Transboundary Water Resources Management for Resilience in the Horn of Africa

Mapping of actors, policies, and initiatives

2020

UNEP-DHI Centre on Water and Environment

UN environment programme

UN environment programme | DHI
UNEP-DHI CENTRE

Table of Contents

Acknowledgements

Main authors: Paul Glennie and Alexandra Murray (UNEP-DHI Centre on Water and Environment)

Contributors / reviewers: Elizabeth Sellwood, Marijn Korndewal, Joakim Harlin, Chris Hodder (UN Environment Programme), Marie Herman (UN Climate Security Mechanism), Sílvia Leirião (DHI), and Gareth James Lloyd (UNEP-DHI Centre).

The authors wish to express their gratitude to numerous regional experts who provided valuable insights through interviews (see Annex A.3), and Pillar 4 colleagues for their feedback.

Disclaimers

Suggested citation: UNEP-DHI and UNEP (2020). Transboundary Water Resources Management for Resilience in the Horn of Africa: Mapping of actors, policies, and initiatives.

Executive Summary

This ‘mapping’ report describes the wide variety of work undertaken to enhance transboundary collaboration over water resources in the Horn of Africa in the last 10-20 years, and makes some recommendations for next steps, based on the findings.

It is intended to support the UN Special Envoy for the Horn of Africa, and the Inter-Governmental Authority on Development (IGAD), in their efforts to promote peace and sustainable development across the region. As such, the report is mainly intended for UN, IGAD, and development partner readers.

In the past decade, some USD 10 billion has been pledged to the Horn of Africa region on activities related to stability and resilience, with much of this directly or indirectly linked to cross-border water resources management, resulting in thousands of activities implemented by hundreds of actors at regional, national, and local cross-border scales.

While this mapping document focusses on initiatives related to cross-border water resources management and the impacts of climate change, any recommendations must be grounded in a solid understanding of the broader resilience landscape.

Much of the work relevant to this initiative has been anchored in the IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) (2012-2027). In 2016 UNDP undertook a review of the first phase of IDDRSI (2013-2017). This review recommended that all resilience building initiatives at regional and national levels should be harmonised under a common IDDRSI programme framework, and that the regional programming paper should be translated into an integrated regional and cross-border investment plan. The review concluded that the initiatives and activities that have achieved the best results tend to be those that adopt a cross-border approach; involve and build on traditional institutions and practices; balance commercial interests and community needs; integrate peacebuilding; take a market approach; and support already-existing mechanisms.

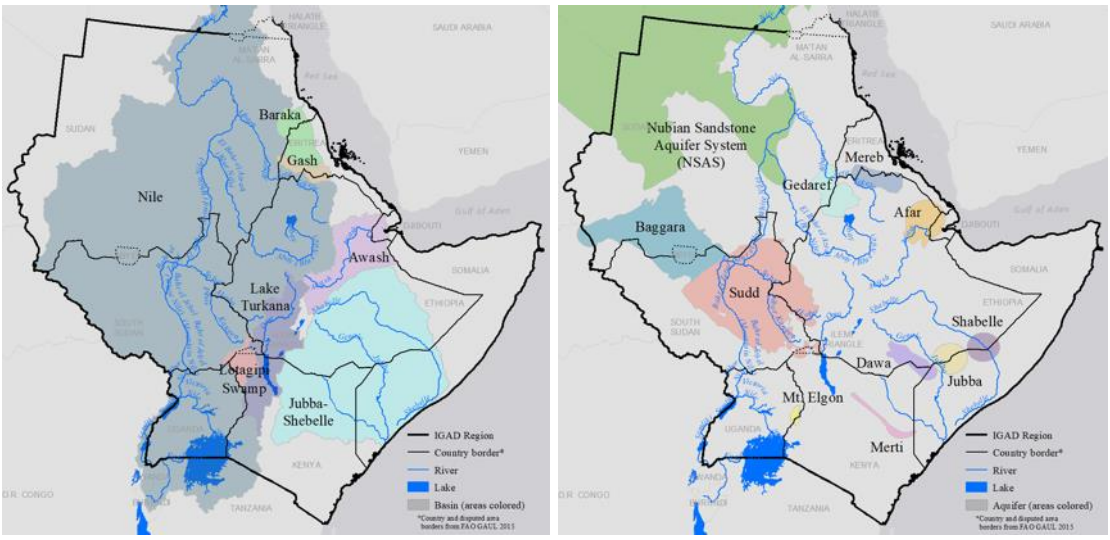
The most significant donor in the region appears to be the EU, with EUR 63.9 million committed under the programme “Collaboration in Cross-Border Areas of the Horn of Africa Region” (2017-ongoing). The majority of this is being implemented through the IDDRSI framework, with a wide range of partners, focussing on eight cross-border clusters. These clusters provide another entry point to transboundary collaboration, in the absence of broader basin-wide frameworks. As noted in the 2020 update on ‘implementation of IDDRSI in cross-border areas’, there are a number of other cross-border programmes and projects that are implemented by other IGAD Divisions and Specialized Institutions and external partners, and that there is “a need for a mechanism to coordinate, harmonize and promote joint cross-border planning and programming.”

Transboundary basins and aquifers

Seven transboundary basins and 10 transboundary aquifers cover around three quarters of the land area of the Horn of Arica, and are home to almost three quarters of the region’s 240 million people, with IGAD Member States sharing more than 10,000km of international borders. Of these 17 transboundary water resources, only the Nile River basin has a dedicated transboundary organization and technical collaboration framework. Within the others, a number of local level projects on cross-border collaboration have occurred (many of these under IDDRSI), with some local level bilateral MoUs signed, but in most of these, water resources management is not sufficiently addressed.

One of the initiatives that has a greater focus on water resources is the EU funded project “Support for Effective Cooperation and Coordination of the Cross-border Initiatives in

Southwest Ethiopia-Northwest Kenya, Marsabit-Borana and Dawa, and Kenya-Somalia-Ethiopia (SECCCI)". The project includes establishing cluster offices, a water data system, and a knowledge management platform. It is recommended that future work on water resources, climate change and resilience in the region builds on experiences from SECCCI.



Transboundary basins (left) and aquifers (right) in the Horn of Africa.

Regional collaboration

At the regional level, IGAD has spearheaded efforts to develop a Regional Water Resources Policy and Protocol. The Policy was signed by all member states in 2015, and negotiations on the Protocol (intended to operationalise the Policy), continued from 2016-2018, but then stalled due to lack of political engagement from all Member States, and lack of funding while this was the case. One element in the Policy is to develop a regional institutional framework for water resources management, and this has not progressed.

UNECE were instrumental in supporting the development and negotiations on the Policy and Protocol, and in ensuring they reflect modern transboundary water resources management arrangements and laws. Work is also ongoing to encourage countries to ratify the UN Watercourses Convention (1997) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention, open to all countries in 2016).

The process relating to SDG Target 6.5 ("By 2030, implement integrated water resources management at all levels, including through transboundary cooperation where appropriate") represents another entry point for advancing with transboundary collaboration in the region. Currently, levels of reporting and progress on indicator 6.5.2 are relatively low in the region.

The African Union Border Programme, and the AU Convention on Cross-Border Cooperation, offer further entry points to increasing cross-border collaboration. However, levels of engagement with either of these in the IGAD region have so far been limited.

Technical capacity, information and data exchange

There are multiple IGAD programmes and centres with related technical expertise on water and climate. However, on the whole, portals and datasets seem fragmented and infrequently updated. There is a need for coordinated, regularly updated information, easily accessible in one portal, that would be able to support decision making at regional and cross-border levels within transboundary basins and aquifers. The most pertinent

institution appears to be the IGAD Climate Prediction and Applications Centre (ICPAC), which is also a designated WMO Regional Climate Centre. It is recommended that options for increasing ICPAC's capacity and scope to host such a portal be investigated.

Key recommendations

Recommendations from the work include, but are not limited to, the following:

1. Initiate dialogue with UN Country Teams to explore how collaboration over transboundary water resources can support national and regional development objectives and peace and security (Sections 4.3 and 4.5).
2. Undertake a 'benefit assessment' to identify, assess and communicate the benefits of transboundary water cooperation for the Horn of Africa, as well as prioritized basins and aquifers (Section 9.3 and 9.4).
3. Initiate a consultative design phase to develop an integrated, sustainable digital platform for transboundary water resources management for the Horn of Africa (Mainly Section 8.3, being aware of recommendations made in Sections 5.5 (Status), 6.3 (Projections), and 7.4 (Infrastructure)).
4. Investigate mechanisms to strengthen the capacity and visibility of the IGAD Water Unit, including its institutional links with other IGAD units and programmes (Sections 3.1.1 and 3.5).
5. Use the IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) as an entry point for strengthening cross-border collaboration over water resources, particularly through the eight cross-border clusters, and building on the experiences of the SECCCI project (Section 3.1.2 and 3.5).
6. Investigate options to provide more support to countries in reporting on SDG indicator 6.5.2 on transboundary collaboration, and build on the reporting to advance transboundary frameworks for collaboration (Sections 4.4 and 4.5).
7. Assess barriers and enablers to establishing appropriate institutional arrangements for transboundary basins and aquifers, and make recommendations on establishing these (Sections 0 and 3.5).
8. Investigate opportunities to support UNECE's dialogue with countries to ratify the Water Convention, including support from the Special Envoy for the Horn of Africa (Section 3.4 and 3.5).
9. Where feasible and appropriate, consider embedding work on transboundary water resources collaboration within a broader context of sustainable development and resilience.
10. In a similar vein, where feasible and appropriate, ensure links to land, energy and environment under Pillar 4 (sustainable natural resources management and climate resilience), as well as the other Pillars under the UN Comprehensive Strategy for the Horn of Africa, being cognisant of the cross-cutting themes of gender, youth, migration, and human rights.

These recommendations are elaborated on, and further recommendations provided, in Chapter 10 of the main report as we all the last section of each chapter.

1 Introduction

Background: In 2019, the United Nations agreed upon a 5-year Comprehensive Regional Prevention Strategy for the Horn of Africa (2019-2023), containing four pillars: (i) regional peace and security; (ii) resilience and socioeconomic development; (iii) inclusive and responsive governance; and (iv) sustainable natural resources management and climate resilience. These four pillars integrate cross-cutting issues such as gender, youth, migration, and human rights in their operationalization.

This document supports UNEP's work under pillar 4. The focus is on water resources management to increase local and regional resilience in the face of socioeconomic and climate stressors.

Aims: The purpose of this analysis is to identify actors, initiatives (projects and programmes), and digital platforms relevant to water resources management in the region, with a focus on cross-border water resources. Recommendations should be made to support the UN Special Envoy for the Horn of Africa, and the Inter-Governmental Authority on Development (IGAD), in their efforts to promote peace and sustainable development across the region.

Objectives:

1. Identify recent historic, current and planned initiatives in the region.
2. Identify outcomes and key lessons from these initiatives.
3. Include surface water and groundwater; focus on cross-border river and lake basins and cross-border aquifers.
4. Include management arrangements and the physical state of water resources.
5. Consider impacts of climate and socioeconomic changes on water resources.
6. Make recommendations on digital platforms to support cross-border water resources management.

Scope: This desktop study includes interviews with and review by selected regional actors. The study covers common water resources in the 8 IGAD Horn of Africa countries: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, South Sudan and Uganda.

Audience: Primarily United Nations agencies and development partners in the region. Aspects of water resources management in the region are sensitive, and care should be taken with the distribution of this document.

Structure: The following is included in each section of this study. Each section ends with a 'Summary and recommendations' sub-section.

Section 2: overview of transboundary surface and groundwater in the region, including physical characteristics and management arrangements (detail on each basin and aquifer in Annex A.1).

Section 3: regional and relevant global activities for cross-border collaboration and resilience.

Section 4: national and bi-lateral activities for cross-border collaboration and resilience.

Section 5: overview of the state of transboundary water resources based on available information, as related to sustainable development objectives, including floods, droughts, water quality, and freshwater ecosystem services.

Section 6: data sources and key trends for climate and socioeconomic projections, as they relate to water resources.

Section 7: overview of large-scale infrastructure with cross-border implications, including data availability, institutional and funding arrangements, and existing and planned infrastructure.

Section 8: digital platforms for water diplomacy.

Section 9: African experiences in cross-border collaboration from beyond the Horn of Africa.

Section 10: conclusions and recommendations.

2 Overview of transboundary waters in the region

Summary: 72% of the land area of the Horn of Africa is covered by transboundary river basins. This area is dominated by two transboundary basins, the Nile and the Jubba-Shabelle, and includes five other transboundary basins. Approximately 70% of the population reside in these areas[1]. Some member states, for instance South Sudan and Uganda, are entirely covered by transboundary basins. Transboundary aquifers are distributed throughout the region, many along the borders of Ethiopia and its neighbours. In some places, especially in the arid northwest part of the Horn, the water table is over 60m below ground surface. However, overall, little is known about aquifers in the region. The area has some 240 million inhabitants, and much is arid or semi-arid.[2]

The combination of climate, socioeconomics, and demographics of the Horn creates a case of high demand and relatively limited availability, yet only the Nile river basin has any significant transboundary institutional and legal frameworks.

An overview of the transboundary basins and aquifers is provided in the following sub-sections, and more detailed information on each of the basins and aquifers is provided in Annex A.1.

2.1 Surface water

There are seven transboundary river basins which lie almost entirely in the Horn of Africa. The Nile basin includes six Horn member states and extends both north and south of the region, to include an additional five recognized members. Note that the Lake Victoria basin is considered as part of the Nile basin for the purposes of this study, as the management of Lake Victoria itself is not likely to be of primary concern to IGAD, given that it extends beyond the region.

[1] TWAP Rivers, 2016
[2] IGAD Description of the region

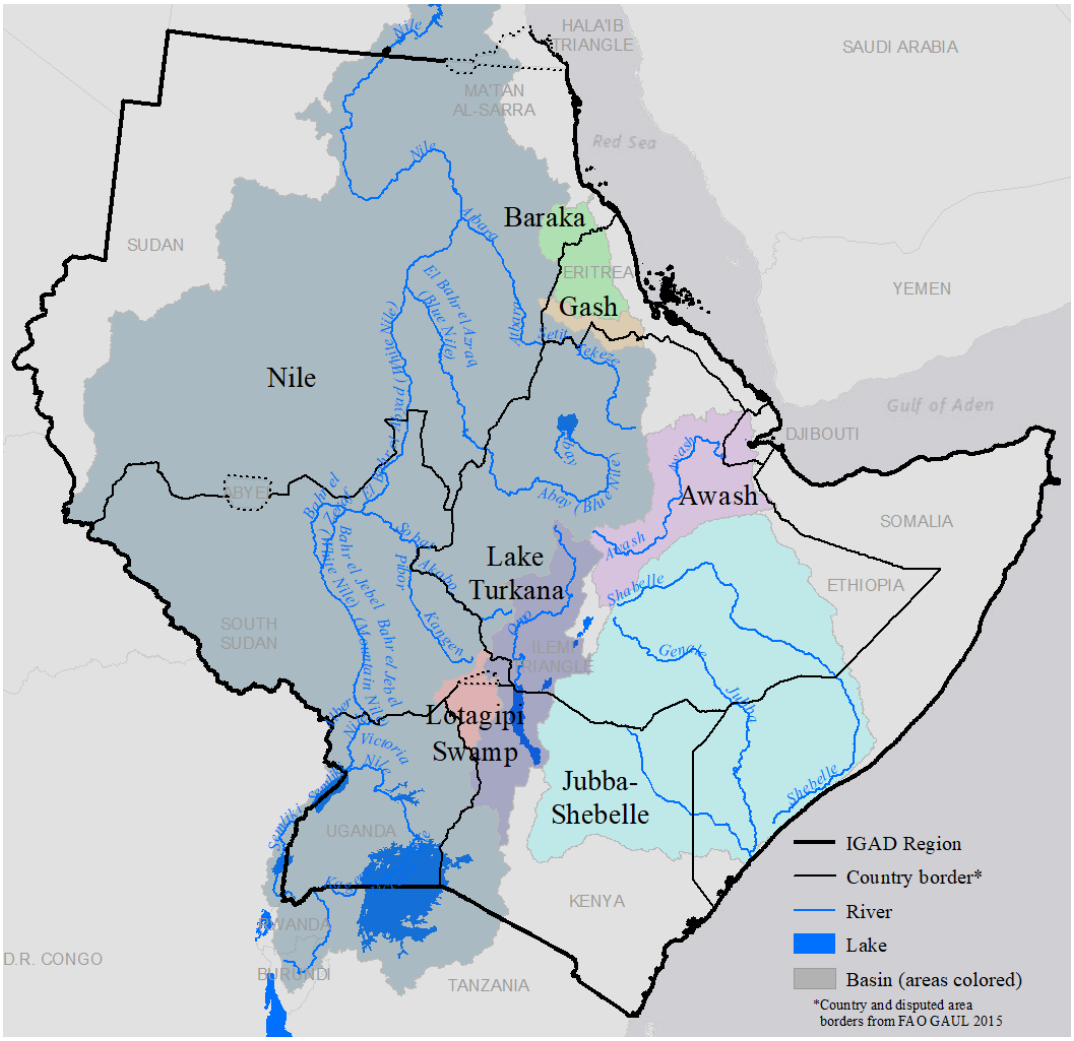


Figure 1 – Seven transboundary river basins in the Horn of Africa (UNEP-DHI, TWAP 2015)

The table below is ordered first by basin area and then by basin country unit area. Runoff is the total rainfall that is captured into the river in that basin country unit. Lower percentages are a factor of less rainfall/more arid climates and smaller basin country unit area. Transboundary Dependency shows the amount of water withdrawn compared to the water that enters the basin within that basin country unit through rainfall. The Transboundary Dependency metric does not account for river discharge and is not a scarcity or sustainability metric. For instance, the portion of the Nile basin in Egypt is extremely arid, and the extremely high transboundary dependency value indicates that much more water is used in Egypt than is added to the river system through rainfall and runoff in Egypt. This high value demonstrates that the Egyptian portion of the Nile basin is dependent on the water that enters the country through river discharge.

Table 1 Transboundary basins exclusively in the Horn of Africa region, in order of size (including the Nile)[3]

Basin	Area [000 km2]	Vol. [km3/yr]	Pop. [mill]	Country*	Area [%]	Pop. [%]	Runoff [%]	Withdrawal [%]	Transboundary Dependency (Withdrawal/ Runoff [%])
Nile	2,933	380	174	Sudan	43%	15%	1%	26%	64%
				South Sudan	21%	4%	5%	1%	1%
				Ethiopia	12%	18%	17%	2%	1%
				Uganda	8%	19%	21%	1%	1%
				Kenya	2%	8%	16%	1%	3%
				Eritrea	0%	0%	3%	0%	5%
				Egypt	7%	21%	0%	69%	25994%
				Tanzania	4%	5%	3%	0%	4%
				Rwanda	1%	4%	8%	0%	7%
				DRC	1%	2%	9%	0%	2%
				Burundi	0%	3%	14%	0%	2%
				Hala'ib triangle	0%	0%	0%	0%	5%
				Abyei	0%	0%	3%	0%	1%
				CAR	0%	0%	0%	0%	0%
Jubba-Shabelle	792	59	20	Ethiopia	46%	59%	36%	37%	3%
				Somalia	28%	28%	16%	49%	15%
				Kenya	26%	13%	48%	14%	1%
Lake Turkana	173	64	12	Ethiopia	57%	89%	58%	75%	1%
				Kenya	38%	10%	16%	22%	2%
				South Sudan	3%	0%	4%	0%	1%
				Uganda	2%	1%	16%	3%	4%
				Ilemi triangle	1%	0%	6%	0%	1%
Awash**	152	25	16	Ethiopia	93%	99%	78%	97%	5%
				Djibouti	7%	1%	22%	2%	6%
Baraka	64	3	2.3	Eritrea	66%	85%	52%	31%	5%
				Sudan	34%	15%	48%	69%	24%
Lotagipi Swamp	32	2	0.3	Kenya	63%	75%	34%	69%	1%
				South Sudan	22%	14%	17%	13%	1%
				Uganda	6%	8%	49%	13%	1%
				Ethiopia	0%	0%	0%	0%	0%
				Ilemi triangle	9%	3%	0%	5%	1%
Gash	24	3	1.9	Eritrea	71%	61%	32%	63%	5%
				Ethiopia	25%	37%	68%	37%	4%
				Sudan	4%	2%	0%	0%	0%

* Light text indicates countries not in Horn of Africa (IGAD), or disputed territories.
**According to the TWAP rivers assessment, which relies on FAO GAUL 2013 and the HydroBASINS datasets, the Awash basin does extend into Eritrea and Somalia, but to such a small extent that it is not included in this table. The vast majority of the Awash basin lies in Ethiopia, and it is often seen as national basin, not a transboundary one.

[3] TWAP Rivers, 2016

However, the Awash river discharges into a series of interconnected lakes, ending in Lake Abbe, on the border with Djibouti, and is therefore technically a transboundary basin (further information in Annex A.1).

Other transboundary river basins shared with countries in the Horn of Africa region, but not likely to be priorities for IGAD or the UN Special Envoy, and therefore not included in this analysis.

Transboundary Basin	Countries
Congo Basin	Angola, Burundi, Cameroon, CAR, Congo, DRC, Gabon, Malawi, Rwanda, South Sudan, Sudan, Tanzania, Uganda, Zambia
Pangani	Kenya, Tanzania
Lake Natron	Kenya, Tanzania
Lake Victoria	Burundi, Kenya, Rwanda, Tanzania, Uganda

2.2 Groundwater

There are ten transboundary groundwater aquifers which lie almost entirely in the Horn of Africa. The Nubian Sandstone Aquifer System (NSAS) is also included, due to its importance to Sudan.

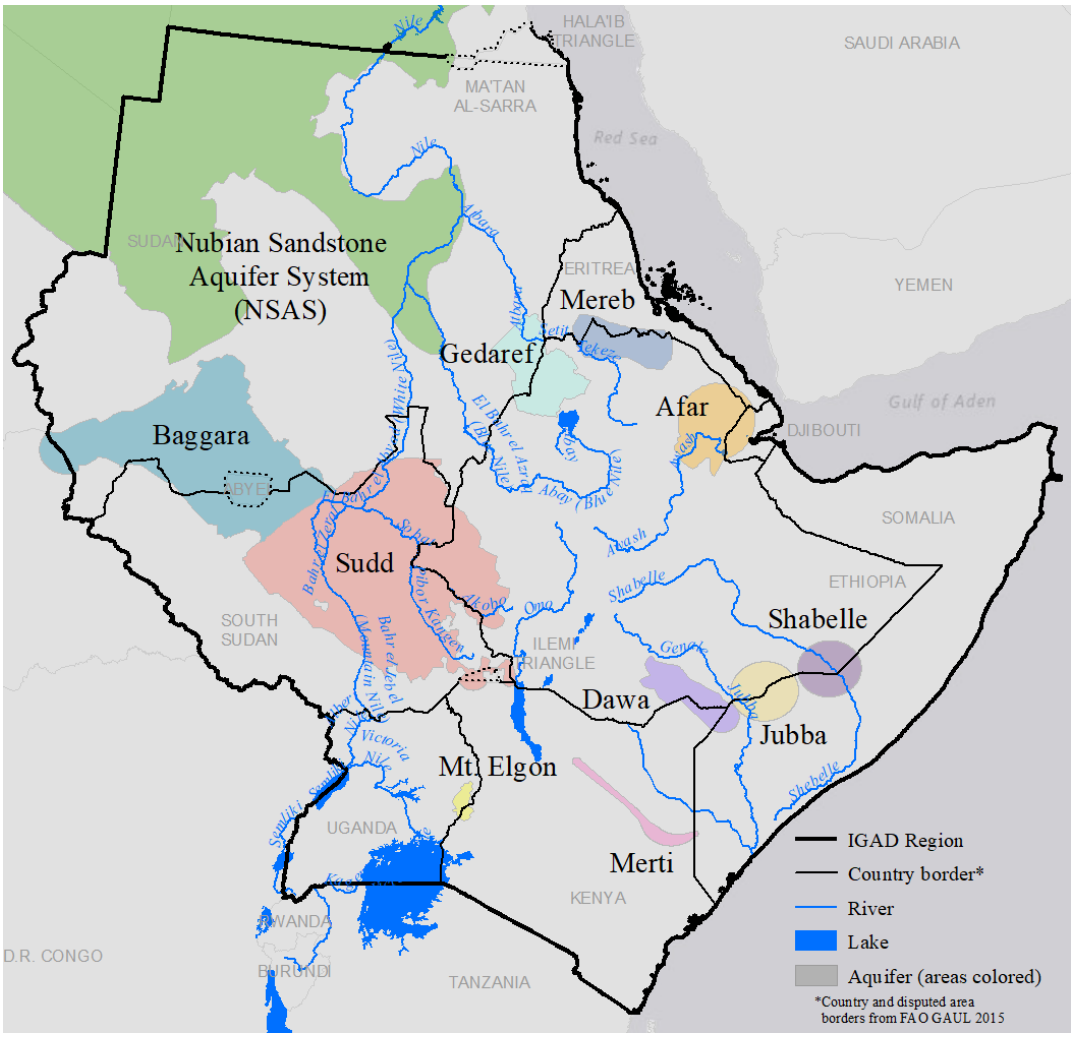


Figure 2 – Eleven transboundary aquifers in the Horn of Africa (IGRAC, TWAP 2015)

Groundwater is both more difficult to survey than surface water and less extensively studied, and thus there are substantial knowledge gaps. Dashed entries in the table below denote unknown values. The data in this table have been collected from global data sources, and more information may be known at national or local scale. For groundwater development stress, values greater than 100% indicate that more water is withdrawn from the aquifer than is recharged each year. Under these conditions, the aquifer is being depleted and will decrease in volume. This is of particular importance for the NSAS aquifer in Sudan, with a development stress percentage, where aquifer recharge rates in the hyperarid zone are extremely low.

Table 2 Transboundary aquifers exclusively in the Horn of Africa region (plus the NSAS), in order of size[4]

Aquifer	Area (km^2)	Country*	Area (%)	Volume (km3)	Abstraction (km3/yr)	Recharge (km3/yr)	GW development stress (GW abstraction / recharge) (%)	Dependency on GW (GW withdrawals / total withdrawals (%)
NSAS	2,479,312	Egypt	34%	200000	1	-	-	-
		Libya	33%	-	-	-	-	-
		Sudan	23%	-	-	0.0014	15815.7%**	-
		Chad	11%	54.75	-	0	-	-
Sudd	332,605	South Sudan	83%	520	0.036	1.15	3.1%	0%
		Sudan	2%	-	-	-	-	-
		Ethiopia	14%	40	0.0016	0.13	1.3%	40%
		Kenya	0.5%	-	-	-	-	-
		Ilemi Triangle	0.5%	-	-	-	-	-
Baggara	213,594	Sudan	73%	0.711	0.0119	0.16	7.9%	100%
		South Sudan	19%	72	0.0028	0.03	9.3%	
		CAR	8%	-	-	-	-	-
Dawa	34,007	Ethiopia	68%	120	0.0009	0.038	2.3%	50%
		Somalia	14%	-	-	-	-	-
		Kenya	18%	10	-	0.01	-	-
Jubba	34,587	Ethiopia	47%	-	-	-	-	-
		Somalia	53%	-	-	-	-	-
Shabelle	30,985	Ethiopia	52%	-	-	-	-	-
		Somalia	48%	-	-	-	-	-
Afar	57,011	Ethiopia	80%	38	0.0042	0.18	2.4%	-
		Eritrea	3%	-	-	-	-	-
		Djibouti	17%	4	0.0028	0.015	18.7%	-
Mereb	38,753	Ethiopia	77%	-	-	-	-	-
		Eritrea	23%	-	-	-	-	-
Gederef	57,831	Ethiopia	54%	0.7	0.12	0.042	287.8%	-
		Sudan	46%	-	-	-	-	-
Merti	13,623	Kenya	99%	-	0.0053	0.003	160.6%	-
		Somalia	1%	-	-	-	-	-
Mt. Elgon	5,398	Uganda	75%	-	-	0.03	-	-
		Kenya	25%	-	-	-	-	-

[4] IGRAC, TWAP 2015

* Light text indicates countries not in Horn of Africa, or disputed territories.
** Value given by TWAP IGRAC database, without abstraction data given.

Other transboundary aquifers shared with countries in the Horn of Africa region, but not likely to be priorities for IGAD or the UN Special Envoy, and therefore not included in this analysis.

Transboundary aquifer	**Countries**
Karoo-Carbonate	CAR, DRC, South Sudan
Coastal Sedimentary Basin I / Karoo Sedimetary Aquifer	Kenya, Tanzania
Kilimanjaro	Kenya, Tanzania
Rift	Kenya, Tanzania
Aquifere du Rift	DRC, Rwanda, Uganda
Kagera	Tanzania, Rwanda, Uganda

2.3 Basin and Aquifer Management

There is a distinct lack of transboundary institutional frameworks and transboundary legal frameworks to manage the water resources of the basins and aquifers described above. The Nile is the only river basin with a dedicated basin organisation to oversee management and facilitate communication and cooperation between member states.[5] Some smaller, local management bodies and projects exist, but these are more technically oriented (see Annex A.1 for details).

[5] The Lake Victoria Basin Commission is also active, with strong links to NBI and East African Community (EAC), though this is not deemed so relevant for the purposes of this study, as it is on the edge of the region.

Table 3 Institutional and legal framework of transboundary rivers and aquifers, grouped by country, and country 'dependency ratios' on transboundary waters.

County	Depend-ency Ratio[6]	Surface Water[7]			Groundwater[8]		
		Basin	Institutional Framework	Legal Framework	Aquifer	Institutional Framework	Legal Framework
Djibouti	0	Awash	None	None	Afar	None	None
Ethiopia	0	Awash	National[9]	None	Afar	None	None
		Gash	None	None	Dawa	None	None
		Jubba-Shabelle	None	None	Gederef	None	-
		Lotagipi	None	None	Jubba	-	-
		Nile	Exists[10]	Partial[11]	Mereb	-	-
		Turkana	None	None	Shabelle	-	-
					Sudd	Agreement under prep.[7]	
Kenya	33	Jubba-Shabelle	None	None	Dawa	None	None
		Lotagipi	None	None	Merti	None	None
		Nile	Exists	Partial	Mt. Elgon	-	-
		Turkana	None	None	Sudd	-	-
Uganda	35	Lotagipi	None	None	Mt. Elgon	None	None
		Nile	Exists	Partial			
		Turkana	None	None			
Somalia	59	Jubba-Shabelle	None	None	Dawa	-	None
					Jubba	-	-
					Merti	None	None
					Shabelle	None	None
Eritrea	62	Baraka	None	None	Afar	-	-
		Gash	None	None	Mereb	None	-
		Nile	Observer	Partial			
South Sudan	66	Lotagipi	None	None	Baggara	None	None
		Nile	Exists	Partial	Sudd	None	None
		Turkana	None	None			
Sudan	96	Baraka	None	None	Baggara	None	None
		Gash	None	None	Gederef	-	-
		Nile	Exists	Partial	NSAS		
					Sudd	-	-

[6] Proportion of total renewable water resources originating outside the country, including groundwater. Aquastat
[7] Transboundary River Basin Factsheets, TWAP Rivers 2016, based on the International Freshwater Treaties Database 2007 (2019 update being processed).
[8] Transboundary Aquifers Project, TWAP Groundwater 2016.
[9] Awash Basin Development Authority
[10] Nile Basin Initiative (NBI), since 1999, with 10 basin countries.

