

Indicator	Scoring criteria
Legal framework	The degree of alignment of existing transboundary freshwater treaties with key legal international water law principles: a) equitable and reasonable utilization; b) not causing significant harm; c) environmental protection; d) cooperation and information exchange; e) notification, consultation or negotiation; f) consultation and peaceful settlement of disputes.
Hydropolitical tension	The potential of hydro-political tension with the development of new infrastructure, and the degree of governance capacity to mitigate the tension, measured by the following 5 components: a) existence of treaty; b) treaty with an allocation mechanism; c) treaty with a flow variability management mechanism; d) treaty with a conflict resolution mechanism; e) existence of river basin organization.
Enabling Environment	The level of implementation of a number of governance factors at the national level, aggregated to the basin level: 1) policies, laws, plans; 2) institutional frameworks; 3) stakeholder participation; 4) capacity building; 5) assessment programmes; 6) management programmes; 7) monitoring programmes; 8) information sharing; and 9) finance.
Exacerbating factors to hydropolitical tension (projected)	The sum of 6 current factors that may exacerbate hydropolitical tensions in the next 10-15 years: a) high or increased climate-driven water variability; b) recent negative trends in water reserves; c) intra-state armed conflicts; d) interstate armed conflicts; e) recent history of unfriendly relationships over water; and f) low gross national income per capita.
Identify linkages	Identify actual and desirable linkages within and among arrangements and clusters.

2 Consideration of environmental protection is not always listed as a key principle of international water law, but is included in both the Helsinki Rules on the Uses of the Waters of International Rivers (ILA, 1996) and the Berlin Rules on Water Resources (ILA, 2004) and has since become part of customary international water law. After consultations held at the UNECE 2nd Workshop "River basin commissions and other joint bodies for transboundary water cooperation: technical aspects" (May 2014) it was determined that environmental protection represents an important stand-alone principle and that it should be considered in this assessment.

Formal arrangements governing transboundary river basins, in the form of international water treaties and river basin organizations, can be particularly instrumental in managing disputes among fellow riparians arising from the development of resources. The calculation of the indicator is based on the estimation of the level of formal institutional capacity expressed by the presence or absence of relevant treaty provisions and river basins organizations, as described in table 4, juxtaposed with the basin's on-going and planned development of water infrastructure in transboundary basins.

The previous two indicators focus on governance at the transboundary scale. It is also important to look at governance at the national scale for countries within each transboundary basin. The Enabling Environment indicator considers the level of development and implementation of a number of governance factors in each country, covering the nine categories described in table 3. It considers the arrangements at various levels (e.g. community, basin, national, private sector) in water management. National level results are aggregated to the basin level based on the 'relative significance' of each country portion in the basin, as measured by population and area.

In order to present an overall picture of governance in transboundary river basins, a governance index was developed, based on the maximum relative risk category of the three indicators. The rationale for this is that the governance capacity of the basin may be compromised by high risk in any one of the three indicators.

Whilst it is extremely challenging to develop projections of future governance situations, analysis of the history of past conflict and cooperation over water in transboundary basins suggests that some political, socioeconomic and physical circumstances could act as exacerbating factors to increase the risk of hydropolitical tensions due to basin development in absence of institutional capacity (Wolf et al., 2003). Therefore, the three baseline indicators described above can be viewed in context of the Exacerbating Factors to Hydropolitical Tension indicator. The indicator considers six factors that could exacerbate hydropolitical tension, as described in table 3 above.

This 'projected' indicator is designed to be broadly comparable with the other projected indicators in the transboundary rivers assessment for the 2030 time period (i.e., within the next 15 years or so). However, it does not attempt to consider political changes that far in the future, but rather considers the exacerbating factors that are currently known, which may have an impact in the next 10-15 years. For this reason, no attempt can be made to project this indicator to the 2050 time period.

3.1.4 LMEs

As indicated in the TWAP MSP report, the LME governance assessment focused on conducting an assessment of governance arrangements or architecture for each transboundary LME (shared by two or more coastal countries) with an emphasis on those LMEs in which at least one of the coastal countries is GEF-eligible (IOC-UNESCO 2011a). The assessment of the targeted LMEs was to be conducted using the TWAP Level 1 Governance Assessment Methodology (Jeftic et al. 2011, Mahon et al. 2011b).

By assessing the current suite of arrangements addressing the key transboundary issues that have been identified in documentation for each LME, an assessment of gaps and weaknesses relating to the governance structure for the LME was obtained. These transboundary arrangements may occur at a level within the LME, at the level of the entire LME or include all or a part of the LME while extending beyond the boundary of the LME.[3]

For each of the 50 multi-country LMEs, a number of sources were reviewed to identify key transboundary issues. Key among these were the relevant individual chapters from the UNEP Regional Seas Report and Studies No. 182, (Sherman and Hempel 2008), GEF documents such as Project Documents (PRODOCs), Transboundary Diagnostic Analyses (TDAs), Strategic Action Programmes (SAPs) and project terminal evaluations for those LMEs that have

3 A detailed description of the approach and methodology used in the assessment of governance architecture for LMEs is provided in the report by Fanning et al. (2016)

received GEF funding, Global International Waters Assessment (GIWA) regional reports, and LME specific reports. In addition, an array of primary and grey literature, websites and consultation with experts for individual LMEs were used to identify key transboundary issues.

Following the identification of key transboundary issues, principally those relating to fisheries, pollution and biodiversity/habitat destruction, a database of all the transboundary arrangements relating to these issues in all selected LMEs was compiled. Relevant agreements were sought in the literature and on the internet where several databases of international agreements can be found. Given the encompassing nature of global arrangements, these were not included as they were not specific to any particular LME. Furthermore, any transboundary arrangement whose area of competence covered less than one percent of the LME was not included in the analysis for that LME. The first step was to assess the completeness of the arrangements that were identified as being relevant to the key issues in each LME. Scoring criteria were used to assign each arrangement with a score for each of seven policy cycle stages for that agreement: (1) Provision of policy advice, (2), Policy decision-making, (3) Provision of management advice, (4) Management decision-making, (5) Management implementation, (6) Management review, and (7) Data and information management (Table 5). These criteria were refined from those initially proposed by Mahon et al. (2011).

The output of this analysis was a set of scores for the individual stages of the policy cycles for each arrangement. From these scores an overall completeness score for the arrangement was derived. Finally, the completeness scores for the arrangements pertaining to an LME were used to calculate an average governance architecture completeness score for the LME.

Table 5. Scoring criteria for policy cycle stages for each arrangement

Policy Cycle Stage	Scoring Criteria
Advisory mechanism (policy and planning/management)	0 = No transboundary science policy mechanism, e.g. COP self advises[1] 1 = Science-policy interface mechanism unclear - irregular, unsupported by formal documentation 2 = Science-policy interface not specified in the agreement, but identifiable as a regular process 3 = Science-policy interface clearly specified in the agreement
Decision-making (policy and planning/ management)	0 = No decision-making mechanism[2] 1 = Decisions are recommendations to countries 2 = Decisions are binding with the possibility for countries to opt out of complying 3 = Decisions are binding
Implementation	0 = Countries alone 1 = Countries supported by secretariat 2 = Countries and regional/global level support[3] 3 = Implemented through a coordinated regional/global mechanism[4]
Review	0 = No review mechanism 1 = Countries review and self-report 2 = Agreed review of implementation at regime level 3 = Agreed compliance mechanism with repercussions
Data and information:	0 = No DI mechanism 1 = Countries provide DI which is used as is 2 = DI centrally coordinated, reviewed and shared[5] 3 = DI centrally managed and shared

Table notes

1 Nothing in documentation indicates a mechanism by which scientific or policy advice is formulated at the transboundary level prior to consideration by decision-making body.

