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Measuring Transboundary Water Cooperation: Learning from the Past to Inform the Sustainable Development Goals



Davison Saruchera and Jonathan Lautze



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**Measuring Transboundary Water Cooperation: Learning from
the Past to Inform the Sustainable Development Goals**

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and
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Summary

Water cooperation has received prominent focus in the post-2015 United Nations Sustainable Development Goals (SDGs). While proposals for measuring water cooperation appear to be converging toward a small set of indicators, the degree to which these proposed indicators draw on past work is unclear. This paper mines relevant past work to generate guidance for monitoring the proposed SDG target related to transboundary water cooperation. Potential measures of water cooperation were identified, filtered and applied in three countries (Botswana, South Africa and Zimbabwe). Six indicators were ultimately determined as being suitable for measuring water cooperation. As the SDG process turns its focus to the selection of indicators, the indicators proposed in this paper may merit consideration.

1. INTRODUCTION

Transboundary water cooperation has emerged as an important issue in the post-2015 United Nations (UN) Sustainable Development Goals (SDGs).¹ The outcome of a consultative, multi-year process that allocates extensive focus to water management under its Goal 6 (ensure availability and sustainable management of water and sanitation for all), the SDGs will provide a powerful frame for approaches to dealing with water across the world. Transboundary water cooperation is a focus of target 6.5, which states “by 2030 implement integrated water resources management at all levels, including through transboundary cooperation as appropriate” (UN 2014).

Inclusion of transboundary water cooperation in the SDG framework has driven the focus on measuring cooperation. The Swiss government and UN-Water proposed a measure of transboundary water cooperation oriented toward the presence of a transboundary water agreement (Confédération Suisse 2013; UN-Water 2014). Country consultations on the SDGs and implemented by the Global Water Partnership (GWP) proposed two key transboundary water management priorities: i) completion of a basin agreement, and ii) creation of a basin organization (GWP 2013). A UN-Water working group has now been formed for target 6.5, and entrusted with the task of identifying indicators for measuring Integrated Water Resources Management (IWRM) and water cooperation.

Despite the attention given to measuring transboundary water cooperation in the SDGs, the proposed indicators seem somewhat detached from a fairly voluminous knowledge base on issues of assessing transboundary water cooperation and the related topic of basin governance (Hooper 2006; Cap-Net 2008; Hooper and Kranz 2009; SADC 2010; UNECE 2011; Manzungu et al. 2012; CRBOM 2013; GIZ 2014; IOW 2014). Hooper (2006) developed and tested 115 river basin governance indicators; Cap-Net, the international network for capacity development in sustainable water management (Cap-Net 2008), developed a set of 22 IWRM indicators; Hooper and Kranz (2009) produced a set of 29 indicators; the Southern African Development Community (SADC) recommended five indicators (SADC 2010); the United Nations Economic Commission for Europe (UNECE) identified seven indicators (UNECE 2011); Manzungu et al. (2012) developed 44 basin management indicators; the Center for River Basin Organizations and Management (CRBOM) produced 14 indicators (CRBOM 2013); Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) proposed five indicators (Henkel et al. 2014); and the International Office for Water (IOW) developed a set of 20 indicators (IOW 2014). These efforts nonetheless predate the SDG discussions, and are therefore not specifically oriented towards capturing the progress of a SDG target.

This paper seeks to identify if and how current proposals for measuring transboundary water cooperation as part of the SDG discussions may be enhanced by past work on the topic. The paper first provides a background on water cooperation in the SDGs, and reviews past work on indicators of water cooperation and basin governance (section 2). The paper then develops an approach to assess the suitability of such indicators for measuring transboundary river basin cooperation (section 3), and applies that approach to generate a short list of indicators. This short list of indicators is then pilot tested in three countries to assess their viability for application at a country level (section 4). Finally, the paper contextualizes key findings (section 5), and considers how the approach used in this paper may help bridge research-to-policy disconnects (section 6).

¹ While the primary objective of this paper is to generate options to measure progress toward a SDG target, it is also relevant to monitoring and implementation of the recently-entered-into-force UN *Convention on the Law of the Non-navigational Uses of International Watercourses*, as well as the United Nations Economic Commission for Europe (UNECE) *Convention on the Protection and Use of Transboundary Watercourses and International Lakes*.

2. BACKGROUND

2.1 Water Cooperation in the SDGs

The SDG process is the UN-led global development framework that builds on the Millennium Development Goals (MDGs), which will expire at the end of 2015. The SDGs will comprise a set of international development targets which are agreed by UN member states for the period 2016 to 2030. The SDG process is coordinated by the UN Open Working Group on SDGs, which draws information from UN agencies such as the United Nations System Task Team (UNSTT) on SDGs, United Nations Development Group (UNDG) and the High-level Panel of Eminent Persons (HLPEP). The Open Working Group compiles and shares guidance notes and other inputs through various platforms, and prepares a final draft document on the proposed goals and targets for the UN General Assembly. Position papers that provide guidance on SDG conceptualization have indeed been accepted from governments and actors such as the African Ministers' Council on Water (AMCOW) and GWP.

The multiple position papers submitted for the SDG target on water take a more holistic approach to water management than the MDGs. AMCOW, Confédération Suisse and United Nations Global Compact (UNGC) proposed a SDG target on water that is anchored on three main components: water, sanitation and hygiene (WASH), water resources management, and wastewater and water quality management (AMCOW 2013; Confédération Suisse 2013; UNGC 2013). HLPEP proposed a SDG target on water that contains the following three components: WASH, wastewater management and efficient use of water (UNU-INWEH/UNOSD 2013). UN-Water offered a proposal with five components: WASH, wastewater management, water resources management, water governance and the management of water-related disasters (UN-Water 2014).

Transboundary water cooperation featured in two of the SDG water proposals mentioned above: the Swiss position paper and the UN-Water proposal. The Swiss position paper (Confédération Suisse 2013) noted that governance of transboundary watercourses should be based on treaties that are sustainable. The UN-Water position paper (UN-Water 2014) proposed an integrated approach to water governance at national and transboundary levels, including the use of three water governance indicators: participation, accountability and established regulatory frameworks. Within the UN-Water dialogues, GWP consultations produced recommendations for the inclusion of transboundary water management agreements, as well as the creation of river basin organizations (RBOs) to facilitate the cooperative agreements (GWP 2013).