3 Regional and cross-border frameworks for collaboration and resilience

This section includes an overview of institutional arrangements and policies / strategies / plans at the regional level, as well as an analysis of strengths and gaps.

Regional frameworks for collaboration over natural resources management are not well-established, compared to other regions in Africa.

Summary:

1. In the last two decades, there have been numerous and substantial efforts and funding allocations to strengthen the regional enabling environment for transboundary water resources management in the Horn of Africa.
2. This effort has mostly been channelled through IGAD, and involved multiple donors (10+)[12], with total funding more than USD 30 million.[13]
3. There have been some successes, including
   - The endorsement of a Regional Water Resources Policy (2015), signed by water ministers from all countries.
   - The establishment of a 'Water Unit' in IGAD (2012), with a mandate to improve transboundary collaboration.
   - Three projects, in particular, facilitated progress on regional-level collaboration (though did not achieve all objectives): Inland Water Resources Management Programme (IWRMP) (EU funded, USD~17.5mill, 2012-2016); Strengthening Transboundary Water Governance in the IGAD Region (US Dept. of State funded, UNECE, IUCN, 2016-2018); and this project was carried out in synergy with Building River Dialogue and Governance (BRIDGE) project (Swiss Agency for Cooperation (SDC) funded, IUCN, UNECE, 2015-2017).
4. However, it is important to learn from past efforts to continue to strengthen transboundary dialogue and cooperation over transboundary water management. The key lessons are:
   - The IGAD region is very diverse (geographically, culturally, and politically) and does not have the same levels of historic collaboration as some of the other African regions. This may be a factor in making regional collaboration on water resources management more challenging.
   - Negotiations on the draft Regional Water Protocol stalled: national priorities are likely to have hindered negotiations.

3.1 Regional level: Inter-Governmental Authority on Development (IGAD)

IGAD (established 1996) Member States: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan and Uganda. One of its core mandates is to address issues of drought and desertification. IGAD has several mandates related to natural resources, peace and security. It is also encourages cooperation between its Member States, including on issues such as environmental protection, utilization of natural resources and meteorological and hydrological networks. These mandates stem from the IGAD Charter (1996), and have been periodically operationalised and updated.

[11] Most of the agreements on the Nile are colonial-era agreements. Some bi-lateral agreements exist, but no basin-wide, 'modern' agreements. See Section 3.2.1 for more information.
[12] For example: AfDB, EU, GIZ, Netherlands, Norway, SDC, SIDA, UKAid, USA, World Bank.
[13] Approximate estimate based on projects identified in this study, to give an idea of the order of magnitude. Not comprehensive, and should not be directly quoted.

3.1.1 Water resources

Institutional:

- IGAD Water Unit, under the Division of Agriculture and Environment, whose objectives are to promote peace and stability and support socio-economic development in the region through efficient and effective water management and governance. The Water Unit has facilitated a number of transboundary water dialogues in the region, such as on River Daua and Omo-Turkana Basin. It also aims to set up an international water law (IWL) training with its partners in the regions to develop a 5 year Horn of Africa capacity building program that will provide annual training workshops for personnel of government agencies, RBOs, NGOs in key positions to influence, advise and or make decisions that take into account transboundary aspects of other users. It has also supported Member States in developing water policies, such as Somalia in developing its national water law. Since 2012, the IGAD Water Unit has also been the driving force behind the IGAD Regional Water Policy and the drafting and negotiation process of the IGAD Water Protocol.[14] The Water Unit is restricted by staffing capacity (3 staff (2 professional, 1 admin)),[15] and has no online presence.
- IGAD has several other related specialized centres and programmes, e.g. Climate Prediction and Applications Centre (ICPAC), Early Warning and Response Mechanism (CEWARN), Drought Disaster Resilience and Sustainability Initiative (IDDRISI), Pastoral Areas and Livestock Development (ICPALD). Land Governance Portal (see also Section 8.2*).* While 'thematic' connections between the mandates of these centres and programmes is clear, and there are tangible connections between them, it is not clear whether institutional coordination mechanisms are formalised and sufficient.

Strategy:

- At the highest level, transboundary cooperation and management of natural resources are all very much included in the overall IGAD strategy, so the institutional mandate exists.[16] Under the IGAD Regional Strategy Implementation Plan 2016-2020, it is stated that natural resources management Programme Area has two components, with 6 projects under them (total cost USD 26 mill., funding gap 84%):[17]
  - Framework for transboundary water resources management programme
  - Renewable energy resources programme Work has begun to develop a regional policy and legal framework for water resources management, but negotiations have stalled and this framework has not become operational.
- **Regional Water Resources Policy**, initiated 2012, endorsed by Ministers (water) in all member states 2015.[18] Facilitated by the IWRMP (see projects below). The Policy is comprehensive, and based on all modern principles of transboundary water management and international water law.

[14] Personal communication, UNEP, September 2020.
[15] Personal communication, IGAD Water Unit, September 2020.
[16] "One of the main thrusts of IGAD is boosting agricultural production and sustainable management of natural resources and the environment to ensure resilient livelihoods and sustained economic growth in the region. This is in line with the vision and mission of the African Union and its organs such as the New Partnership for Africa Development (NEPAD) and the African Union Commission's Department of Rural Economy and Agriculture (AU-DREA), whose mission is to "strengthen the agricultural sector, rural economies and the environment in order to improve the livelihoods of the African people and ensure poverty eradication". To drive its agriculture and environment agenda, IGAD developed regional policies and strategies such as the IGAD Food Security Strategy; the IGAD Fisheries Strategy IGAD Regional Environment Policy; IGAD Environment and Natural Resources Strategy; IGAD Environment Impact Assessment (EIA) Policy Framework; IGAD EIA Guidelines; IGAD EIA Protocol; IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) Strategy; and IGAD Comprehensive Africa Agriculture Development Programme (CAADP)." https://igad.int/about-us/strategy
[17] For details on projects, see Annex 1A, Pillar 1, EP-SP1 and EP-SP2.
[18] Not publicly available online. Received via Personal Communication, UNECE, September 2020.

- **Draft Regional Water Protocol**, initiated 2015, but negotiations stalled since around 2017.[19] It was envisaged that the Protocol would operationalise the Policy, becoming the regional legal framework on water resources.[20] Many of the provisions of the draft Protocol were derived from the UN Watercourses Convention (see Section 3.4), the Draft Articles on the Law of Transboundary Aquifers and international legal instruments applying elsewhere, as long as they were deemed suitable to the IGAD region. As in the case of the Policy, inspiration was also drawn from the Agreement on the Nile River Basin Cooperative Framework. The working document was first discussed at the technical level, among Technical Advisory Committee members (TAC), legal experts and water managers from IGAD Member States, and then submitted to the Member States for negotiation. Each Member State appointed three representatives to a Regional Negotiation Committee, including a legal adviser. The objective of the committee was to formulate, and agree upon, the final text of the Draft Protocol, which would eventually be submitted for approval by the competent policy organs of IGAD and ratification by Member States. The Negotiation Committee held its first meeting in October 2015, a second meeting in May 2016, and a third meeting in October 2016. The process has since stalled, partly due to attention being focussed on negotiations on the Grand Ethiopian Renaissance Dam (GERD), and a lack of funding towards the process, with some donors requiring formal engagement from all countries prior to disbursal of funds, which has not yet happened.[21] Restarting negotiations would be particularly challenging until negotiations on the GERD are either completed or progressing well.
- **IGAD Policy and Protocol on Water Related Data sharing and Exchange**: initiated 2016, discussed under UNECE/IUCN project (2018-2019), never finalized, and negotiation essentially stalled.[22]

Projects/Programmes:

- Inland Water Resources Management Programme (IWRMP) (Donor: EU, 14.7mill EUR) (2012-2016). Sustainable management of natural resources for economic growth and poverty alleviation through: 1 “Regional Cooperation in Water Resources Management established and institutionalized”; 2 “Policy & Legal Frameworks in water resources management improved”; 3 “Regional and national institutions for water resources management in the region; and, 4 Regional Water Resources Management Information Systems and observation networks strengthened/developed. **Outcome:** This project was catalytic in that it led to the formation of the IGAD Water Unit, and the drafting, negotiation and approval of the Regional Water Resources Policy. However, many of the programme objectives were not achieved.
  - Under the IWRMP, IGRAC and Acacia Water carried out a feasibility study for Managed Aquifer Recharge (MAR) (2014), in the transboundary Merti Aquifer (Kenya / Somalia), which showed that there is potential for MAR in the aquifer.
- Strengthening Transboundary Water Governance in the IGAD Region [IGAD, UNECE, IUCN. Donor: U.S. Department of State] (2016-2019): carried out in synergy with activities funded by the Swiss Agency for Cooperation (SDC): Building River Dialogue and Governance (BRIDGE) in the Horn of Africa, implemented by IUCN, and Support to transboundary water cooperation on the basis of the UNECE Water Convention, implemented by UNECE. Regional-level processes (IGAD-TAC) and cooperation mechanisms in a demonstration basin (Sio-Malaba-Malakisi, sub-basin of Nile

[19] Not available online, not assessed. Context provided via Personal Communication, UNECE, September 2020.
[20] This was to include agreements on (a) the Status of the water resources, (b) exchange and sharing of information and data, (c) investment policies, (d) establishment of transboundary organization(s) for water resources development and management, (e) service providers and IWRM, (f) regulations for water quality, (g) regulations for water quantity, and (h) regulations on environmental standards (Personal Communication, UNEP, September 2020).
[21] Personal Communication, UNECE and IGAD Water Unit, September 2020.
[22] Not available online, not assessed.

(Kenya/Uganda). **Outcomes:** A benefit assessment was undertaken in the Sio Malaba Malakisi (SMM) River Basin (Kenya, Uganda, sub-basin of Nile, 2017-18), which resulted in the SMM Basin Investment Framework and the SMM 4 clusters of prioritized investments projects. It would be worth considering a similar approach in other basins and aquifers, and even looking into the feasibility of conducting such a 'benefit assessment' for the whole Horn of Africa.

- Mapping, Assessment and Management of Transboundary Water Resources in the IGAD Sub-Region [OSS. Donor: AWF/AfDB, €1.8 mill.] (2007-2011)[23]: The project contributed to a greater understanding of transboundary water resources in the region, as well as making recommendations for next steps, many of which have been started, but mostly remain uncompleted, although they are still relevant today. The project was a pre-cursor to the Inland Water Resources Management Programme (IWRMP) (2012-2016).

3.1.2 Resilience

IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) (2012-2027): The following is taken from the 2020 update "Implementation of IDDRSI in cross border areas". Following the severe drought of 2010/11, regional Heads of State convened a special Summit (2011) where they made a collective decision that called for a strategy to end drought emergencies while emphasizing the need to do things differently. In 2012, their decision was translated into a Regional Strategy called IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI). IDDRSI was aligned with Member States' long term plans through Country Programming Papers (CPPs). Priority issues that have further regional coverage were identified and formulated as Regional Programming Papers (RPP). The IDDRSI strategy has markedly changed design elements of the development programmes and projects by harmonizing short and medium term humanitarian interventions with long term development programmes to build resilience over time. The other fundamental change introduced by IDDRSI is a focus on arid and semi-arid lands management and a holistic cross-border development that has been adopted by range of IGAD projects, and other bilateral and multi-lateral projects, which are widely documented. This focus on cross-border areas is reflected in initiatives by development partners, such as the UNDP Africa Borderlands Centre, and the World Bank's report "From Isolation to Integration: An Overview of the Borderlands of the Horn of Africa".

Moving to its phase 2 of implementation (2019-2024), IDDRSI promotes eight priority intervention areas and it laid a foundation for a sustainable development in the region that would ensure resilience of individuals, households, communities, nations and the region at large, with a focus on pastoral and marginalized cross-border areas. The most relevant Priority Intervention Area (PIA) is PIA 1: Natural Resources & Environment Management; 1.1 Water Resources Development and Management: Expected outcome: Enhanced Water Resources Development and Proper Management for Sustainability and Equitable Access. Strategic Interventions: (a) Regional assessment on transboundary water resources, both surface water and groundwater; (b) Promotion on regional framework for transboundary water management; (c) Capacity building in handling transboundary waters; (d) Mapping and increased investment for enhanced transboundary water availability for livestock and concomitant infrastructure to improve productivity, reduce resource based conflict and increase trade capacity.

IDDRSI now under the newly formed Division of Planning, Coordination and Partnerships, has a Regional Programme Coordination Unit (PCU) which is supported by National Resilience Coordinators based in the Member States, is mandated to coordinate projects and programmes initiated under IDDRSI. There are however other

[23] Synthesis Report 2011: Overview and general recommendations. AWF 2007 inception description.

cross-border programmes and projects that are coordinated and implemented by other IGAD Divisions and Specialized Institutions as well as IGAD Implementing Partners (IPs). The implementation of cross-border programmes and projects at regional and local levels being undertaken by the relevant IGAD entities and initiatives need to be coordinated centrally. There is therefore a need for a mechanism to coordinate, harmonize and promote joint cross-border planning and programming. A Cross-border Development Facilitation and Coordination Unit (CBDFU) was established in Moroto, Uganda (2018) (Karamoja cluster) as a pilot to be scaled to other clusters.[24]

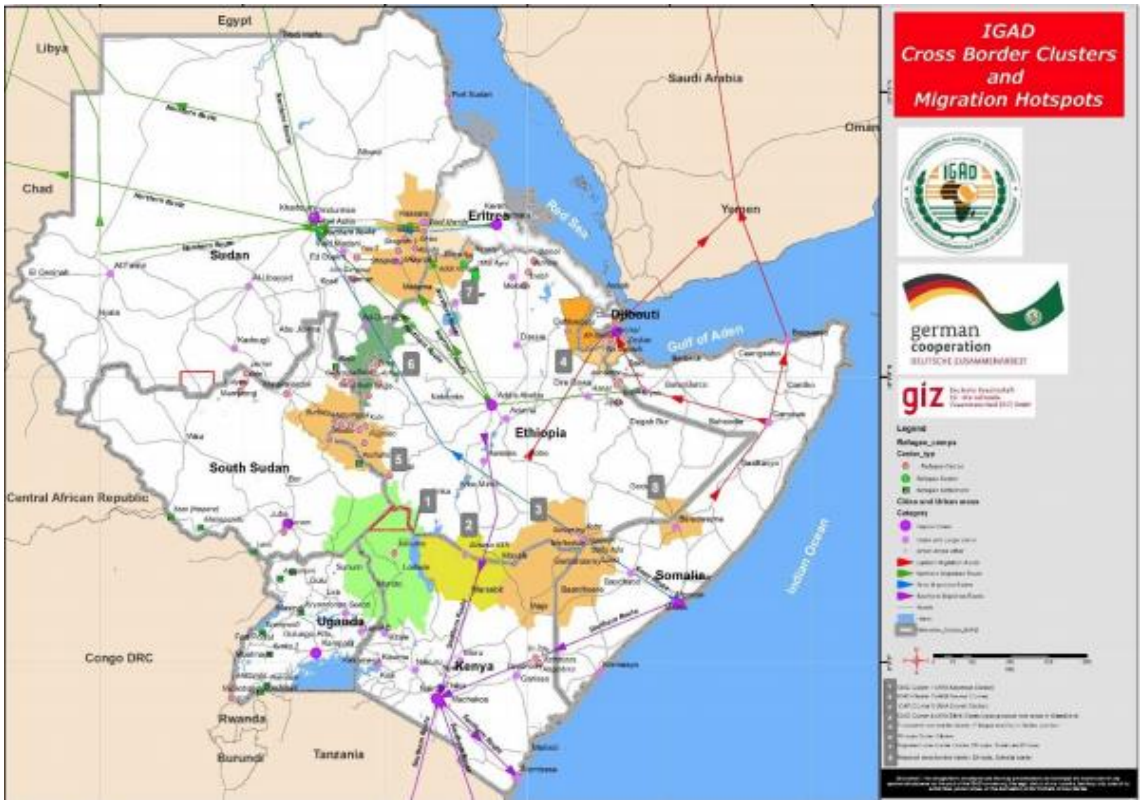


Figure 3 – IGAD 8 border clusters. Source: 2020 update Implementation of IDDRSI in cross border areas.

- Support for Effective Cooperation and Coordination of Cross-border Initiatives in Southwest Ethiopia-Northwest Kenya, Marsabit-Borana and Dawa, and Kenya-Somalia-Ethiopia (SECCCI) [EU funded (co-financing UNDP and UNEP), USD 10mill] (2018-2021). From IGAD, includes CEWARN, ICPALD, ICPAC. **Objectives:** strengthen regional policy frameworks and protocols for cross-border cooperation between national and local governments, the private sector, civil society and international technical and financial partners in development; Develop capacities of communities, local governments, and civil society to engage in planning and development processes; Ensure effective cooperation and coordination, monitoring and evaluation of cross-border initiatives. **Outcomes** (project ongoing)**:** IGAD's involvement in transboundary water management is not currently accepted by one of the Member States. UNEP was therefore given the responsibility for leading the transboundary water components of the project. IGAD and UNDP focus on strengthening cross-border cooperation, in relation to areas such as trade and pastoralism.

[24] 2020 update Implementation of IDDRSI in cross border areas.

- Building Opportunities for Resilience in the Horn of Africa (BORESHA) [EU funded EUR 13.3mill] (2017-2020). Objectives: promote economic development and resilience, particularly among vulnerable groups in the Mandera Triangle.
- Strengthening the Capacity of IGAD towards Enhanced Drought Resilience in the Horn of Africa (**SCIDA II**) [GIZ, IGAD, IDDRSI, Donor: EU 2.1mill] (2016-2020): project to strengthen IDDRSI. **Outcomes**: In the 8th Steering Committee meeting, IGAD and the Member States recognised migration and cross-border initiatives core thematic areas for regional resilience strengthening; introduction of knowledge-sharing, impact-based monitoring and spatial planning methods (implemented in seven countries); established first IGAD office for cross-border cooperation in the Karamoja Cluster; 3 training centres build capacity of local authorities to support the implementation of the IDDRSI strategy on the ground; capacity analysis of local peace structures for long-term and multi-sectorial mitigation; and establishment of an inter-institutional working group and a web-based tool to monitor migration.
- Strengthening Coordination and Implementation of IDDRSI (SCII) [IGAD, IDDRSI, Donor: Sweden] (2019-2022).

IGAD Centre for Pastoral Areas and Livestock Development (ICPALD): (2012-ongoing). Has a department of Drylands Agriculture and Climate Change Adaptation. One of the strategic objectives: Promote and facilitate elaboration and harmonization of regional livestock and dry-lands policies and development initiatives of Member States. ICPALD is strongly connected to IDDRSI, and has an objective to develop links with other IGAD institutions such as ICPAC, ISSP, and CEWARN.

- IGAD-FAO Partnership Programme (ongoing, USD 10 mill. over 5 years), with a focus on cross-border areas between Kenya, Somalia and Ethiopia, and one of the thematic areas on natural resources management.
- Technical capacity: In the Footsteps of Resilience: The Case of Karamoja Cluster portal: 3,266 investments across 4 countries, local water infrastructure tab (3,000 investments), groundwater resource tab (data on 2,130 boreholes).

3.1.3 Environment

IGAD has an Agriculture and Environment Department, though most of the work appears to focus on broader agricultural resilience and drought. Some relevant frameworks include:

- IGAD Environment and Natural Resources Strategy (2007): strongly features transboundary management of natural resources. Implementation of strategy unclear.
- IGAD Biodiversity Management Programme (BMP) (2012-2018, EU, Eur 14 mill.). With the support of the programme, IGAD developed a regional Biodiversity Policy, a regional Biodiversity Protocol, and four other related strategies, namely, the IGAD Wildlife Management Strategy, the IGAD Invasive Species Control and Management Strategy, the IGAD Biodiversity Benefits Sharing Strategy and the IGAD Strategy on Domestication of regional Policies and Strategies. It also supported member states to strengthen / establish national and regional biodiversity databases and information systems.
- IGAD Regional Forestry Policy and Strategy: Endorsed March 2020, with the Secretariat charged to develop a Protocol to operationalise the Policy.

3.2 Transboundary basin and aquifer frameworks

At the basin level, there is a lack of 'modern' agreements on transboundary water resources management. The few agreements that exist mostly date from the period of colonial rule in the region (such as in the Gash basin, the Jubba-Shabelle basin and the Nile Basin). More recent agreements and cooperation frameworks can be found in the Nile Basin. The Nile is the only transboundary river basin or aquifer with a dedicated transboundary organisation (Nile Basin Initiative). Various initiatives are ongoing to encourage basin cooperation; these initiatives are implemented through the NBI in the Nile Basin, and the SECCCI project includes a hydrodiplomacy component in the Lake Turkana and Jubba-Shabelle basins.

With only the Nile having a dedicated institutional arrangement, investigate the potential (barriers, enablers, options), for establishing basin and aquifer level institutional arrangements. These do not have to be new institutions, but could be other arrangements such as committees.

There are no known multilateral institutions or agreements that address transboundary aquifer management in the region.

Recognising that most of the transboundary basins and aquifers in the region have had various studies completed on them, consider undertaking a simple literature review, and potentially further assessment to fill any knowledge gaps, to understand the key drivers and issues in each basin and aquifer, as well as mapping significant actors, with a view to making recommendations on advancing transboundary collaboration. The analysis could be based on the GEF TDA/SAP process (Transboundary Diagnostic Analysis / Strategic Action Programme).

See Section 2.3 and Annex A.1 for further information on the individual basins and aquifers.

3.3 Africa-wide frameworks for water resources management

African Union (AU)

Strategy:

- **Africa Water Vision 2025** (2000)**:** vision "4. Water-resources institutions have been reformed to create an enabling environment for effective and integrated management of water in national and transboundary water basins, including management at the lowest appropriate level", "5. Water basins serve as a basis for regional cooperation and development, and are treated as natural assets for all within such basins". Target: Enabling environment for regional cooperation on shared water: Implemented in 100% of existing river-basin organizations by 2015; *Initiated* in 100% new river-basin organizations by 2015; *Implemented* in 100% new river-basin organizations by 2025. **Outcome:** progress towards targets unclear, but unlikely to be reached. It is understood that SDG indicator 6.5.2 – Proportion of transboundary basin area with an operational arrangement for water cooperation – has in practice replaced the aforementioned targets for regional cooperation on shared water (see Section 0).
- **Sharm El-Sheikh (2008):** Commitments for accelerating the achievement of water and sanitation goals in Africa (under MDGs). "Request the Regional Economic Communities and the Rivers and Lake Basin Organizations to initiate regional dialogues on climate change and its impacts on the water sector with the aim of designing appropriate adaptation measures";
- **Convention on Cross-Border Cooperation** (adopted by AU in 2014) (Niamey Convention). One of the aims of the Convention is to develop agreements on sharing

transboundary resources. **Outcome:** As of 16/07/2019, no countries in the region had signed the Convention. Nonetheless, a number of cross-borders MoUs in the Horn of Africa have been signed or are under discussion (see Section 4.2).

- African Water Resources Management Priority Action Programme 2016 – 2025. While transboundary cooperation isn't the main focus of any of the 4 'Priority Action Areas', transboundary aspects are mentioned in most of them. The priority action areas relate to: water security; resilience to climate change and water-related disasters; information systems for water resources assessment and modelling; and environmental integrity through wastewater and water quality management.

Institutional:

- Division on Environment, Climate Change, Water, Land and Natural Resources, under Department of Rural Economy and Agriculture.
- Programme for Infrastructure Development in Africa (PIDA) (see Section 7.1).
- **The African Union Border Programme (AUBP):** while focussing on demarcation of national boundaries, objectives include: "Developing, within the framework of the RECs and other regional integration initiatives, local cross-border cooperation". Some, but relatively little, work in the Horn of Africa, with IGAD or countries, compared to other sub-regions. Recommendation: there may be some scope for initiating water-related cross-border projects through AUBP, though this would need further discussion and likely clear requests.

African Ministers' Council on Water (AMCOW): Formed in 2002, to promote cooperation, security, social and economic development and poverty eradication among member states through the effective management of the continent's water resources and provision of water supply services. In 2008, Heads of State and Government of the AU agreed on commitments to accelerate the achievement of water and sanitation goals in Africa and mandated AMCOW to develop and follow up an implementation strategy for these commitments. AMCOW has also being accorded the status of a Specialised Committee for Water and Sanitation in the African Union. The AMCOW Strategy 2018-2030 has Strategic Priority #3: Promote good water governance and transboundary water cooperation. Not much detail specifically about transboundary cooperation, and seemingly relatively little activity in this regard in the Horn of Africa. Given AMCOW's mandate, and representation from each country, there is potential for AMCOW to play a role in transboundary water resources management in the region.

African Water Facility[25] (AWF): AMCOW initiative, financed by AfDB, has initiatives throughout Africa that support increasing capacity for water governance, meeting water needs, and informed decision making while also helping secure a solid financial base in African countries. 19 projects listed under 'Transboundary water resources management', with about 4 relevant to the region.

1. 2007: IGAD received €1.8 million to implement and operate an Integrated Transboundary Water Resources Management process. **Outcome:** see IGAD projects in previous section.
2. 2012-14: The Eastern Nile Technical Regional Office (ENTRO, the technical arm of the Nile Basin Initiative), received € 2 million for a development study to support investment efforts to finance the Baro-Akobo-Sobat development programme. South Sudan, Ethiopia. Documentation on outcomes not able to be identified during this study.
3. 2015-ongoing: Nile Equatorial Lakes Subsidiary Action Program (NELSAP) received €1.97 million to increase water availability for multiple purposes in the Nyimur region of Uganda and South Sudan. Documentation on outcomes not able to be identified during this study.

[25] African Water Facility Homepage, accessed July 2020.

4. 2006 (completed): The African Network of Basin Organisations (ANBO) received €439,000 to consolidate and build its institutional capacity and operations, strengthen its interaction with other river basin organisations, with a view to increasing the number of basin members, creating new basin organisations and building the capacities of the existing ones. English documentation on outcomes not able to be identified during this study, though project completion report available in French.

African Network of Basin Organisations (ANBO): Regional arm of International Network of Basin Organisations (INBO). Various projects to increase ANBO's capacity (see below), yet online presence remains low, so information is not readily available.

Projects:

- "Strengthening of Transboundary Water Management Institutions in Africa" (SITWA): [(EU), ANBO, GWP, others] (2013-2016): Six components: (1) Institutional strengthening of ANBO; (2) Governance (legal / institutional support to BOs); (3) Capacity Building; (4) Knowledge Management; 5: Mobilization of Financial Resources and; BO's Assessment of IWRM, Climate Change, Data Management and Infrastructure Development. Documentation on project outcomes could not be identified during this study.
- "Strengthening the institutional capacity of ANBO, contributing to improved transboundary water governance in Africa" [(GEF), ANBO, GWP, AMCOW, IGRAC / UNESCO-IHP] (2017-2020). USD 2 mill.: To strengthen the coordination and collaboration capacity of African Lake and River Basin Organizations (L/RBOs), Commissions and/or cooperative framework for transboundary groundwater management and their member states towards improved transboundary water governance in Africa through improved support by ANBO. IGRAC, UNESCO-IHP focussing on groundwater, with 2 case studies in southern and western Africa (not Horn of Africa). For groundwater component: Trainings, data collection for case studies Orange-Sengu river basin / Stampriet aquifer and the Senegal river basin / Senagalo-Mauritanian aquifer, and creation of the AGWIS platform. Potential to transfer capacity building approaches to aquifers in Horn of Africa region. Documentation on project outcomes could not be identified during this study.

Nairobi Convention: Kenya and Somalia are members of the Nairobi Convention, a regional seas initiative that is concerned with upstream and land-based activities as they impact marine waters. Implemented a GEF project WIOSAP (Annex A1.1), which details the Jubba-Shabelle catchment characteristics. Secretariat hosted by UNEP.

3.4 Global frameworks

These are concerned with transboundary collaboration over water, but would be implemented at national level.

Convention on the Law of the Non-Navigational Uses of International Watercourses (Watercourses Convention 1997) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention**,** open to all countries from 2016). None of the countries in the region are signatories to either of these conventions, though some countries are in dialogue with UNECE about accession, mostly Uganda and Kenya. 14 African countries have ratified the UN Watercourses Convention (with 9 in West Africa), and 3 African countries have ratified the Water Convention (Chad, Ghana, Senegal). Further dialogue with countries on the Conventions (with a view to ratification) would be one step in advancing the enabling environment for cooperation in the region. UNECE, as host of the Convention Secretariat, would be the main institution to facilitate this dialogue.

SDG Target 6.5: By 2030, implement integrated water resources management at all levels, including through transboundary cooperation where appropriate (see Section 0)

3.5 Summary and recommendations

At the regional level, some progress has been made, with the adoption of the Regional Water Resources Policy (2015). However, political tensions have hindered progress on the Water Resources Protocol, with tensions around the Grand Ethiopian Renaissance Dam (GERD) likely to have contributed to this. Institutionally, the IGAD Water Unit appears to have insufficient capacity, visibility and influence to effectively advance regional collaboration on water resources, particularly in light of the challenging regional political environment. Given these challenges, the Water Unit has made some commendable contributions.

More focus and funding has been channelled through cross-border initiatives, with a broader socio-economic development objectives, most notably through the IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) (2012-2027), with the EU contributing more than USD 70 million[26] to various projects within and supporting this framework in the last 10 years.