2 This refers to decisions on matters that will have a direct impact on ecosystem pressures or state. It does not refer to mechanisms for making decisions on the organization itself, such as process or organizational structure.

3 This means support from regional programmes or partner organizations arranged via secretariat

4 For example a coordinated enforcement system with vessels following a common protocol and flying a common flag identifying them as part of the mechanism, for example the FFA surveillance flag

5 For both 2 and 3 scores, data are checked for quality and consistency. The difference is that for a score of 3, there is a centralised place where all the data can be found, whether as actual data or metadata.

The second governance architecture measure to be assessed was integration among the arrangements. This was based on the extent to which issue specific arrangements in a system share a responsible body at various policy cycle levels. The integration score can thus range from zero where each arrangement has a totally separate set of responsible bodies, to one, where all arrangements share the same responsible bodies at every level. A score of one was assigned for LMEs in which there was a demonstrated attempt by the countries in the region to develop and support an overarching integrating mechanism for the issues associated with fisheries, pollution and biodiversity in the LME.

A third measure of governance architecture, an engagement indicator, was developed based on the extent to which countries in each LME had committed to the various agreements that are relevant to that LME. This was estimated as an average percentage commitment.

Lastly, a qualitative measure of governance architecture was developed; spatial fit of arrangements to area to be governed. For each agreement in each LME, the spatial fit of the agreement to the LME was estimated based on the percentage overlap. Fit was considered in four categories: A = Exact match between agreement and LME; B = LME larger than and includes arrangement; C = Arrangement larger than and includes LME; D = Arrangement and LME offset. As a set, these provide a view of the extent to which there is mismatch between governance arrangements and the area to be governed for each LME. Each of categories B-D presents governance challenges that should be addressed.

To summarise, three directional indicators (1-3) and one qualitative one were estimated for each LME:
1. Percent completeness of arrangements in the LME
2. Integration of arrangements in the LME
3. Engagement of countries with arrangements in the LME
4. Fit of arrangements in the LME to system to be governed

3.1.5 Open Ocean

The Open Ocean governance assessment took ABNJ as its focus (IOC-UNESCO 2011b). It concentrated on the governance architecture (networks) and the roles of organisations and institutions in the policy cycles for fisheries, pollution, biodiversity and climate change. It paid particular attention to science-policy interfaces, linkages of ABNJ arrangements to regional governance architectures, and sought to do so from the perspective of emerging global governance concepts and their application to the ocean. This assessment differed from those for the other four water categories in that it did not develop indicators, although some metrics were employed. Full details of the approach, conceptual basis and methods can be found in Mahon et al. (2016). The full Open Ocean report can be found in IOC-UNESCO (2016b).

The approach taken to the assessment was to assemble all governance agreements that were found to have relevance to the four issues of concern mentioned above. These agreements were compiled into a database to facilitate assessment of the extent to which the issues are covered either globally or regionally. The assessment also examined each arrangement from the perspective of policy processes to determine whether processes considered to be adequate for good governance are in place. The arrangements were also examined from a spatial perspective to determine geographical overlaps and gaps as well as the extent to which ABNJ are covered by governance arrangements.

An arrangement is any multilateral agreement, together with organisational structures and processes in place to give effect to it. The determination of direct relevance is based on whether the agreement is intended to address an ABNJ or straddling issue. On this basis, all relevant global agreements were included as well as many regional ones, such as regional fisheries conventions and Regional Seas Programme conventions that were considered to be relevant to ABNJ. The process of identifying agreements continued until no new ones were found. Relevant agreements were sought in the literature and on the Internet where several databases of international agreements can be found. The criteria for selection of regional agreements to be included differed depending on the issue area.

With regard to fisheries, all agreements for Regional Fishery Management Organisations (RFMOs) and Regional Fisheries Bodies (RFBs) with responsibility extending into ABNJ or for highly migratory or straddling stocks were included. It should be noted that this includes a wide diversity of types of fisheries bodies with mandates ranging from purely advisory to those with the capacity to make binding decisions on fisheries management (Molenaar 2005, Freestone 2011).

With regard to pollution, the approach taken recognised that all land-based sources of pollution (LBS) that impact ABNJ pass through coastal waters. Therefore, regional agreements addressing LBS were considered to be directly relevant to ABNJ. Most marine-based sources of pollution (MBS) also have the potential to be transported by currents from EEZs into ABNJ. The exception might be dumping of non-polluting non-soluble solids. However, dumping agreements also cover many kinds of wastes that can be transported by currents and were therefore included. This approach leads to a preponderance of pollution-oriented agreements which are primarily aimed at addressing coastal pollution problems.

For biodiversity, the inclusion of agreements oriented towards national waters was considered. These are primarily protocols arising from Regional Seas conventions. It was thought that while the inclusion of pollution agreements under Regional Seas conventions was important for the reasons given above, the case for inclusion of biodiversity agreements was less clear. For the majority of Regional Seas-based biodiversity agreements, the only connection with ABNJ would be when protected areas or other measures were established that provided protection for straddling or highly migratory species (HMS) such as sea turtles, seabirds, and marine mammals. It was decided that including these agreements would provide a biased picture regarding biodiversity conservation in ABNJ.

The inclusion of shipping arrangements was also considered. For example, IMO routing measures under the Safety of Life at Sea (SOLAS) Convention has been used to minimise impacts of shipping on biodiversity. However, it was agreed that this convention could not be perceived as having a stated mandate for biodiversity conservation or ecosystem-based management (EBM), and that it should not be included in the database.

For each of the agreements included in the database, a variety of information was obtained. The primary sources for the information included in the database were the actual conventions and agreements, rules of procedure for the organisations and secretariats for the agreements, and organisational websites. When these sources did not yield all the desired information, other documentation and websites were explored. The database is in the form of an Excel spreadsheet with the key information in the cells. Comment boxes are used to record details, such as excerpts from agreements that are considered necessary context for what was included in the table cells. The first part of each database record includes basic background information on the agreement. The second part of each record includes information aimed at evaluating the policy processes that are intended to give effect to the agreement (see Mahon et al. (2016) for a full list of variables in the database). The approach used to assess completeness of arrangements is the same as described for LMEs and used the criteria in table 5.

In addition to assessment of the individual arrangements, the entire set or arrangements was examined from network and spatial perspectives to determine formal relationships and spatial overlaps. The formal relationships were determined from the documentation for the arrangements and the latter were determined quantitatively via GIS analysis. Together these were used to evaluate global and regional level clustering of arrangements which was based on a combination of visual inspection and the overlaps.

3.2 Experience with formulation and implementation of indicators

3.2.1 Aquifers

The data on the four governance indicators for aquifers were acquired through a questionnaire survey. The survey included the full range of aquifers data being sought, and was responded to by more than 200 national experts from 76 countries. Ultimately, the overall aquifers assessment covered 199 transboundary aquifers (consisting of 506 country segments). In many instances data on national level governance was available for only some of the countries sharing an aquifer making it difficult to come up with aquifer levels values for the indicators. The assessment of governance was therefore considered by the authors to be very preliminary (UNESCO-IHP, IGRAC and UNEP 2016) Information on the four governance indicators were only forthcoming for limited amount of country segments and a small number of entire transboundary aquifers, as shown in Table 6 below.