Ultimately, the water goal in the Open Working Group (OWG) proposal (Goal 6) contained six targets, of which transboundary water cooperation is captured in target 6.5 (UN 2014, 9). While the OWG proposal stops short of specifying how progress made towards targets will be measured, a logical assumption would be for indicators to be drawn from position papers, and as such implementation of transboundary water cooperation to be measured primarily by conclusion of agreements and creation of RBOs.²

2.2 Past Efforts to Measure Water Cooperation and Basin Governance

Past attempts to measure water cooperation and transboundary river basin governance have been undertaken under the auspices of various titles. At times RBOs were assessed, and at other times

² Indeed, the UN-Water Working Group appears to place focus on an area covered by a transboundary water agreement.

adaptive water management and IWRM were assessed. This section reviews the various approaches used to measuring water cooperation and basin governance regardless of the titles under which that measurement may have been conducted. Further, the section reviews evidence from both transboundary and national river basins, as both may generate insights.

The first set of relevant indicators identified were from a project implemented by UNECE, which focused on water cooperation in newly independent states. In 2003, UNECE produced a first assessment report for this project on the practice of IWRM in adaptive management in transboundary waters. Three main performance indicators were examined: existence of institutions, existence of water quality standards and defined water rights (UNECE 2003).

A related, but broader, effort was undertaken in the context of '*New approaches to adaptive water management under uncertainty*' (NeWater), a project funded by the European Union, implemented between 2005 and 2009 in Europe, Central Asia and Africa. The project measured adaptive management capacity of five transboundary basins - the Nile, Orange-Senqu, Elbe, Guadiana and Amu Darya. Measurement was undertaken through the use of five performance indicators: financial support, information management, stakeholder participation, inclusive policy development and reliable communication (Kranz et al. 2005a; Kranz et al. 2005b; Raadgever 2005; Timmerman 2005).

In North America, Hooper (2006) and Hooper and Ward (2006) developed and tested a set of indicators. Hooper (2006) compiled a list of 115 indicators and classified them into 10 categories. His work utilized indicators which focused on issues such as accountability, monitoring mechanisms and capacity building. Hooper and Ward (2006) tested some of these indicators in the transboundary Rio Grande Basin and in the national Delaware Basin. The tests used three indicators – coordinated decision making, reduction in water allocation conflicts and information management – to measure adaptive basin governance.

Cap-Net (2008) produced a set of indicators that measures IWRM implementation at a basin level. The indicators were focused around seven functions: water allocation, pollution control, monitoring, basin planning, economic financial management, information management and stakeholder participation. Out of 22 indicators identified, seven were specific to water governance. These are processing of water licenses, water allocation criteria, data management, frequency of meetings, stakeholder structures, availability of information to managers and gender inclusion. These indicators were developed as a toolkit, but were not tested in any basin.

Hooper and Kranz (2009) produced a handbook on transboundary water governance indicators for river basins in Africa. Their work refines the long list of 115 indicators of Hooper (2006) to a short list of 29 indicators, grouped into eight themes. Most of these 29 indicators, such as user participation and resource monitoring, were focused on basin governance. Some of these indicators, such as benefit sharing, were more oriented towards basin management outcomes. The indicators were developed as a guideline to assess basin cooperation in an African context and were not pilot tested.

In southern Africa, SADC (2010) offered five indicators for measuring the financial sustainability of RBOs. These are adequate funding to cover priority issues, self-funding for core activities, efficient financial management, transparent reporting of investments and coordination of donor funds. These indicators were developed primarily for transboundary basins and reflect the reality that external funding plays a major role in southern Africa's river basins.

UNECE (2011) produced a report on transboundary rivers, lakes and groundwater that provides specific information on measuring transboundary water management. The proposed indicators identified were: reliable data management systems, standardized reporting procedures, reduction of water allocation conflicts and evidence of implementation of basin plans. Particular emphasis

was placed on the need for joint programs of monitoring and regular exchange of information. The indicators are given as recommendations and were not tested.

Manzungu et al. (2012) built on the indicators produced by Cap-Net (2008) to evaluate the management of the Mzingwane catchment, a sub-basin of the Limpopo that falls entirely within Zimbabwe. Indicators were identified through a participatory workshop held with stakeholders, and were adapted to make them locally relevant. The workshop resulted in the prioritization of the following indicators: financial reporting, up-to-date information management, stakeholder participation and establishment of water user associations (Manzungu et al. 2012).

CRBOM developed a set of 14 indicators to assess the capacity of RBOs to undertake IWRM. The 14 indicators were grouped into five categories – mission, stakeholders, learning and growth, internal business process and finance (CRBOM 2013). Governance indicators that were developed include data exchange, organizational design, existence of treaties and reduced conflicts, human capacity development, planning maturity, cost recovery and efficient financial management. Indicators were tested in 10 Asian river basins in Sri Lanka, the Philippines, Vietnam and Indonesia. CRBOM continues to utilize these indicators and even provides a commercial service of RBO benchmarking (CRBOM 2013).

In 2014, two further reports that focused on basin governance were released. The first, GIZ (2014), identified five indicators of financial sustainability for transboundary RBOs: financing of regular budget, degree of basin self-financing, efficient financial management, level of financial reserves and leverage of regular budget funding. The second, IOW (2014), examined the experiences of transboundary basin management in Africa and contained 20 indicators for measuring basin governance. The indicators were grouped into seven categories: finance, legal framework, participation, planning, coordination, information systems and political processes. Seventeen of the 20 indicators focus on basin governance processes while three are more oriented towards measuring governance outcomes.

Currently, the United Nations Environment Programme (UNEP) is implementing the globally-focused transboundary waters assessment programme (TWAP). TWAP undertakes assessments of five different types of transboundary water systems (groundwater, lakes/reservoirs, river basins, large marine ecosystems and open ocean areas) with the aim of producing globally applicable benchmarks in transboundary water management. Water governance is studied under the themes of i) governance architecture, ii) river basin resilience, and iii) water legislation. Relevant indicators developed so far are coordination, control of corruption, enforcement of rules, stakeholder participation, sufficient funding and existence of national-level IWRM plans. Their work has not been formally published, although reports on the methodology for the assessment exercise have already been produced (UNEP-DHI Centre for Water and Environment 2011).