The following are recommended for further consideration:

1. Increase the capacity and visibility of the IGAD Water Unit, and clarify its mandate and objectives. Explore ways to strengthen the links between the Water Unit and IDDRSI, to facilitate the Water Unit having greater influence and participation in IDDRSI.
2. Building on experiences from the SECCCI project, explore ways to increase consideration of water resources and environmental management to support the eight IDDRSI pillars, particularly in the eight cross-border clusters.
3. Building on the analysis in this study, which focusses at the regional level, consider further coordinated analysis at the basin and aquifer level. This may include:
   - Investigating the potential (barriers, enablers, options), for establishing basin and aquifer level institutional arrangements. These do not have to be new institutions, but could be other arrangements such as committees.
   - Assessing the key drivers and issues in each basin and aquifer, as well as mapping significant actors, with a view to making recommendations on advancing transboundary collaboration.
4. Opportunities to advance transboundary cooperation through the following should be further investigated:
   - Ratification of the AU Convention on Cross-Border Cooperation (Niamey Convention)
   - Ratification of the Water Convention (global)
   - Using SDG Target 6.5 as an entry point to supporting progress on many of the SDGs.

[26] Approximate value from EU Emergency Trust Fund for Africa: Horn of Africa, and IDDRSI projects webpages. Not to be quoted directly.

4 National and bi-lateral activities for cross-border collaboration and resilience

In the absence of an effective regional framework for cross-border collaboration, there have been some national and bi-lateral initiatives, though the sustainability of these can be threatened without an overarching regional framework in place.

4.1 National (government)

This section covers institutional arrangements and strategic frameworks, as they relate to transboundary water management.

Summary:

1. National development plans and water policies were assessed to see to which extent they mention transboundary water management. Note that many documents are not publicly available online.
2. While management of (transboundary) water resources should be data-informed to be sustainable, consulted documents repeatedly highlight lack of data on water resources.
3. Although South Sudan's water policy and the Somalia National Development Plan acknowledge the challenge of transboundary water management, only Kenya and Uganda's development plans currently contain concrete indicators regarding transboundary water management. This will likely change in the near future, as countries such as Ethiopia and Somalia are drafting development plans and policies. Finally, Djibouti's development plan does mention that it is installing a water pipeline from Ethiopia[27], but does not frame it as transboundary cooperation.
4. None of the countries in the Horn of Africa are party to the Water Convention.

The table provides a summary of selected national strategies and institutions relating to water in each country.

[27] It is understood that a bi-lateral agreement is in place, but not yet located.

Country	National strategy documents	Institute(s) directly related to water at national level
Djibouti	• Stratégie de Croissance Accélérée et de Promotion de L'Emploi 2015-2019	Ministère de l'Agriculture, de l'Eau, de la Pêche et de l'Élevage chargé des Ressources Hydrauliques
Eritrea	• The Eritrean Water Law, Proclamation, No. 162/2010	Ministry of Land, Water and Environment
Ethiopia	• 10-year development plan of Ethiopia 2020-2030 (ppt. Presentation) • National Water Policy and Strategy (2020; draft) • Climate-Resilient Green-Economy Strategy (CRGE-Strategy) (2011-2025)	Ministry of Water, Irrigation and Energy
Kenya	• Kenya's Vision 2030	Ministry of Water & Sanitation and Irrigation; National Water Harvesting and Storage Authority and the Kenya Water Institute
Somalia	• National Water Resources Management: Strategic Plan (under development since 2019) • National Development Plan 2017-2019	Ministry of Energy and Water Resources
South Sudan	• National Development Strategy (NDS) 2018 – 2021 of South Sudan • Water policy 2007	Ministry of Irrigation and Water Resources
Sudan	• (River basin simulation for improved transboundary water management in the Nile: a case study of the Tekezze-Atbara: this is not a policy document but a Sudan-authority led initiative) • (Wadi El Ku Catchment Management Project: this is not a policy document but a UNEP led initiative)	Ministry of Water Resources, Hydraulic Research Center
Uganda	• Joint Water and Environment Sector Support Programme 2018-2023	Ministry of Water and Environment

The following text provides a brief description of how transboundary-related issues may be addressed in the national documentation. It is not a comprehensive overview.[28]

Djibouti: Lack of information regarding water is highlighted in the planning documents, and alleviating the water supply deficit is a major objective. Desalination plants, a water pipe from Ethiopia, borehole development in the north, and reuse of wastewater effluent for irrigation are planned. The agreement with Ethiopia is not detailed in the plan.

Eritrea: Relevant issues mentioned include systemization of studies and documentation of data on water resources, promotion of integrated water resources management, and establishment of a pertinent legal framework and institutions with clear mandates in consonance with the principles of integrated water resources management.

Ethiopia: The planning documents from Ethiopia place emphasis on hydroelectric and large-scale agricultural infrastructure development. Transboundary water management,

[28] A review by UN Country Teams would add value to this section. Most of the current text is derived from the few documents available online, as well as information provided from UN staff (particularly UNEP), including presentations, which may be referenced as 'Personal communication'.

both within the Horn region and between the Horn and other regions, is recognized in the planning strategy. Strategies include establishment of a National Consultative Group on transboundary issues, development of large-scale storage structures to satisfy sectoral water demands and reduce supply deficit, strengthening data collection, monitoring and assessment of the transboundary resource base to inform decision-making, development and implementation of bi-lateral or multi-lateral projects on transboundary waters. The National Consultative Group on transboundary water issues is expected to be inter-ministerial, involving, to some extent, academia and civil society.

A new national water policy and strategy is currently undergoing consultations (2020). A full chapter is dedicated to transboundary water resources (6.12 Transboundary Water Resources). Highlights of this chapter:

- 6.12.1 Access and Use of Transboundary Waters
- 6.12.2 Institutional and Capacity Building
- 6.12.3 Cooperation and Coordination

Kenya: The planning document acknowledges inadequate frameworks for many transboundary water bodies, and explicitly states ones that it plans to implement. Concrete transboundary indicators, a plan to develop a transboundary water policy legal framework, emphasis on large-scale irrigation projects, and plans to build water storage structures are included in the document (although the last two are not directly linked to transboundary water management).

Somalia: Specific indicators regarding water are limited to WASH. Planning documents highlight the lack of transboundary policies and structures and lack of groundwater monitoring and management as needs to be addressed. The Strategic Plan is still under development, through an extension public consultation process. Based on the latest consultation workshop, one of the 20 strategies is: Establish a basis for transboundary basin management.[29]

South Sudan: Recent water policies have no mention of transboundary water, and older documents focus on the Nile basin. Relevant issues mentioned include assessment of the needs of South Sudan based on research, data, and technical understanding.

Sudan: The Sudanese Hydraulic Research Center is attempting cooperation in transboundary water management between Sudan and Ethiopia in the Nile basin.

Uganda: Transboundary water resource management is the third priority in the water and environment programme. Several concrete indicators are defined, and the plan details participation in international water resources programmes, operationalization of a water resources institute, strengthening national monitoring and management systems, and capacity building for integrated development and management of water resources. Uganda scores 84% on SDG 6.5.2 (2017).

4.2 Bilateral

Summary: Many dialogues on cross-border MoUs are facilitated by IGAD and the UN Resident Coordinator's Office of the respective countries. The cross-border MoUs could provide an opportunity to encourage transboundary water cooperation at the local level. Although most of the current MoUs are not focussed on water, or even particularly

[29] National Water Resources Management: Strategic Plan – A framework for action. 2nd Technical Consultation Workshop, Outcome report, 12-14 October 2020.

relevant for water per se, they do illustrate that cross-border collaboration exists between the countries in various forms, and many provide useful models for cross-border MoUs on natural resources management, including water. The following is a selection of bilateral arrangements, though is not intended to be comprehensive.[30]

Ethiopia-Djibouti

It is understood that there is a bilateral agreement regarding pipeline infrastructure, but documentation could not be sourced during this study.

Ethiopia-Kenya

- Special Status Agreement (2012). Provides an overarching framework on areas of agreed priorities, including infrastructure (including energy) and food security and sustainable livelihoods (including joint development, management and use of transboundary natural resources in accordance with international law). Agreed to establish a Joint Technical Committee to monitor the implementation of the agreement.
- Cross-border integrated programme for sustainable peace and socio-economic transformation (2015) reflected in MoU signed at national government level. Including clauses on effective management of natural resources.
- Dukana-Dillo-Maikona peace declaration (2009, revised 2017 (with support from USAID)): Externally facilitated local level arrangement between traditional leaders on both sides. Mainly related to shared access to grazing and watering resources, as well as education and health services, and opening cross-border trade.
- MoU on cross border cooperation on animal health and sanitary measures signed at national level (2016); does not mention water but may be a useful model for cross-border MoUs.

Ethiopia-Somalia

MoU on cross-border cooperation and coordination on animal health and sanitary measures (2019) (with involvement of IGAD). Covers all border areas between Ethiopia and Somalia. No specific mention of water, but the text and collaboration mechanisms established provide a useful model to potential collaboration on water resources management. This includes the establishment of a Joint Steering Committee, a Multidisciplinary Technical Team, with a coordinator, and an outline clause on financing the arrangement.

Kenya-Uganda

- The cross-border integrated programme for sustainable peace and socio-economic transformation for the Karamoja cluster (2019) is reflected in a MoU signed at national government level. It includes objectives such as: reduce tensions and competition over access to resources, notably water and pasture; improved environmental and natural resource management. The programme is supported by UN Country Offices and IGAD, with the intention of establishing a Joint Technical Committee under the respective national ministries, which would work with local governments.

[30] A review by UN Country Teams would add value to this section. Most of the current text is derived from the few documents available online, as well as information provided from UN staff (particularly UNEP and the UN Climate Security Mechanism), which may be referenced as 'Personal communication'.

4.3 UN Country Offices

Summary: Most of the consulted UN country level analysis and planning documents (CCA and UNDAF/UNSDCF) don't systematically discuss transboundary waters and their management. [31] The exceptions are Ethiopia and Kenya, where it is explicitly brought up, and, to some extent, Somalia.[32]

In Ethiopia, although the importance of transboundary resources and their management is highlighted[33] in the analysis document and explicitly acknowledged in the UNSDCF[34] no action is to be found in the planning document[35]. The Somalia 2020 CCA companion document does discuss transboundary water in the context of SDG6 and the need for strengthened integrated water management capacities. It recognises that "There is very high dependency on transboundary water for [the Shabelle and Jubba] rivers, particularly from Ethiopia", and mentions World Bank efforts "to support the Government of Somalia to structure its transboundary agenda and explore and use the appropriate avenues to pursue dialogue". Furthermore, the companion document mentions "The absence of transboundary partnerships for environmental information sharing and cooperation", which is highlight relevant for the recommendations made on a digital platform in Section 8.3 of this document. However, the main CCA document itself doesn't discuss transboundary natural resource management and transboundary natural resource management is not mentioned in the SDCF. Therefore, only Kenya explicitly includes action on transboundary water in the planning document.

Water in the other UN country level analysis and planning documents concerns mostly WASH and to a lesser extent integrated water resource management and water desalination, and includes the need to develop water policies, without explicitly mentioning transboundary issues.

The limited consideration of transboundary water issues in UN strategic documents at country level is striking given both the importance of transboundary waters in the region, particularly with regard to stability of the region, and given the prevention mandate of the UN. Incorporating transboundary water resource management in analysis documents (CCAs) is a start, however moving it into a more actionable level in cooperation frameworks (previously UNDAF/SPCF now UNSCDF) requires willingness of national governments to address these issues within the framework of their cooperation with the UN.

---

[31] Consulted documents: Djibouti UNDAF 2018-2022, Eritrea SPCF 2017-2021, Ethiopia draft CCA 2020 & UNSDCF 2020-2024 (drafts), Kenya UNDAF 2018-2022 and Concept note UNRC rapid assessment ASAL, Somalia 2020 CCA, Somalia Strategic framework 2021-2025, South Sudan Cooperation Framework 2019-2021, Sudan UNDAF 2018-2021, Uganda CCA 2020 and UNDAF 2016-2020.

[32] Note that the Somalia 2020 CCA companion document does discuss transboundary water in the framework of SDG6 and the need for strengthened integrated water management capacities (p.50-51). On page 52 the document mentions the WB efforts "to support the Government of Somalia to structure its transboundary agenda and explore and use the appropriate avenues to pursue dialogue;". The companion document also mentions "There is very high dependency on transboundary water for [the Shabelle and Jubba] rivers, particularly from Ethiopia." However, the CCA main document itself doesn't discuss transboundary natural resource management and transboundary natural resource management is not mentioned a single time in the SDCF.

[33] The draft CCA has a specific paragraph on shared natural resources and another on neglected transboundary issues. The CCA considers regional and transboundary issues and shared natural resources among the critical trends and dynamics. "Achieving a step change in transboundary cooperation" figures as one of the six conclusions of the document.

[34] "A cluster of six factors need to be tackled head on in order for Ethiopia to have a good chance of achieving the SDGs."; the sixth one of this is taken from the CCA "Achieving a step change in transboundary cooperation."(p.8)

[35] No explicit reference to transboundary issues is to be found under outcomes and outputs. Water is considered under Outcome 1.1 access to basic services, Output 1.3. Under Outcome 2.1 water and sanitation is considered as a major sector.

Recommendation: there is potential for country offices to incorporate transboundary cooperation around water resources, as well as natural resources management for resilience, into upcoming CCAs, and new UNSDCFs. Upcoming documents where there is (potentially) still scope to integrate transboundary water management: Uganda UNSCDF 2021-2025. Only Ethiopia (2020), Somalia (2020) and Uganda (2020) have completed Common Country Assessments (CCA), so there is opportunity to encourage consideration of transboundary water resources issues in other countries, through engagement with UN Resident Coordinator Offices.

There is some form of 'cooperation framework' between the national government and UN Resident Coordinator's Office in each country. The following documents have been consulted:

- Djibouti UN Development Assistance Framework (UNDAF) 2018-2022
- Eritrea Strategic Partnership Cooperation Framework (SPCF) 2017-2021
- Ethiopia Common Country Assessment (CCA) 2020 (draft) and Sustainable Development Cooperation Framework (UNSDCF) 2020-2024
- Kenya UNDAF 2018-2022 and Concept note UNRC rapid assessment ASAL
- Somalia Strategic framework 2017-2020 and Sustainable Development Cooperation Framework 2021-2025, Somalia CCA 2020 and companion document.
- South Sudan Cooperation Framework 2019-2021
- Sudan UNDAF 2018-2021
- Uganda CCA 2020 and UNDAF 2016-2020. (UNSCDF 2021-25 not sighted, being drafted).

For an overview of how water is included in UN country office documents, and whether transboundary issues are explicitly mentioned, see Annex 0.

4.4 National status on transboundary cooperation under the SDGs

Summary:

1. Opportunity: As all UN Member States have committed to Agenda 2030, there is a potential entry point to support countries to achieve Target 6.5 "implement integrated water resources management at all levels, including through transboundary cooperation where appropriate" by 2030.
2. Current data collection round in 2020 (no opportunity to influence), with next likely data collection round in 2023. Opportunity for progress / capacity building 2021-2022.
3. SDG 6.5.2 on the proportion of transboundary basin area with an operational arrangement for water cooperation: in 2017 (baseline) only 3 of 8 countries reported on the indicator (Somalia 0%, Kenya 27%, Uganda 84%, and Ethiopia's submission was not finalised). In 2020, 5 countries reported (Ethiopia, Kenya, Somalia, South Sudan and Uganda, though at the time of writing, the reports were not finalised).
4. SDG 6.5.1 on the degree of integrated water resources management implementation: in 2017 6 of 8 countries reported (all except Djibouti and Eritrea). Average of transboundary aspects in the region: 44/100, but with a range from 0 (Somalia) to 80 (Uganda). In 2020, the same 6 countries reported (average 42/100).

Indicator 6.5.1: Degree of integrated water resources management implementation. While indicator 6.5.1 focusses mostly at national level, the survey instrument contains 4 questions at the transboundary level, on: agreements (1.2c), organizational frameworks (2.2e), data and information sharing (3.2d), financing (4.2c).

Table 4 SDG 6.5.1[36] (transboundary aspects) (2020, with 2017 scores in brackets), and 6.5.2[37] scores (2017)

	6.5.1 (scores out of 100)					6.5.2 (2017)		
	Agreements (1.2c)	Org. framework (2.2e)	Data & info. sharing (3.2d)	Financing (4.2c)	Average	Surface	Ground water	Overall
Djibouti	-	-	-	-	**-**	-	-	**-**
Eritrea	-	-	-	-	**-**	-	-	**-**
Ethiopia	30 (20)	40 (20)	40 (20)	40 (20)	**33 (20)**	-	-	**-**
Kenya	80 (40)	70 (40)	40 4(0)	60 (60)	**60 (45)**	36	0	**27**
Somalia	20 (0)	10 (0)	40 (0)	0 (0)	**13 (0)**	0	0	**0**
South Sudan	20 (80)	60 (80)	40 (60)	20 (20)	**35 (60)**	-	-	**-**
Sudan	80 (70)	20 (60)	40 (50)	40 (60)	**45 (60)**	-	-	**-**
Uganda	80 (60)	60 (80)	60 (60)	50 (100)	**58 (80)**	98	0	**84**
Average	**48** (48)	**43** (47)	**43** (38)	**35** (43)	**42** (44)	44	0	**37**

Legend:

Implementation categories	Very low	Low	Medium-low	Medium-high	High	Very High

4.5 Summary and recommendations

In most countries, national consideration of transboundary water management and collaboration is in early stages. A number of cross-border MoUs have been signed, including at the local level, but few of these contain details on water resources or environmental management. Consideration of transboundary issues within the strategies of the UN country offices is generally low but increasing, generally in line with national development objectives.

Recommendations:

1. Engage with UN Country Teams, to discuss how consideration of water resources management in a more cross-border context could support both national development objectives and regional peace and security (Section 4.3).
2. The above would include identification of 'needs' to support this work, for example access to information, which could be facilitated by digital platforms (see Section 8.3).
3. Consider developing a common regional strategy for UN country offices to work towards sustainable transboundary natural resources management and resilience.
4. Explore options for embedding natural resources management into existing MoUs, as well as exploring options for developing new MoUs with a focus on transboundary natural resources management, building on experiences of negotiating existing bilateral MoUs in the region.

[36] http://iwrmdataportal.unepdhi.org/aboutsdg651
[37] SDG 6.5.2 global baseline indicator report (2018).

5 Status of water and environment in the Horn

This section provides brief descriptions of how water in the Horn impacts the population, specifically regarding the topics of socioeconomics, droughts, floods, and freshwater ecosystems. Chronic aridity and shock events (floods and droughts) shape daily life in the Horn and is a contributing factor to peace and food security. Land degradation from human activity can exacerbate the impact from these events.

From smallholder farming to energy generation from hydropower, the Horn is dependent on water resources, and human action in turn impacts the hydrology of the region.

A summary of all topics is provided in Section 5.5.

5.1 Socioeconomic dependence on water

70% of the IGAD region is categorized as Arid or Semi-Arid Lands (ASAL),[38] and with a population of 240 million and one of the highest population growth rates in the world, the region faces socioeconomic challenges regarding water and the demands placed on water resources by the agricultural, domestic, and industrial sectors. Crop and livestock agriculture employ 80% of the population, and a baseline amount of water for sanitation and domestic use is also essential for the health of the growing population.[39]

It was estimated in 2015 that there are 38 million pastoralists in the Horn, comprising approximately 16% of the total population. Agropastoralism is the predominant livelihood in marginal ASAL lands, the borderlands areas. The arid environment and yearly rainfall patterns mean that mobility for access to water and replenished grazing lands is essential to pastoralists' way of life, Government development projects and policies support sedentary agriculture and industrial parks, which limit pastoralists' access to water resources, increases land degradation from overgrazing, and fuels conflict.[40] Safe, regulated transhumance routes are currently being negotiated in cooperation with IGAD and 65 stakeholders to address these challenges, and livelihood diversification options are also being investigated by ICPALD, where water can be an important factor.[41,42]

Smallholder, subsistence, rainfed agriculture is the dominant type of agriculture in the region. Food insecurity arises when disturbances, such as drought or social distancing measures from the COVID-19 pandemic, interrupt planting timing with the rains.[43] Irrigation can help alleviate this constraint,[44] and it is estimated based on remote sensing analysis that 17-35% of cropland areas are currently irrigated[45], up from 1% of all cultivatable land in 2000.[46] Ethiopia in particular has focused on increasing

[38] UNEP, Global Drylands: A UN System-Wide Response, 2011
[39] IGAD Description of the region
[40] World Bank. 2020. From Isolation to Integration: The Borderlands of the Horn of Africa. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/33513
[41] UNDP, SECCCI project: Transhumance Routes for Survival, 2020
[42] ICPALD, IGAD, Stocktaking Study of Complementary Livelihoods Market and Value Chain Analysis for Identified Priority Products in IGAD Region Cross-Border Areas, RPLPP, 2017
[43] Ayanlade and Radeny, COVID-19 and food security in Sub-Saharan Africa: implications of lockdown during agricultural planting seasons, Nature npj Science of Food, 2020
[44] Moyo, Bah, and Verdier-Chouchane, Transforming Africa's Agriculture to Improve Competitiveness. World Economic Forum, World Bank and AfDB, 2015
[45] Vogels et al., Spatio-Temporal Patterns of Smallholder Irrigated Agriculture in the Horn of Africa using GEOBIA and Sentinel-2 Imagery, 2019
[46] FAO, Food Insecurity in the Horn of Africa, 2000

sedentary, large scale agriculture and irrigation schemes,[47,48,49] but the FAO still estimates that 68% of cropland with potential for irrigation is irrigated.[50] Some areas are irrigated illicitly, as local farmers make breakages in riverbanks to siphon water for crops. This is especially prevalent in Somalia, where civil conflict led to the disrepair of large irrigation infrastructure and all agriculture is essentially subsistence agriculture.[51,52] Agricultural productivity in the Horn is also limited by gender inequalities. Women farmers are predominantly subsistence and smallholder farmers yet comprise 47% of the labour force in sub-Saharan Africa. Women's agricultural yields would rise by 30% if they had access to the same resources as men,[53] and this includes access to water and irrigation opportunities.[54,55]

Domestic and industrial use of water comprises a small percentage of water use in the region. Statistics available for Ethiopia rank irrigation use at 85%, livestock use at 7%, municipal use at 8%, and industrial use at less than 1%.[56] Only 58% of all households in Eastern Africa have access to potable water,[57] and only Ethiopia and Uganda are categorized by the JMP as having any degree of safely managed drinking water service.[58] Improving WASH is a focus for countries in the IGAD region (See the CCAs for each country, Annex A.4, and Section 4.3 for more information); because of this and the projected population increases (see Section 6.2), domestic water demand is expected to grow.

Industry is a low water consumer in the Horn region at present, but IGAD member states' economic development goals include industrial expansion to secure employment for the rapidly growing population. Goals include construction of industrial parks and exploration and extraction of oil and gas.[59,60] This has impacts for land use, pastoralist mobility, and contamination and increased of use of water resources, especially with water intensive oil extraction methods.[61,62]

Access to electricity in the Horn is, in general, very low. While approximately half of urban populations have access to electricity, only approximately 5% of rural populations do. The predominant source of energy in Eastern Africa is biomass, which is problematic as overuse of this can lead to land degradation.[63] In addition to producing energy, hydropower can also facilitate water storage and distribution and is a focus for socioeconomic development in the Horn region. Expansion of hydropower is one goal of Africa Water Vision 2025,[64] and 11% of potential hydropower in Africa has been utilised as of 2019,[65] up from 3% in 2004.[66] It is expected that demand for energy from the growing population and industry expansion will be met in part by hydropower resources.

[47] Stevensen, article in *Land*, Plantation Development in the Turkana Basin: The Making of a New Desert?, 2018
[48] Oakland Institute, How they tricked us: Living with the Gibe III dam and sugarcane plantations in southwest Ethiopia, 2019
[49] Ethiopian Press Agency, Irrigation projects worth emulating, 2020
[50] FAO, Ethiopia Country Profile, Irrigation and Drainage
[51] FAO, Somalia Country Profile, Aquastat
[52] SWALIM and FAO, Flood Monitoring
[53] Shimeles, Verdier-Chouchane, and Boly, Building a Resilient and Sustainable Agriculture in Sub-Saharan Africa, Introduction, 2018
[54] OCHA, Horn of Africa: Impact of conflict and drought crises on women and girls, 2017
[55] The Africa Report, Women: Empowering Africa's agricultural backbone, 2014
[56] FAO, Ethiopia Country Profile, Water use
[57] UNECA, Report on Sustainable Development Goals for the Eastern Africa Subregion, 2015
[58] JMP, Household Drinking Water Totals, 2017
[59] WB, Ethiopia's Industrial Parks are Making Jobs a Reality, 2019
[60] SIPRI, Water Security and Governance in the Horn of Africa, 2020
[61] Lesrima, PhD Thesis, 2019
[62] ECDPM, The Price of oil? Extractive development and conflict risk in Kenya, 2018
[63] UNECA, Report on Sustainable Development Goals for the Eastern Africa Subregion, 2015
[64] AfDB, Africa Water Vision 2025, 2004
[65] International Hydropower Association, Africa Regional Profile, 2019
[66] AfDB, Africa Water Vision 2025, 2004

This is likely to bring conflict over distribution of resources between plantations and smallholder agriculture and over displacement.[67] Major infrastructure projects are elaborated upon in Section 7.

Water, specifically transboundary water, and socioeconomic dependence in the Horn is complex and is intricately linked to land use and energy production/consumption (See Pillar 4 reports on land and energy). To establish connections between environment, water, and socioeconomics requires holistic analysis of various elements, including water availability, water distribution, hydropower development and operation, irrigation, fisheries management, watershed ecosystem health, and flood/drought climate predictions.

5.2 Water scarcity

All IGAD member countries have ASAL regions that receive extremely little rainfall – less than 600mm per year.[68] Figure 4 (left) shows highly arid areas are located in the north, south, and eastern parts of the Horn region. Most rainfall in the region occurs in central and western Ethiopia. Because of its central location and these rainfall patterns, all cross-border basins except two include Ethiopia. Rainfall in the Horn is also not uniformly distributed throughout the year; most precipitation occurs during the wet months of June-October. The Horn region thus faces water resources quantity, storage, and distribution challenges.

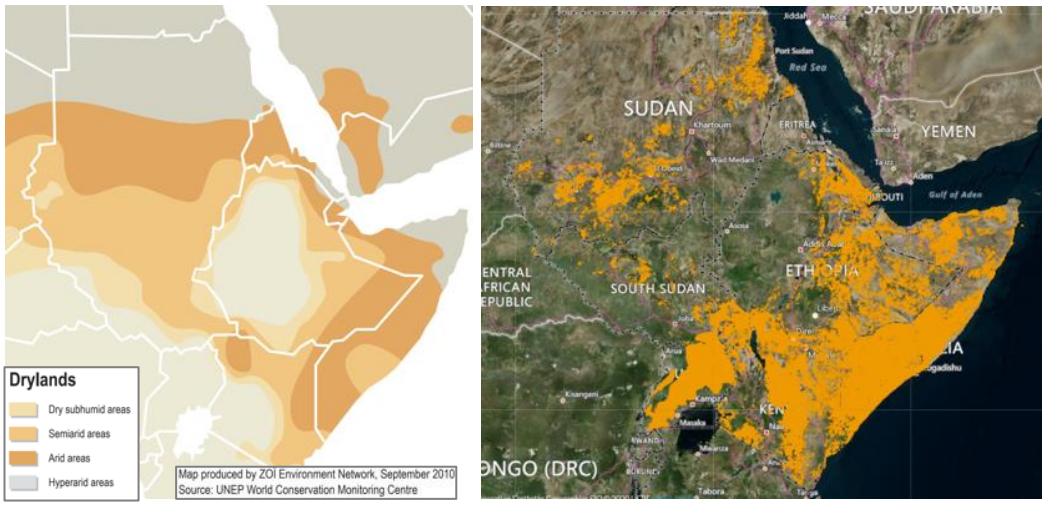


Figure 4 – Left: Drylands based on aridity index in the IGAD region. Note that beige coloured areas are not arid, and grey areas are hyperarid.[69] Right: Drought prone areas in the IGAD region.[70]

Drought prone areas, which experience acute water scarcity shocks, are shown in Figure 4 (right). All countries in the IGAD region, except South Sudan, have experienced six or more serious drought events from 1990-2016 affecting more than 50 million people. The severe drought in 1999 affected more than 20 million people in Kenya alone. In the 2010/11 drought in Kenya, Somalia, and Ethiopia, 10 million people were affected, and 250,000 deaths due to drought were recorded in Somalia.[71]

[67] Oakland Institute, How they tricked us: Living with the Gibe III dam and sugarcane plantations in southwest Ethiopia, 2019
[68] UNEP, Global Drylands: A UN System-Wide Response, 2011
[69] UNEP, Global Drylands: A UN System-Wide Response, 2011
[70] ICPAC Geoportal 2017 http://geoportal.icpac.net/maps/264
[71] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018

People living in arid areas with groundwater aquifers derive 40-100% of their water from this source to overcome rainfall unpredictability and difficulty distributing water to marginal lands.[72] Abstraction in most transboundary aquifers in the Horn is below 10% of the recharge rate; thus there is potential for sustainable development of subsurface water resources. However, sustainable use of groundwater in the region necessitates capacity building. There are drawbacks to reliance on aquifers, including the cost of pumping from deep wells and effects on pastures from aquifer draw-down, to consider.[73] Many aquifers would require more investigation to better determine their size and extent, and managing bodies lack knowledge and skills for effective aquifer management. This is currently being addressed by the "Horn of Africa Groundwater Initiative" (see projects below) Figure 5 shows that some aquifers, for instance the Merti and Gederef, are exploited unsustainably, while others, for instance the Jubba and Shabelle, have no data and are poorly delineated.