Table 6. Data availability for governance indicators for aquifers

Indicator	Entire TBA		Country segments	
	Number	Percent	Number	Percent
Transboundary legal framework	25	13	193	38
Transboundary institutional framework	27	14	192	38
Control of groundwater abstraction	20	10	168	33
Groundwater quality protection	17	9	152	30

3.2.2 Lakes

It became evident during the assessment of transboundary lakes that there is scarce attention directed specifically to the governance of transboundary lakes and reservoirs. Lakes and reservoirs (whether transboundary or national in scope) are not mainstream items in water governance activities. Most governance attention directed to lakes is typically presumed to be encompassed (if mentioned at all) in existing national/state legislation or general agreements on water. The presumption seems to be that they are adequately covered under existing governance structures, which does not appear to be the case in many instances.

It should be noted that the unique features of lakes and other lentic water systems of an integrating nature, long residence time, and non-linear responses to inputs, for example, ensures that river basins containing multiple lakes will typically respond more slowly to environmental 'insults' and also to remedial measures implemented to address them because of the buffering capacity resulting from these lake characteristics. Such realities are not usually considered in drawing up national-level legislation and governance concerning lakes and other lentic water systems. Ultimately, the authors of the lakes report provided a rapid survey of lake basins for which there are transboundary agreements, or which lie within river basins for which there are transboundary river management agreements. Of the 53 transboundary lake systems examined, 18 had transboundary agreements, 25 were in river basins with transboundary river agreements and 10 had no relevant agreement at all.

3.2.3 Rivers

The original methodology for TWAP River Governance architecture included a qualitative analysis of the governance architecture for a selected numbers of representative river basins (UNEP-DHI 2011). It was aiming to build on and complement the other two governance indicators on “Enabling environment” and “Hydropolitical tension”. The initial approach included a survey based on stakeholder interviews to establish a picture of the governance architecture within transboundary river basins, following the approach described in sections 2.2 and 2.3 above. The survey was to have mapped the Meta-mode (articulation of principles, visions and goals), Institutional Mode (agreed ways of doing things reflected in plans and/or organizations) as well as Operational Mode (capacity to achieve goals cooperatively and effectively).

During further development of the respective methodology for the three indicators the approach for the governance architecture was adjusted to better complement the other indicators, as well as to give a more coherent picture of the governance architecture in place by:

- Extending the coverage by assessing all transboundary river basins rather than a small collection;
- Better complementing the other two indicators by focusing only on legal arrangements and key legal principles in place (both "Enabling environment "and Hydropolitical tension" already covered to some extent Meta-mode, Institutional Mode as well as Operational Mode described above).

A set of key water management principles (WMPs) has developed in international water law as a model for transboundary agreements. They have developed from existing international conventions and treaties, customary law, judicial decisions, and writings of qualified legal practitioners. The set of WMPs is largely adopted from The International Law Association's 1966 Helsinki Rules, the United Nation 1997 Convention on Non-navigable Watercourses, and existing TBAs. The principles include: equitable and reasonable utilization, cooperation and information exchange, notification, not causing significant harm, consultation or negotiation, consultation and peaceful settlement of dispute and environmental protection. The existence of legal arrangements reflecting these principles together with countries' ratification of the two key Global Water Conventions was thought to provide a picture of the governance architecture in place and the framework for the allocation of uses between States.

With the adjustment of the methodology the three governance indicators, legal framework, hydro-political tension and enabling environment were thought to complement each other better by more clearly addressing various aspects of the governance needs and pressures in a transboundary river basin.

3.2.4 LMEs

The main difficulty in formulating indicators that can be used to assess governance architecture in LMEs arose from having to develop them de novo. This meant that both the concepts underlying the selection of relevant indicators and the methodology for implementing them needed to be accepted by all partners prior to their use in the TWAP FSP (Jeftic et al. 2011). However, as previously noted, the various water categories each had their own prior perception of how governance should be approached.

To address the issue of relevance, an extensive review of leading governance approaches and frameworks was undertaken to ensure potential indicators were consistent with the concepts underpinning current governance thinking. This resulted in the identification of the three directional indicators (level of completeness, level of integration and level of engagement) and one non-directional indicator (spatial fit of arrangement to address issue). A primary concern in terms of formulation was the development of the scoring criteria to be used to measure completeness. The criteria needed to be sufficiently distinct to assess differences between different stages of the policy cycle for each arrangement and to be sufficiently easy to apply objectively so that the same score would be obtained regardless of the assessor. This was tested by having different assessors score the same arrangements leading to finalizing the set of scoring criteria.

Several problems were encountered and addressed during the implementation of the methodology assessing governance architecture in LMEs. The first issue related to access to data to conduct the assessment. Due to budgetary and timing constraints, a number of decisions had to be made regarding both the identification of critical transboundary issues within individual LMEs and the form of arrangements to be assessed. In the case of identifying issues, key documents relating to each LME were reviewed. However, it was recognized that all might not be reflected in the literature reviewed.

Similarly, the arrangements that are included in the analysis of governance architecture for LMEs do not include the large number of informal processes that are in place to support and facilitate good governance in several LMEs included in this assessment. This omission was not due to a perceived lack of importance of these informal arrangements, but rather time and resource constraints. Consequently, it was decided to limit the analysis to formal arrangements.

The three indicators of governance arrangements were assessed based on a percentage score (completeness and engagement indicators) or a decimal score ranging from 0 to 1 (integration). For comparison purposes, these scores were converted to correspond to five categories of risk ranging from very low, low, medium, high to very high. With regard to the three indicators it is assumed that (a) the more complete governance processes are, (b) the more countries are actively engaged in participating in agreements to address transboundary issues within the LME and (c) the more integrated organizations involved in implementing these agreements are, the more likely processes that meet good governance criteria will be in place. Therefore, the risk categories were inversely related to the scores attained. However, while the five risk categories from very high to very low risk were assigned to assessed scores for each directional indicator ranging from very low (0-20%) to very high (80-100%), it is important to stress that the assigned risk category does not necessarily correspond to information on the level of degradation of the LME based on the governance arrangements in place. This is because the level of degradation and impact on the state of the LME reflect the performance of governance arrangements and, as has been clearly identified previously, this study does not focus on assessing governance effectiveness but rather the structure or architecture of the governance arrangements to facilitate good governance. As such, caution must be exercised by the reader in ensuring any conclusions reached as a result of the assigned risk category is limited to those regarding good governance criteria and a recognition that governance assessment is necessarily context-driven.

In terms of implementing measurement of the qualitative indicator assessing ‘fit’, the spatial competence of each arrangement needed to be mapped and overlaid using existing geospatial data. This was very time consuming tracking down the existence and availability of the data and also required a high level of technical competence to ensure the accuracy of the area being mapped.

The analysis of completeness score and ranking provides a tool by which LMEs can be monitored over time and as agreements are added or arrangements strengthened. The current literature on governance architecture suggests that effort should be made to increase the level of completeness of the policy cycle for any arrangement. This is seen as critical as it strengthens and facilitates the flow of valuable data and information into the analysis and advice stage of the cycle, which in turn provides the structures that contribute to informed decision-making, implementation and review. Finally, it can also be assumed that complete policy cycles demonstrate implementation of key principles associated with good governance and which have become the norm in many multinational and national governance instruments. These include principles of transparency and integration in decision making, inclusivity and participation in the provision of policy-relevant and management level advice from a cross section of stakeholders to inform decision making, collaboration and efficiency to assist with implementation, and accountability and adaptive management in terms of monitoring and evaluation.