3. METHODS

3.1 Literature Search and Data Compilation

To obtain documents containing measures and indicators related to transboundary water cooperation, literature was collected through the library of the International Water Management Institute (IWMI), contacts in research networks and by also searching the Internet. For the library and Internet searches, the following key words were used: river basin, performance indicators, benchmarks, measures, effectiveness, cooperation and water governance. Input was also sought from contacts within IWMI and other organizations, notably the Stockholm International Water Institute (SIWI), GIZ, UNEP-DHI Centre for Water and Environment, and GWP.

The literature search produced 30 journal articles, 64 reports from various national and international projects, and three book chapters. From these sources, more than 100 indicators were identified that measure water cooperation or basin governance. Indicators from these sources nonetheless contained some overlap. Consolidating indicators to reduce overlap, and harmonizing indicators with minor language differences, resulted in a set of 33 indicators.

3.2 Developing a Consolidated Long List of Basin Governance Indicators

For organizational purposes, 33 indicators contained in the initial list were grouped into 10 categories adapted from the work of Hooper (2006) and CRBOM (2013). The 10 categories are given below:

- i. **Information management** - the production and dissemination of information.
- ii. **Legislation** - the role of legislation in basin management.
- iii. **Participation** - the inclusiveness of basin governance, including representation of stakeholders.
- iv. **Coordination** - the organization and working relationships of different stakeholders in basin management.
- v. **Finance** - the financial management of basin funds.
- vi. **Organizational design** - the structure of the basin organization's management roles.
- vii. **Basin planning** - existence of strategic plans to identify basin objectives.
- viii. **Goal completion** - actual progress of the implementation of a basin's mandate.
- ix. **Capacity building** - training and development of staff members tasked with implementing basin water cooperation.
- x. **Monitoring and evaluation** - activities undertaken to monitor resource use.

The indicators were also classified as either paper- or practice-based. Paper-based indicators refer to those indicators that mainly capture the existence of 'paper-based' cooperative activity. Practice-based indicators are those indicators that measure on-the-ground cooperative activity. The two are complementary and reinforcing. Paper-based cooperation often sets out the modalities of practical cooperation, and practical cooperation is institutionalized through agreement on paper.

3.3 Filtering the Long List of Indicators

In an effort to create a lean set of indicators that is recognized as legitimate on the one hand, and can be feasibly applied to measure transboundary cooperation on the other, the long list of indicators were filtered down to a short list. Indicators were sifted according to the following five criteria: recognition, applicability at a transboundary level, logistical feasibility, applicability in a variety of institutional contexts and objectivity. Such criteria were adapted from the work of Makin et al. (2004) and Hooper (2006). Table 1 provides a description of each of these criteria, as well as clarification on how they were applied. Ultimately, the five criteria were applied to indicators in a stepwise fashion. Only the indicators that met all the criteria advanced to the short list.

TABLE 1. Criteria applied to sift indicators.

Criteria	Description	Sifting mechanism
Recognition	Degree to which an indicator was cited in the literature.	At least two sources must make reference to an indicator.
Applicability at a transboundary level	Degree to which an indicator captures issues that measure cooperation at a transboundary level.	Indicators that can only be applied at national level were excluded.
Logistical feasibility	Degree to which an indicator can be populated in a logistically feasible manner.	Indicators that can be populated through phone calls, emails or a single visit to the relevant office were considered feasible; indicators requiring additional effort for population were considered infeasible.
Applicability in a variety of institutional contexts	Degree to which an indicator is free from bias toward a particular organizational form of cooperation.	Indicators measuring the existence of a particular organizational form, such as secretariat-based RBO, were excluded.
Objectivity	Degree to which the result of an indicator's application will be accepted.	Indicators conducive to population with grey data were excluded.