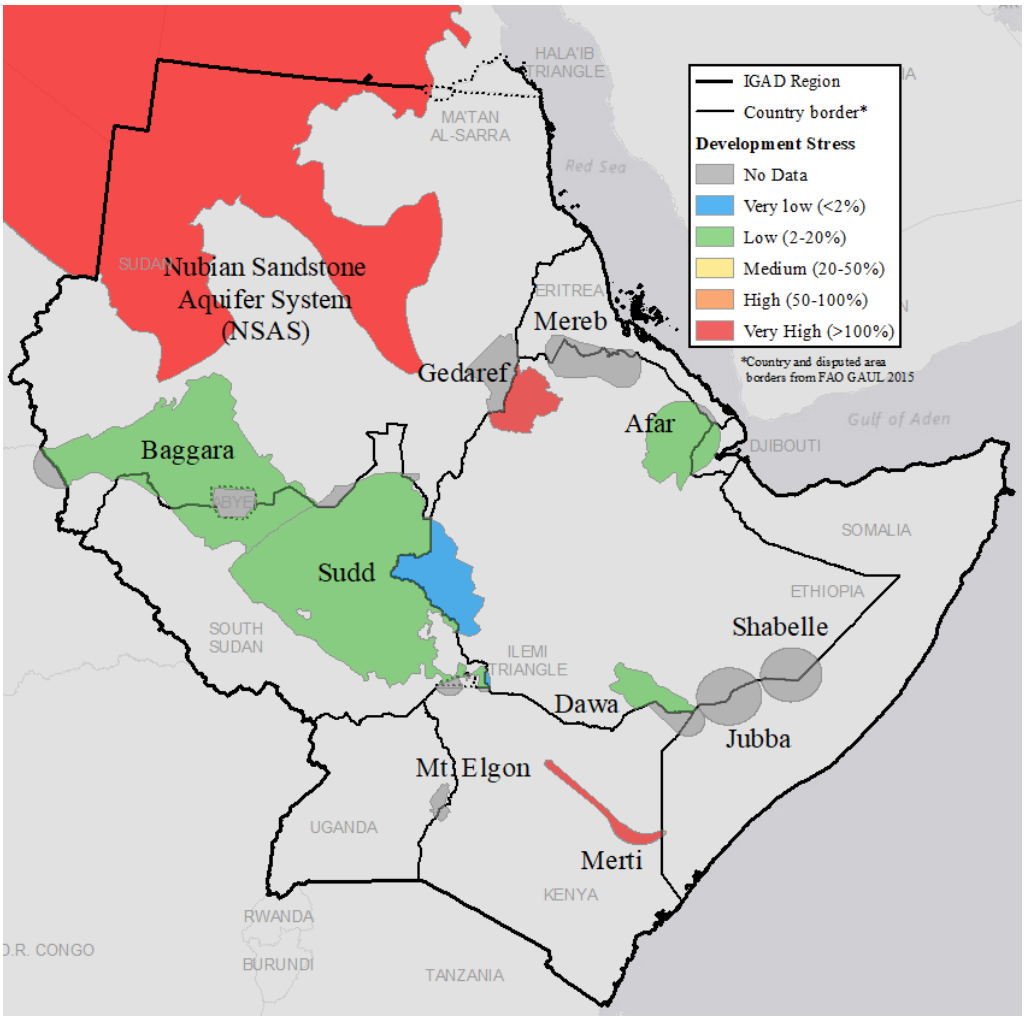


Figure 5 – Transboundary groundwater development stress (abstraction/recharge) (country segments). TWAP 2016.

Development of small-scale infrastructure to store and distribute water has so far been successful in rural Somalia.[74] Sand dams and subsurface dams can be instrumental in transforming wadis into small-scale reservoirs for irrigation, livestock, and domestic

[72] IGRAC, TWAP Groundwaters Portal Viewer, Metric GC2.1 Human Dependency on Groundwater, 2016
[73] WB, Somalia – Water for Agro-Pastoral Productivity and Resilience (Biyoole), page 9, 2019
[74] Personal communication, WB, September 2020

use.[75] Use of sand dams during typical climate conditions and groundwater boreholes during drought events is a strategy with strong potential in the arid Horn region.

Very little water availability and water use data is collected for the Horn region in general, especially for groundwater. Knowledge about the current state and current trends for water resources is essential to development and implementation of management strategies. Remote sensing technology and water accounting are tools to assess water availability and use in different sectors, such as irrigation used by smallholder farms in the East African region.[76] The current availability of water resources, the contribution of surface and groundwater to these resources, consumption by different sectors, and safe caps for water withdrawal have been determined for the Awash basin in Ethiopia.[77] Broader application of these tools, to all sectors, to the entire region, and over time to determine changes in use and availability, would greatly benefit decision makers in the Horn.

Organizations and projects related to water availability and drought mitigation:

IDDRSI [IGAD] (2011-present): Addresses the underlying causes of vulnerability in drought-prone areas through cross-border cooperation. Focus on both natural resources and peace-building. **Outcome**: The IGAD Resilience Portal (see Section 8.2).

- **RAU**[78] [IDDRSI/IGAD, FAO, UNICEF, UNDF, UN-OCHA, WFP] (2014-present): Resilience Analysis Unit, technical arm of IDDRSI platform. Goal is to understand vulnerability, assess impact of resilience enhancement, and ensure better information, analysis, and guidance to stakeholders at all levels. **Outcome**: Receives and responds to technical support requests, initiates capacity building activities for technical experts and policy makers, and guided policy reviews in Ethiopia, Kenya, and Uganda.[79]

- **SCIDA II** [GIZ, IGAD, IDDRSI] (2016-2020): project to strengthen the Drought Disaster Resilience and Sustainability Initiative (IDDRSI), which is directly linked to the fight to eliminate this cause of conflict and displacement[80]. **Outcome**: introduction of harmonised management tools and monitoring methods (implemented in seven members), pastoralism mapping, and establishment of an inter-institutional working group to monitor migration.

ICPAC [IGAD] (2003-present): IGAD Climate Prediction and Application Centre. Provides climate forecasting services to the IGAD region plus Rwanda, Tanzania, and Burundi. WMO Regional Climate Centre of excellence for East Africa. ICPAC is the regional partner for G-WADI, an international network to support cooperation for water resources management in Arid Lands. **Outcome**: ICPAC Includes a focus on disaster risk management and warns national authorities of upcoming drought events. For more information about ICPAC's forecasting services, see Section 6.2.

RLACC I and II [GEF, AfDB, ICPAC] (2015-2020): Rural Livelihoods' Adaptation to Climate Change in the Horn of Africa, USD 36 mill. Primarily focused on Kenya and

[75] WB, Somalia – Water for Agro-Pastoral Productivity and Resilience (Biyoole), 2019
[76] Vogels et al., Spatio-Temporal Patterns of Smallholder Irrigated Agriculture in the Horn of Africa using GEOBIA and Sentinel-2 Imagery, 2019
[77] FAO and IHE Delft, Water accounting in the Awash River Basin, 2020
[78] Measuring, understanding and building the resilience of vulnerable population in the Horn of Africa. Resilience Analysis Unit. Brochure
[79] Joint Programming Document for the Resilience Analysis Unit. 2015. IGAD.
[80] Working with the Intergovernmental Authority on Development (IGAD) to increase drought resilience in the Horn of Africa. (2016-2020). GIZ.

Djibouti as a response to the damages caused by the 2008-2011 drought, and RLACC II is part of the Somalia National Adaptation Programme of Action to build resilience to climate variability. Aim to strengthen agro-pastoral communities through integrated watershed management.[81]

Groundwater-specific

Horn of Africa Groundwater Initiative [WB (CIWA), IGAD] (2019-2021): US$2.7mill. Aims to maximize the benefits of groundwater to strengthen resilience to drought by improving access to groundwater data, building institutional capacity, and conducting feasibility studies on economically exploitable groundwater resources in three transboundary aquifers (prioritized by IGAD member states). **Outcome**: Project prepared and approved in 2019 and implementation is underway. Mt. Elgon (Kenya/Uganda), Merti (Kenya/Somalia), and Bagara Aquifers (South Sudan / Sudan) chosen for feasibility studies.[82] So far, focus has been on the Merti aquifer.

IGRAC [UNESCO-IHP, WMO] (2003-present): International Groundwater Resources Assessment Centre is a UN organization that promotes international sharing of information and knowledge required for sustainable groundwater resources development. Institution that contains knowledge that is highly relevant to IGAD member states' goal to develop groundwater resources to strengthen resilience to drought. **Outcome**: A number of portals and tools, including the TWAP portal and the SADC portal for southern Africa (see Section 8.3), as well as projects in the Horn.

- **MAR** [IGRAC] (2014): managed aquifer recharge project in Merti aquifer (Kenya/Somalia). **Outcome**: deepwater injection wells are the best solution for the aquifer. Also included training for local experts in management application.
- **ISARM** [UNESCO-IHP, UNECE, IGRAC] (2002-present): Internationally Shared Aquifer Resources Management, organization founded to oversee initiatives in transboundary aquifer management. **Outcome**: Hosts GGIS and related online tools. TBA atlas. Most work carried out with close cooperation from IGRAC. ISARM Africa appears to not be very active in the past decade.

5.3 Floods

Extreme weather patterns in the Horn region are not limited to lack of water; the area suffers from extreme flooding events as well. Floods occur along all major waterways (Figure 6, left), especially in low-lying drainage areas as extremely dry periods are followed by intense rainfall. Between 1990 and 2016, each country in the Horn experienced an average of 13 floods – about one every other year.[83]

Floods are a natural part of the yearly pattern of heavy rain, and local peoples practice flood recession agriculture.[84] However, intense floods cause economic loss, displacement and loss of life. In the 2020 March-April-May season, hundreds have lost their lives and hundreds of thousands have been displaced in Kenya alone due to flooding events.[85] Somalia has also recorded an increase in severe floods causing

[81] AfDB, RLACC I project inception documentation, 2016
[82] WB Project Information Document, 2019; CIWA, Annex B – Regional Engagements and Projects Annual Report, 2019
[83] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[84] DAFNE project deliverable, Key Ecosystems, 2020
[85] CropMonitor special report, 2020

casualties.[86] In South Sudan, both a large area and high proportion of the population is impacted (Figure 6, right). Due to climate change, precipitation events and therefore flooding events are becoming more intense and more erratic. As is discussed further in Section 6.1, the effects from flooding will likely only intensify.

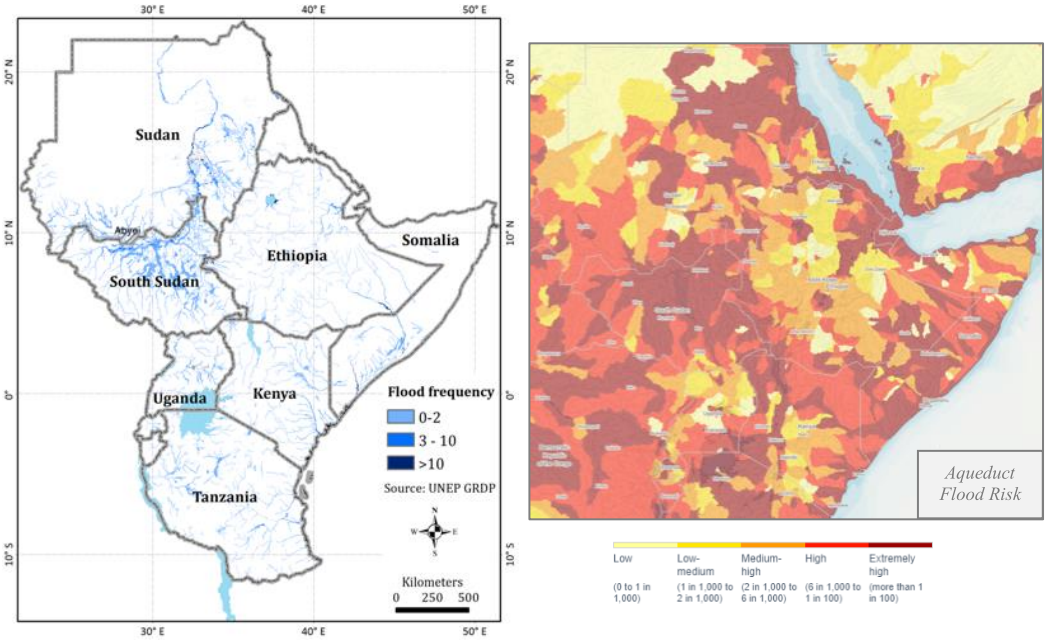


Figure 6 – Left: Riverine flood risk locations and frequency (number of events between 1999-2007) for the greater Horn of Africa.[87] Right: average proportion of population expected to be affected by riverine flooding, accounting for existing flood-protection standards, as assessed by river overflow and population in flooded zone.[88]

Regional scale precipitation and climate forecasts are produced by ICPAC[89], however the most updated flooding map available in a regional data portal appears to be from 2012[90]. The WFP and ICPAC have published recent historical flooding trends[91] (Figure 6, left), and UNDRR is preparing probabilistic flood mapping for the region, but this is not yet available.[92] The Aqueduct Flood Risk analysis (global scope) gives a picture of risk that includes both likelihood of flooding and populations impacted[93] (Figure 6, right). Currently flood warning at the regional scale, for example from ICPAC, seem to be interpreted from extreme rainfall event forecasts. In Somalia, disaster prevention initiatives seek to also predict flooding based on areas with riverbank breakages, for example openings made by local farmers for irrigation during the dry season.[94]

Selected organizations engaged in flood warning and preparation:

ICPAC DRM [IGAD] (2004-present): The IGAD Disaster Risk Management Programme is aimed at reducing risk from disaster in the IGAD region. It is specifically geared

[86] SWALIM and FAO, Flood Monitoring
[87] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[88] Aqueduct Alliance, Aqueduct Water Risk Atlas, 2019
[89] ICPAC, Climate Services
[90] IGAD SEC, IGAD Spatial Web Portal, 2012. This is the latest available on the Spatial Web Portal, giving an indication on frequency of updates.
[91] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[92] Personal communication, ICPAC, August 2020
[93] Aqueduct Alliance, Aqueduct Water Risk Atlas, 2019
[94] SWALIM and FAO, Flood Monitoring

toward climate change adaptation and flood risk management, with a special focus on early warning systems. **Outcome**: DRM frameworks have been produced and a mapping document for flood, drought, and locust risks, among others, was published in 2013. A portal or publicly available early warning system do not appear to be outputs of the programme. ICPAC has also participated in the ForPAc project, in an effort to move from monitoring based flood warning to forecast based flood warning systems.

FPEW [ENTRO, NBI] (unknown-ongoing): Flood Preparedness and Early Warning in the eastern Nile basin; goal is to reduce human suffering caused by flooding while preserving the environmental benefits of flooding. **Outcome**: As of 2016, Phase 1 complete: Established a regional flood coordination unit in Sudan, Ethiopia, and Egypt; flood forecasting and communication system (strengthened flood forecasting centres in Egypt and Sudan, and created one in Ethiopia); and launched a database management system for flood management operations. Since 2018, flood forecast bulletins have been produced for three areas in the Nile basin, and four flood warning platforms are currently operational.

5.4 Freshwater ecosystems and water quality

Resilience to environmental shocks, including floods, droughts, and locusts, is high priority in the Horn, and water is an important element for ecosystems to bolster resilience to disasters. Healthy freshwater ecosystems provide clean water for crop irrigation, livestock, and fishery habitats; and watersheds with less erosion provide soil with more nutrients for crops.[95] Land productivity, of which these freshwater ecosystem services are a crucial element, is a key component of resilience and food security for the Horn.[96]

Much of the land in the hyper-arid areas in Sudan and Somalia and also the agricultural areas in Ethiopia experience Moderate to Very High levels of land degradation (Figure 7, left). Land degradation is defined as the decrease in land productivity due to soil erosion, nutrient depletion, deforestation, over-exploitation of crop and rangelands, human impact on water resources, and rapid population growth.[97] Moreover, the IPCC has found robust evidence of desertification in sub-Saharan Africa, which is likely due to climate change.[98] Drought contributes to ASAL land degradation by affecting vegetation growth and from pastoralists concentrating livestock in remaining viable rangelands. Impacts from drought and consequent land degradation are acute in water-scarce, ASAL areas, where 75% of all labourers are dependent upon smallholder, rain-red agriculture.[99]

The Hunger and Climate Vulnerability Index (HCVI) (Figure 7, right) is the relationship between the degree of climate stress on populations (exposure), the degree of responsiveness to stress (sensitivity) and the ability of populations to adjust to the climatic changes (adaptive capacity), as defined by the IPCC.[100] Large portions of the Horn are vulnerable to a Medium to Very High degree and addressing the capacity of ecosystems to withstand environmental shocks can reduce vulnerability for ASAL populations.

[95] DAFNE project deliverable, Key Ecosystems, 2020
[96] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[97] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[98] IPCC, Climate Change 2014: Chapter 22 Africa, 2014
[99] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[100] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018

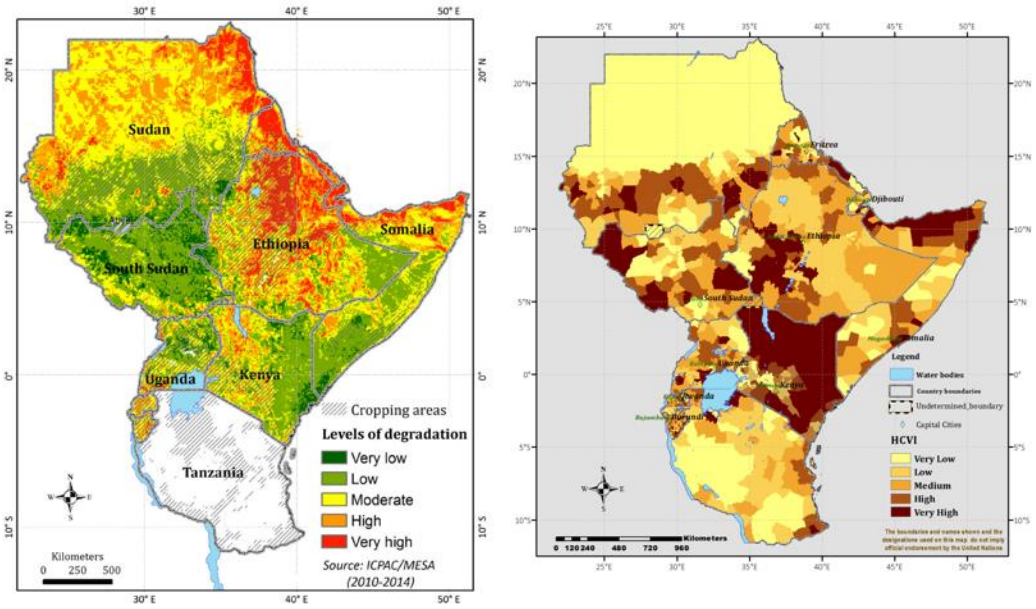


Figure 7 – Left: Land degradation in the greater Greater Horn of Africa region (includes Burundi, Rwanda, and Tanzania). Right: Hunger and Climate Vulnerability Index (HCVI) in the Greater Horn of Africa Region[101]

Many resilience projects and programmes incorporate ecosystem and water resources management into their initiatives. The Great Green Wall initiative seeks to reverse land degradation in the Sahel from Senegal to Djibouti and has so far restored 15 million hectares of degraded land in Ethiopia.[102] IDDRSI[103] and ICPALD[104] both use this comprehensive approach and include water resources in their resilience initiatives.

Despite the importance of ecosystem services for resilience, little water quality data could be found for the transboundary basins and aquifers in the Horn region. The focus in the arid Horn region appears to be on water quantity rather than quality, which can inhibit water resources projects in the region.[105]

The TWAP river basins and groundwater portals do display what little water quality and ecosystem indicators are available at the regional level – for example, only the Sudd aquifer in South Sudan has reporting on ecosystem dependence on groundwater.[106] The TWAP rivers portal At the basin level, the DAFNE project has undertaken an extensive ecosystem services investigation in the Omo-Turkana basin and proposed ecosystem management pathways.[107] As countries seek to meet SDG target 6.3 on ambient water quality and 6.6 on ecosystems, it is hoped that more information on water quality and the health and extent of freshwater ecosystems will be available in the Horn.

Selected organizations and projects addressing freshwater ecosystem health in the Horn:

SECCCI [EU, IGAD, UNDP, UNEP] (2018-2021): The Support for Effective Cooperation and Coordination of the Cross-border Initiatives in Southwest Ethiopia-Northwest

[101] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[102] Great Green Wall Results
[103] IDDRSI Priority Intervention Areas
[104] ICPALD, Karamoja Cluster Resilience
[105] Personal communication, DHI, October 2020
[106] TWAP 2016, based on 2010 data
[107] DAFNE project deliverable, Key Ecosystems, 2020

Kenya, Marsabit-Borana and Dawa, and Kenya-Somalia-Ethiopia project aims to improve understanding of water resources and ecosystems, in particular in the Omo-Turkana and Jubba-Shabelle basins. See Section 3.1.2 for more detailed information about the project.

DAFNE [ETHZ, IWMI, plus 12 others] (2016-2021): A research project to develop a decision-analytic framework to support assessment of social, economic, and environmental impacts from expanding energy and food production, with one of the focus areas being the Omo river basin. This directly relates to water resource management in the Horn region. **Outcome**: A number of scientific publications, policy briefs, and reports. Deliverables include: key ecosystems and ecosystem services; water governance, economic development, and demographic/cultural development models; decision framework architecture; and dissemination plans; among others.

NELSAP [NBI, AfDB, AWF, NBTF, CIWA, CIDA, NORAD, SIDA, Netherlands, JBIC, GIZ, KfW] (1999-present): the Nile Equatorial Lakes Subsidiary Action Program facilitates projects in the IGAD member states that are riparian to the Nile. **Outcome**: a number of projects, including fisheries and basin management projects, including an 8-year project to develop management frameworks for subbasins within the Nile, e.g. the Lake Victoria Basin Commission. Fisheries and lake focused projects focus on aquatic ecosystem conservation and supporting biodiversity.

ENWMP [ENTRO, NBI] (unknown-ongoing): Eastern Nile Watershed Management Project aims to address issues of watershed sedimentation, soil erosion, and exploitation. **Outcome**: Cooperative Regional Assessment completed and long-term plan determined. Projects in the following basins have been implemented: Upper Rib, Upper Gumera, Jemma (Ethiopia) and Dinder, Ingasena, Lower Atbara (Sudan).

Biodiversity conservation and utilisation of ecosystem services in wetlands of transboundary significance in the Nile Basin [GIZ, NBI] (2015-2021): transboundary wetlands project has strengthened capabilities for sustainable management of transboundary wetlands in the Nile Basin with an emphasis on biodiversity and ecosystem services. **Outcome**: Analysis for required minimum discharge to support ecosystems, case studies in four wetlands for The Economics of Ecosystems and Biodiversity reports, NBI study on greenhouse gas storage with political recommendations.

Nile Transboundary Environmental Action Project, Tranche 1 [GEF, WB, NBI] (2003-2011): Project of USD 17 million with a focus on environmental education and awareness, wetlands and biodiversity conversation, and water quality monitoring. This included such specific issues as aquatic invasive species, ecosystems services from transboundary aquifers, and transboundary habitat for key species. **Outcome**: From Tranche 1, outcomes are improved capacity of communities to manage land, forest, and water resources; completed soil erosion studies; conducted public awareness and education activities; and established a wetlands network and education programs. It was decided that data management and DSS systems development should be left to water resources management projects in the NBI, and this project focused rather on capacity building and public outreach.

5.5 Summary and recommendations

The Horn of Africa is significantly impacted by both droughts and floods. More than 60% of the Horn region is arid or semi-arid and faces extreme water availability issues. Rainfall onset and precipitation forecasts can be instrumental in mitigating risk from drought. Use of groundwater and subsurface or sand dams can alleviate acute and chronic water stress. Data regarding groundwater availability and water use are lacking.

Many transboundary aquifers in the region are not well delineated and recharge or abstraction statistics could not be found. In some aquifers, statistics are known, but there are cases where abstraction greatly exceeds recharge.

Flooding is a natural part of the yearly ecosystem pattern in the Horn region, but extreme and erratic events cause damage, especially affecting the 80% of the population employed by agriculture. Flood prediction strategies seem to be direct interpretations from measurement stations or inferred from rainfall forecasts, rather than based on hydrological/hydraulic models, and available regional flood map data is nearly a decade old. Hundreds lose their lives and hundreds of thousands their homes to flooding each year.

Initiatives that encompass ecosystem and water quality in the Horn region are often relatively small parts of efforts to increase resilience to shock climate events. In arid environments, ecosystem degradation can occur rapidly and be difficult to reverse. Reducing or reversing ecosystem degradation has a positive impact on livestock health, food security, and peace in the region.

The following are recommendations to address the environmental issues and knowledge gaps present in cross-border water resources management to ensure sustainable use of water resources and prevention of conflict in the Horn region:

1. Gather and disseminate water, climate, and environment data to fill knowledge gaps: to discuss sustainable, cooperative management of water resources, the state of the resource must first be well-defined and well-understood by decision makers
   - Delineate and better define the characteristics of groundwater aquifers
   - Increase knowledge in governing institutions on sustainable management of groundwater aquifers
   - Gather information on water use as an element of management plan development, for instance by remote sensing
   - Develop a common source of regional environmental timeseries data that is user-friendly and interactive, to bridge the gap between raw data and dissemination of interpreted data
2. Produce and disseminate flood forecasts based on rainfall-runoff models and water use data
3. Ensure all stakeholders, including often marginalised stakeholders such as pastoralists or women farmers, are involved in development and infrastructure projects so that their needs are taken into account
4. Focus on transboundary water resources as one part of a resilience effort which includes ecosystem services and restoring degraded land
5. Focus on the similarities shared by countries in the region and how stakeholders have common aims and goals (resilience to shock events, preparation for demographic shifts, etc.), rather than on the differences that can divide them (rainfall patterns, water availability, etc.).

6 Climate and Socioeconomic Projections

Summary: Climate and socioeconomic trends will greatly impact transboundary water resources, and informed, effective management will be vital for the security of the people in the region. The Horn of Africa is primarily arid and is projected to become more arid due to climate change. Approximately 50% of the population lives below the poverty line and the region has one of the highest population growth rates in the world.[108]

Accounting for future climate and socioeconomic changes is essential during development and implementation of transboundary water management strategy.

6.1 Climate projections

Summary: Increased frequency of floods and droughts exacerbates the risk to already vulnerable populations. Much of the Horn of Africa already faces erratic rainfall, and this is projected to become more erratic.

Climate change is impacting the Horn of Africa now. Hotspots for drought include the northern Horn region (Figure 8, left). In particular, Sudan, Eritrea, and northern Ethiopia are experiencing acute episodes of decreased rainfall. Portions of Sudan and western Ethiopia are experiencing environmental degradation as a result of continuing agriculture with increased temperatures and decreased rainfall, and this results in higher levels of climate stress in these areas.[109] Areas of increased drought (Figure 8, left), decreased rainfall (Figure 8, right) correspond to areas of increased land degradation (Figure 7, left) (see Section 5.2 for further information on land degradation). Decreases in rainfall are observed in central Ethiopia, Kenya, and Southern Somalia, some areas which are less highly impacted by drought (Figure 8, right), indicating both acute and chronic water scarcity issues are important across the region.

More intense, erratic rainfall events increase the incidence of flooding in other hotspot areas, particularly South Sudan (Figure 8, left). Flooding can be beneficial to agriculture and fisheries, as it can replenish the soil with nutrients, but can also cause damage and loss of life.[110,111] Working on a local scale within the greater transboundary context can help to meet the needs of the local peoples.[112]

[108] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[109] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[110] Stevensen, article in *Land*, Plantation Development in the Turkana Basin: The Making of a New Desert?, 2018
[111] Oakland Institute, How they tricked us: Living with the Gibe III dam and sugarcane plantations in southwest Ethiopia, 2019
[112] Personal communication, UNECE, September 2020

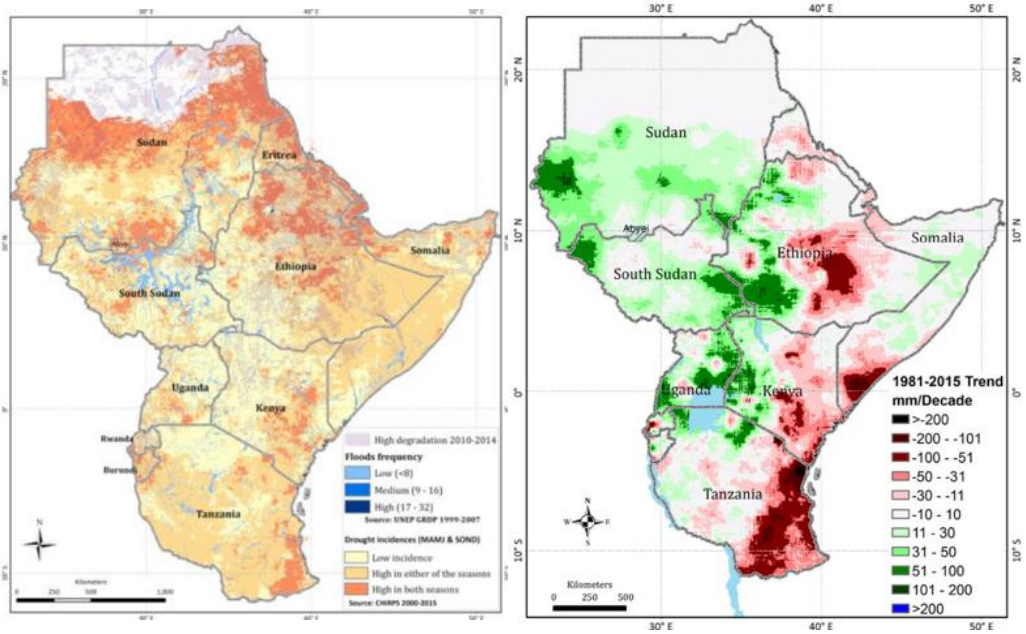


Figure 8 – How climate impacts the Greater Horn of Africa currently. Left: hotspot areas of high frequency of floods or droughts. Right: Precipitation changes in the period from 1981-2015 for the Greater Horn of Africa, hotspots of increased precipitation identified in green, decreased precipitation in red.. [113]

Model simulations also show changes in rainfall throughout the year, with the biggest changes occurring in December, January, and February, but not all studies agree on how these changes manifest. One model projected that during these months, rainfall would increase in Ethiopian and parts of Somalia by more than 30%, but also decrease in the northern portion of the Horn by more than 30% (note that these figures are coarse, derived from continental scale simulation results).[114] Another study, focused on the Horn, has predicted substantially decreased annual rainfall in the central and northern Ethiopian.[115]

The IPCC notes that droughts have become more frequent in East Africa in the last 30 years and that this trend is likely to continue, while also projecting increased occurrence of extreme wet events by the mid-21st century.[116] Rainfall during the long wet season is predicted to decrease in duration, with later onset and earlier cessation, even while absolute rainfall is predicted to increase.[117]

[113] ICPAC and WFP, IGAD Climate Risk and Food Security Atlas, 2018
[114] CIWA, Climate Resilience in Africa, 2017
[115] Osima et al., Projected climate over the Greater Horn of Africa under 1.5C and 2C global warming, Environmental Research Letters, 2018
[116] IPCC, Climate Change 2014: Chapter 22 Africa, 2014
[117] HyCRISTAL, University of Leeds, Scientific Understanding of East African climate change from the HyCRISTAL project , 2018

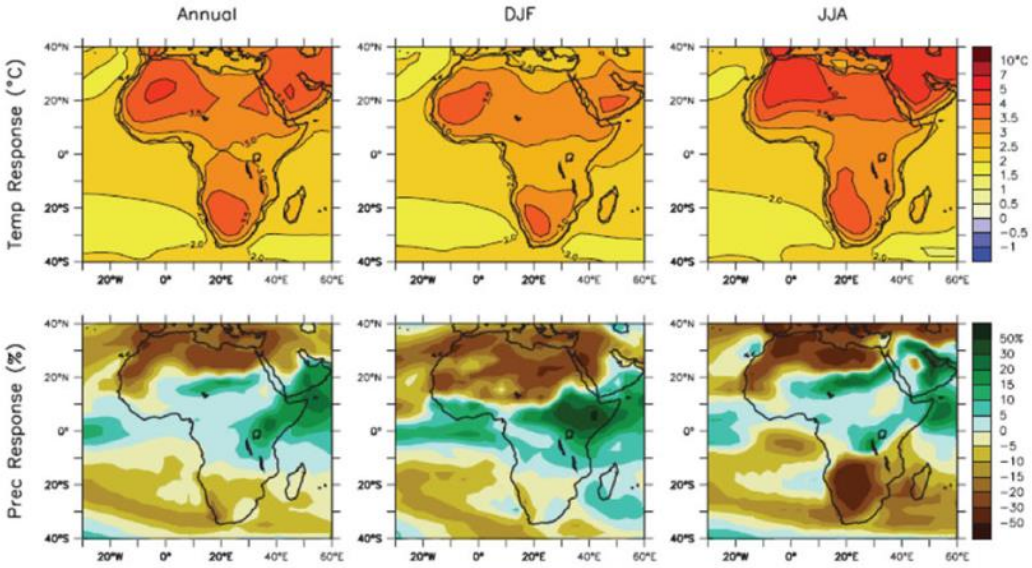


Figure 9 – Changes from 1980-1999 and 2080-2099 for temperature (top row) and precipitation (bottom row) predicted by 21 climate models. The "Annual" column shows yearly average changes, "DJF" for December, January, and February, and "JJA" for June, July, and August.[118]

Selected climate studies and organizations that have contributed to climate analysis in the region:

ICPAC [IGAD]: The IGAD Climate Predictions and Applications Centre provides early warning information and assistance to users of climate information. ICPAC provides weekly, monthly, and seasonal climate forecasts that include rainfall, temperature, and onset/duration of dry periods for the Horn region as a whole. This data is distributed to the governmental ministries of the ICPAC member states and to regional institutions via monthly focal point meetings, where it is intended for use in decision making. Challenges for ICPAC are that they rely heavily on remote sensing and global datasets for model inputs, and member states need to downscale the regional models to apply them in their areas.[119]

HyCRISTAL [ICPAC, Future Climate for Africa, UK Met Office, University of Leeds, organisations in Kenya, Uganda, and Tanzania; funded by UKAID and NERC] (2015-2021): project for approx. USD 420k, Integrating Hydro-Climate Science into Policy Decisions for Climate-Resilient Infrastructure and Livelihoods in East Africa (HyCRISTAL). **Outcome:** Though not yet complete, the project has led to significant increase in scientific knowledge on projected climate impacts in East Africa. Some pilot projects have facilitated collaboration between policymakers and inter-disciplinary research to quantify risks and provide the necessary tools to use climate change information for decision making on a 5-40 year timescale. While the focus of these has not been on transboundary issues, experiences from these processes can be built upon, with ICPAC potential the first entry point.