Regarding the interpretation of the calculation of an overall score for level of integration among arrangements in the LME, there is no a *priori* criterion for the extent of clustering that would be considered optimal. Nonetheless, the assumption underpinning the scoring was based on an expectation that without considerable attention to linkages and interaction among arrangements, it would be difficult to have the integrated approach within a system that is needed to achieve EBM. At the other end of the scale, in a system with highly diverse issues, one would not normally expect to find them all covered by the same responsible bodies. In fact, depending on complexity and capability, it may be more effective and flexible for arrangements to have common responsible organizations at policy setting stages, but different responsible organisations at technical and operational policy cycle stages. The results for integration across the LMEs provide some evidence that both scenarios are in play.

In terms of assessing engagement as a measure of governance architecture, the analysis suggests that in general, binding agreements have a lower level of engagement than non-binding agreements regardless of the type of issue the agreement is meant to address. The level of effort or accountability needed by countries engaged in binding agreements to comply with the conditions of the agreement may explain this finding but this still needs to be verified. Despite this, the research has identified that the overwhelming majority of agreements formulated to address transboundary issues are binding. A detailed understanding of these findings requires a closer examination

of the rationale used by countries for determining their level of engagement for binding versus non-binding issue-specific types of agreements. This would be further informed by analysis of the arrangements in place to implement the agreement in terms of the completeness of their policy cycles as it relates to engagement. One could speculate that an arrangement with a low level of completeness across its policy cycle stages, suggestive of possible fractures in the policy process, may prove less effective in achieving its governance objectives even with a 100% engagement by the countries involved than one in which completeness is higher. This applies regardless of the binding or non-binding nature of the agreement.
The results regarding spatial fit of arrangements indicate that, to an overwhelming degree (96%), LME boundaries played little role in influencing the areas of competence for agreements, suggesting that what is lacking may be more than the *"political will... to apply the LME concept for the sustainable development... in many parts of the World Ocean."* (Sherman and Hempel 2008, p.9). These findings are significant from an LME governance architectural perspective if LMEs are to be used as rational units of EBM. For supra-LME arrangements, the potential exists for countries outside of an LME to be able to exercise influence, either directly or indirectly, that is contrary to the needs of those within the LME. The potential for challenges associated with 'fit' is also demonstrated when arrangements are offset from the LME scale or at a sub-regional level.

To summarize, while rankings of indicators of governance architecture within LMEs are possible and progress can be made towards enhancing these by direct intervention by GEF, other donor agencies and regional organisations, it is essential to reiterate that governance success requires a detailed understanding of the complexity of the system to be governed. Any preliminary conclusion of ranking of any indicator for any LME must be seen as simply a flag to determine whether the assessment points to the need for intervention or whether the identified ranking is in fact appropriate for the system.

3.2.5 Open Ocean

The Open Ocean (ABNJ) assessment was qualitatively different from those for the other four water categories as the ocean comprises a single system. Nonetheless, for some of the indicators used in the assessment, e.g. the Cumulative Human Impact Index (Halpern and Frazier 2016) or plastics (Kershaw et al. 2016) the Open Ocean was divided into regions (IOC-UNESCO 2016b). This approach was not feasible for governance, which took the full suite of global and regional arrangements relevant to ABNJ as its starting point then examined the arrangements to determine issue coverage and geographical coverage. As was the case for LMEs, there were no off-the-shelf methods available for assessment. Therefore, it was necessary to develop the approaches used.

A primary source of difficulty in analysing the completeness of ocean arrangements according to the criteria in Table 5 was that it was based entirely on formal documentation that could be sourced through the internet. It was recognised that not all practices were formally documented. Conversely, not all formally documented processes are practiced. To address this deficiency, it would be necessary to engage officials and/or stakeholders who were active in all the arrangements to determine what actual practices are.

The spatial analyses that were used to determine overlaps required a considerable amount of data sourcing and manipulation. The GIS shape files for the arrangements came from several sources, and in some cases had to be created. The various challenges encountered in this exercise and the solutions to them employed are described by Baldwin and Mahon (2014).

The clusters of regional arrangements were identified visually, based on overlaps. Although a more quantitative way of identifying them was sought, such as cluster analysis no satisfactory method could be found. This was due to the wide range in area covered by these arrangements (e.g. from Atlantic Ocean wide in the case of ICCAT to very local in the case of the SRFC in the Gulf of Guinea) and the fact that there was considerable spatial nesting among them. Neither the use of spatial overlap among arrangements nor the distance between their spatial centroids was thought to provide a suitable measure for cluster analysis.

4 The TWAP indicators in relation to the governance assessment framework

This section examines how the indicators that were measured by each of the five TWAP water components relate to the expanded GEF framework presented in Section 2. Although the focus of this report is on the governance architecture and process indicators, it is useful to see how the full set of indicators for each water category relates to the entire expanded GEF indicator framework. This broader view would give an indication of the extent to which the entire set of indicators covered the two aspects of governance assessment: good governance and governance performance. The full sets of indicators for each water category can be found in the respective working group reports (UNESCO-IHP, IGRAC and UNEP 2016, ILEC and UNEP 2016, UNEP-DHI and UNEP 2016, IOC-UNESCO 2016a, 2016b). The limitations evident in the assessments undertaken by each of the five water components underscore the need for the GEF to pay closer attention to the full range of indicator types needed to assess governance arrangements and effectiveness. One area in particular that could be improved would be for the GEF to use the framework to improve the TDA guidelines so that both performance evaluation of good governance criteria (e.g. by assessing architecture and process) as well as performance of effectiveness to enhance societal well-being (e.g. by assessing achievement of outcomes aimed at reducing pressures and improving environment) are measured during TDAs and built into SAP monitoring.

4.1 Mapping the TWAP component indicators to the indicator framework

The indicators used by the five water category assessments were allocated into the indicator categories in expanded GEF framework (Figure 1). Additionally, while assigning the indicators into the seven categories, it was found to be useful to allocate the indicators into the sub-categories discussed in Section 2. The allocation of the indicators into the indicator categories was based on input provided by the working group members representing the components (Table 7). The majority of the indicators could be assigned to one of the seven indicator categories in the framework, thereby informing an overall assessment of governance effectiveness (Figure 1). Some of the indicators were largely contextual and were termed 'risk factors' (Table 5).

Table 7. Comparison of TWAP WG activities in relation to the expanded IW governance indicators. Indicators in italics were derived using a common methodology across all water categories as part of a crosscutting activity.

Indicator component	Aquifers	Lakes	Rivers	LMEs	Open Oceans
Governance architecture indicators					
Institutions/ agreements	• Transboundary institutional framework • SIDS groundwater management institutional framework		• Hydropolitical Tension (including institutional vulnerability)	• Completeness of governance arrangements	• Completeness of governance arrangements
Policy/ Legislation	• Transboundary legal framework • SIDS groundwater management legal framework		• Legal framework		

Indicator component	Aquifers	Lakes	Rivers	LMEs	Open Oceans
Integration				• Integration of governance arrangements	• Integration of governance arrangements
Other			• Enabling environment[4] (national, converted to basin level)	• Spatial fit of governance arrangements	
Governance process					
Regulatory responses	• Control of groundwater abstraction • Groundwater quality protection			• Change in MPA coverage	
Stakeholder engagement					
Participation				• Engagement with governance arrangements	
Population	• Population density • Groundwater development stress	• Population density • Population number		• Population living within 100 km of coast • Night light development index • Population living on coast below 10 m elevation	• Populations living within 100 km of coast
Habitat/ biodiversity					• Coral reef threats
Fisheries		• Fishing pressure • Aquaculture pressure	• Threat to fish (fishing pressure and number of non-native fish species)	• Fishing effort • Ecological footprint of fisheries • Catch from bottom-impacting gear • Ratio of subsidies to catch value	• Demersal fishing effort
Pollution				• Nutrient inputs from watersheds	
Infrastructure			• Ecosystem impacts from dams		

4 Note that the Enabling Environment indicator is based on about 60 questions covering institutions/agreements, integration, policy/legislation, regulatory responses, and participation. The results of the final indicator could be disaggregated to provide information on any one of the above areas.