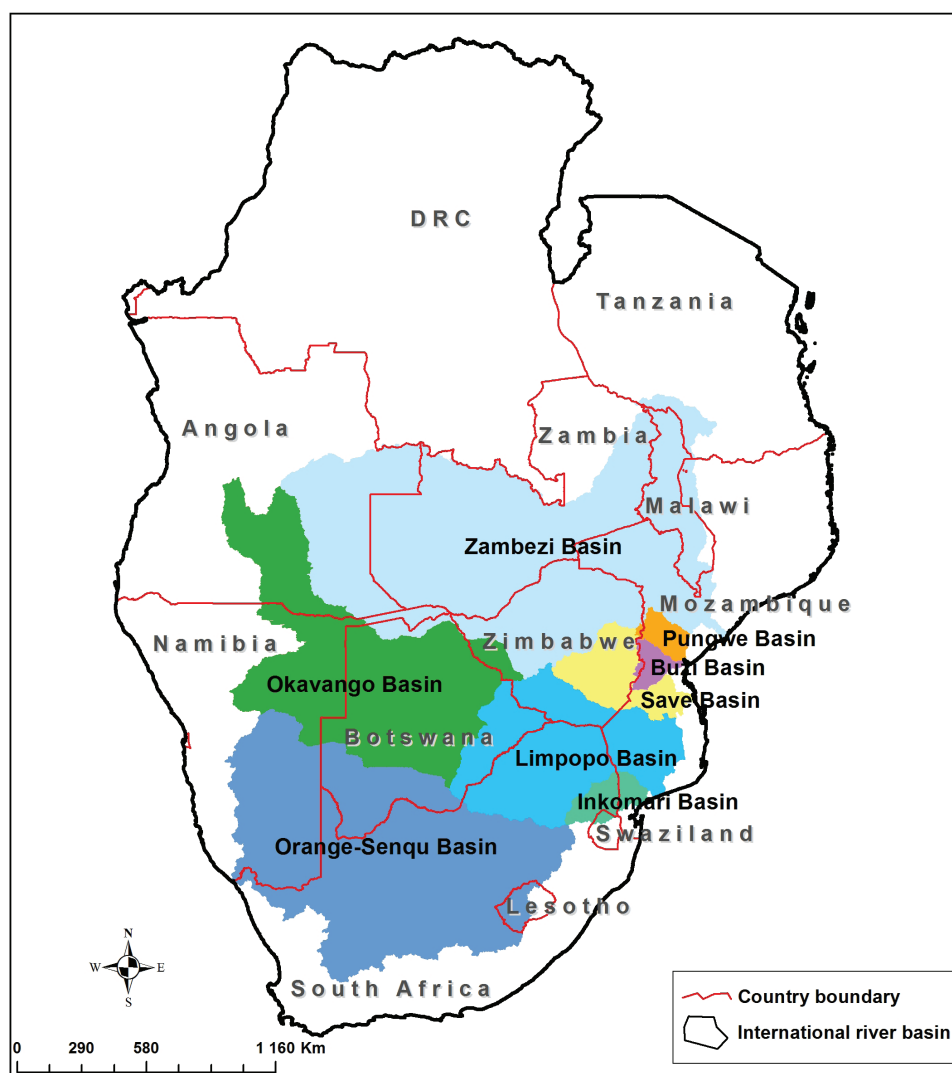
3.4 Pilot Testing the Indicators

Indicators from the short list were applied in three countries in southern Africa (Botswana, South Africa and Zimbabwe) (Figure 1). Botswana is riparian to four transboundary river basins – Limpopo, Okavango, Orange-Senqu and Zambezi. South Africa is riparian to three transboundary river basins – Inkomati, Limpopo and Orange-Senqu. Zimbabwe is riparian to two large transboundary river basins – Limpopo and Zambezi – and three smaller, adjacent basins – Save, Buzi and Pungwe. These three smaller basins are administered as a combined single unit (SADC 2014), and a RBO which will include these three basins is currently being established. The Save, Buzi and Pungwe are thus combined into one unit of analysis in this paper.

Application of indicators was undertaken through telephone interviews. In the Limpopo, Okavango, Orange-Senqu and Zambezi river basins, telephone interviews were conducted with personnel at basin secretariats. Triangulation was then conducted through interviews conducted with representatives of each country's government department responsible for water resources. Where no basin secretariat existed, telephone interviews were conducted with catchment representatives, who are senior government managers in charge of transboundary water cooperation. Email communications were used to receive electronic copies of documents, for example, basin plans.

To reduce subjectivity, a straightforward binary approach was applied for indicator population that gauged the presence or absence of a particular parameter. Country scores for each indicator were then measured on a scale between zero and 100%, according to the percentage of a country's area that is covered by shared waters in which a particular parameter was present. For example, if a country possesses a transboundary water agreement on a particular basin that covers 60% of its shared waters, but has no agreement applying to basins that cover the other 40% of its shared waters, a country score of 60% was assigned.

FIGURE 1. Map of river basins and countries where pilot tests were undertaken.



Indicators were applied at a country level, in order to align with national-level targets specified in the SDGs. Nonetheless, it is worth noting that previous indicators of water cooperation were often designed for basin- rather than country-level application. While application of indicators at an alternate scale from which they were initially designed may have compromised their strength, it is believed that this compromise was necessary to render them suitable for use in the context of the SDGs.

3.5 Reflection on the Final Set of Indicators for Measuring Water Cooperation

In addition to measuring the strength of water cooperation in countries, pilot tests were implemented to gauge indicator viability. As such, when undertaking pilot tests, attention was paid to the ease with which data could be obtained to populate indicators, and the level of objectivity or clarity with which indicators can be applied. More specifically, pilot tests were employed to sift indicators using the following two criteria:

- Ease of data collection: Indicators that could be populated through a straightforward telephone call were considered to be easily applicable. Conversely, indicators that required

follow-on analysis, based on multiple interviews and/or additional investigation, were considered more difficult to apply.

- Clarity: Indicators that were populated in an unambiguous manner were considered to be clear. Conversely, indicators for which complications arose, judgement was required or those which yielded results that could be perceived as subjective were considered unclear.

4. RESULTS

4.1 Consolidated Long List of Indicators

In total, the long list contained 33 indicators that were grouped into 10 categories (Table 2): 13 paper-based indicators received 52 citations and 20 practice-based indicators received 81 citations. The columns in Table 2 show the following information: column one contains the 10 categories and associated aggregate number of citations; column two provides specific indicators in each category; column three specifies whether an indicator is paper-based or practice based; column four highlights the number of times the indicator is cited in literature; and column five contains the sources that identify the indicator.

TABLE 2. Long list of indicators.

Category (associated aggregate number of citations)	Indicators	Class	Number of sources identifying this indicator	References
Information management (33)	Existence of information management systems	Paper	13	Makin et al. 2004; Kranz et al. 2005a, 2005b; Raadgever 2005; Timmerman 2005; Hooper 2006; Timmerman and Interwies 2007; Cap-Net 2008; Hooper and Kranz 2009; UNECE 2011; Manzungu et al. 2012; CRBOM 2013; IOW 2014
	Communication	Practice	9	Makin et al. 2004; Raadgever 2005; Timmerman 2005; Kranz et al. 2005a, 2005b; Timmerman and Interwies 2007; Hooper and Kranz 2009; Sungguh 2009; IOW 2014
	Evidence of regular data exchange	Practice	6	UNECE 2003; Makin et al. 2004; Timmerman and Interwies 2007; Sungguh 2009; Manzungu et al. 2012; CRBOM 2013
	Harmonized standards and units of measurement	Practice	5	Hooper and Ward 2006; Hooper and Kranz 2009; UNECE 2011; Manzungu et al. 2012; IOW 2014
Finance (27)	Efficient financial management	Practice	9	Kranz et al. 2005a, 2005b; Raadgever 2005; Timmerman 2005; Hooper and Kranz 2009; Sungguh 2009; SADC 2010; Henkel et al. 2014; IOW 2014

(Continued)

TABLE 2. Long list of indicators (continued).