Greater Horn of Africa Climate Risk and Food Security Atlas [ICPAC, WFP] (2018): The analysis includes all IGAD countries, as well as Tanzania, Rwanda, and Burundi. The atlas documents areas in the Horn that are vulnerable to climate change, accounting for both climate and socioeconomic projections. **Outcome:** The report

[118] CIWA, Climate Resilience in Africa, 2017
[119] Personal communication, ICPAC, September 2020

concludes that government policies, development plans, and farming systems (irrigation and crop selection) need to adapt and be reformed to mitigate the coming changes. The report recommends using the atlas to target reformation to hotspot areas, which are particularly vulnerable to degradation.

CIWA [WB]: The CIWA program was created in 2011 to address constraints to cooperative management and development in transboundary water. The organization directly support riparian governments in Sub-Saharan Africa, including the Horn, to assist in the sustainable, inclusive, climate-resilient growth. **Outcome:** Many recommendations and projections are included in the report Climate Resilience in Africa: The Role of Cooperation around Transboundary Waters (2017), including investment in information management, cooperative monitoring, regional multi-sectoral organizations. It also recommends to be deliberate in operationalizing transboundary management, focusing on tying initiatives and institution strengthening to poverty reduction and economic development projects.

RICCAR [ESCWA, SMHI] (2016): The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region completed extensive climate modelling on the Arab region, capturing all headwaters of rivers in that region. This encompasses the whole of the Horn. **Outcome**: Temperature and precipitation will change during the next century in all locations in the Horn in both conservative and extreme climate scenarios. Some areas will become wetter while others will become drier. Note that data from this report is useful for the Horn, but interpretation focuses on the MENA region, which does not include any Horn members excepting Somalia and Sudan on occasion.

WFP: The world food program (UN) has food security analyses that incorporate climate and seasonal analyses. Food security is an integral part of overall security and well-being for the Horn region, however these analyses are less directly applicable to transboundary water management than the more general climate analyses conducted by ICPAC.

Eastern Nile Climate Analysis Tool [ENTRO, with WB funding]: Still online, but appears to be out of date and no longer operational.

6.2 Socioeconomic projections

Summary: The population of the Horn is predominantly young and is growing rapidly. This places pressure on the region, which is exacerbated by the negative effects of climate change to agricultural employment. Internal migration is expected to be significant in the Horn by 2050.

At 3%, the population growth rate in the Horn of Africa is among the highest in the world.[120] Figure 10 (right) shows that individual country growth in the Horn is much higher than the world average. The population is projected to double every 23 years, and by 2050, the Horn region is expected to have a population of more than 500 million. This rapid growth rate is accompanied by an expanding youth demographic – 50% of the population of Horn is categorized as youth.[121] The youth bulge and rapid growth places pressure on the region to provide adequate jobs, food, and water for the growing population, to prevent risk of radicalization inherent with a large, unemployed,

[120] WB Press Release, 2020.
[121] IGAD https://igad.int/about-us/the-igad-region

marginalized youth demographic (this links to Pillar 1 (regional peace and security) of the UN Regional Prevention Strategy).[122,123]

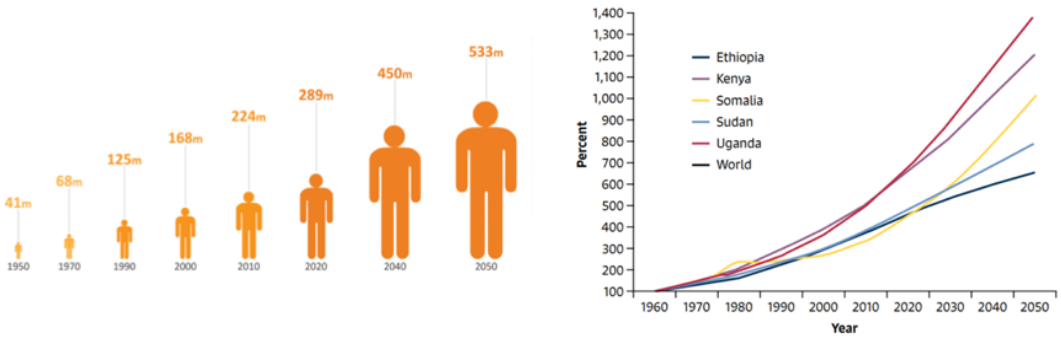


Figure 10 – Projected population growth in the Horn of Africa, total (left)[124] by millions of people and (right) by country [125]. Percent on the y-axis depicts population as a percentage of the population in 1960 and projected until 2060.

Migration is a way of life for nomadic pastoralists within the Horn region, however migration patterns are changing. Irregular migration can be due to numerous factors, including conflict and impoverishment.[126] Millions are expected to migrate within the Horn region due to the impacts of climate change and environmental degradation. Figure 11 depicts the predicted migration patterns for 2030 and 2050 for East Africa, including Djibouti, Kenya, Eritrea, Ethiopia, and Somalia in the Horn. It is expected that people will move from dry areas, that will become drier, such as the areas around Addis Ababa, to wet areas, such as the eastern highlands in Ethiopia. Ethiopia is expected to increase in population by 60-85% by 2050, partly due to climate in-migration and partly due to the youth bulge. Lake Victoria will also become an in-migration hotspot.[127] (Figure 11)

[122] WB, UNHCR, Forced Displacement and Mixed Migration in the Horn of Africa, 2015
[123] International Youth Foundation and USAID, YouthMap Uganda: Navigating Challenges. Charting Hope – A Cross-Sector Situational Analysis on Youth in Uganda, 2011
[124] IGAD presentation, 2015
[125] WB, Borderlands Horn of Africa Report, 2020
[126] https://www.homeaffairs.gov.au/research-and-stats/files/horn-of-africa.pdf
[127] WB, Groundswell report, 2018

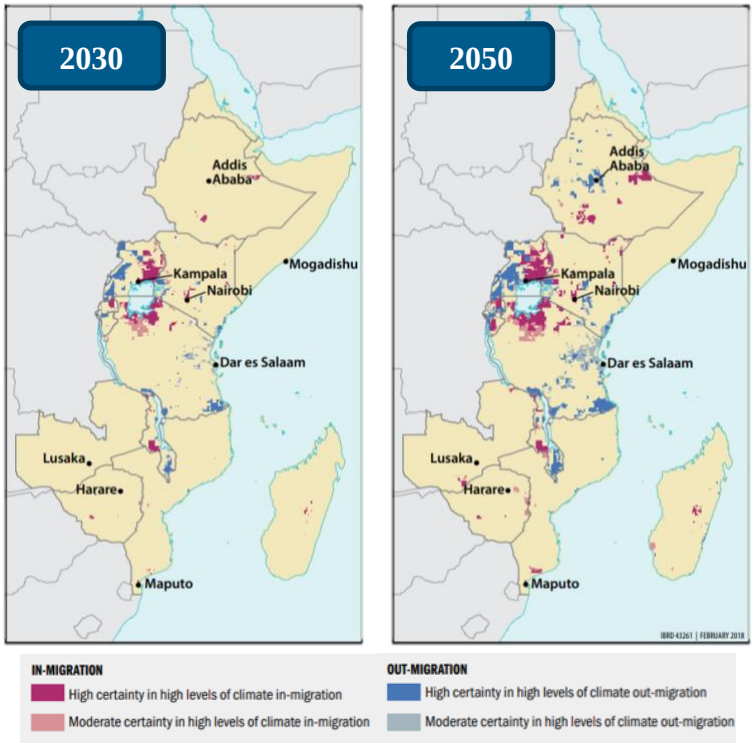


Figure 11 – Migration projections due to climate change for parts of the Horn of Africa region for 2030 (left) and 2050 (right).[128]

Natural resource intensive agricultural and industrial developments, and even agro-industrial parks,[129] create competition for water between users. Dams are constructed and water is used for large-scale irrigation and for oil extraction.[130] Hydraulic patterns are changed and limited resources are left for pastoralists and smallholder agriculture, which can cause conflict, especially during the dry season, and can spur migration.[131,132,133]

Selected projects and organizations that have contributed to socioeconomic analysis in the region:

Groundswell: Preparing for Internal Climate Migration [WB, CIESIN] (2018): Sub-Saharan Africa, South Asia and Latin America, but with a case study on Ethiopia, and focus on East Africa available (does not include Sudan and South Sudan). Projections for 2030 and 2050. Includes factors such as water availability, crop productivity (and rising sea level and storm surges). **Outcome:** Project that climate related migration will increase until 2050, when it will begin to increase dramatically. Sub-Saharan Africa will face 86 million climate migrants, of which many will be in the Horn region. Predicts hotspots of movement, based directly on climate change hotspots.

[128] WB, Groundswell report, 2018
[129] AfDB, Environmental and Social Impact Assessment Report, Proposed Yirga Alem and Dila staple crops processing zone (Ethiopia), 2020
[130] For example, in the Lake Turkana region in Kenya. ECDPM, article, 2018
[131] Lesrima, PhD Thesis, 2019
[132] Oakland Institute, report, 2019
[133] Unruh, et. al, Linkages between large-scale infrastructure development and conflict dynamics in East Africa, Journal of Infrastructure Development, 2019

FAO: The FAO tracks socioeconomic and agricultural trends in order to assist in their mission of ending world hunger. The FAO has previously reported Projected water use in the Nile Basin (2011), but this appears to be a singular report, and was not completed for other basins or been repeated. The FAO additionally tracks Agricultural Prospects and Challenges for the next decade (2016) in Sub-Saharan Africa and produces an agricultural outlook for all regions in the globe.

WFP: The WFP produces socioeconomic projections for use in its analysis of critical hunger hotspots, and has partnered with ICPAC to produce the Greater Horn of Africa Climate Risk and Food Security Atlas (2018).

UN World Population Prospects (2019): Extensive and comprehensive demographic profiles and projections for world regions, including the East Africa, last completed in 2019. Includes interactive maps and charts.

African Development Bank Group: Tracks demographic trends and makes projections for the economic outlook of each African region. Produces an economic outlook document each year for each region. The current report for 2020 stresses that the shift from an agriculturally dominant to a service dominant economy remains, and that economic projections have not been met largely due to behavioural shifts caused by COVID-19.

6.3 Summary and recommendations

Water resources management strategies in the Horn must account for climate trends to meet socioeconomic needs. Population growth and national development goals will increase water demand, and environmental change will alter water availability. Mid-century and end-century projections show that rainfall in the wet months will increase by up to 30% in already wet areas, and decrease by up to 30% in dry months in already dry areas. Increased occurrence and intensity of extreme weather events due to climate change will also necessitate resilience strategies to shock events.

The population of the Horn is expected to more than double by 2050 and increase domestic demand on water resources. Urban areas are expected to become more densely populated as the growing youth demographic move to cities to find employment. The Ethiopian national government in particular seeks to create jobs and supply food for the growing population via focus on building industrial parks and large-scale irrigation for agriculture, which also increases water demand from these sectors. Socioeconomic and climate projections indicate that people will migrate within the Horn from areas heavily impacted by climate change to more environmentally favourable areas, such as from dry, central Ethiopia with failing crop yields, to the eastern Ethiopian highlands where conditions are projected to become more favourable. Patterns due to future conflict or political factors are not, or less widely, available.

Climate projections with reasonably certain results have been conducted for the African continent and for larger basins in the Horn – namely the Nile and Jubba-Shabelle basins[134]. However, the smaller basins are no less important to the people who depend on them, and more knowledge about patterns in these basins would increase the efficacy of transboundary water cooperation efforts.

[134] CIWA, Climate Resilience in Africa, 2017

The following are recommendations to regional and national institutions to incorporate climate and socioeconomic projections into their water resources management strategies:

1. A regional, coordinated strategy is important when designing a water resources management strategy –pastoralism is fundamental to Horn, but climate change will spur cross-border movement in new patterns
2. Invest in water resources management as an element of WASH, to complement national focus on sanitation in growing urban areas – increasing water supply and sanitation infrastructure is only useful if there is water to run through the pipes[135]
3. Invest in water resources management infrastructure, e.g. hydropower, and its sustainable management as an element of meeting increased energy demands.
4. Conserve existing freshwater ecosystems and the services they provide – these systems are difficult to restore once degraded, and freshwater ecosystem services are a key element in increased resilience to climate change. To do this, it is important to map and understand different types of ecosystems, the services they provide, and the threats to them, now and in the future.[136]
5. A harmonized strategy of groundwater and small-scale dams could be useful for extremely arid areas that will become more arid
6. Flood early warning systems would mitigate effects from increased incidences of flooding. ICPAC is a participant in a project to create flood early warning systems based on modelling and forecasts, and these efforts could be strengthened.
7. Conduct water-use projections for the sub-region, and investigate the feasibility of doing this by transboundary basin and aquifer.[137]
8. Conduct long-term climate projections for the region that are more certain than those already produced. This would include smaller basins (projections have been simulated for the Nile and Jubba-Shabelle) and increase the efficacy of transboundary cooperation efforts at the regional level by having a shared, foundational data source. Partnering with ICPAC would be ideal for this endeavour, as ICPAC already uses long term forecasting from other WMO centres to support the IGAD member states in climate adaptation, but there is some uncertainty over the accuracy of these forecasts for the East African region.[138]
9. Address limitations to modelling and using projection results:
   - Currently, reluctance to share data curtails the ability of regional level modelling organizations such as ICPAC to downscale. One way forward is to build trust between member states and actualize data-sharing intentions between basin-sharing nations and between member states and regional institutions. Another is to continue to rely on global, openly available datasets, such as those obtained through remote sensing.
   - Modelling and decision making regarding these sub-basins currently fall in the realm of each member state, however, member states may be limited by resource capacity and rigidity. Another way forward would be to empower local ministry staff – make them aware of the wide array of tools available, train them on their use, and empower them to use these skills.[139]

[135] Personal communication, EU Delegation to Ethiopia, November 2020
[136] Has been conducted in the SECCCI project, Personal communication, DHI, October-December 2020
[137] Has been conducted in the SECCCI project, Personal communication, DHI, October-December 2020
[138] Personal communication, ICPAC, August 2020
[139] Some recommendations take into account personal communications, ICPAC, August-September 2020.

7 Large-scale infrastructure

It is widely recognised that large-scale water infrastructure with transboundary impacts can be a potential source of tension between countries – particularly in the absence of adequate institutional capacity. With growing populations, increasing water demands, and added stresses from climate change (Section 6), governments are likely to look to large-scale infrastructure as one of the options for securing water supply and electricity (hydropower).

The amount of large-scale infrastructure in the Horn is predicted to increase; as most hydropower potential is in transboundary basins this is a critical issue for potential hydro-political tension in the region.

Large-scale infrastructure in this section primarily refers to dams, significant pipelines, large-scale irrigation schemes, and significant groundwater extraction infrastructure.

7.1 Institutional landscape

Summary: There are some regional and Africa-wide investment programmes that work on transboundary infrastructure projects and attempt to maximize cross-border benefits and ensure agreement between countries (e.g. AfDB's NEPAD and PIDA, and the NBI's ENTRO and NELSAP investment programmes). Lessons should be taken from these successes. However, given the general lack of institutional arrangements for transboundary dialogue outlined in Section 3, the risk of tension due to infrastructure construction and operation remains high.

Regional oversight and coordination

There is no dedicated institutional arrangement for regional oversight and coordination of large-scale infrastructure with transboundary impacts. Similarly, there does not appear to be any regional policy, strategy or plan for the coordinated development of hydropower. Furthermore, there is no publicly accessible database of the region's large-scale water infrastructure. However, there are some arrangements and data in the Nile basin, some Africa-wide programmes, and some donor / investment bank knowledge of the situation (see below). **Recommendation:** it is recommended that a database be developed of existing and planned water infrastructure projects in the region. This could be housed within IGAD, and/or within a proposed digital platform (see Section 0.3).

Basin or aquifer-wide coordination of infrastructure development

The only transboundary basins or aquifers which appear to have an institutional arrangement to manage large-scale infrastructure is the Nile basin. The **Nile Basin Initiative (NBI) (1999)** has two sub-regional investment programs, ENTRO and NELSAP, which cover both infrastructure and 'softer' management, dialogue and capacity building initiatives. NELSAP appears more active than ENTRO.

- **ENTRO** (est. 1999): The Eastern Nile Technical Regional Office (ENTRO) is the technical arm of the Eastern Nile Subsidiary Action Program (ENSAP) – comprising Egypt, Ethiopia and Sudan. The intention was for ENTRO to support the Eastern Nile Council of Ministers (ENCOM) and Eastern Nile Subsidiary Action Program Team (ENSAPT) in preparing cooperative water resources investment programs and projects, capacitating and strengthening institutions and providing secretariat support to its governance. However, it appears Egypt and Sudan have disengaged somewhat from the arrangements, with ENTRO focussing on 'softer' initiatives such as hydro-diplomacy capacity building (Sudan, GIZ, 2019), Eastern Nile Irrigation System dialogue, and scenario development for coordinated operation of the cascade of dams in the Eastern

Nile (Ethiopia, South Sudan, Sudan, 2019, GIZ)[140]. One of the significant successes of ENTRO was the Ethiopia-Sudan Transmission Interconnection Project (2013, USD 56 mill (Egypt and Sudan self-funded)), which allows Ethiopia to sell surplus hydropower to Sudan.

- **NELSAP** (1999): The Nile Equatorial Lakes Subsidiary Action Program Coordination Unit (NELSAP-CU) (headquartered in Kigali, Rwanda), is governed by and reports to the Council of Water Ministers from 10 Nile Basin member states (Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania and Uganda). NELSAP-CU renders support to national initiatives and focuses on two investment areas of: (i) power development and trade; and (ii) natural resources management and development. NELSAP-CU has mobilised finances totalling USD 1.050 billion. NELSAP works with multiple investment banks and donors. There are several completed and in-progress projects under both the water resources and power sub-programs, including: Nyimur/Limur Multipurpose Water Resources Project Studies (irrigation and hydropower, Uganda-South Sudan, 2014-17, Eur 2 mill, AWF); Angololo Water Resources Development Project (feasibility and design), through Sio Malaba Malakisi (SMM) River Basin Management project) (potable water supply, irrigation, hydropower, Kenya-Uganda, 2019-21, USD 1.65 mill., AfDB, NEPAD, country contributions).

Continental oversight and coordination

Most **African Union** projects are funded through the **African Development Bank**. The primary funding mechanism is the **NEPAD** Infrastructure Project Preparation Facility (NEPAD-IPPF) (est. 2005). Aims include "promoting infrastructure projects and programs aimed at enhancing regional integration and trade", and from 2017 has "made concerted efforts to mainstream climate change, gender, fragility and resilience and job creation in project preparation activities". Target beneficiaries include "…Power Pools, River Basin Organizations, corridor authorities and other intra-African infrastructure-related institutions…". NEPAD-IPPF has had sequential strategies/programmes:

- NEPAD Medium to Long Term Strategic Framework (MLTSF) (launched 2006).
- Programme for Infrastructure Development in Africa (**PIDA**) (2010-2030): Includes four investment programmes: (Energy, Transport, Information and Communication Technologies (ICT) and Transboundary Water Resources). Phase 1 2010-2020, Priority Action Plan Phase 2 (**PIDA-PAP2**) 2021-2030.

In 2010, there was a Terms of Reference for a study on "existing policies and strategies relevant for infrastructure development, physical infrastructure, and the regulatory and institutional frameworks to optimise the management of the resources, as well as the outlook for the future." Specific output of that analysis has not been identified during this study, but presumably it influenced **PIDA's Water vision**[141]: Promoting integrated water resource management to develop transboundary water infrastructure projects, strengthen transboundary management frameworks for regional integration and ensure water security for the socioeconomic development of Africa by: • Strengthening institutions for efficient cooperation on shared water resources • Developing transboundary water infrastructure to meet increasing water demands while protecting people and the environment • Strengthening finances for transboundary water development and management • Improving knowledge on transboundary water basins and shared aquifers.

Under PIDA Phase 2, it is recognised that "The PIDA sub-sector on Transboundary water infrastructure is one that demands attention, due to the lack of and or limited water projects submissions in PIDA-PAP-1. Therefore, an urgent need to intensify

[140] ENTRO 2019: Nile-Flow, quarterly ENTRO Newsletter, August 2019. Also Pers. Comm. Abdulkarim Seid, NBI.
[141] Programme for Infrastructure Development in Africa: Interconnecting, integrating and transforming a continent (likely 2012). PIDA's long-term strategic plan, 2012-2040.

efforts on the development of Transboundary water infrastructure is paramount, as well as addressing the adverse impacts of climate change for the transformation and socio-economic development to achieve regional integration in Africa." A webinar was held in May 2020 to take stock and promote project submissions within Transboundary water infrastructure during PIDA-PAP2. **Outcome:** Should transboundary water resources infrastructure projects be identified, PIDA would be a potential funding mechanism, including during a project planning phase.

Selected PIDA Projects include:

- Drought Resilience and Sustainable Livelihood Program in the Horn of Africa (Phase 1 and 2, 2012-ongoing). Included one project to "strengthen IGAD's capacity to fulfil the obligations of its regional mandate in leading and coordinating the implementation of the drought resilience initiative (~USD7.5mill), and national interventions in Djibouti, Ethiopia, Kenya, Sudan).
- Rural Livelihoods' Adaptation to Climate Change in the Horn of Africa (RLACC I and RLACC II, with Global Environment Facility (GEF)), (2016-ongoing, Djibouti, Somalia and Sudan).
- Transboundary Water Resources Sector study (2011), which should "cover an assessment of existing policies and strategies relevant for infrastructure development, physical infrastructure, and the regulatory and institutional frameworks to optimise the management of the resources, as well as the outlook for the future." Only ToR identified.

Infrastructure Consortium for Africa (ICA): encourages, supports and promotes increased investment in infrastructure in Africa, from both the public and private sectors. Focus areas: water (mostly WaSH), energy, transport, ICT (similar to PIDA focus areas). **Outcome:** Has overview of infrastructure spending across the continent (including East Africa as a sub-region), and financing sources.

Donor/Investor oversight and coordination:

European Investment Bank (EIB): in 2018 committed USD 3.74 billion in 20 African countries for infrastructure development in water, energy, and transport. Relatively little in the Horn of Africa. Investment in the region dates back to 1975, with East Africa regional representation established in Kenya in 2005. Selected projects: Gilgel Gibe II Hydropower Plant (Ethiopia (Lake Turkana basin), 2005, EUR 50 mill.); Bujagali Hydroelectric Project (Uganda (Nile basin), 2007, EUR 93 mill.).

EU-Africa Infrastructure Trust Fund (EU-AITF): 2007-2019, EUR 763 mill, Africa-wide. Same four sectors as PIDA: water, energy, transport, ICT. Apparently no significant projects related to transboundary water infrastructure.

KfW Development Bank (Germany - BMZ): investments in most countries in HoA, including in water quality, water security, efficient resource use, and access to WASH. No investments identified of particular relevance to transboundary water resources.

7.2 Completed infrastructure

Summary: There is no single publicly accessible repository of data on large-scale infrastructure in the region. Data is available at a basin level in most cases, though not easily accessible. FAO maintains a geo-referenced database on dams in Africa, which

is updated roughly every 5 years through country focal points (the last major update was 2013, and the next version is expected to be published in 2021).[142,143]

In the Nile, the location of completed dams is available through numerous sources, including the various NBI knowledge platforms and InfoNile (a cross-border group of geojournalists working to uncover critical stories in the Nile), with data sourced from FAO's Aquastat database (see Figure 12).

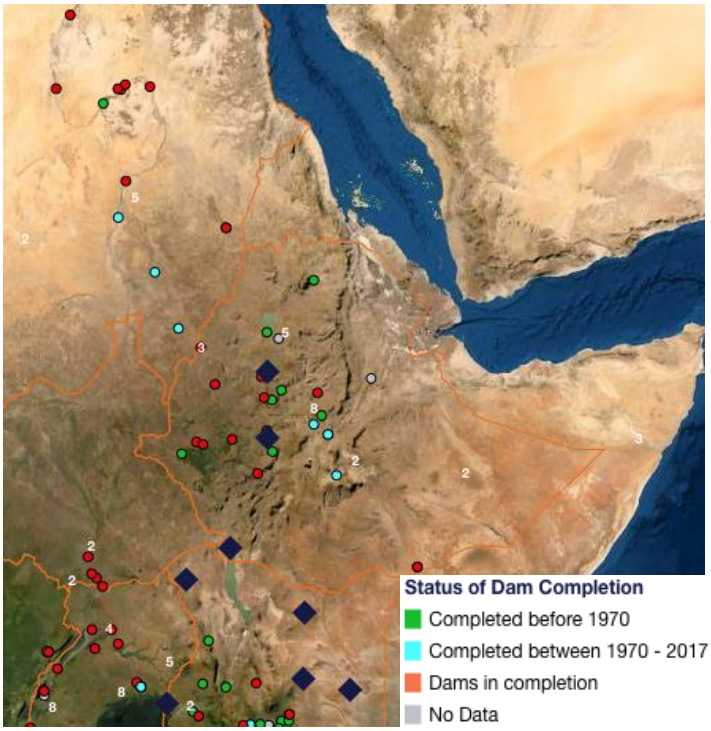


Figure 12 – Status of Dam Completion in the Horn of Africa, InfoNile, from Aquastat Database, FAO

The obvious and most significant potential source of hydro-political tension in the region is the Grand Ethiopian Renaissance Dam (GERD). The dam will be the largest in Africa and the 7th largest in the world, with a storage capacity of 74 km^3, and an installed hydropower capacity of roughly 6.3 GW. Construction began in 2011, and filling began in 2020, which may take 5-15 years, depending on rainfall and operation of the dam. Negotiations on the construction and operation of the dam have been ongoing, facilitated by the African Union. [144,145,146]

Basin level data on water abstraction and significant infrastructure can be found in ecosystem assessments, such as the one completed in the SECCCI project. In the Omo-Turkana basin, the government of Ethiopia has launched the Kuraz Sugar Development Project, which will cover 175,000 hectares and include associated large-scale infrastructure for abstraction from the Omo River. The assessment also identified four major hydropower schemes in the basin, with two further planned.[147] The area downstream from each of the dams has been identified as an ecosystem hotspot susceptible to ecosystem degradation.[148]

Significant, large-scale groundwater abstraction infrastructure was not identified during this mapping study. Current use of groundwater appears sporadic and non-coordinated, and it is primarily informal development and management of shallow aquifers by

[142] Aquastat Help Desk, personal communication, November 2020.
[143] Globally, various datasets exist, such as the Global Georeferenced Database of Dams (GOODD), though sustainability (frequency of updates) and accuracy of such global datasets, for operational work at basin and aquifer level, needs to be carefully considered.
[144] UN News, Water cooperation between States 'key' to Blue Nile dam project, 2020
[145] Institute of Electrical and Electronics Engineers, The Grand Ethiopian Renaissance Dam Gets Set to Open, 2016
[146] GERD Coordination Office, About the dam, 2020
[147] UNEP-DHI, SECCCI Project, Support to Sustainable Development in Lake Turkana and its River Basins, Ecosystem Services Assessment, 2020
[148] UNEP-DHI, SECCCI Project, Support to Sustainable Development in Lake Turkana and its River Basins, Hotspot Identification and ESS Baseline, 2020

smallholder farmers.[149,150] Shallow resources are vulnerable to seasonal variations; deeper groundwater aquifers are less susceptible, and therefore valuable for development. More information, such as the deep aquifers' vulnerability to climate change, what technological requirements are needed for infrastructure development, etc., is required for further development.[151]

7.3 Planned and under-construction infrastructure

Summary: Planned infrastructure activities are managed and executed at the national level, with no apparent regional overview, and few instances of joint planning could be found.