Indicator component	Aquifers	Lakes	Rivers	LMEs	Open Oceans
Water quantity		• Dam density • River fragmentation • Consumptive water loss • Human water stress • Agricultural water stress • Flow disruption			
Ecosystem state					
Ecosystem	• Groundwater depletion	• Fraction of land area devoted to crops • Fraction of impervious surface area • Livestock density • Wetland disconnectivity	• Environmental water stress • Human water stress • Agricultural water stress	• Primary productivity • Chlorophyll a • Sea surface temperature • Aragonite saturation state (acidification) • Ocean Health Index • Cumulative Health Index	• Sea level • Ocean heat content change • Ocean deoxygenation • Aragonite saturation state (acidification) • Primary productivity - chlorophyll Indicators and timing • Marine Trophic Index • Ocean Health Index • Cumulative Human Impact Index
Habitat/ biodiversity		• Non-native fishes % • Non-native fishes abundance	• Extinction risk • Wetland disconnectivity	• Mangrove extent • Warm water reef extent • Reefs at risk index	• Zooplankton abundance, composition • Biodiversity
Fisheries				• Change in catch potential due to warming • Value of reported landings • Fishing in Balance Index • Marine Trophic Index • Stock-catch status	• ABNJ tuna catch • Demersal fish catch • Fishing in Balance index • Catch potential

Indicator component	Aquifers	Lakes	Rivers	LMEs	Open Oceans
Pollution	• Groundwater pollution	• Soil salinization • Nitrogen loading • Phosphorus loading • Mercury deposition • Pesticide loading • Sediment loading • Organic loading • Potential acidification • Thermal alteration	• Nutrient pollution • Wastewater pollution	• Coastal eutrophication • Persistent organic pollutants • Floating plastic debris	• Floating plastic marine debris concentration • Plastics in the deep ocean • Persistent organic pollutants • Nitrogen inputs
Social justice					
Well-being					
Economic				• Numbers below national poverty levels	• 2100 HDI
Demographic			• Societal wellbeing	• Human Development Index	
Services					
Risk factors					
	• Aquifer buffering capacity • Aquifer vulnerability to climate change • Aquifer vulnerability to pollution • Human dependency on groundwater • Human dependency on groundwater for domestic water supply • Human dependency on groundwater for agricultural water supply • Human dependency on groundwater for industrial water supply • Ecosystem dependency on groundwater • Prevalence of springs • Mean annual groundwater recharge depth (mean annual recharge volume per unit of area) • Annual amount of renewable groundwater resources per capita • Natural background groundwater quality	• Gross national Income	• Economic dependence on water resources • Exposure to floods and droughts	• Fish contribution to animal protein • Contemporary climate related extreme events index • Contemporary threat index (overall) • Sea level rise threat index • Tourism revenues • Tourism contribution to GDP • Fishery production potential	• Vulnerability to sea level rise

The assignment of indicators was not always clear cut, as some were ambiguous and could be considered as belonging to more than one category. This was usually the case when the indicator was made up of multiple sub-indicators, which might belong in different indicator categories, for example, the Enabling Environment indicator used by the Rivers Working Group which consisted of 60 sub-indicators, and the Cumulative Human Impact Index (CHI) for oceans which is a composite index. The CHI comprises a mixture of system pressure and state variables. In other cases, the allocation of the indicators into framework categories was challenging due to the possibility of multiple interpretations. For example, in the case of aquifers 'prevalence of springs' can also be classified as a state indicator because when aquifers are overexploited this value becomes smaller, while a high prevalence of springs may be an indicator for a better state of the aquifer.

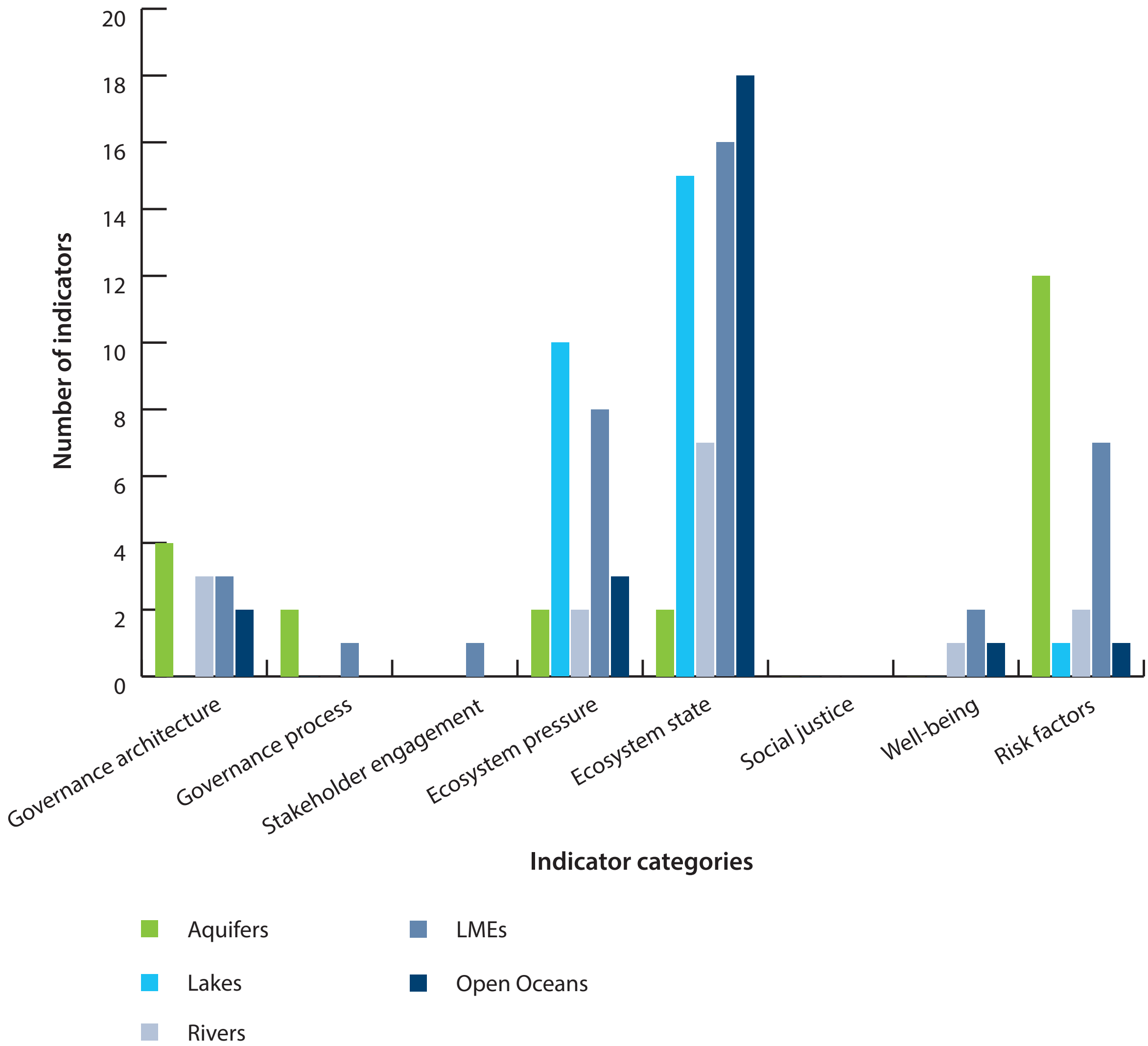
This allocation into the indicator categories allowed for rapid identification of the extent to which the suite of indicators used in each TWAP water component covered the seven categories in the expanded GEF framework. However, it must be stressed that the allocation of the suite of indicators in Table 5 shows only the extent to which the seven categories are represented by indicators in each of the five transboundary water components. It does not address concerns regarding availability and accessibility of data, scale appropriateness of the data, data quality or methodological consistency in data collection. Nor does it address the extent to which these indicators cover all significant issues of concern.