Category (associated aggregate number of citations)	Indicators	Class	Number of sources identifying this indicator	References
	Financial support	Practice	7	Makin et al. 2004; Hooper 2006; Hooper and Kranz 2009; ILEC 2011; CRBOM 2013; GIZ 2014; IOW 2014
	Cost recovery	Practice	6	Makin et al. 2004; Hooper 2006; Raadgever et al. 2008; Sungguh 2009; SADC 2010; IOW 2014
	Self-funding	Practice	3	Hooper and Kranz 2009; SADC 2010; Henkel et al. 2014
	Accountable and transparent investments	Paper	2	Hooper and Kranz 2009; SADC 2010
Participation (25)	Existence of mechanisms for stakeholder participation	Paper	7	Walmsley et al. 2001; UNECE 2003; Timmerman and Interwies 2007; Raadgever et al. 2008; Hooper and Kranz 2009; ILEC 2011; IOW 2014
	Inclusive policy development	Practice	5	Kranz et al. 2005a, 2005b; Raadgever 2005; Timmerman 2005; Hooper 2006
	Specified roles and responsibilities for stakeholders in basin management institutions	Paper	4	Hooper 2006; Hooper and Kranz 2009; ILEC 2011; IOW 2014
	Reduction of water allocation conflicts	Practice	3	Makin et al. 2004; Sungguh 2009; UNECE 2011
	Representation of all stakeholders	Practice	2	Raadgever et al. 2008; Hooper and Kranz 2009
	Representation of all basin countries	Paper	2	Hooper and Kranz 2009; IOW 2014
	Gender equity	Paper	1	Hooper and Kranz 2009
	Number of meetings per term by stakeholders	Practice	1	Cap-Net 2008
Legislation (15)	Existence of enforceable legal statutes in the basin organization	Paper	8	Makin et al. 2004; Timmerman 2005; Hooper 2006; Raadgever et al. 2008; Sungguh 2009; Hooper and Kranz 2009; ILEC 2011; IOW 2014
	Reference to transboundary cooperation in national water legislation	Paper	4	Hooper 2006; Hooper and Kranz 2009; ILEC 2011; IOW 2014

(Continued)

TABLE 2. Long list of indicators (continued).

Category (associated aggregate number of citations)	Indicators	Class	Number of sources identifying this indicator	References
Coordination (12)	Conclusion of a basin-wide transboundary water agreement	Paper	2	Hooper 2006; Timmerman and Interwies 2007
	Accountability to constituent governments	Practice	1	Raadgever et al. 2008
	Coordinated, consensus-based decision making	Practice	5	Hooper 2006; Hooper and Ward 2006; Hooper and Kranz 2009; SADC 2010; IOW 2014
	Existence of coordination mechanisms	Practice	3	Hooper and Kranz 2009; ILEC 2011; IOW 2014
Monitoring and evaluation (6)	Responsive decision making	Practice	2	Hooper 2006; Hooper and Ward 2006
	Overarching reporting mechanisms (to each government)	Paper	2	Hooper and Kranz 2009; IOW 2014
	Joint water resource monitoring programs	Practice	4	UNECE 2003; Timmerman and Interwies 2007; Cap-Net 2008; Manzungu et al. 2012
	Transparent monitoring mechanisms	Practice	1	Hooper and Kranz 2009
Capacity building (4)	Control of corruption	Practice	1	ILEC 2011
	Ongoing training of staff for relevant basin needs	Practice	4	Makin et al. 2004; Hooper 2006; Sungguh 2009; CRBOM 2013
Basin planning (4)	Inclusive completion of a basin plan	Paper	3	Hooper and Kranz 2009; CRBOM 2013; IOW 2014
	Planning maturity - level of planning	Paper	1	Sungguh 2009
Goal completion (4)	Evidence of implementation of basin plans (completion of some stages of basin plans)	Practice	4	Hooper 2006; Hooper and Kranz 2009; UNECE 2011; IOW 2014
Organizational design (3)	Organizational structure designed to suit basin needs	Paper	3	Hooper 2006; Cap-Net 2008; CRBOM 2013

The information management category, containing four indicators, received the highest number of citations (33) among all the 10 categories. *Existence of information management systems* is the most-cited indicator (13 citations) in this category, followed by *communication* (nine citations). *Evidence of regular data exchange* was cited six times, and *harmonized standards and units of measurement* is the least-cited indicator (five citations) in the category.

The finance category received a total of 27 citations and contains five indicators. *Efficient financial management* is the most-prevalent indicator (nine citations) and *financial support* is second with seven citations. *Cost recovery* is the third most-prevalent indicator (six citations) in the category. Other indicators received much fewer citations, with *self-funding* receiving three citations and *accountable and transparent investments* receiving only two citations.

Participation is the category with the third highest number of aggregate citations (25). It includes eight indicators, of which *existence of mechanisms for stakeholder participation* and *inclusive policy development* received the highest number of citations with seven and five citations, respectively. *Specified roles and responsibilities for stakeholders in basin management institutions* was cited four times. Other indicators in this category received fewer citations, with *reduction of water allocation conflicts* cited just three times, and *representation of all basin countries* and *representation of all stakeholders* were each cited only twice.

With a total of 15 citations, the legislation category contains four indicators, of which the most significant is the *existence of enforceable legal statutes in the basin* with eight citations. *Reference to transboundary cooperation in national water legislation* was cited four times and *conclusion of a basin-wide transboundary water agreement* was cited only twice.

Coordination is the fifth most-cited category with 12 citations for the four indicators. The indicator with the highest number of citations (5) is *coordinated, consensus-based decision making*, while *existence of coordination mechanisms* is second with three citations. *Responsive decision making* and *overarching reporting mechanisms* are both cited twice.

Monitoring and evaluation is the sixth most-cited category. With a total of six citations, the category contains three indicators. *Joint water resource monitoring programs* is the most notable indicator, which is cited four times. The other two indicators are less notable.

The other four categories received substantially fewer citations on aggregate. The capacity building category, with four citations, contains only one indicator: *ongoing training of staff for relevant basin needs*. The basin planning category received only four citations for two indicators. Of these two indicators, *inclusive completion of a basin plan* is the most cited with three citations.

The least cited categories are goal completion and organizational design. They both contain just one indicator. In the goal completion category, *evidence of implementation of basin plans* is cited four times. In the organizational design category, *organizational structure designed to suit basin needs* is cited thrice.