Most countries in the region have an interest in developing infrastructure, to support growing economies and growing populations, for multiple purposes, including water supply, irrigation, hydropower, and flood control. For example, in the Nile basin, hydropower capacity is projected to increase significantly by 2035 (Figure 13). With most of the potential dam sites located on transboundary rivers, it is imperative for regional stability that transboundary implications are understood at an early stage of the planning phases, and that impacted countries are involved in planning to maximise the benefits for all countries. Again, a region-specific overview of planned and under-construction infrastructure could not be identified during this study, with most information being held at national levels. However, there are some examples of joint planning (for example the SMM basin development between Kenya and Uganda).

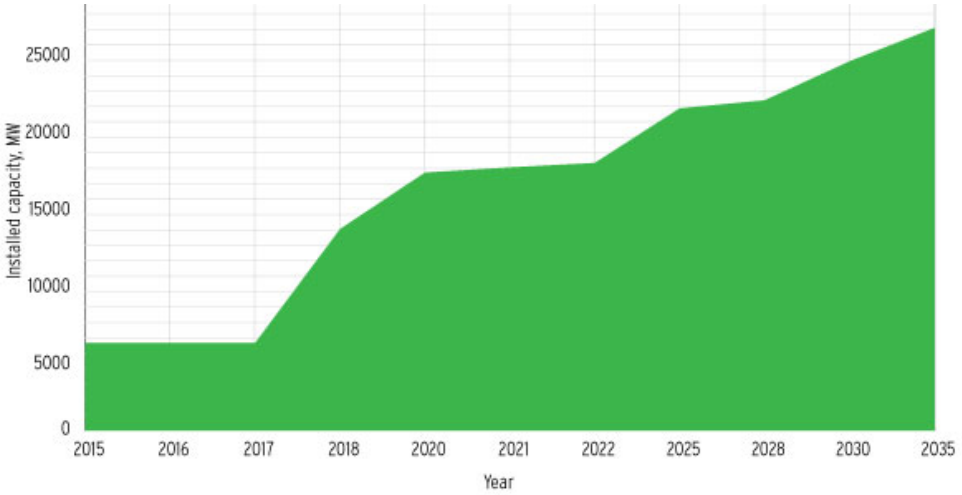


Figure 13 – Projected growth in total installed capacity of hydropower plants on the Nile (MW). Source: Nile Basin Water Resources Atlas (2016)

Some examples of planned infrastructure with transboundary impacts:

- **Sia-Malaba-Malakisi** (SMM), sub-basin of Nile (4 million people, which overlaps with the Mt. Elgon transboundary aquifer): Kenya/Uganda. Long-term process, with a 2018-19 project supporting a Benefit Opportunity Assessment Dialogue between Kenya and Uganda, resulting in four clusters of prioritised investment projects (roughly USD 200

[149] Personal communication, IWMI, October 2020
[150] WB, Assessment of Groundwater Challenges and Opportunities in Support of Sustainable Development in Sub-Saharan Africa, 2018
[151] WB, Assessment of Groundwater Challenges and Opportunities in Support of Sustainable Development in Sub-Saharan Africa, 2018

million), as well as a Basin Investment Framework. **Lessons:** long-term joint planning; each country involved; external facilitation and technical support.

- **Omo-Turkana Basin:** Two more dams planned (one commissioned, one planned) on the Omo river in Ethiopia, which flows into Lake Turkana (shared with Kenya). These will be in addition to the three existing dams in Ethiopia (Omo river) and one dam in Kenya (Turkwel river).[152] The existing and planned dams are understood to be controversial, with environmental and local socio-economic impacts cited, but the extent of dialogue and joint planning between Ethiopia and Kenya on existing and planned dams is unknown. The impacts of planned dams will be modelled as part of the SECCCI project.[153]

7.4 Summary and recommendations

The demand for large-scale water infrastructure in the region is projected to increase. This is due to various factors including: increasing hydropower generation to meet the growing demand for electricity; increasing water supply for agriculture, including irrigation; increasing domestic water supply and sanitation needs from a growing population; and increasing commercial and industrial demands. With most of the hydropower potential in the region located in transboundary basins, this is a critical issue for potential hydro-political tension in the region. Most of the remaining hydropower potential in the region lies in Ethiopia, Uganda, and Kenya.

Recommendations:

- Develop a database of large-scale water infrastructure in the region, by basin and aquifer. Infrastructure may be characterised as existing, planned, proposed, or under construction (to be considered with recommendations made in Section 8.3).
- Explore potential mechanisms to facilitate open dialogue of planned and proposed dams, at an early stage, to maximise benefit sharing in cross-border situations, and mitigate potential for conflict. This is likely to involve further research to understand and learn from previous efforts in the region (e.g. SMM basin project, and experiences from NELSAP and ENTRO).
- Ensure that marginalised stakeholders are involved in infrastructure development, such that benefits are not gained at the expense of others. Prevention of further disenfranchisement can prevent conflict.
- Proactively characterize and explore untapped deep cross-border groundwater resources, such as has been started with the Merti aquifer in the Horn of Africa Groundwater Initiative (Section 5.2).
- Explore alternatives to large-scale ‘grey’ infrastructure for water storage and hydropower production. This may include ‘green’ infrastructure (safeguarding and improving ecosystem services for water supply), landscape storage, run of river hydropower.[154]
- Explore potential institutional arrangements for facilitating long-term planning and dialogue between countries. This may involve national focal points with a regional coordinator (e.g. a representative from IGAD, AU, or UN).
- Shift the discourse from ‘resource sharing’ to ‘benefit sharing’, in regard to significant infrastructure projects.

[152] UNEP-DHI, SECCCI Project, Support to Sustainable Development in Lake Turkana and its River Basins, Ecosystem Services Assessment, 2020
[153] Personal communication, DHI, December 2020.
[154] AUC, Small Hydropower Potential is being explored in Southern Africa, 2020

8 Digital Platforms for Water Diplomacy

Summary: Access to reliable, current, and useful data and information is a cornerstone of effective and inclusive cross-border water management. It is also very difficult to achieve in practice, largely due to political sensitivities and 'national' thinking. It is often also hampered by a lack of capacity to develop and/or use the data in management processes.

While efforts have been made to develop data and information sharing arrangements and platforms in the Horn, at regional, cross-border, and basin and aquifer level, on the whole they tend to be fragmented and short-lived, and have not resulted in a sustainable and workable knowledge exchange platform.

This section first looks at the institutional mandates, capacity, and experiences of developing digital platforms (Section 8.1), and then explores successes and limitations of various initiatives to develop them at regional, cross-border and national level, as well as drawing on some global level examples with potential for application in the Horn (Section 8.2). Summary and recommendations are provided in Section 8.3.

8.1 Regional institutional considerations

Summary: This section considers institutional / technical capacity to host and/or contribute to an online platform, at different geographic levels: regional, cross-border, national. At the regional level, IGAD has numerous relevant centres and portals, which would indicate there is some institutional mandate and capacity to host a water resources portal, but further discussions would be needed to determine appropriate institutional arrangements. There are other continental and regional institutions that may be in a position to provide support to technical capacity building. At the national level, there appears to be some institutional capacity in each country (to be confirmed), with AMCOW M&E Focal Points and 4 NEPAD Centres of Water Excellence also providing potential entry points to relevant national institutions. Furthermore, NBI has significant technical capacity and experience, covering 5 out of the 8 countries in the Horn.

Regional:

IGAD: already has a number of relevant centres/portals, which would indicate there is institutional capacity to host some form of water resources portal. However, it would first be important to understand the status, effectiveness, and capacity of the existing portals, to avoid duplication and build on them.

- **IGAD Climate Prediction and Application Centre** (ICPAC), including water monitoring and modelling, capacity building for member states, and forecasting for water resources. ICPAC is a designated WMO Regional Climate Centre. Project: Integrating Hydro-Climate Science into Policy Decisions (HyCRISTAL). **Capacity:** Short, medium and long range forecasts are developed for the IGAD region plus Burundi, Rwanda, and Tanzania. ICPAC has a water resources department of 3 people that produce rainfall runoff models and uses global data. Model results are communicated to focal points in the ministries of each member state.
- **Drought Disaster Resilience and Sustainability Initiative** (IDDRISI): including Resilience Portal developed through the SECCCI project (repository of information). IGAD 3W map is one of the key components of the unified Knowledge Management system and serves as a project portfolio management tool. However, it appears the user is unable to search by theme (e.g. water). 7 IDDRISI Pillars, most of which are highly

relevant for this project, Priority Intervention Areas: 1. Natural resources and environmental management; 3. Enhanced production and livelihood diversification; 4. Disaster Risk Management, Preparedness & Effective Response; 5. Research, Knowledge Management and Technology Transfer; 6. Conflict Prevention, Resolution and Peace Building. **Capacity:** seems to have the potential to be highly relevant, but no concrete initiatives / tools yet identified that would specifically overlap with this project. See also Section 3.1.2.

- **Land Governance Programme**: The Land Governance Portal was developed as a part of the Land Governance Programme, which started in 2015. This portal is a collection of maps and documents. The maps display information including land degradation and drought, but nothing directly related to surface or subsurface water or cross-border basins or aquifers. The link to water resources management is present, but not in focus. **Capacity:** While the Land Governance Programme is well represented, the Land Governance Portal itself is not mentioned in the Land Scoping Study, a partner project to this study, which suggests the portal may not be widely utilized. There is potential for intersecting interests, as IGAD's mandate on land governance includes sustainable management of shared natural resources.

- **ICPALD** [IGAD] (2009-present): IGAD Centre for Pastoral Areas and Livestock Development works to promote sustainable agriculture, as specifically relating to livestock in dry lands. Their aim is to reduce land degradation and increase resilience in peoples who live and raise livestock in marginal lands. **Capacity**: ICPALD has coordinated programs with the FAO, among others, and has developed a portal, focused on the Karamoja Cluster in Ethiopia, Kenya, South Sudan, and Uganda, tracking a number of metrics related to resilience, including boreholes, dams, pans, ponds, aquifer yield, and aquifer storage.

Africa:

- **AU**: The African Union Border Programme has some, but limited capacity for cross-border water resource management (mostly work with country boundary delimitation). The AU Department of Rural Economy and Agriculture (DREA) works with Environment, Climate Change, Water, and Land at the continental level, through work such as the Great Green Wall (Section 5.4), projects to increase access to natural resources information, disaster risk reduction programmes, and advancing the African Water and Sanitation agenda. The AU delegates much of their water resources management work to AMCOW, which also tracks progress on the Africa Water Vision 2025.

- **AMCOW**: hosts the African Water Sector and Sanitation Monitoring and Reporting portal (2016-ongoing), with M&E Focal Points in each country. The portal was developed by DHI, with ongoing support. **Capacity:** The national M&E Focal Points may provide useful entry points to relevant national institutional arrangements.

- **Digital Earth Africa** (formerly Africa Regional Data Cube) [Australian Government, Helmsley Charity, many partners] (2019-ongoing): mission is to process openly accessible and freely available data to produce decision-ready products. Working closely with the AfriGEO community, DE Africa will be responsive to the information needs, challenges and priorities of the African continent … will leverage and build on existing capacity to enable the use of Earth observations to address key challenges across the continent. **Capacity:** May be a useful regional partner with country connections, to support with capacity building.

- **NEPAD Water Centres of Excellence:** four institutions in the region (with another 15 in western and southern Africa): Water Research Centre at the University of Khartoum, Sudan; Ethiopian Institute of Water Resources at Addis Ababa University; Geography

Geo-Informatics and Climatic Sciences department at Makerere University, Uganda; IGAD Climate Prediction & Applications Centre (ICPAC), based in Nairobi, Kenya. **Capacity:** These four Centres of Excellence (3 national and 1 regional) may provide useful national entry points for work and capacity building in the region and are well connected through the AU Development Agency (NEPAD).

- **TIGER-NET:** [ESA, DHI-GRAS, DTU, Geoville, Danida] (2012-2015): supported the satellite based assessment and monitoring of water resources from watershed to cross-border basin level through: (1) Development of an open-source Water Observation and Information System (WOIS); (2) Capacity building and training of African water authorities and technical centres in harnessing remote sensing data (with one of the key host institutions being NBI).

- **African Academy of Sciences** (AAS): The AAS, founded in 1985, seeks to transform lives on the African continent through science One of their five strategic focus areas is Environment and Climate Change, and one such programme is Climate Research for Development (CR4D). **Capacity**: The current research strategy is in place until 2022. The AAS has a variety of partners, including UNICEF, UNECA, NEPAD, and the Royal Society.

Cross-border:

Nile Basin Initiative (NBI): NBI is the only cross-border institution in the region (though it extends beyond the region) with relevant technical capacity. It would be sensible and useful to build on NBI's technical capacity and experience in the relevant Horn of Africa countries (5 out of 8 HoA countries: Ethiopia, Kenya, South Sudan, Sudan, Uganda (although Eritrea participates in NBI as an observer, it is not expected to have relevant technical capacity through NBI.)). **Capacity**: NBI has a number of portals and tools that are described in detail in Section 8.2.2. Furthermore, NBI has experience and skills related to cross-boundary water resources cooperation and relationship building.

Countries:

The below are a selection of relevant platforms following initial research. There are likely to be more which may be identified upon further research and discussions.

- **Ethiopia:** NEPAD Water Centre of Excellence based in Ethiopia: Ethiopian Institute of Water Resources (EIWR), Addis Ababa University, Water and Land Resource Centre (WLRC) [SDC, Government of Ethiopia] (2011-present): aims to address land degradation and associated poverty through research and increased information. Research outcomes, in particular the WALRIS database (see Section 8.2.3).

- **Kenya: CETRAD** [the Government of Kenya, Ministry of Water and Irrigation; Government of the Swiss Confederation, Centre for Development and Environment of the University of Bern] (2002-present): Kenyan WLRC project is led by CETRAD, specializes in arid lands. Note IGAD-ICPAC is also based in Kenya. Research outcomes, in particular the SHIP tool (see Section 8.2.3).

- **Sudan: Hydraulic Research Centre (HRC)** [Sudan] (1976-present): Under Ministry of Water Resources and Electricity. For example, was a partner in the project "River basin simulation for improved cross-border water management in the Nile: Tekeze Atbara sub-basin, with Ethiopia and UNESCO-IHE. Undertook study: Assessment of the impacts of the GERD on the downstream hydrology and water resources.

- **Uganda:** NEPAD Water Centre of Excellence based in Uganda: Geography Geo-Informatics and Climatic Sciences department at Makerere University.

8.2 Digital Platforms

Summary: There are dozens of digital platforms that can give a complete hydrological picture to inform cross-border water management strategies. However, none of these serve as a foundation for shared understanding to provide regional, updated, hydrological and socioeconomic data and analysis in a clear, interactive format. It is recommended that options for developing a digital platform that can support integrated decision making in transboundary basins and aquifers in the Horn, are investigated.

This section assesses the digital platforms relevant to water resources and climate at different geographic levels: regional, cross-border, and national. It also considers other platforms that may be global, or developed for other areas, that have potential to be adapted for the Horn of Africa region.

For each of the platforms, the following is described as applicable:

- Strengths and limitations: what the digital platforms can and cannot provide, in terms of visualisation, data download, spatial and temporal analyses, user metrics, and public access.
- Status: whether the digital platforms are active or not, status of funding, sustainability, ownership and key actors.
- Potential: if/how the digital platform could be applied to meet the objectives (including scaling-down global applications, or scaling up basin/aquifer applications).

8.2.1 Regional

Summary: Water resources management platforms at the regional level are nearly all affiliated with IGAD or its branches and programmes. The platforms, in general, contain varied and comprehensive data, but do not appear to be regularly updated and maintained. Much of the information available in the portals is static and not interactive. ICPAC's forecasts are produced regularly, but up to date climate information is not incorporated. Portals/tools developed for the African continent appear to be developed for use in research rather than by decision makers.

Horn of Africa:

- **IGAD Spatial Web Portal** (EU, GIZ, dates/status and funding unknown). Perhaps intended as an 'umbrella' portal for various other IGAD portals. Apparently containing the following datasets (117 layers, 86 documents, 3 pre-made maps, 113 users (including institutional users). Includes many maps and layers related to transboundary aquifers, basins, lakes, and rivers. Information appears to be collected from other portals (such as the AGWIS) and does not appear to include time series data. The portal does include climate, but this does not appear to be updated or maintained (latest maps from 2017). The portal does not appear to be very dynamic or updated in general.

- **ICPAC GeoPortal** : Appears to function similarly to the IGAD Spatial Web Portal. Includes 377 layers, 265 static maps, has 10 users, and does not appear to include time series data. Most recent water maps from 2017, and similar to the Spatial Web Portal does not appear to be updated or maintained. Does not contain many layers pertaining to the region as a whole.
- **ICPAC Apps Portal** (2017-ongoing, level of update unclear)**:** contains data on climate, disaster risk management, water, and agriculture. Must have a login to access, and no other links on the Portal homepage appear to function properly.
- **IGAD-ICPAC live map – Flood** [IGAD, ICPAC, UNITAR-UNOSAT. Funding: Norway] (2015): This portal is intended to communicate flood hazards, flood alerts, and river flow indicators, but appears to be no longer active.
- **ICPAC website** [IGAD, WMO] (2003-present): Provides short, medium, and long range climate forecasts (precipitation, temperature, wind) in a 10x10 km grid for the IGAD region plus Burundi, Rwanda, and Tanzania. Regional forecasts and water resource model results are communicated monthly to each member country's focal point to be implemented for flood/drought mitigation and water resource management. ICPAC's modelling efforts are limited by what data member states choose to share with regional organizations.[155] ICPAC has the knowledge, skills, and range to be a valuable partner in regional platform development.
- **IGAD-HYCOS**[156] [IGAD, WMO. Donor: EU] (2012-17) project to promote sustainable and integrated water resources development and management in the Horn of Africa through enhancement of regional cooperation and collaboration in the collection, analysis, dissemination and exchange of hydro-meteorological data. The project aimed to provide capacity building for regional cooperation in information exchange. 123 surface water and 76 groundwater stations installed, and national databases were strengthened, with the intention to contribute to a regional database. However, this database is not publicly available.
- **IGAD Resilience Portal** [IDDRSI, IGAD, SECCCI, EU, UNEP, UNDP] (ongoing): Provides an overview of all resilience projects in the region, with a cross-border focus on the eight IGAD clusters. Sharing news, events, information resources, dissemination, experiences and good practices. The IGAD 3W portal shows a "Who, What, Where" of projects in the region. Includes 617 projects (121 completed, 394 ongoing, 35 planned projects), and allows for transboundary aquifer overlay. Appears that new projects continue to be added, but that old projects are not updated (for example, projects that have ended in 2016-2019 are still listed as "ongoing"). Does not provide information about the project outcomes.

Continental:

- **African Flood and Drought Monitor (AFDM)** [UNESCO-IHP (G-WADI programme), Princeton University] (developed 2014): web-based platform, macro-scale hydrological modelling for Africa, using remote sensing and in-situ data. Developed by Princeton University and requires login. Has potential for filling a need for flood and drought dissemination in the Horn region, however it appears to be tailored for use by researchers and for specific projects, rather than for decision makers.

[155] Personal communication, ICPAC, August 2020.
[156] Case study of implementation in Uganda; Project Document; 4th Steering Committee meeting in 2015.

- **African Groundwater Information System (AGWIS)** [ANBO, IGRAC, BGS, NERC, UKRI] (2016-present): groundwater-related information sharing at the pan-African level to support decision making in AMCOW. This portal includes groundwater maps for all of Africa and contains hydrogeological maps for all of the IGAD region except for Eritrea. Does not contain real-time or time-series data. Does not appear to have been updated since 2019.
- **Digital Data Initiative**[157] [CIWA, AMCOW, ANBO, NBI, Digital Earth Africa Initiative, Global Partnership for Sustainable Development Data] (2018-): project still in initial stages. Aim is to help countries and basins in data collection, management, analysis, and interpretation. This includes station data and remote sensing in water resource applications. Whole of Africa.[158]

8.2.2 Basin

Summary: Many cross-border basin-level platforms available in the Horn region have been developed for the Nile under the NBI. Some of these tools function more as static repositories of information/historical data, and others are more frequently updated and have options for the user to interact with the data. Newer portals have been developed through the SECCCI project in the Jubba-Shabelle and Omo-Turkana basins, and there is potential to build upon the format of these portals for use at the regional scale.

Nile:

- **Nile Basin Decision Support System**[159] [NBI, DHI] (2012-present): DSS platform used for communication and information management. Includes maps (GIS), models (MIKE suite), databases, and workspaces to support decision makers. Significant technical expertise and software needed for operation (each member state has this expertise). A common computer-based platform for communication, information management and analysis of water resources.
- **Nile Information System, Nile-IS** [NBI] (2013): Part of the tools and platforms available from the NBI. Collection of all policies and documents, where they can be shared with all NBI members. Login required. Nilebasin.org appears to be non-functional much of the time.
- **Nile Basin Regional Hydromet**[160] [NBI (GIZ, EU)] (2018-2021): to provide more reliable data and information for water resources management including flood disaster preparedness, coordinated management of water storage dams, navigation and improved adaptation to climate change. 79 hydrometric stations proposed and the hydromet design is published, but no information could be found regarding implementation.
- **Nile Basin Water Resources Atlas** [NBI (GIZ)] (2017): Online report of the Nile: its physical, climactic, and socioeconomic characteristics; sub-basins; and infrastructure. Provides a thorough snapshot of the state of the Nile in 2017, but does not present real-time or updated information.
- **Nile Basin Adaptation to Water Stress**: Comprehensive Assessment of Flood & Drought Prone Areas [DHI, UK-Met Office, UNEP-DHI, NBI, UNEP, SIDA] (2012-2015): Regional Climate Model (RCM) and basin hydrological model were developed. A regional scale modelling framework was developed to support and inform decision-making for large transboundary river basins and applied to the Nile. The framework incorporates climate change modelling and hydrological modelling to account for climate shifts.

[157] CIWA, Annex B – Regional Engagements and Projects. Annual Report, 2019
[158] Personal communication, CIWA, October 2020
[159] Equitably sharing the Nile Basin. DHI. Brochure
[160] Nile Basin Regional Hydromet. Water Resources Atlas. Launched 2019.

- **ENTRO Flood Preparedness and Early Warning systems (FPEW)** [NBI] (ongoing): Seasonal flood forecasts for the Lake Tana Floodplain, Blue Nile, Baro-Akobo-Sobat, and Atbara Tekze Setit basins. These digital platforms have potential for users with technical expertise, as the visualisation includes time series data for river discharge as well as rainfall, which can be exported in different file formats. The map displays are interactive for both rivers and catchments. The digital systems do not include a link to socioeconomic data, which could be useful for decision-makers, however the platforms are well-maintained and the latest forecasts are up to date.

Jubba-Shabelle

Jubba-Shabelle Water Tools Portal [UNEP-DHI, SECCCI project] (2020): A portal that combines three different applications: access to data, access to root cause analysis, and a document repository. Data visualisation is interactive and up to date, and includes climate change data, climate time series (such as rainfall) from global weather sources, and other spatial datasets. Root cause analysis is a decision-making tool that allows users to analyse environmental issues and decide which should be addressed. The portal can be adapted to different users based on their needs and their level of technical expertise. There is potential for this style of portal to be expanded to include other basins, such that a user at the regional level can have access to more than one basin. Furthermore, there is an agreement that the portal will be maintained and in operation for five years.

Omo-Turkana

Omo-Turkana Water Tools Portal [UNEP-DHI, SECCCI project] (2020): This portal is similar to the Jubba-Shabelle Water Tools Portal, in that it contains data from a variety of sources, is interactive, is maintained and up to date, and is adaptable to different users. The portal contains two additional applications, Indicators and Planning. The Indicators application is an updateable library of indicator descriptions, including their purpose, interpretation, and spatial and temporal resolution. The Planning application allows for users to combine and analyse river basin development, rehabilitation, adaptation, and climate change scenarios, and to use Multi-Criteria Decision Analysis to identify the best basin options. Except the decision-making applications, which may contain sensitive information, this portal is open to the public.

Lake Victoria

Lake Victoria Water Resources Information System [DHI, LVBC] (2014-2018): the information system is a data and knowledge repository for the region, enabling stakeholders to access, share and evaluate available basin data. It includes a GIS-based database for land-use, hydrology, and biodiversity in the basin.

8.2.3 National

Summary: The few national platforms that were identified appear to be relatively well-maintained. Upscaling national-level platforms to the regional level has less potential than upscaling basin-level platforms, as there is potential for data sharing issues when moving to cross-border cooperation.

The below are a selection of relevant platforms following initial research. There are likely to be more which may be identified upon further research and discussions.

Ethiopia:

WALRIS [WLRC-Eth, SDC, CDE-Bern] (website last updated 2014): Database for sharing environmental information, data, documents, models, procedures, etc. in Ethiopia, has a focus area for the Nile Basin as well.

Kenya:

Social and Hydrological Information Platform (SHIP)[161] [CETRAD] (2015-ongoing): Cloud based online application to facilitate easy and efficient access to data, maps, and documents. Currently only for Kenyan basins.

Somalia:

FRRIMS (Flood Risk and Response Information Management System for Somalia) [SWALIM, FAO] (website last updated 2020): Includes information on rain forecasts, vegetation, temperature, soil moisture, river levels, and riverbank breakages. Gives early warnings in the form of a forecast. Disseminates information about flash floods in intermittent streams and river flooding. Portal is hosted by SWALIM and appears to be well maintained and updated frequently.

8.2.4 Global / other

Summary: There are many water resources platforms that have been produced at the global scale that may be relevant to the Horn region. FAO and IGRAC have each produced many specialized platforms that include aspects relevant to water resources management, but not all aspects necessary for integrated decision making. UNEP-DHI has created digital platforms at the global scale, and also at the basin scale, that include all relevant information with the ability of adapting the platform to meet the users' needs.

FAO

The tools produced by the FAO, in particular AQUAMAPS and AQUASTAT, are comprehensive and include in depth information for the globe, although the most up-to-date information available for some countries is more than a decade old. Other portals use selected water resources information for a specific purpose, such as evapotranspiration data displayed in the WaPOR portal. FAO tools include:

- **AQUASTAT** [FAO] (ongoing): FAO's global water information system, statistics focus and information focus, used to calibrate and validate model maps that result from AQUAMAPS.
- **WaPOR** [FAO] (2019): a remote sensing portal for water productivity and food security. Data available for all of Africa, including the Horn.
- **AQUAMAPS** [FAO] (2014): FAO's spatial database on water and agriculture. Includes Hydrosheds basins, rivers, water bodies, irrigation and infrastructure, and links to climate data. The tool incorporates models and analyses.
- **AquaCrop**[162] [FAO] (2016-ongoing): crop-water productivity software model, goal is to increase food security by assessing the effect of environment and management on crop production.
- **RICCAR** and **RDMS** [FAO]: The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) has produced a data portal hosted by the FAO which displays climate scenarios for the entire Horn region.

[161] SHIP Introduction. 2020. CETRAD. Link to Intro.
[162] AquaCrop. FAO. Software homepage accessed July 2020.

- **GAEZ**[163] [FAO] (Version 1.0 released 2000): Global Agro-Ecological Zones tool, supplies data from the GAEZ methodology used by the FAO to support decision-makers.

IGRAC (groundwater)

The portals/tools produced and maintained by IGRAC are all contained under the GGIS platform. There is focus on cross-border aquifers. IGRAC has partnered with regional bodies – notably SADC – to produce regional information portals. However, the IGRAC-SADC portal lacks any link to surface water, which would be useful for an integrated water resources management approach. There is potential for a similar regional engagement with IGRAC for a groundwater element of a regional application. IGRAC portals/tools include:

- **SADC Groundwater Information Portal** (GIP) [IGRAC] (2017): This portal covers Southern Africa (Kenya and Uganda occasionally appear in the maps). The setup for the portal is the same as the IGAD Spatial Web Portal, including static data and maps. Also includes many references to other groundwater resource pages for Africa. Potential for similar overlap between the Water Unit of IGAD and IGRAC.
- **GGIS** (Global Groundwater Information System) [IGRAC (ISARM), IGAD] (Manual released 2015-ongoing): platform for sharing transboundary groundwater aquifer data. GGIS is the overall system, which includes tools, each with their own underlying map. GGRETA, GGMN, MIM, TBA, and TWAP tools are under the GGIS umbrella.
- **GGRETA**[164] [GGIS, IGRAC, SDC] (2013-2016): Groundwater Resources Governance in Transboundary Aquifers, goal is to increase knowledge of physical and socioeconomic characteristics in transboundary aquifers. Case study is in Southern Africa.
- **GGMN**[165] [GGIS, IGRAC] (Manual released 2016): Global Groundwater Monitoring Network platform for sharing groundwater data. Includes both data sharing and personal network elements. Database is available on mobile for android.
- **MIM**[166] [GGIS, IGRAC]: Meta Information Module for sharing information, such as references, in addition to maps stored in the other data systems.
- **TBA**[167] [GGIS, IGRAC]: Transboundary Aquifers is a collection of maps with global groundwater resources. Latest map is from 2015, ongoing since at least 2009.
- **TWAP**[168] [GGIS, IGRAC, UNESCO-IHP, GEF] (2016): Transboundary Waters Assessment Program online tool gives information about transboundary waters, including 199 groundwater aquifers.
- **MAR Portal** [IGRAC, TU Dresden, Acacia Water] (2015-ongoing): Managed Aquifer Recharge information for the entire globe.

UNEP-DHI

The UNEP-DHI Centre has created a number of platforms specifically designed for integrated water resources management, for use by decision makers, technical specialists, and other stakeholders. Other portals developed by UNEP are a part of meeting the UN SDGs and focus on ecosystems and water quality, which could be useful in the Horn region as a component of resilience initiatives. Platforms developed by UNEP-DHI include:

[163] Global Agro-Ecological Zones About Data Portal. FAO. Webpage accessed July 2020.
[164] Groundwater Resources Governance in Transboundary Aquifers. IGRAC. Project description.
[165] GGMN: Global Groundwater Network. IGRAC. Project description.
[166] Meta Information Module. IGRAC. Project description.
[167] Transboundary Aquifers of the World map. IGRAC. Project description.
[168] TWAP Groundwater. IGRAC. Project description.