The extent to which there were indicators for all categories of the expanded GEF framework the data in Table 7 is summarised in Figure 2. There is a clear preponderance of ecosystem pressure and state indicators across water categories; especially the latter. The exception is aquifers for which it might be argued that only water quantity and water quality indicators are relevant, and that the term ecosystem state is a misnomer. While this perspective would reflect the view that their connection to ecosystems is indirect through adjacent surface and coastal water systems, there are indeed aquifer dependent ecosystems that should be considered as integral components of aquifers. The aquifers assessment was not able to explore the status of these ecosystems in much depth, as its focus was on initial inventory and mapping of transboundary aquifers.

Only LMEs had indicators in more than four categories (Figure 2). Social justice indicators were missing for all water categories, although the Human wellbeing indicator used by the Rivers WG includes the Gini-coefficient of inequality which is a social justice indicator. Governance indicators, especially process and stakeholder engagement were few. So were well-being indicators, although here again the composite Human wellbeing indicator used by the Rivers WG comprises four separate well-being indicators (access to improved drinking water, access to improved sanitation, adult literacy, infant mortality) as well as the Gini coefficient, as mentioned above. Risk factors were also used, especially for aquifers, where again, many threats are external to the actual aquifer.

The preliminary conclusion from the mapping of the indicators to the framework is that there are considerable gaps in assessment coverage within transboundary water categories. The pattern observed in Figure 2 indicates that additional indicators may be needed in each water category in order to monitor the outcomes and impacts of interventions in a staged manner starting with improved governance and ending with improved well-being. What is shown in this report is only the beginning of developing a structured approach that would provide a comprehensive assessment. Even where there are indicators in successive indicator categories, it is by no means clear that there is a successional relationship between them. For example, to have comprehensive assessment of governance effectiveness of a particular issue (say water quality) one would need indicators for water quality governance, pressure, state, etc. Consequently, the CCWG recommends that more attention needs to be placed on identifying and monitoring indicators that reveal the connectivity between the different categories of the expanded GEF framework within a given water system.

Figure 2: *The distribution of indicators among the indicator categories of the expanded GEF indicator framework from Figure 1.*



4.2 Focus on governance architecture and process indicators

In this section we focus on the governance indicators in the governance architecture and governance processes indicator categories of the framework. As discussed in relation to the TWAP Level 1 Governance assessment focus and methodology, the aim of the crosscutting governance assessment methodology that was to be applied in each of the five transboundary water components was to focus on assessing governance architecture by determining: (1) whether the critical transboundary issues are covered by governance arrangements that have fully-functioning decision-making processes or policy cycles, and (2) the level of integration across the different arrangements in place to address these concerns (Mahon et al. 2011). The initial expectation of the CCWG was that in addition to component-specific indicators, all five component working groups would use the same Level 1 methodology for assessing governance in at least a subset of systems, thereby allowing for a comparative analysis across aquifers, rivers, lakes, LMEs and the Open Ocean. However, it was recognized that previous investment in other methodologies by some of the transboundary water component working groups (e.g. lakes with the ILEC ILBM Platform methodology) might preclude the use of a common methodology across all water systems. Furthermore, since the TWAP assessment was based on using existing data, even with agreement to use the common methodology, the availability of data specific to the agreed upon indicators was found to be lacking in some cases (e.g. for aquifers and lakes) or too time consuming to acquire (e.g. rivers).

Ultimately, each of the water component working groups used somewhat different sets of indicators (see Table 7) making direct comparison among systems in different water categories difficult. However, each component did seek to address some aspects of governance albeit with a limited number of indicators. As illustrated in Figure 3, there is a range of aspects of the governance arrangements in place to address key transboundary issues in water systems for which indicators are needed. These include the presence, structure (completeness) of policy cycle, scale (local/national/subregional/regional/international), nature (formal/informal) and integration mechanisms. Indicators for process (and stakeholder engagement) explore the extent to which the processes provided for in the architecture are operating and producing outcomes such as advice to decision-makers and decisions (which may take the form of policies, strategies, plans, legislation and regulations).

4.3 Comparison of methods used by different water systems

The extent to which the indicators measured by the water categories provided coverage of the aspects identified in Figure 3 is summarised in Table 8. Furthermore, the evaluation in Table 8 is somewhat biased towards the LME and open ocean governance assessments as they were developed based on the expanded framework. Additionally, as was noted in section 3.1.2 for the lakes transboundary water component, it was decided that given the unavailability of data but for a few prominent lakes, no governance indicators were pursued for transboundary lakes. Therefore, the comparison in Table 8 is perhaps more illustrative of how a comparative assessment might be approached than an actual assessment.

The aspect of scale pertains to the extent to which the assessment examines the coverage of the multiple geographical/organisation levels involved in transboundary governance, ranging from local through national and regional to global. The aquifers and rivers assessments addressed scale primarily by looking at both national and regional levels of arrangements. LMEs dealt with scale by examining the level which was responsible for each of the various stages of the policy processes, while in the open ocean the global and regional levels of governance were explored. Mechanisms for linkages between levels were not examined by any assessment.

Figure 3: *Some key aspects of governance to be addressed in the governance architecture indicator category of the governance assessment framework.*