4.2 Short List of Indicators

Application of filtering criteria to the long list of potential indicators resulted in a short list of 10 indicators (Table 3). The columns in Table 3 show the following information: column 1 contains indicators that met all the five criteria applied as filters; and column 2 provides explanation of how indicators were populated.

Titles of several indicators were subjected to minor elaboration and refinement in order to improve the precision with which they capture the intended aspect of transboundary water cooperation. In one case, *financial support* was refined to *riparian financing for transboundary institutional activities* to reflect the reality that greater riparian financing on core organizational

TABLE 3. Short list of indicators and means of verification.

Indicator (class)	Methods used to populate indicators
Conclusion of a basin-wide transboundary water agreement (paper)	Interview relevant representatives from riparian government/basin organizations and obtain the agreement document, if it exists.
Reference to transboundary cooperation in national water legislation (paper)	Review legislation of each country for existence of reference to transboundary water management.
Inclusive completion of a basin plan (paper)	Interview relevant basin/government personnel to establish existence of the plan. Where the plan exists, obtain the document.
Existence of information management systems (paper)	Interview relevant basin/government personnel. If a system is in place, request evidence of it.
Evidence of regular data exchange (practice)	Interview relevant representatives from the basin/riparian government to confirm frequency of data exchange.
Harmonized standards and units of measurement (practice)	Interview relevant technical personnel from riparian governments/basin organizations to get the units of measurement used; compare units utilized across countries to confirm harmonization.
Joint water resource monitoring programs (practice)	Interview relevant representatives from basin organizations/riparian governments to confirm joint monitoring. Then, request documents that provide evidence of a joint water monitoring mission.
Riparian financing for transboundary institutional activities (practice)	Interview relevant representatives from basin organizations/riparian governments and request budget figures.
Existence of mechanisms for stakeholder participation (paper)	Interview relevant representatives from basin organizations/riparian governments and triangulate with representatives of various stakeholder groups. Request appropriate documentation or reference to institutions that prove the existence of such platforms.
Specified roles and responsibilities for stakeholders in basin management institutions (paper)	Interview relevant representatives from basin organizations/riparian governments and triangulate with representatives of various stakeholder groups. Request documents that show the involvement of stakeholders in basin management.

issues is feasible and desirable, yet riparian financing for infrastructure activities may be less straightforward. Indeed, external funding to cooperative infrastructure activities may be a positive reflection on the effectiveness of riparian financing and management of institutions.

Six of the indicators are ‘paper-based’, i.e., they reflect cooperation that occurs on paper and can ultimately be verified as to whether or not the relevant ‘paper’ exists. Verification is achieved through interviews with appropriate personnel to ascertain the existence of relevant papers and a review of relevant documents. The other four indicators are ‘practice-based’, i.e., they reflect the activity of cooperation in practice and are verified through enquiries with knowledgeable personnel.

4.3 Results from the Pilot Tests

Pilot testing the short-listed indicators in the three countries (Botswana, South Africa and Zimbabwe) revealed some commonality. Across all three countries, high scores are consistently achieved in the areas of *conclusion of a basin-wide transboundary water agreement*, *existence of information management systems*, *evidence of regular data exchange* and *existence of mechanisms for stakeholder participation*. However, all three countries appear to demonstrate

weak cooperation in the areas of *harmonized standards and units of measurement, joint water resource monitoring programs and specified roles and responsibilities for stakeholders in basin management institutions*.

In Botswana, the aggregate level of water cooperation can be described as moderate, despite wide variation in cooperation in specific areas (Table 4). Evidence of good cooperation can be found in the areas of *conclusion of a basin-wide transboundary water agreement, existence of information management systems, evidence of regular data exchange and existence of mechanisms for stakeholder participation*. Evidence of mediocre cooperation can be found in the areas of *inclusive completion of a basin plan and riparian financing for transboundary institutional activities*. Poor cooperation is found in the areas of *reference to transboundary cooperation in national water legislation, harmonized standards and units of measurement, joint water resource monitoring programs and specified roles and responsibilities for stakeholders in basin management institutions*. The average score for Botswana is just under 52%.

TABLE 4. Measuring water cooperation in Botswana.

Indicator	River basin				Coverage (%)
	Limpopo (37.6%)	Okavango (23.2%)	Orange-Senqu (33.4%)	Zambezi (5.8%)	
Conclusion of a basin-wide transboundary water agreement	Yes	Yes	Yes	Yes	100
Reference to transboundary cooperation in national water legislation	No	No	No	No	0
Inclusive completion of a basin plan	No	Yes	Yes	No	56.6
Existence of information management systems	Yes	Yes	Yes	Yes	100
Evidence of regular data exchange	Yes	Yes	Yes	Yes	100
Harmonized standards and units of measurement	No	No	No	No	0
Joint water resource monitoring programs	No	No	No	No	0
Riparian financing for transboundary institutional activities	No	Yes	Yes	Yes	62.4
Existence of mechanisms for stakeholder participation	Yes	Yes	Yes	Yes	100
Specified roles and responsibilities for stakeholders in basin management institutions	No	No	No	No	0
Country average					51.9

South Africa records slightly stronger cooperation than Botswana, although the wide variation in performance persists (Table 5). Evidence of good cooperation can be found in the areas of *conclusion of a basin-wide transboundary water agreement, reference to transboundary cooperation in national water legislation, existence of information management systems, evidence of regular data exchange and existence of mechanisms for stakeholder participation*. *Riparian financing for transboundary institutional activities* is achieved only in one large basin

(Orange-Senqu), and *inclusive completion of a basin plan* and *harmonized standards and units of measurement* were manifested in just one basin (Inkomati). Performance in the areas of *joint water resource monitoring programs* and *specification of roles and responsibilities for stakeholders in basin management institutions* were not strong in South Africa. The average score for South Africa is 58%.

TABLE 5. Measuring water cooperation in South Africa.