- **Water Tools Portal** [DHI] (ongoing): The Water Tools Portal is a flexible web platform that offers access to different applications including Basin planning, Data visualisation, Earth Observation data etc. A workspace can be configured for client/organisation and can be managed separately (access to specific users, public access…). The technology has been applied in several river basins and countries: Jubba-Shabelle, Lake Turkana and its river basins, Ayeyarwady basin, Cambodia etc. for water resource management applications. This type of portal has potential for application in the Horn.
- **Cascade (WBOC)** [DHI, UNEP] (beta version): Water bodies of concern portal, shows forecasting and indicators (hydrological, socioeconomic, and water quality) for target water bodies. Information from the Flood and Drought Portal and the Global Hydrological Model are used in real-time to update the indicators and the status of the water bodies. Indices can be viewed historically as time series, but it does not appear that users can interact with the raw data. Contains 13 points relevant to the Horn region. The information presented in this portal is up to date and presented in an interactive format, elements of which has potential for application in the Horn.
- **Flood and Drought Portal** [DHI, UNEP, GEF, IWA] (2016-present): A number of apps, including flood assessment, drought assessment, water indicators, etc., that can be used by decision makers as support for policy decisions. Limited technical skills required, login is required (free to register) and a number of online courses are available for first-time users. Available for all cross-border basins. Portal was developed as part of Flood and Drought Management Tools project[169] and currently maintained by DHI.
- **Freshwater Ecosystems Explorer** [UNEP] (2019-ongoing): Part of SDG 6.6.1, the ecosystems explorer measures change in ecosystems using multiple types of data for different types of ecosystems.
- **Global Hydrological Model (GHM)**[170] [DHI] (beta): global hydrological model being developed by DHI. Covers 88% of the globe (excludes the Arctic and Antarctic) using a rainfall runoff model to provide forecasting. Can be downscaled to apply to the regional or country level. This model provides hydrological forecasting in areas without specialized basin-scale rainfall-runoff models using global remote-sensing data, which would be useful in the Horn, where data sharing can be problematic.
- **Transboundary Rivers Assessment** (TWAP) [UNEP-DHI, UNEP] (2016): An assessment of all transboundary rivers and their basins. Includes spatial data, political boundaries, and environmental indicators. Data are available as spreadsheets, shapefiles, factsheets, or as interactive visualisation through the portal. This cross-boundary information is fundamental to creating a shared understanding of water resources in the Horn, but the portal lacks the functionality of a decision-making tool.

Other

- **Water, Peace and Security (WPS) Global Tool** [Dutch govt., IHE Delft (lead), WRI, Deltares, The Hague Centre for Strategic Studies (HCSS), Wetlands International and International Alert] (2018-ongoing): Global tool on water insecurity and impacts on ecosystems, livelihoods, security. Regional versions for Iraq (with UN International Organization for Migration (IOM)) (2020), and Mali. There may be plans to create a regional tool for the Horn of Africa.
- **Aqueduct tools** [WRI, Aqueduct Alliance] (2011-ongoing): A variety of tools for water and food security risks. Includes the Water Risk Atlas, which shows general risks, such as Water stress, depletion, and sanitation, and a Floods tool, which shows flooding by country or basin. Metrics are available as historical data or as projections. These tools show indicators and analysed data, but do not allow the user to interact with the data itself.

[169] Flood and Drought Management Tools. 2014-2018. Project homepage accessed July 2020.
[170] DHI Annual Report 2019. 2019. DHI. Global Hydrological Model factsheet.

8.3 Summary and Recommendations

Summary

The digital platforms listed in Section 8.2 display a variety of data at local, regional, and global scales and are hosted by competent and reputable organizations. Many global scale platforms are specialized to display a specific type of data in a clear manner, such as remote sensing data in the FAO WaPOR portal or cross-border aquifer indicators in the IGRAC TWAP groundwater portal. Regional platforms are nearly all affiliated with IGAD, and while various elements of water resources management are incorporated into these platforms, they are not in focus for the user and their use for water resources related decision-making could be challenging for non-technical users. Furthermore, these platforms appear to be irregularly maintained and some key elements related to water resources are out of date (e.g. the most recent flood risk map in the regional geo-portal is nearly a decade old).

There is also information that is not yet presented for the Horn that would be valuable to decision makers. Time series data and climate/socioeconomic projection data are available for Arab states and for the African continent but have not been presented for the Horn in a format that can be easily integrated into management strategies. Additionally, most regional tools have static maps and are not continuously updated and maintained. Current and projected time series data combined with decision-making applications are available at the basin level, for example in the portals developed through the SECCCI project.

IGAD had begun an initiative in 2015 to create a water resources tool to address these gaps at the regional level, but this intent was never realized. There is consensus that a platform of some kind would be useful – it would be welcomed by the individual member states, and the process of platform creation itself is immensely valuable when cultivating transboundary relationships.[171]

Recommendations

To address the challenges described above, it is recommended that an integrated, sustainable digital platform for transboundary water resources management be developed for the Horn of Africa region. This would provide an evidence base to support the Office of the Special Envoy, UN Country Teams and development partners, and Member States to implement work on sustainable natural resources management and climate resilience in the region.

Sustainability

Given the number of disused and unfunded digital platforms, it is critically important that any new portal should serve a clear purpose. To achieve this, development must start with a comprehensive design phase, to answer the following questions:

- **Who:** which stakeholders would use it, which partners would develop and host it, and what are the potential sources of funding?
- **Why:** which questions do users need answered, to support evidence-based decision-making?
- **What:** what data and analytical functionality do they need?
- **Where:** what scales (regional, basin, local) and locations are they interested in?
- **When:** how often do they need the data updated, which historic time periods are useful, and which projection periods are useful for planning?

[171] Personal communication, NBI, September 2020.

- **How:** What criteria or thresholds do decision-makers need to meet? What issues do they need to prioritize?

While the above should be elaborated upon during a detailed design phase, some suggestion are provided here, based on the analysis curried out during this study.

- **Objectives**: the platform should support efforts to facilitate constructive dialogue and consensus building in the Horn of Africa, towards decisions and actions that enhance equitable and transparent sharing and governance of transboundary water resources between and within regional states.
- **Integration of issues**: For integrated water resource management, it is vital to have integrated information, including hydrological, water quality, land use, climate, and socioeconomic data. In the current portal landscape, one must use many different portals to find relevant information.
- **Integration across scales**: a platform could contain separate but linked 'workspaces' at different scales, such as a workspace at the regional level, and dedicated workspaces for each cross-border river basin and aquifer in the region. This would allow work on each basin/aquifer to develop according to capacity and priority, whilst benefiting from a common framework.
- **Groundwater and surface water**: while there are huge differences in the knowledge on groundwater and surface water in the region, management should consider both water sources, and as such, ideally the platform would be flexible enough to incorporate both groundwater and surface water.

Content and its organisation and presentation is important to consider carefully when creating a comprehensive knowledge platform, as knowledge is only valuable to the user when it can be digested and analysed. Content areas that might be considered include: drought and flood hazards, human water stress, agricultural water stress, aquifer productivity, river connectivity, population growth, migration patterns, vulnerable populations, infrastructure, water use, land use, and governance. When considering data to support these aspects, it should be transparent, trusted, reliable, independent (e.g. remote sensing data), regularly updated, cost effective, and gridded (with potential for aggregation to basins, sub-basins, and aquifers).

Development and implementation of a comprehensive, timeseries-based, interactive water resources platform for the Horn region would need to consider the following challenges (with potential mitigation measures provided in brackets):

- Internet instability and low speeds for access and maintenance (Mitigation: pen easy and light access data formats)
- Data can become stuck in the processing pipeline, from collection to analysis (Mitigation: Monitoring workflow to do tracking and locate when there is a 'blockage' in the 'pipe')
- Reluctance of countries to share data with regional organizations and other countries (Mitigation: use global and publicly available data).
- Lack of capacity and institutional memory at regional, national, and local levels (Mitigation: training)
- Limited longevity due to lack of funding and/or inability to meet the users' needs (Mitigation: set a minimum maintenance period by the institution hosting the server)

Ultimately, one of the most valuable aspects of tools is their creation and shared maintenance. The process of working together to create something that is owned by all members of a transboundary basin fosters shared understanding, normalizes cooperation, and lays a foundation for more complex or sensitive topics at a later stage. It is therefore recommended that the *process* of developing a digital platform is given sufficient attention to try to achieve these outcomes.

9 African experiences and lessons from beyond the region

9.1 Regional experiences

Experiences from other regional bodies in Africa can provide valuable lessons for advancing transboundary water management in the Horn of Africa. Arguably the most advanced of these are SADC and ECOWAS, which will be discussed in this section. Relevant experiences from EAC will also be discussed, as the EAC region overlaps with the IGAD region through Kenya, South Sudan, and Uganda.

SADC

SADC has a comprehensive and long-established enabling environment for water cooperation.

Institutionally, the Water Division falls under the Directorate for Infrastructure and Services and is responsible for coordinating and facilitating the implementation of regional water related activities in close collaboration with the member states of SADC.

The SADC instruments for water cooperation include: the Revised Protocol on Shared Watercourses (first 1998, revised 2000), the Regional Water Policy (2005), the Regional Water Strategy (2006), and the Regional Strategic Action Plan on Integrated Water Resources and Development Management (first adopted in 1998, and has been running in five-year phases since, with the most recent being the fourth phase (2016-2020)).

Beyond 'water', there is also a Southern African Power Pool (SAPP), established 1995, which has clear implications for coordinated transboundary power development.

Lessons:

1. All efforts are underpinned by the fact that water is perceived as an instrument for peace and stability.
2. The integrated nature of water resources management across sectors is recognised and prioritised, including the water-food-energy nexus.
3. Regional strategic action plans are developed through broad stakeholder participation and input from all countries, guided by the SADC secretariat, with convening support and technical inputs from Waternet (a regional network of research institutes), and technical and financial support from multiple donors.
4. The SADC Water Division has the responsibility to oversee policies on water resources and sanitation infrastructure in the region.
5. A critical component of the dialogue between SADC and International Cooperating Partners is the Water Strategy Reference Group, which consists of the SADC Secretariat and all International Cooperating Partners currently engaged in the SADC Water Sector. This reference group is guided by the Windhoek Declaration (2006), which requires all development assistance is coordinated through the SADC-ICP Partnership Dialogue (currently led by Germany through GIZ).
6. The SADC Groundwater Management Institute promotes sustainable national and cross-border aquifer development and use, and acts as focal point for national, regional and cross-border groundwater initiatives and institutions.
7. Broadly speaking, SADC has a strong enabling environment on Gender, which includes a SADC Protocol on Gender and Development (2008), and a SADC Handbook on Mainstreaming Gender in the Water Sector (2015). This regional framework is frequently cited as an enabler to the promotion of gender objectives by

countries in the region, particularly in relation to national and transboundary water resources management.[172]

8. Collaboration has resulted in the establishment of transboundary River Basin Organisations in 6 out of 13 transboundary river basins in the region, and there are a series of SADC guidelines on strengthening River Basin Organisations (RBOs) (Establishment and Development; Environmental Management; Stakeholder Participation, Funding).

ECOWAS[173]

The instruments for water cooperation include: Directive on West African Shared Water Resources (unanimously adopted 2000), Regional Water Resources Policy (WARWP) (2008), Guidelines for Development of Water Infrastructure in West Africa (2012). Driven by a common desire of West African states to have a binding regional instrument for implementing the Policy, the process of elaboration and validation of the directive started in 2013 and was completed in 2017, through a participatory, consultative process across ECOWAS countries, and supported by CIWA. The three priority areas in the regional Policy are: (1) regional and national water governance reform; (2) promotion of investments in the water sector; (3) promotion of cooperation and regional integration in the water sector.

The ECOWAS Water Resources Coordination Centre (WRCC) is the executive organ of the Permanent Framework for Coordination and Monitoring of IRWM. It is responsible for monitoring and supervising ECOWAS activities in the field of water management, through the implementation of the WAWRP and its regional action plan.

Lessons:[174]

1. Both the regional Policy and the Directive were developed and approved through a participatory approach, which took several years.
2. The Water Resources Coordination Centre (WRCC) plays an important coordinating role in promoting IWRM principles in transboundary water management. A template collaboration protocol was prepared that could be used by Transboundary Basin Organisations (TBOs) and the ECOWAS WRCC to formalize their collaboration. One of the main domains where ECOWAS helps is by facilitating structured exchanges of experience among TBOs and strengthening of some of their functions.
3. Financially and institutionally sustainable regional organizations provide effective water management services to countries. Several financing mechanisms are used, including Member State contributions, a dedicated regional tax, user fee-based financing, polluter fee-based financing, sale of data and services, project management fees for infrastructure projects, management and administration fees, dividends from an investment fund, donor contributions, and public-private partnerships (PPPs). For a relatively small basin – Mono Basin Authority (MBA) – it was recommended to establish a small user-fee-based levy to the hydropower and mining sectors to allow a compact MBA to focus on priority functions and, most importantly, to function independently from member state contributions.
4. Having developed its Gender Policy in 2004, ECOWAS included a gender principle in its Water Resources Policy (2008).
5. In 2017, ECOWAS (with support from CIWA), undertook a comprehensive study of the Fouta Djallon area in the Guinean highlands, which is the source of three major transboundary river basins (Gambia, Niger, Senegal).

[172] AMCOW 2018. 2018 Status report on the implementation of integrated water resources management in Africa: A regional report for SDG indicator 6.5.1 on IWRM implementation.
[173] With much of the publicly available ECOWAS work being in French, most of the information in this section is derived from a CIWA report.
[174] Many of the lessons are derived from a WB CIWA assessment.

9.2 Cross-border basin / aquifer experiences

With 63 transboundary river and lake basins (covering 90 percent of Africa's surface water resources), and 72 transboundary aquifers (underlying 40 percent of the continent), there are numerous examples of transboundary collaboration between countries, including institutional arrangements, strategic planning and agreements, data sharing, and joint financing. There are many more arrangements for surface waters than groundwaters. The below is a selection of some success stories and some common lessons.

Nile

While the lessons from the Nile are discussed elsewhere in this report, we would like to stress the importance of building on the experiences of Nile cooperation, particularly with 5 of the 8 countries being part of the basin (with Eritrea also being an observer member of the NBI, and only Somalia and Djibouti not part of the basin). Some key lessons include:

1. The relative success of the Nile Basin Initiative (NBI) in fostering collaboration between the 10 member states, and building capacity. While this has focussed on 'technical' collaboration (i.e. data and information sharing, developing joint management platforms for planning, and developing joint plans and strategies), this collaboration always has a political component.
2. However, despite these relative successes, a lack of up-to-date and legally binding political cooperation framework has meant that significant tensions still arise in the basin, particularly between upstream and downstream countries.

Southern Africa: Zambezi, Okavango

Zambezi Watercourse Commission (ZAMCOM, est. 2014, 8 countries), and Permanent Okavango River Basin Water Commission (OKACOM, est. 1994, 3 countries).

West African cluster: Niger, Volta, Senegal

Senegal River Basin Development Organization (OMVS) and Niger Basin Authority (NBA) are success stories. The Geneva Water Hub has determined the main success factors to be: climatic and hydrological shocks, international aid, socio-economic stability and the relative homogeneity between member states of both organisations.[175]

North Western Sahara Aquifer System (3 countries). The 'project' (transboundary collaboration) was initiated in 1999, at first focussing on better understanding the aquifer system, and later working on sustainable management planning. There is no specific multilateral organisation, but a 'consultation mechanism' (est. 2002), with the Sahara and Sahel Observatory (OSS) overseeing a Steering Committee, composed of General Directors of the national institutions responsible for water resources in the Member States, as well as UN agencies and donors.

[175] Policy Brief n°4 - Transboundary Governance of the Senegal and Niger Rivers: Historic Analysis and Determining Factors Identification (French). 2016. Geneva Water Hub.

9.3 Continental and global

There is a large volume of work concerned with the benefits of transboundary water cooperation. Some selected entry points are provided below.

In 2017, the World Bank published a report “Climate Resilience in Africa: The role of cooperation around transboundary waters”.[176] It provides a useful summary of the benefits of transboundary cooperation in building climate resilience. Some of the key findings include:

- Building resilience to climate change requires strengthening water management systems, including information, institutions, and infrastructure.
- The case studies underlying this report show that appropriately planned transboundary cooperation can improve the resilience of economies, livelihoods, and ecosystems in Africa. Specifically, the case studies show that
  1. Shared, trusted information enables:
     - Preparedness through cross-border sharing of information can greatly improve prediction and help avert large losses of lives and property; and
     - Shared planning tools can help riparian’s jointly decide ways to optimize water use, manage trade-offs, and share benefits;
  2. Flexible, adaptive institutions enable:
     - Alignment of regional and national policies that help countries build climate resilience through integration and interconnectivity of regional systems; and
     - Frameworks for cooperative action that help countries learn together and collectively manage their responses to a changing climate in a flexible and adaptive manner;
  3. Shared approaches to infrastructure enable:
     - More cost-effective, efficient, sustainable, and climate-robust investments in both natural (for example, watershed management, and reforestation) and built (for example, multipurpose dams) infrastructure. Since infrastructure represents both a major cost, and sometimes a major ecosystem risk, the potential benefits of a joint approach can be considerable; and
     - Resource and capacity stretched countries to pool together technical capacity, mobilize financial resources, and adopt increased transparency to facilitate improved design, operation, and restoration of built and natural infrastructure.

In 2015, the UNECE published a “Policy Guidance Note on identifying, assessing and communicating the benefits of transboundary water cooperation”, to support Governments and other stakeholders in realizing the potential benefits of transboundary water cooperation. It does so by introducing the wide range of benefits of cooperation and providing step-by-step guidance on how to carry out a benefit assessment exercise. This includes the separate but related tasks of identification, assessment and communication of benefits. It suggests how to approach those tasks, as well as how the assessment of benefits can be integrated into policy processes to foster and strengthen transboundary water cooperation. A benefit assessment was undertaken in the Sio Malaba Malakisi (SMM) River Basin (Kenya, Uganda, sub-basin of Nile, 2017-18), which resulted in the SMM Basin Investment Framework and the SMM 4 clusters of prioritized investments projects. It would be worth considering a similar approach in other basins and aquifers, and even looking into the feasibility of conducting such a ‘benefit assessment’ for the whole Horn of Africa.

[176] World Bank 2017. “Climate Resilience in Africa: The role of cooperation around transboundary waters” World Bank, Washington, DC. Text provided is directly quoted from the Executive Summary of the report.

9.4 Summary and recommendations

1. At regional level, strong institutional responsibility, and jointly-owned frameworks for coordinated development and sustainable use are significant enablers to cross-border collaboration in basins and aquifers.
   - Consider undertaking a more detailed analysis of African regional frameworks, with the aim of making recommendations for the IGAD region.
   - Explore opportunities for peer-to-peer learning between IGAD and SADC and/or ECOWAS counterparts, focussing on enablers to advancing water collaboration at a regional level.
2. At basin and aquifer level, institutional arrangements greatly facilitate sustainable and long-lasting collaboration. Depending on the size of the basin/aquifer, these may be in the form of 'consultation mechanisms', or similar, and do not have to be large, multilateral organisations.
3. There are various modalities for financing cross-border collaboration and institutional arrangements, but in most cases in Africa, donor funding has played a significant role in at least establishing cross-border mechanisms. In some cases, there has been ongoing, long-term financial support.
4. Consider scaling-up the 'benefit assessment' approach, undertaken in the SMM basin, for other transboundary basins and aquifers, as well as a regional 'benefit assessment'.
5. In assessments and institutional arrangements, include relevant cross-cutting elements and expertise, such as economy, ecology, and gender.

10 Conclusions and Recommendations

Both the Intergovernmental Authority on Development (IGAD) and the UN Special Envoy to the Horn of Africa have a mandate to promote peace, prosperity and regional integration. Fostering collaboration over the management and use of transboundary water resources in the region is an important element in working towards this mandate.

Cross-border collaboration over water resources underpins several regional sustainable development objectives, including:

1. Building resilience in marginalised cross-border communities, including supporting pastoralist communities.
2. Reducing the risk of tension over development of water resources with transboundary impacts.
3. Promoting benefit-sharing between upstream and downstream countries, when developing water resources infrastructure that impacts the natural flow.
4. Balancing and connecting the social, economic, and environmental dimensions of sustainable development, thereby facilitating sustainable use of resources.
5. Disaster risk management and preparedness.

This section provides summary recommendations based on the findings of this study. However, please note that the last section in each of the chapters in this report contains more detailed conclusions and recommendations as follows (section number in brackets):

- Regional and cross-border frameworks for collaboration and resilience (Section 3.5)
- National and bi-lateral activities for cross-border collaboration and resilience (4.5)
- Water and environment in the Horn (Status) (5.5)
- Climate and Socioeconomic Projections (6.3)
- Large-scale infrastructure (7.4)
- Digital Platforms for Water Diplomacy (8.3)
- African experiences and lessons from beyond the region (9.4)

Recognising the significant work that has been done in the Horn of Africa to foster collaboration over transboundary water resources, and the significant political challenges faced, it is recommended that, broadly speaking, advances can be made by:

1. Embedding transboundary water resources management in a broader sustainable development and resilience agenda.
2. Continuing to leverage opportunities at all levels, through all means, to make advances wherever possible.
3. Pursuing both ‘technical’ and ‘political’ collaboration pathways, recognising they intersect.

Institutional frameworks for collaboration:

- IGAD Secretariat: Although water is recognised at strategic level in IGAD, the Water Unit (established 2012), under the Division of Agriculture and Environment) remains low on human and technical capacity and has low external ‘visibility’. **Recommendation:** investigate root causes of this and explore appropriate institutional ‘locations’ for the Water Unit, and potentially closer connection or integration with other units and initiatives, and the capacity development needs and the most cost-effective ways of achieving this.
- IDDRSI: The eight IGAD cross-border clusters are likely to provide a practical entry point for local level cross-border collaboration, and several donors have coordinated inputs through the Initiative, and it appears to have broad engagement from all countries. However, transboundary basins and aquifers extend beyond these clusters, and upstream management and development of water resources may have impacts on water availability and quality in the clusters. **Recommendation:** map how the clusters overlap

with the transboundary basins and aquifers in the region; explore opportunities for mainstreaming transboundary water resources management within IDDRSI.

- ICPAC: has the most technical capacity in the region regarding water and climate. **Recommendation:** identify opportunities for increasing ICPAC's capacity and scope, as well as supporting them to increase country capacity to utilise their outputs in decision-making processes.
- AU: There is potential for the African Union to combine its work on water resources (supported by AMCOW) with its work on regional integration through initiatives such as the AU Border Programme. The AU, being one step removed from sub-regional political tensions, may be in a strategic position to facilitate cross-border collaboration, as demonstrated by its current role in GERD negotiations.
- Transboundary Basin/Aquifer level: With only the Nile having a dedicated institutional arrangement, this severely hampers collaboration over other shared waters. **Recommendation:** investigate the potential (barriers, enablers, options), for establishing basin and aquifer level institutional arrangements. These may not have to be full multilateral institutions, but could be in the form of simpler arrangements, such as committees.

Strategic frameworks for collaboration:

- Regional water policy and protocol, and data and information sharing protocol: while negotiations on the first mobilization and the annual operation of the GERD continue (between Egypt, Ethiopia and Sudan), a resumption of negotiations on the Regional Water Resources Protocol is neither expected to be practical, nor gain traction. Furthermore, there appears to be consensus among countries that the Protocol should only move forward with the participation of all countries. **Recommendation:** negotiations on the Protocol are unlikely to make progress until negotiations on the GERD have reached a conclusion. This should be revisited in 2021 if negotiations on the GERD are not progressing, in which case alternative pathways could be explored.
- **Recommendation:** drawing on the Guidelines for Development of Water Infrastructure in West Africa (ECOWAS), explore opportunities to develop such a guideline, potentially through the IGAD Secretariat (Water Unit).
- **Recommendation:** Continental frameworks for cross-border collaboration such as Africa Water Vision 2025, the AU Convention on Cross-Border Cooperation (Niamey Convention), and Agenda 2063 may also serve as entry points to enhancing collaboration in the Horn of Africa. None of the countries in the region have ratified the Niamey Convention.
- **Recommendation:** In the absence of basin and aquifer-wide agreements, bilateral agreements may offer a practical way to expedite collaboration between two countries, though care must be taken not to make agreements that would have detrimental effects on other countries sharing the basin/aquifer.
- **Recommendation:** Global frameworks such as Agenda 2030 (in particular SDG indicator 6.5.2 on transboundary cooperation), and the Water Convention can provide opportunities for national action which would increase the potential for transboundary collaboration. None of the countries in the region have ratified the Water Convention, and 3 of the 8 countries have yet to report their baseline on SDG indicator 6.5.2.

Knowledge platforms for collaboration (see Section 8.3 for further information)

The current landscape of knowledge platforms related to water resources management is generally fragmented, with many platforms being out of date and no longer funded. **Recommendation: develop an integrated, sustainable digital platform for transboundary water resources management for the Horn of Africa.** This would provide an evidence base to support the Office of the Special Envoy, UN Country Teams and development partners, and Member States to implement work on sustainable natural resources management and climate resilience in the region. The design phase should be comprehensive, with relevant stakeholder engagement, to ensure the platform fulfils a clear purpose, with defined user groups, so that it can facilitate planning and decision-

making. Based on the findings of this study, it is recommended that such a platform should, to the extent feasible:

- Support dialogue in the region, to enhance equitable and transparent sharing and management of transboundary water resources.
- Be transparent, trusted, reliable, regularly updated, cost effective, and sustainable.
- Integrate various issues where feasible, including surface and groundwater, climate projections, infrastructure, land use, and socio-economic patterns and projections.
- Be compatible across different scales (e.g. applying a common framework at regional, basin, aquifer, and local levels).
- Be flexible to meet user needs and capacities at various scales (e.g. customisable for each basin or aquifer).

Finally, one main lesson learned from the successes of the NBI platforms is that the value of collaboration between countries during platform development and ownership over the shared platform can be just as valuable as the platform itself.

Support to UN system and development partners

UN Country Teams

Given the relative lack of regional frameworks for cooperation over water resources, it is **recommended** that discussions are initiated with UN Country Teams to explore how consideration of water resources management in a more cross-border context could support both national development objectives and regional peace and security, and hence increase the visibility and action on these issues in the Common Country Assessments (CCAs) and Cooperation Frameworks with countries. To facilitate this, it is **recommended** that:

- A Focal Point on Natural Resources Management and Climate Resilience (aligning with Pillar 4) be nominated within each UN Country Team.
- Information sharing and training is facilitated by Pillar 4 leads.
- The digital platform described above should support UN Country Teams to develop their knowledge and understanding of cross-border natural resources management, and that it should be useful for their work in supporting countries to implement country programmes.

Role of Office of the Special Envoy

Given the challenging and changing circumstances within the region, there is a notably opportunity for the Special Envoy to play a pivotal role in terms of water security and regional peace. Soma actions the Special Envoy may wish to consider are as follows:

- Support to mobilise UN Country Offices to establish a network of Focal Points for sustainable natural resources management and climate resilience.
- Look to establish a donor coordination mechanism on resilience, drawing on the example of the “Water Strategy Reference Group” in SADC, which consists of the SADC Secretariat and all International Cooperating Partners (Section 9.1).
- Coordinate capacity-building support to IGAD, particularly within UN system. Consider establishing coordination mechanism.
- Facilitate dialogue with the IGAD Secretariat to explore needs and opportunities for increasing IGAD’s institutional capacity on water management.

UN Strategy for the Horn of Africa

Transboundary water resources management is inextricably linked with land and energy, and all three are strands of Pillar 4 – sustainable natural resources development and climate resilience – in the UN’s Comprehensive Regional Prevention Strategy for the Horn of Africa (2019-2023). As such, initiatives within Pillar 4 should be coordinated and

integrated wherever practical and meaningful. Similarly, transboundary water management is linked to, and supports, the three other pillars of the Strategy, namely: (i) regional peace and security; (ii) resilience and socio-economic development; and (iii) inclusive and responsive governance.

Annexes

A.1 Transboundary basin and aquifer management

This annex considers the following for each transboundary basin: institutional arrangements, strategies/plans, and projects.

A.1.1 Surface water

The only dedicated basin level organisations in the region are the Nile Basin Initiative (NBI), and the Lake Victoria Basin Commission (LVBC), and both include Member States outside the IGAD region.

There are no dedicated transboundary aquifer organisations.

4 of the 7 transboundary river basins are “endorheic”, meaning they drain into a lake or wetland, not the ocean. This can mean the lakes or wetlands are particularly sensitive to activities in the catchment, particularly over-extraction and pollution.

1. Nile: (Abyei, Burundi, Central African Republic, DRC, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, Uganda). There have been many initiatives related in the Nile basin. Much has been achieved, but significant transboundary tensions remain. A key challenge is the lack of a political agreement that sets the stage for formal cooperation. Technical cooperation, including the development of decision support and forecasting tools, has progressed beyond political cooperation.

Institutional:

Nile Basin Initiative (NBI) (1999, HQ Entebbe): Multiple donors, including WB, GIZ, SIDA.

- Eastern Nile Technical Regional Office (ENTRO) (1999, HQ Addis Ababa), hosting the Eastern Nile Subsidiary Action Program (ENSAP). Egypt, Ethiopia, Sudan. ENTRO supports Eastern Nile Council of Ministers (ENCOM) and Eastern Nile Subsidiary Action Program Team (ENSAPT)
- Nile Equatorial Lakes Subsidiary Action Program Coordination Unit (NELSAP) (1999, HQ 1999).
- Nile Basin Discourse (2003, HQ Entebbe): network of Civil Society organizations established with the support of World Bank and other development partners to strengthen civil society participation in Nile Basin development processes, projects, programs and policies. This could be useful partner for civil society engagement/participation in Nile sub-basins.