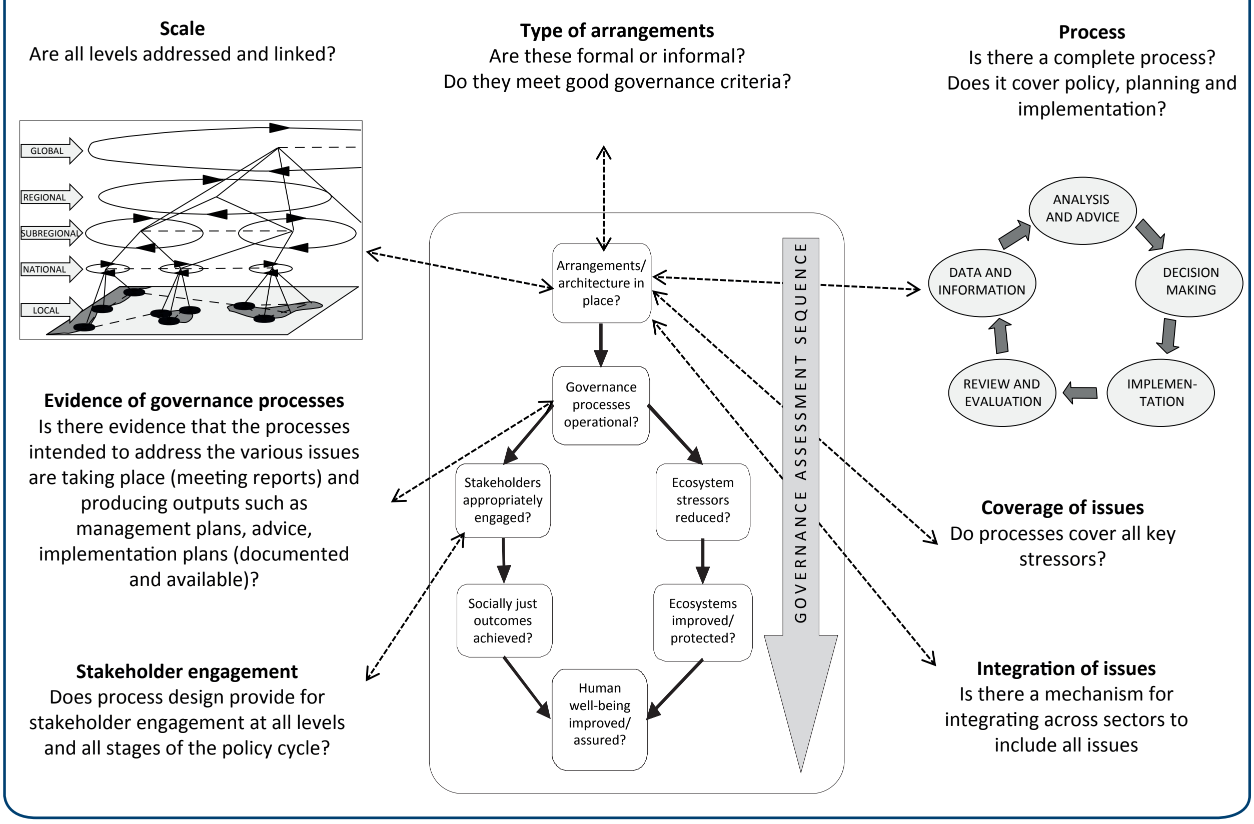


Table 8. Coverage of governance architecture aspects by governance indicators for each TWAP component (✓= low, ✓✓= medium, ✓✓✓ = high)

Indicator	Aquifers	Lakes	Rivers	LMEs	Open Ocean
Scale considered	✓✓	✓	✓✓	✓✓	✓✓
Type of arrangements	✓✓	✓		✓✓	✓✓✓
Completeness of processes				✓✓✓	✓✓✓
Policy, planning, implementation	✓✓	✓	✓	✓	✓
Coverage of issues				✓✓	✓✓
Fit of arrangements to system				✓✓	
Integration	✓			✓✓	✓✓
Stakeholder engagement				✓✓	

The type of arrangement relates to characteristics such as whether the arrangements are formal or informal, binding or voluntary, constituting or operational, etc. Lakes treated this by looking solely at whether a formal transboundary arrangement existed for either the lake system or the river basin system in which the lake occurred. Aquifers examined the institutional and legal status of any transboundary agreements in place as well as those in Small Island Developing States (SIDS)(Table 3). Rivers examined the principles upon which formal agreements were based, as well as the legal frameworks in in place for the countries that shared the river basin. For LMEs and Open Ocean, one criterion of the evaluation of completeness assessed was the extent to which decisions were binding. Open ocean looked in detail at differences between constituting and operational agreements.

The completeness of the processes associated with governance pertains to the extent to which there is a complete policy cycle in place that includes data and information, provision of advice, decision making, implementation and review. Both LMEs and Open Ocean approached this explicitly with a set of scoring criteria which assessed completeness (Table 5).

Policy, planning and implementation are three different levels of policy process for which there should be identifiable arrangements in place. With the exception of lakes, all components included some aspect of the extent to which there was functionality in arrangements at all three levels. In the case of rivers, this was focussed largely at the national level. For LMEs and Open Ocean the completeness scoring process explicitly included evaluation of arrangements in place at the transboundary level.

Governance arrangements should be in place to cover all of the critical issues for the water system being evaluated. In the case of the TWAP assessment these are water quality, water quantity, fisheries and biodiversity. All that are relevant for the system being examined should be covered by issue specific arrangements. Only LMEs and Open Ocean explicitly examined whether there were governance arrangements in place for key issues. For LMEs this was factored into the average completeness for the entire LME, while for Open Ocean it was dealt with looking qualitatively at coverage of issues by arrangements at the regional level.

Fit, the extent to which the governance arrangements in place for a system match the geographical extent of the system, is an important aspect of governance architecture. Fit was evaluated in LMEs but not in other components. In the open ocean it is not applicable at the global level, but should be considered at the regional level. In lakes and rivers, geographical boundaries are more easily determined than in ocean systems, so fit may not be as significant an issue. Aquifer boundaries are often unclear and fit may be an issue as there are only seven cooperative agreements on transboundary aquifers. Indeed their governance may often be under other regional agreements such as river basin organisations or protocols for regional economic communities, and these will not have exact 'fits' to the transboundary aquifers.

Integration across sectors is an important aspect of governance at any level if ecosystem based management is to be achieved. The presence of integrating mechanisms was assessed for LMEs using a quantitative indicator. For Open Ocean, the evaluation of integration was qualitative at two levels; global and within regions.

Provision for stakeholder engagement in governance processes is necessary if governance architecture is to promote inclusivity. Only the LME assessment examined engagement at the transboundary level based on the extent to which the countries in the LME had engaged with the various multilateral agreements that were applicable to the LME.

5 Linkages between adjacent water systems in different water categories

The CCWG noted that the likely biophysical interlinkages among adjacent water systems, both within and between water categories, could have significant implications for governance assessment. Many such linkages are known to occur. Clearly, governance that deals with an issue as if the water system was closed may be rendered ineffective by these linkages. While these interlinkages were not examined in TWAP it is useful to be aware of them and their implications for governance.

A matrix of likely interactions has been prepared to provide a basis for discussing how important the linkages are likely to be and the extent to which they should be addressed in future work (Table 9). The color coding shows the extent to which there are biophysical linkages. The yellow coding shows that water quantity issues are bidirectionally connected among aquifers, rivers and lakes; and between these and LMEs. The blue coding shows that there may be bidirectional water quality issues among aquifers, lakes, rivers and LMEs; and between LMEs and the open ocean. These are directly linked to the flow of water and water-borne substances between systems. The green linkages are strictly biological, relating to the active migratory and passive movement of organisms between systems, for example diadromous fishes, as well as to ecosystems that may straddle water systems from several categories, for example a coastal forest. The pink shading emphasises that all waters systems on Earth are linked through the global hydrological cycle.

The implications of these linkages for governance are that if interventions are to be successful they should attempt to address groups of systems that are highly linked rather than treating the impacts of the linkages as externalities. In the second case (yellow) the pattern would be interpreted as showing areas where upstream and downstream linkages between systems or surface-subsurface water usage are likely to be sufficiently important that interventions addressing risk factors in a system will probably be undermined by upstream/connectivity effects. In this case the conclusion may be that the intervention should include the upstream system, treating the effect as internal to the system.

There are also socioeconomic linkages among systems that are perhaps even more complex. Problems in one system may therefore be transferred to other systems both adjacent and remote, for example rerouting a river through a mountain range to address water shortage. Human settlements and business enterprises may straddle and depend on several types of adjacent systems. For example if fisheries are rehabilitated in one river system, lake or LME, fishers may migrate from an adjacent system where fisheries remain degraded to the one where they are better. Ultimately, governance arrangements will have to be integrated across both sectors and geography in order to address these linkages. These matters of scale, scope and dealing with interconnectivity are currently among the most challenging for governance scholars and practitioners.

Table 9. Biophysical interactions among IW water categories. Interactions that extend across two or more water categories are color coded.