Indicator	River basin			Coverage (%)
	Inkomati (3.7%)	Limpopo (23.5%)	Orange-Senqu (72.8%)	
Conclusion of a basin-wide transboundary water agreement	Yes	Yes	Yes	100
Reference to transboundary cooperation in national water legislation	Yes	Yes	Yes	100
Inclusive completion of a basin plan	Yes	No	No	3.7
Existence of information management systems	Yes	Yes	Yes	100
Evidence of regular data exchange	Yes	Yes	Yes	100
Harmonized standards and units of measurement	Yes	No	No	3.7
Joint water resource monitoring programs	No	No	No	0
Riparian financing for transboundary institutional activities	No	No	Yes	72.8
Existence of mechanisms for stakeholder participation	Yes	Yes	Yes	100
Specified roles and responsibilities for stakeholders in basin management institutions	No	No	No	0
Country average				58.0

Zimbabwe's level of water cooperation is the weakest of all three countries (Table 6). Zimbabwe performs well in the areas of *reference to transboundary cooperation in national water legislation* and *existence of information management systems*. *Conclusion of a basin-wide transboundary water agreement*, *evidence of regular data exchange* and *existence of mechanisms for stakeholder participation* are typically present in the country's larger basins (Limpopo and Zambezi) but absent in the Save, Buzi and Pungwe basins. Financial support is provided only in the Zambezi Basin, and therefore the indicator *riparian financing for transboundary institutional activities* receives a score of 60.2%. The remaining four indicators – *inclusive completion of a basin plan*, *harmonized standards and units of measurement*, *joint water resource monitoring programs* and *specified roles and responsibilities for stakeholders in basin management institutions* – received a score of 0%. The average score for Zimbabwe is 48.5%.

TABLE 6. Measuring water cooperation in Zimbabwe.

Indicator	River basin			Coverage (%)
	Limpopo (14.6%)	Save, Buzi and Pungwe (25.2%)	Zambezi (60.2%)	
Conclusion of a basin-wide transboundary water agreement	Yes	No	Yes	74.8
Reference to transboundary cooperation in national water legislation	Yes	Yes	Yes	100
Inclusive completion of a basin plan	No	No	No	0
Existence of information management systems	Yes	Yes	Yes	100
Evidence of regular data exchange	Yes	No	Yes	74.8
Harmonized standards and units of measurement	No	No	No	0
Joint water resource monitoring programs	No	No	No	0
Riparian financing for transboundary institutional activities	No	No	Yes	60.2
Existence of mechanisms for stakeholder participation	Yes	No	Yes	74.8
Specified roles and responsibilities for stakeholders in basin management institutions	No	No	No	0
Country average				48.5

4.4 Reflection on the Final Set of Indicators for Measuring Water Cooperation

Pilot testing the 10 indicators provided greater clarity on the viability of their application. It was possible to populate six of the 10 indicators with data that were easily obtainable, and these generated unambiguous results and provided meaningful indication of the strength of cooperation (Table 7). These six indicators, three paper-based and three practice-based, are *conclusion of a basin-wide transboundary water agreement*, *reference to transboundary cooperation in national water legislation*, *inclusive completion of a basin plan*, *evidence of regular data exchange*, *harmonized standards and units of measurement* and *riparian financing for transboundary institutional activities*.

Four indicators – *existence of information management systems*, *joint water resource monitoring programs*, *existence of mechanisms for stakeholder participation* and *specified roles and responsibilities for stakeholders in basin management institutions* – did not prove to be as viable. These indicators proved to either i) require extensive data collection, or ii) generate somewhat ambiguous results, or both. *Existence of information management systems* proved to be fuzzy, since virtually any form of record keeping can qualify as an information management ‘system’; obtaining data for the indicator was also not straightforward. *Joint water resource monitoring programs* proved somewhat ambiguous, since monitoring may be effectively undertaken within countries rather than at a basin level; obtaining data for the indicator also proved tedious, since it required multiple interviews with key personnel. Finally, populating indicators on *existence of mechanisms for stakeholder participation* and *specified roles and responsibilities for stakeholders in basin management institutions* proved laborious,

with judgement utilized to place stakeholder participation, roles and responsibilities into a binary classification framework.³

TABLE 7. Final set of indicators.

Indicator	Included in the final list?	Justification
Conclusion of a basin-wide transboundary water agreement	✓	Results of the application of the indicator are unambiguous. Data are easily obtainable from the Internet.
Reference to transboundary cooperation in national water legislation	✓	Application of the indicator produces unambiguous results. Data are obtainable through Internet searches.
Inclusive completion of a basin plan	✓	Application of the indicator is reasonably clear. Data are obtainable through email.
Existence of information management systems		Indicator parameters are opaque. Data are slightly cumbersome to obtain.
Evidence of regular data exchange	✓	Application of the indicator yields clear results. Data are easily obtainable through telephone interviews.
Harmonized standards and units of measurement	✓	Application of the indicator is clear. Obtaining data is easy.
Joint water resource monitoring programs		Some ambiguity surrounding the necessity for application of the indicator at transboundary level. Obtaining data is tedious.
Riparian financing for transboundary institutional activities	✓	Indicator parameters are clear. Data are obtainable with ease.
Existence of mechanisms for stakeholder participation		Classification requires judgement. Obtaining data is a long process.
Specified roles and responsibilities for stakeholders in basin management institutions		Specification of roles proved ambiguous. Data are obtained through a lengthy process.

5. DISCUSSION

This paper collected more than 30 indicators of transboundary water cooperation. These were filtered to arrive at a short list of potentially viable indicators, which were pilot tested in three countries (Botswana, South Africa and Zimbabwe) to yield a final set of indicators that the SDG process may seek to use to measure the progress made toward its target related to transboundary water cooperation. Ultimately, this process produced a final set of six indicators that gauge a country's level of cooperation in its shared waters. This paper is believed to be the first effort to thoroughly review related past work and propose a set of indicators that can respond directly to a target emerging from the SDG process.