Strategy / agreements:

Nile Basin Sustainability Framework (NBSF) (approved by Nile Council of Ministers (Nile-COM) in 2011): lays down NBI’s approach to developing guiding principles for water

resource management and development across the Nile Basin countries. While it is not a legal framework, the NBSF – which is a suite of policies, strategies, and guidance documents – functions as a guide to national policy and planning process development and seeks to build consensus. It is intended that it will contribute to the gradual alignment of the Basin's body of (national) water policies to meet international good practice, and help to demonstrate to national governments and international financiers of water infrastructure that the NBI has a systematic approach for dealing with issues of sustainable development within the Basin. Strategies/policies under the NBSF include:

- Climate Change Strategy (2013)
- Information and Disclosure Policy
- Communication and Stakeholder Engagement Strategy (2018-2023)
- Strategy for Management of Environmental Flows in the Nile Basin
- Wetland Management Strategy
- NBI Gender Mainstreaming Policy and Strategy

Projects: There are many transboundary projects that have taken place within the Nile basin and its subbasins. The following are a selection:

- Nile Cooperation for Results (NCORE) [All countries, WB-CIWA] (2018-2021): CIWA supports NBI with the incoming multi-sectoral, upstream, and cooperative regional investments are in the NBI pipeline. This includes supporting the Hydromet, Flood Forecasting and Early Warning systems, and mentorship programs.
- Engaging Civil Society for Social and Climate Resilience in the Nile project [Nile Basin Discourse, WB-CIWA] (2014-19): NBD engaged with Subsidiary Action Programs (SAPs) in Nyimur, Baro-Akobo-Sobat (BAS), and Lakes Edward and Albert Fisheries (LEAF) and Nyimur-Aswa Transboundary Project which led to increased Community participation in NBI's investment projects.
- Supporting hydro diplomacy in the Nile Basin [All countries (GIZ)] (2016-2019): strengthening skills, diplomacy, negotiation efforts around the GERD and NBI more generally.
- BRIDGE Project [ICUN, UNECE] (2019): Case study in the Sia-Malaba-Malakisi sub-basin (Kenya/Uganda), to move beyond resource management as infrastructure investment to also prioritize catchment restoration and sustainability.
- ENTRO [AfDB] (2014-ongoing): Baro Akobo-Sobat development programme (Ethiopia, South Sudan, Uganda). The overarching programme includes water supply and sanitation, hydropower development, irrigation, flood control, drought management, navigation, fisheries, watershed management and tourism.

2. Jubba-Shabelle (Ethiopia (u/s), Kenya (u/s), Somalia (d/s): The Jubba and Shabelle rivers are the two most important rivers in Somalia. They join together before reaching the sea; during dry periods the Shabelle is categorized as an intermittent stream and may not reach the Jubba.

Institutional: no known specific multilateral basin institutions.

Strategy / agreements: no known specific multilateral basin agreements.

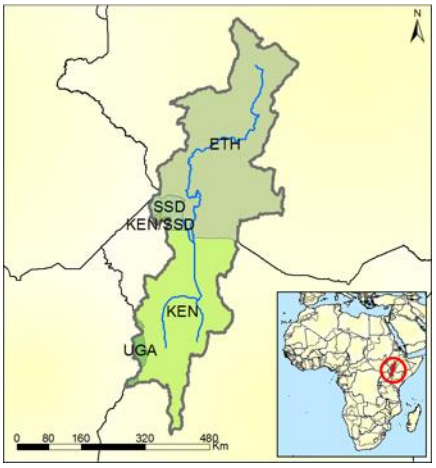
Projects: multiple. The following are a selection:

- SECCCI (2018-2021): Not exclusively for the basin. Objective: strengthen regional policy frameworks, structures and protocols for cross-border cooperation. UNEP will complete a science-based desktop study to serve as an

informational foundation for dialogue. Somalia will receive extra support to ensure capacity for engagement. For further information see Section 3.1.2.

- The GEF project WIO-SAP (2016-2021) describes the basin characteristics, including ecology and governance policies, in detail.

3. Omo-Turkana (Ethiopia (u/s), Kenya (d/s), South Sudan, Uganda (u/s)) (includes Omo River basin, which discharges into Lake Turkana).



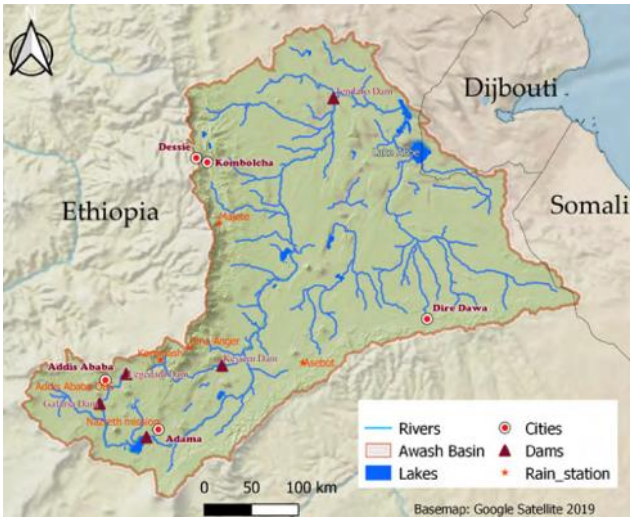
Institutional: no known specific multilateral basin institutions.

Strategy / agreements: no known specific multilateral basin agreements.

Projects: multiple. The following are a selection:

- SECCCI (2018-2021) Not exclusively for the basin. Objective: strengthen regional policy frameworks, structures and protocols for cross-border cooperation. UNEP will complete a science-based desktop study to serve as an informational foundation for dialogue. For further information see Section 3.1.2.
- DAFNE (2016-ongoing) includes a case-study of this basin and has organized negotiations on sustainable resource use (but this project is a bit more 'research' oriented). For further information see Section 5.4.

4. Awash (Ethiopia (u/s), Somalia (u/s, not significant), Djibouti (d/s)) (mainly in Ethiopia, with discharge into a series of interconnected (hypersaline) lakes at the Djibouti border).



Map from FAO report (2020)

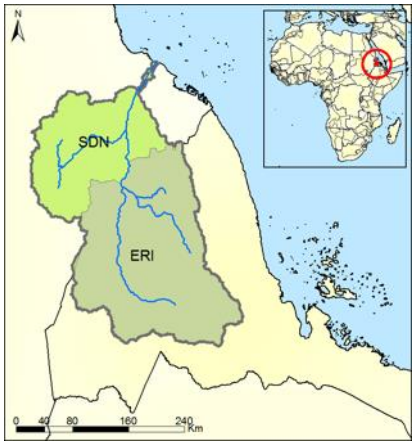
Institutional: no known specific multilateral basin institutions.

Strategy / agreements: no known specific multilateral basin agreements.

Projects: no known projects specifically related to transboundary cooperation. The following have been conducted on the basin:

- REACH has led a number of research initiatives, including water quality investigations, climate projections (2014) and economic impacts (2018), and water security analyses (ongoing).
- A World Bank study (2010) ranked the Awash among the most vulnerable to climate change.
- The FAO has led a water accounting investigation in the Awash (2020).
- Under the Regional Biodiversity Management Programme (BMP), there was an initiative in the he Awash – Lake Abe area, between Ethiopia and Djibouti

5. Baraka (Eritrea (u/s), Sudan (d/s)) comprises 1% of Sudan's basins by area.[177]



Institutional: no known specific multilateral basin institutions.

Strategy / agreements: no known specific multilateral basin agreements.

Projects: no known projects specifically related to transboundary cooperation. The following have been conducted on the basin:

- An academic study (2020) investigates applications of floodwater/runoff harvesting in Sudan for irrigation.
- A World Bank study (2010) ranked the Baraka among the most vulnerable to climate change of global transboundary basins.

6. Lotagipi Swamp (Uganda, Kenya, South Sudan, Ethiopia.)

Institutional: no known specific multilateral basin institutions.

Strategy / agreements: no known specific multilateral basin agreements.

Projects: no known projects specifically related to transboundary cooperation. The following have been conducted on the basin:

- The FAO has investigated the wetlands in this basin in the Kenya portion (no date, but prior to 2000).

7. Gash (Eritrea (u/s), Ethiopia (u/s), Sudan (d/s)). Also known as Mareb. Usually dissipate in the sands of the eastern Sudanese plains, but occasionally reaches the Atbara (a tributary of the Nile), in flood.

Institutional: no known specific multilateral basin institutions.

Strategy / agreements: no known specific multilateral basin agreements.[178]

Projects: no known projects specifically related to transboundary cooperation. The following have been conducted on the basin:

[177] Fanack Water, Sudan country profile

[178] 1925 colonial era arrangement concerning sharing waters between Eritrea and Ethiopia. Apparently reaffirmed in 1951 as independent countries. Current status unknown. International Freshwater Treaties Database.

- A floods and ecosystem services modelling project (2017) completed by HRC-Sudan found that replenishment of the aquifer in the Sudanese portion was highly dependent on flooding in the Gash river, and that groundwater abstraction affected the river flow.

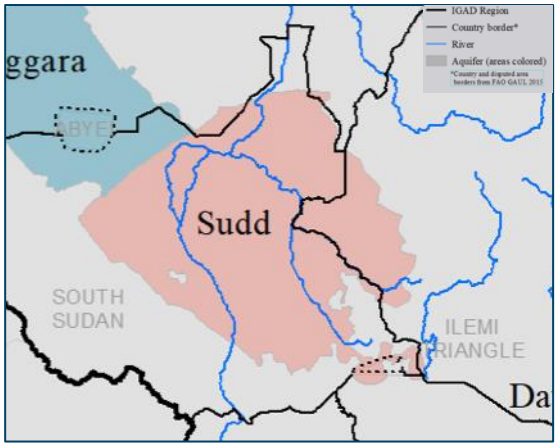
Other basins not included in this mapping, as they are not likely to fall under IGAD's area of interest: Lake Victoria, Mara River (headwaters of Nile), Congo.

A.1.2 Groundwater

Groundwater aquifers in the Horn region are much less well characterized than the region's river basins. In addition to less information available as to the physical characteristics of the aquifers, there are no known multilateral institutions or agreements that address transboundary aquifer management. Lack of information about groundwater aquifer extent, where recharge zones are located, and how much is abstracted are all knowledge gaps for most aquifers. The following contains a brief description about each aquifer's characteristics and selected projects in the aquifer. Information in each numbered item description is from the TWAP groundwater portal unless otherwise indicated.

The Nubian Sandstone Aquifer System is not included, because while it is important to the northwest Horn, it is not likely to fall under IGAD's area of interest.

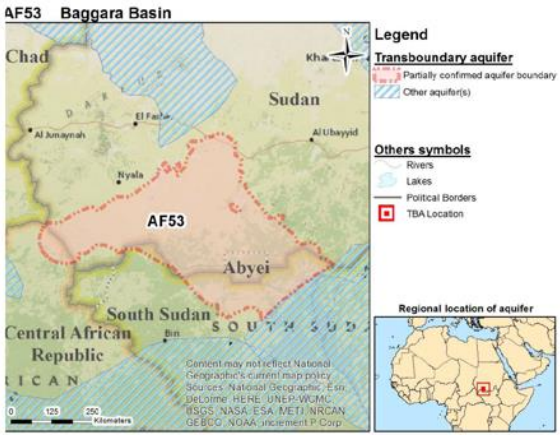
1. Sudd (Ethiopia, Kenya, South Sudan, Sudan): No aquifer information brief available from the TWAP groundwater portal. Most up to date information on the aquifer comes from the BGS Africa Groundwater Atlas compiled in 2016 with data for hydrogeology in South Sudan dating from the 1980s. This report categorizes the deep groundwater aquifer in the Sudd region as low productivity.



Projects:

- A recent study (2019) has investigated the link between surface and groundwater in the Sudd swamp and Sudd aquifer, and found that the Sudd is a shallow aquifer with limited storage, and that hydrology in the area depends on surface water inputs.
- Was included in a GEF project (2008-2011) to include groundwater into the integrated management of the Nile basin.

2. Baggara (Sudan, South Sudan, CAR): A mostly confined multi-layered system with an average depth to water table of 60m and thickness of 350-400m. High porosity and high horizontal connectivity.



Projects:

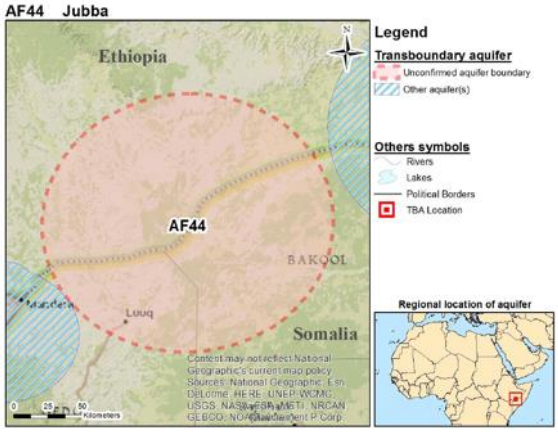
- One of three chosen aquifers in the Horn of Africa Groundwater Initiative (2019-2021), though focus was given to the Merti aquifer.
- Was included in a GEF project (2008-2011) to include groundwater into the integrated management of the Nile basin.

3. Dawa (Ethiopia, Kenya, Somalia): Semi-confined with a depth to water table of 100m and thickness of 200m in Ethiopia, and unconfined with a depth to water table of 6m and thickness of 110m in Kenya. 50% of the aquifer within Ethiopia does not satisfy drinking standards due to natural salinity. The geochemistry and quality of the aquifer has been investigated, unlike the nearby Jubba and Shabelle aquifers.

Projects:

- A water quality study (2009) found that the western portion of the aquifer is less vulnerable to pollution due to greater groundwater depths, but that the eastern portion of the aquifer is susceptible to nitrate contamination.
- A geochemical study (2016) was conducted to gain insight on how increased population growth and the associated farming and waste disposal pollution could impact the aquifer quality.

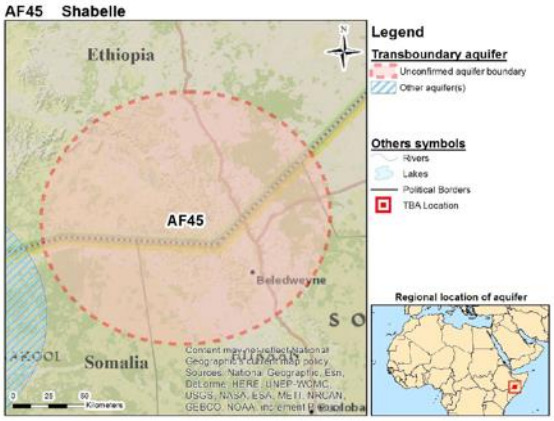
4. Jubba (Ethiopia, Somalia): A fairly extensive aquifer about which very little is known (the aquifer is depicted as round in the image to the right to denote that the delineation is unknown). It is estimated that the depth to the water table is <5 m below ground surface.



Projects:

No projects associated with donor organizations relevant to the aquifer have been identified at this time.

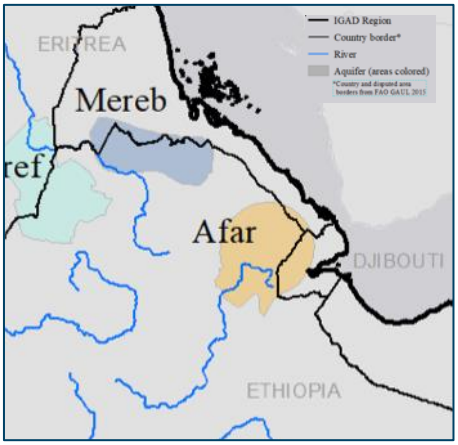
5. Shabelle (Ethiopia Somalia): A mostly unconfined, single-layer aquifer with a water table located 110m below ground surface and an average thickness of 78m. High porosity and yield. The groundwater quality in much of the Somalian portion is unsuitable for drinking due to high natural fluoride. Little else is known about this aquifer (the aquifer is depicted as round in the image to the right to denote that the delineation is unknown).



Projects:

No projects associated with donor organizations relevant to the aquifer have been identified at this time.

6. Afar (Djibouti, Eritrea, Ethiopia): No aquifer information brief available from the TWAP groundwater portal. Groundwater here is available from 60-150m below surface, and is impacted by active volcanic centers and thermal springs (it is sometimes 50°C or higher when extracted).[179]



Projects:

- A recent study (2019) cites that there are no institutionalized monitoring networks, and has attempted to estimate abstraction via other methods.

7. Mereb (Eritrea, Ethiopia): An unconfined, multi-layered system with an average thickness of 40m. Characterized by low porosity and vertical fractures. Most focus appears to be on surface water in the region.

Projects:

- Managed aquifer recharge (MAR) project mentioned in review of transboundary MAR (2020), but original project not found.

[179] Thomas et al., Quantifying increased groundwater demand from prolong drought in the East African Rift Valley, Science of the Total Environment, 2019

8. Gedaref (Ethiopia, Sudan): A mostly confined, multi-layered system with a depth to water table of 63m and thickness of 350m. Low transmissivity, but with vertical and horizontal fractures. The aquifer is a primary source of drinking water in the area, and compared to the other aquifers in the Horn, is well characterized and researched.

Projects:

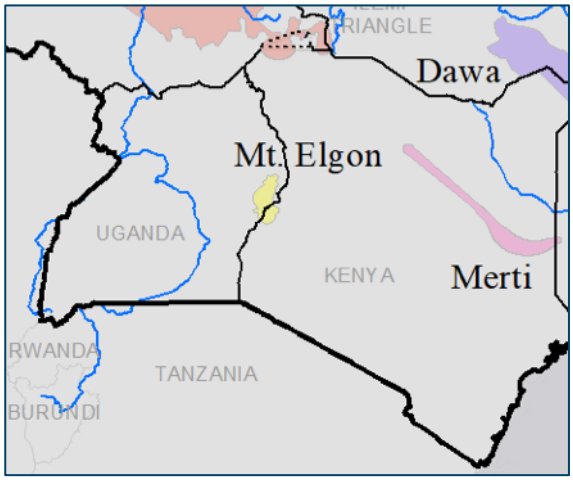
- One of three chosen aquifers in a Groundwater project (2020) funded by the GEF and implemented by the NBI. Pilot projects will be implemented in the study areas.
- A recent GIS study (2019) on Gedaref using GIS. It wound that the quality was suitable for drinking, even though the aquifer is overworked.

9. Merti (Kenya, Somalia): A largely confined aquifer in semi-consolidated sandstone and limestone with a water table located 110m below ground surface. As of 2013, there were 43 boreholes in the Merti, but this number has likely grown in the past decade.[180]

Projects:

- IGRAC project with IGAD has completed a Managed Aquifer Recharge (MAR) (2014) project to assess potential for recharge in the aquifer.
- Acacia Water modelling study (2014) on aquifer drawdown and decreased quality with different water supply scenarios.
- A feasibility study by IGAD as a part of the Horn of Africa Groundwater Initiative Project (2019-2021) to take place starting 2020.

10. Mt. Elgon (Kenya, Uganda): No aquifer information brief available from the TWAP groundwater portal. The aquifer originates from the extinct volcano of the same name and is inconsistent in geometry and composition[181]. A

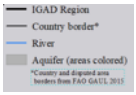


[180] Kuria and Kamunge, Merti aquifer recharge zones determination using geospatial technologies, Journal of Applied Sciences, Engineering, and Technology for Development, 2013
[181] Odida, Aquifer Geometry and structural controls on groundwater potential in Mount Elgon aquifer, MSc Dissertation, 2015

local report showed the water table at 18m depth.[182]

Projects:

- One of three chosen aquifers in a Groundwater project (2020) funded by the GEF and implemented by the NBI. Pilot projects will be implemented in the study areas.
- One of three chosen aquifers in the Horn of Africa Groundwater Initiative (2019-2021), though focus was given to the Merti aquifer.



[182] Earths Scope-Geo Hydro Services, Hydrogeological assessment report, 2012

A.2 Acronyms

AfDB	African Development Bank
AGWIS	African Groundwater Information System
AMCOW	African Ministerial Council on Water
ASAL	Arid and Semi-Arid Lands
AU	African Union
AWF	African Water Facility
BGS	British Geological Survey
BMZ	Federal Ministry of Economic Cooperation and Development
BRIDGE	Building River Dialogue and Governance
CCA	Country Common Analysis
CETRAD	Center for Training and Integrated Research in ASAL Development
CEWARN	Conflict Early Warning and Response Mechanism
CIWA	Cooperation in International Waters in Africa
CRGE	Climate-Resilient Green-Economy Strategy
DAFNE	Decision Analytic Framework to explore the water-energy-food Nexus in complex transboundary water resource systems of fast developing countries
DHI	DHI Center for Water and Environment
DRM	Disaster Risk Management
EAC	East African Community
ECDPM	European Centre for Development Policy Management
EIA	Environmental Impact Assessment
EIB	European Investment Bank
ENTRO	Eastern Nile Technical Regional Office
ESCWA	United Nations Economic and Social Commission for Western Asia
EU	European Union
EU-AITF	EU-Africa Infrastructure Trust Fund
FAO	Food and Agriculture Organization
GEF	Global Environment Facility
GERD	Grand Ethiopian Renaissance Dam
GGMN	Global Groundwater Monitoring Network
GIZ	German Technical Cooperation Agency
G-WADI	Global Network on Water and Development Information for Arid Lands
HoA	Horn of Africa
ICPAC	Climate Prediction and Application Centre
ICPALD	Pastoral Areas and Livestock Development
IDDRISI	Drought Disaster Resilience and Sustainability Initiative
IGAD	Inter-Governmental Authority on Development
IGRAC	International Groundwater Resources Assessment Center
IHE	Delft Institute for Water Education
IHP	International Hydrological Programme (UNESCO)
IPCC	Intergovernmental Panel on Climate Change
ISARM	Internationally Shared Aquifer Resources Management
IUCN	International Union for Conservation of Nature
IWA	International Water Association
IWRM	Integrated Water Resources Management

JMP	Joint Monitoring Programme
KfW	German Development Bank
L/RBO	Local/Regional Basin Organization
LVBC	Lake Victoria Basin Commission
MAR	Managed Aquifer Recharge
MoU	Memorandum of Understanding
NBA	Niger Basin Authority
NBI	Nile Basin Initiative
NBTF	Nile Basin Trust Fund
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEPAD	New Partnership for Africa's Development
NERC	Natural Environment Research Council
NSAS	Nubian Sandstone Aquifer System
OCHA	Office for the Coordination of Humanitarian Affairs
PIDA	Programme for Instrastructure Development in Africa
RICCAR	Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
SADC	Southern African Development Community
SDC	Swiss Development and Cooperation Agency
SDG	Sustainable Development Goal
SECCCI	Support for Effective Cooperation and Coordination of Cross-border Initiatives
SIDA	Swiss Development and Cooperation Agency
SIPRI	Stockholm International Peace Research Institute
SMHI	Swedish Meterological and Hydrological Insitute
SMM	Sio-Malaba-Malakisi sub-basin
SWALIM	Somalia Water and Land Information Management
SWP	Shared Water Partnership
TWAP	Transboundary Waters Assessment Programme
UKAID	UK Development Agency
UNDAF	UN Development Action Framework
UNDP	UN Development Programme
UNDRR	The United Nations Office for Disaster Risk Reduction
UNECA	United Nations Economic Commission for Africa
UNECE	UN Economic Commission for Europe
UNEP	UN Environment Programme
UNESCO	UN Education, Science and Culture Organization
UNHCR	UN Refugee Agency
UNSDCF	UN Strategic Development Cooperation Framework
USAID	US Development Agency
WASH	Water, Sanitation and Hygiene
WB	World Bank
WFP	World Food Programme
WINS	Water Information Network System
WIOSAP	Western Indian Ocean from land-based sources and activities
WLRC	Water and Land Resource Centre
WMO	World Meteorological Organization
WRI	World Resources Institute

A.3 Interviews Conducted

During this study, the following individuals were interviewed. Their perspectives have been incorporated into this work.

Name	Position	Affiliation	Date
Mohammed Hassan	Senior Hydrologist	ICPAC	28-08-2020
Chantal Richey	Senior Water and Sanitation Specialist	WB	01-09-2020
William Rex	Senior Advisor	IWMI	03-09-2020
Chantal Demilecamps Remy Paul Kinna	Environmental Affairs Officer Environmental Affairs Officer	UNECE	07-09-2020
Fred Mwango Khadija Mohamed	Team Leader - Water Unit Project Administrator	IGAD	10-09-2020
Abdulkarim H Seid	Deputy Executive Director	NBI	21-09-2020
Haifa Aboubaker Mohamadou Abdoul	Technical Advisor Advisor	AU Border Programme	22-09-2020
William Rex Rachel von Gnechten	Senior Advisor Research Analyst	IWMI IWMI US	24-09-2020
Eva Ludi Haileslassie, Amare	Country Representative, East Africa Principal Researcher	IWMI Ethiopia	01-10-2020
Sílvia Leirião	Water Resources Engineer	DHI	08-10-2020 & 15-12-2020
Sanne Willem Pablo Molina Del Pozo	Section leader Programme Officer	EU Delegation to Ethiopia – Economy and Infrastructure	17-11-2020
Jean-Baptiste Fauvel*	Programme Manager	EU Delegation to Ethiopia - Energy, Urban WASH, Transboundary Water	17-11-2020
Ian Dupont*	Political Officer	EU Delegation to the AU	17-11-2020
Erwin De Nys Ai-Ju Huang	Director Deputy Director	CIWA	30-10-2020

*Written communication only

A.4 UN Country Offices: Common Country Assessments (CCAs) and related cooperation frameworks

Water in documents	Transboundary mentioned
Djibouti: UNDAF 2018-2022	
-Water desalination as strategic priority as well as wastewater treatment -Focus on WASH and water access	No
Eritrea: SPCF 2017-2021	
- Pillar 1: WASH as a priority: sustained water supply and sanitation coverage -Pillar 2: Environmental sustainability, resilience and **disaster risk management**; -Depletion of groundwater and drought as well as flash flooding exacerbated by climate change. -Ecosystem based **environmental and natural resources management** as UN contribution and strategy (no explicit mention of water)	No
Ethiopia: CCA 2020 & UNSDCF 2020-2024 (drafts)	
CCA: - Stresses importance of transboundary issues and risks and benefits of management of shared natural resources across borders - Jubba-Shabelle and lack of agreements on common utilisation with Somalia - "Insufficient coverage of hydro-meteorological observational infrastructure coupled with low capacity to analyze and model climate and environmental data, has led to inadequate information to support decision-making processes." - "Practically speaking, the country doesn't know how much water is withdrawn or abstracted from the different water sources mainly for economic development (agriculture) and how efficiently that is used to produce." - Mention of IGAD Regional Water Resources Policy and Council of Ministers on Water Resources - Ethiopian government reform of water and sanitation sector - Hydropower	In the CCA amply discussed, among others in executive summary and in paragraph on "neglected transboundary issues" HOWEVER in the cooperation framework no actions on transboundary level are found. Nothing particular related to water is found in cooperation framework.
Kenya UNDAF 2018-2022; Concept note UNRC rapid assessment ASAL	
UNDAF: - WASH is included in priority II of the UNDAF and outcome 2.5 is related to WASH - Strengthening government capacity to implement risk-informed strategies to increase water security, and provide effective response and recovery to drought and flood emergencies through supporting Government of Kenya Flagship Programmes: water resource management programme, trans-boundary waters and water research program (no indicators included in UNDAF) - Outcome 33. By 2022, people in Kenya benefit from sustainable natural resource management and resilient green economy; indicator: Proportion of important sites for terrestrial	Yes, however no concrete actions on this issue stipulated in UNDAF. Concept note repeatedly mentions transboundary issues.

and freshwater biodiversity that are covered by protected areas, by ecosystem type. (SDG 15.1.2) . Baseline: 12.4 % Target: not specified. Data source: KNBS/NVR Concept note: aims to define entry points for designing interventions that deliver sustainable solutions for the management of water resources in ASAL counties under the overall guidance of the **UNRC, UNESCO and UNEP** and technical support of FAO, UNDP and UNICEF. Includes analysis of institutional arrangements, regulatory frameworks and policies and documentation of past, present and future water-related initiatives, projects and programmes "UN agencies such as FAO, UNDP, UN Environment Programme (UNEP) and UNESCO, have been involved in water-related projects and research in ASAL counties, covering issues of groundwater, surface water, transboundary water, water governance, agriculture and community resilience."	
Somalia: CCA 2020, Strategic framework 2017-2020	
Water mentioned in framework of low access to safe water UN resilience portfolios to link up with interventions on climate change and sustainable and equitable management of natural resources, improved water management and related infrastructure … including technical support to natural resource management institutions, and the establishment of early warning systems. Outcome 4.1 related to disaster risk reduction: Government capacities, institutions, policies, plans and programmes strengthened to better prevent, prepare for, respond to and recover from the impact of natural and man-made shocks at Federal, FMS levels and local level Strategic priority 5 includes WASH. Role of UN: Support to strengthening, rehabilitating and maintaining water supply systems including shallow wells and boreholes; Support water policy development, planning and coordination.	No, focus on Disaster risk reduction and WASH; no mention of transboundary water. Mention border conflicts (e.g. Ethiopia) but do not elaborate over natural resource conflicts and no specific mention of water. "In the absence of local reconciliation, disputes among political entities over borders and territory, natural resources, as well as clan tensions over control of nascent administrations persist. " Focus of SF= Support to strengthening, rehabilitating and maintaining water supply systems Support water policy development, planning and coordination ==> Could potentially include transboundary issues however not mentioned in framework of resource management and already many challenges to tackle at national level
South Sudan: Cooperation Framework 2019-2021	
Water mentioned only 4 times in 56 pages. Related to sustainable "water provision", only water-related indicator concerns WASH (Priority Area III: Strengthening Social	No, mention only **"**historical local conflict and competition for natural resources, including

Services): 3.5: % of households with basic water services, disaggregated by sex and geography	land, persist, often with ethnic and inter-communal overtones. “
Sudan: UNDAF 2018-2021	
2.2) UNDAF Focus Area 2: Environment, Climate Resilience and Disaster Risk Management - depletion of groundwater sources -limited environmental awareness and management capacity, scattered environmental information and data, and fragmented coordination. -disaster risk reduction policy and capacity are insufficient UN agencies will support the Government with the integration of best practice in natural resource management. Areas of special interest are natural resource governance including forest and rangelands, water policy, Community-based natural resource management models within the water sector <u>Indicators:</u> - Number of new or amended policies, strategies and programmes that enable secure and equal access to productive resources - Degree of **integrated water resources management** implementation (0-100) - Number of new or amended policies, strategies, programmes and plans integrating environment and climate management and disaster risk reduction 2.3) UNDAF Focus Area 3: Social Services: Water and sanitation; support equitable access to quality water, sanitation and hygiene (WASH)	No
Uganda: CCA 2020; UNDAF 2016-2020	
CCA: Natural water bodies cover some 42,000 km2, or about 18percent of Uganda’s total area () It is therefore imperative that Uganda manages these water bodies in a manner that will promote sustainable use of these resources. () Resources spent in the water and environment () have been especially low (respectively 0.1 per cent () of GDP). UNDAF: Focus on WASH; no mention of transboundary water issues (NOTE: new CF to come out for 2021-2025) The UN and **Ministry of Water and Environment** (MWE) should carry out climate proofing of infrastructure in key sectors such as agriculture, transport, health and water.	No