		Recipient category				
		Aquifers	**Lakes**	**Rivers-deltas**	**LMEs**	**Open Ocean**
Source category	Aquifers		• Water quantity[1] • LBS pollution[2]	• Water quantity[1] • LBS pollution[2] • Relative sea level rise on deltas[3]	• Water quantity[4] • LBS pollution[2]	• None direct
	Lakes	• Water quantity[5] • LBS/WBS pollution[6]		• Water quantity • LBS/WBS pollution[7] • Shared/ migratory resources • Interference with upstream fish migration[8]	• Water quality[9] • LBS/WBS pollution	• None direct
	Rivers deltas	• Water quantity[10] • LBS/WBS pollution	• Water quantity • LBS/WBS pollution[12] • Shared/ migratory resources[13]		• Water quantity • LBS pollution[14] • Diadromous resources	• None direct
	LMEs	• Water quality[15]	• Diadromous resources	• MBS • Diadromous resources • Sea level rise on deltas		• LBS pollution[16] • MBS pollution • Shared/migratory resources[17]
	Open Ocean	• Hydrological cycle (drought/ flood) • Water quality[20]	• Hydrological cycle (drought/ flood)	• Hydrological cycle (drought/ flood) • Diadromous resources • Sea level rise on deltas	• Hydrological cycle (drought/ flood) • LBS pollution[18] • MBS pollution • Shared/ migratory resources[19]	

Table notes

1 When aquifers are depleted, water levels in lakes may be reduced and rivers may experience reduced water inputs
2 Direct pollution of aquifers can be transferred to lakes, rivers and LMEs.
3 Depletion of coastal aquifers can affect subsidence and consequently Relative Sea Level Rise (RSLR).
4 Depletion of coastal aquifers can result in reduced freshwater input to coastal ecosystems and changes to their ecological functioning.
5 Reduction in lake levels may affect quantities of water in aquifers.
6 Any pollution entering a lake may find its way into an associated aquifer.
7 Lakes can buffer against impacts of upstream pollutant loads on downstream portion of river.
8 Reservoir dams can interfere with upstream fish migration for breeding purposes.
9 Lakes can be LBS or WBS pollutant sinks, protecting water quality, or act as pollutant source, if highly polluted, for LMEs, if located in close proximity to the LME. Lakes can buffer against water inflows to LMEs, if located in close proximity to LME.
10 Reduction in river flows may affect quantities of water in aquifers.
11 Any pollution entering a river may find its way into an associated aquifer.
12 Any pollution entering a river may find its way into an associated lake.
13 Exploited species as well as those of biodiversity concern may migrate between rivers and lakes either ontogenetically or seasonally.
14 Any pollution entering a river may find its way into an adjacent LME, including sediments and airborne pollutants (not directly from rivers but land areas in drainage basins- watershed-based)
15 Saltwater intrusion into coastal aquifers.
16 LBS pollution entering the marine environment in an LME may be transported to the open ocean.
17 Exploited species as well as those of biodiversity concern may migrate between LMEs and the open ocean either ontogenetically or seasonally.
18 LBS pollution entering the marine environment in an LME may be transported to the open ocean and thence into another LME.
19 Exploited species as well as those of biodiversity concern may migrate between LMEs and the open ocean either ontogenetically or seasonally.
20 Sea level rise may lead to salt water intrusion in groundwater systems of Small Island Developing States

6 Conclusions and the way forward

This comparative analysis of governance assessment in the five components of the TWAP has illustrated the variety of approaches used in attempting to assess governance. It has also illustrated the extent to which interactions between water categories occur and may affect governance outcomes.

The application of the crosscutting methodology developed in the TWAP MSP was found in several components to be too time-consuming and demanding of data. The approaches that were actually used did focus on a variety of aspects of architecture and process, namely the 'good governance' aspects of governance. While indicators that would be needed to assess 'governance effectiveness' in achieving desired results were included in all assessments, they were not necessarily connected with the 'good governance' indicators to provide an overall assessment of governance. This connection should be made in future assessments if there is to be a useful assessment of both good and effective governance and the relationship between the two.

Ultimately, the fact that many of the indicators developed are composite makes it difficult to determine the extent to which the key areas were covered. The pros and cons of using complex composite indicators, some based on as many as 60 variables, is discussed in the rivers report (UNEP-DHI and UNEP 2015). The use of many input variables is thought to contribute to the robustness of the indicators, but to also make it difficult to determine the effects of individual variables when considering remedial interventions. Given the complexity of most indicators, direct comparison of the indicators used in the five assessments is somewhat superficial. Should it be considered important to have comparability of governance assessments across the five water categories, as may be needed to deal with the interlinkages among water systems in them, it may be necessary to devise a common approach to the assessment of governance.

In reflecting on the preceding governance analysis, it must be acknowledged that the application of the framework and the way that governance is treated in this report is post-hoc and was not anticipated when the component assessments were developed. Nonetheless, this retrospective examination does provide insight into the value that could be added by approaching the assessment in a structured way using a framework. As the first of two overarching recommendations, the CCWG recommends that in future assessments, whether global or not, the GEF adopt an approach in which all known critical issues for the water system being assessed are covered by a full suite of indicators covering all seven indicator categories in the expanded framework.

The real value of this perspective could be realised most fully by building the use of the framework into GEF IW projects from start to finish through the TDA-SAP process. The use of the framework and indicator categories in conducting a TDA would reveal the issue specific gaps in governance architecture and process in all the dimensions shown in Figure 3. It would provide a structured approach to diagnosing problems with governance that is currently missing from the TDA process. Furthermore, the framework would facilitate the development and implementation of the SAP by building it around the extent to which the issue specific architecture and processes needed for good governance are in place and are supported by issue specific indicators in all the indicator categories required to assess governance effectiveness. Ultimately, this approach would facilitate the development of a SAP that would be aimed at filling the gaps found in the framework, and improving associated enabling conditions or mitigating risk factors. It would also facilitate SAP monitoring. Thus, as the second overarching recommendation, the CCWG recommends that the expanded governance framework be used to improve the TDA-SAP process.

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The water systems of the world – aquifers, lakes, rivers, large marine ecosystems, and open ocean- sustain the biosphere and underpin the socioeconomic wellbeing of the world's population. Many of these systems are shared by two or more nations. These transboundary waters, stretching over 71% of the planet's surface, in addition to the subsurface aquifers, comprise humanity's water heritage.

Recognizing the value of transboundary water systems and the reality that many of them continue to be degraded and managed in fragmented ways, the Global Environment Facility Transboundary Waters Assessment Programme (GEF TWAP) was developed. The Programme aims to provide a baseline assessment to identify and evaluate changes in these water systems caused by human activities and natural processes, and the consequences these may have on dependent human populations. The institutional partnerships forged in this assessment are envisioned to seed future transboundary assessments as well.

The final results of the GEF TWAP are presented in the following six volumes:
Volume 1 – ***Transboundary Aquifers and Groundwater Systems of Small Island Developing States: Status and Trends***
Volume 2 – ***Transboundary Lakes and Reservoirs: Status and Trends***
Volume 3 – ***Transboundary River Basins: Status and Trends***
Volume 4 – ***Large Marine Ecosystems: Status and Trends***
Volume 5 – ***The Open Ocean: Status and Trends***
Volume 6 – ***Transboundary Water Systems: Crosscutting Status and Trends***

A *Summary* for Policy Makers accompanies each volume.

This document - Comparison of Governance Assessments Conducted by the Transboundary Waters Assessment Programme Components, the Report of the TWAP Crosscutting Working Group on Governance - is supplementary to the six main volumes listed above. It seeks to draw together the work that was done on governance in the five water categories and to promote a consistent approach to governance in international waters programmes.

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