Comparison of the final set of six indicators proposed in this paper – (i) conclusion of a basin-wide transboundary water agreement, (ii) reference to transboundary cooperation in national water

³ In fairness, a more detailed classification framework would likely still require judgement when classifying.

legislation, (iii) inclusive completion of a basin plan, (iv) evidence of regular data exchange, (v) harmonized standards and units of measurement, and (vi) riparian financing for transboundary institutional activities – with those proposed by the GWP (GWP 2013), Swiss government (Confédération Suisse 2013) and UN-Water (UN-Water 2014) highlights only one alignment. UN-Water and the Swiss government both focus on the existence of agreements, which is one of the six indicators proposed in this paper. GWP (2013) also proposed a basin organization, which is not proposed in this paper. Criteria applied in this paper eliminated *establishment of river basin organizations* on the grounds that it prescribes a particular organizational form of cooperation, and as such could not be impartially applied in a variety of institutional contexts. The conceptual basis for this filtering criterion is that water governance must allow solutions that work in each individual context and not recommend particular frameworks (Giordano and Shah 2014).

While it is possible to apply a more comprehensive set of indicators to assess the degree of cooperation in a given basin, there is a need to balance the depth of the assessment with time sensitivity and logistical feasibility of the approach to arrive at a set of measures that can be applied at a frequency suitable for use in the context of SDGs. Against this background, it is worth noting that the four indicators eliminated from the final ten, as well as those forming part of the broader set of 33 indicators that were not included in the final list, are clearly relevant and useful in certain contexts. In the context of the envisioned role for the measures identified through the work of this paper, however, they were not determined to be suitable.

A critique of the final six indicators proposed in this paper may be that they are normative, i.e., stipulating how best to do things. While this point is not without merit, at the same time it strikes upon broader issues as the whole SDG development framework is guided by the need to achieve certain targets, many of which are likely to be normative. Nevertheless, the final set of indicators were selected and crafted in such a way that it is possible to accommodate differences across basins, as long as riparian countries achieve progress toward the SDG target related to transboundary water cooperation.

More broadly, one point that may merit attention is the governance focus of SDG target 6.5. Perhaps, unlike other targets which place greater focus on practical outcomes, the governance orientation of target 6.5 presents at least two issues that are not found in other targets. First, there is a particular danger that ‘blueprint’ institutional models will be prescribed. As already noted, in reaction to this, more prescriptive indicators such as formation of RBOs were avoided. Second, the governance focus implies that achievement of this target is not only an important objective in its own right, but it is also important to foster progress toward broader aspirations (e.g., effective water management).

Related, one area of future work could involve assessing the degree to which satisfaction of the proposed six indicators correlate with improvements in water management outcomes. This paper reviewed topical literature to compile cooperative indicators that have been identified by experts; one presumes that a major reason for their identification is that issues covered by such indicators are believed to facilitate improved water outcomes. Nonetheless, rigorous establishment of correlations between indicators and outcomes would validate the use of indicators and help to clarify their relative importance. While clear attribution of water management outcomes to cooperative strength may present challenges, establishing greater connection between cooperation and positive outcomes would mark a notable step forward.

A final point worth acknowledging is that levels of water cooperation revealed through the application of the identified six indicators may bear distinctions from the level of actual cooperation taking place. An agreement can be signed, for example, but not implemented, and informal, but effective, cooperation may exist in the absence of a formal agreement. Further, it may be that

riparian countries can overcome or reconcile certain indications of lack of cooperation, such as un-harmonized standards and units of measurement. Nonetheless, the six indicators proposed through this paper are believed to reflect points that *generally* represent a higher level of water cooperation among countries, and it is due to this fact that such indicators are commonly found in relevant literature.

6. CONCLUSION

This paper set out to identify how the current SDG target related to transboundary water cooperation can be informed by past work on water cooperation and basin governance. The paper mined previous work to identify, filter and apply a set of water cooperation indicators in three countries: Botswana, South Africa and Zimbabwe. The final list of six indicators can be applied to measure progress toward the SDG target related to water cooperation. Three of these indicators could be considered ‘paper-based’ and the other three could be considered ‘practice-based’. All of these indicators can be applied relatively easily and provide a meaningful indication of cooperation in transboundary waters. As such, the SDG process might wish to draw from this work to identify indicators to assess the progress made towards water cooperation.

One point highlighted by this paper is the importance of going beyond paper-based measures to assess transboundary water cooperation. Pilot tests of indicators revealed that the use of both paper- and practice-based indicators capture a fuller picture of the level of cooperation taking place in transboundary basins. This point underlines limitations of the indicators currently proposed, which are more focused on paper. Ultimately, it is imperative to identify indicators that are most feasible and meaningful in capturing water cooperation in practice, even if measuring cooperation in practice is a more cumbersome exercise than gauging cooperation on paper.

One limitation of this paper relates to the countries in which indicators were tested. The global relevance of the indicators may be questioned because pilot tests were carried out only in countries that are in southern Africa. The three countries in this study all exist within the SADC region, where a history of cooperation in political and economic issues has existed for approximately two decades. Moreover, SADC member states are all signatories to a protocol for shared watercourses that appears to be functioning well. A more globally diverse set of basins may have unearthed additional nuances or revealed far less cooperative forms of transboundary interactions.

A final point should be raised about the precise wording of the water cooperation target in the SDGs. The current text of the proposed SDG target 6.5 states “by 2030 implement integrated water resources management at all levels, including through transboundary cooperation *as appropriate*.” While it is not entirely clear what ‘as appropriate’ is intended to imply, one suspects that such language was used for one of two possible reasons: (i) to explicitly acknowledge that there is flexibility in the form that cooperation can take; cooperation can be adapted to local conditions as needed and the same form of cooperation is likely not needed everywhere; and (ii) to build in flexibility about the necessity for cooperation on transboundary waters. The second reason is less likely, but not an impossible reason for the use of such language. Whatever the case, if cooperation is only determined to be necessary on a subset of transboundary waters, the set of indicators identified in this paper may be applied to that subset.

In conclusion, it is worth underlining that existing knowledge can provide a powerful basis on which to develop indicators to measure progress toward SDG targets. With increasing acceptance of SDG goals and targets comes the increasing opportunity to mine past research to derive indicators that directly respond to agreed objectives. Timely research that synthesizes work that has been

carried out can indeed play a critical role in the formulation of development measures. By mining past work on water cooperation and basin governance, it will be possible to identify viable indicators that can be used to measure the strength of transboundary water cooperation in the context of the SDGs. It is hoped that this paper provides an example of bridging the research-to-policy gap.

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