Cross-border water resources management in the Horn of Africa:

Status and trends in transboundary basins and aquifers

This brief is part of a series of knowledge briefs on “Cross-border water resources management in the Horn of Africa”:

1. Status and trends in transboundary basins and aquifers
2. Regional and transboundary initiatives and frameworks for cooperation
3. Digital platforms for collaboration and decision-making

These knowledge briefs draw on the full report “Transboundary Water Resources Management for Resilience in the Horn of Africa: Mapping of actors, policies, and initiatives”, UNEP-DHI Centre on Water and Environment, 2020. The work supports the UN’s five-year Comprehensive Regional Prevention Strategy for the Horn of Africa (2019-2023), in particular Pillar 4 on sustainable natural resources development and climate resilience.

This knowledge brief gives an overview of: the socioeconomic dependence on transboundary basins and aquifers in the Horn of Africa; threats to socioeconomic development in the form of droughts and floods; the future impacts of climate change and socioeconomic shifts; and the importance of natural resources management for resilience.

This brief is intended as a dialogue starter that may be used in discussions with country governments and other national stakeholders in the IGAD region, UN Country Offices, IGAD, donors, and development partners.

Disclaimers

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Regional water resources

Three-quarters of the people in the Horn of Africa live within river basins and over aquifers that are shared by two or more countries, known as 'transboundary' or 'cross-border' basins and aquifers. Shared understanding and these cross-border resources is vital for sustainable development and management of these resources.

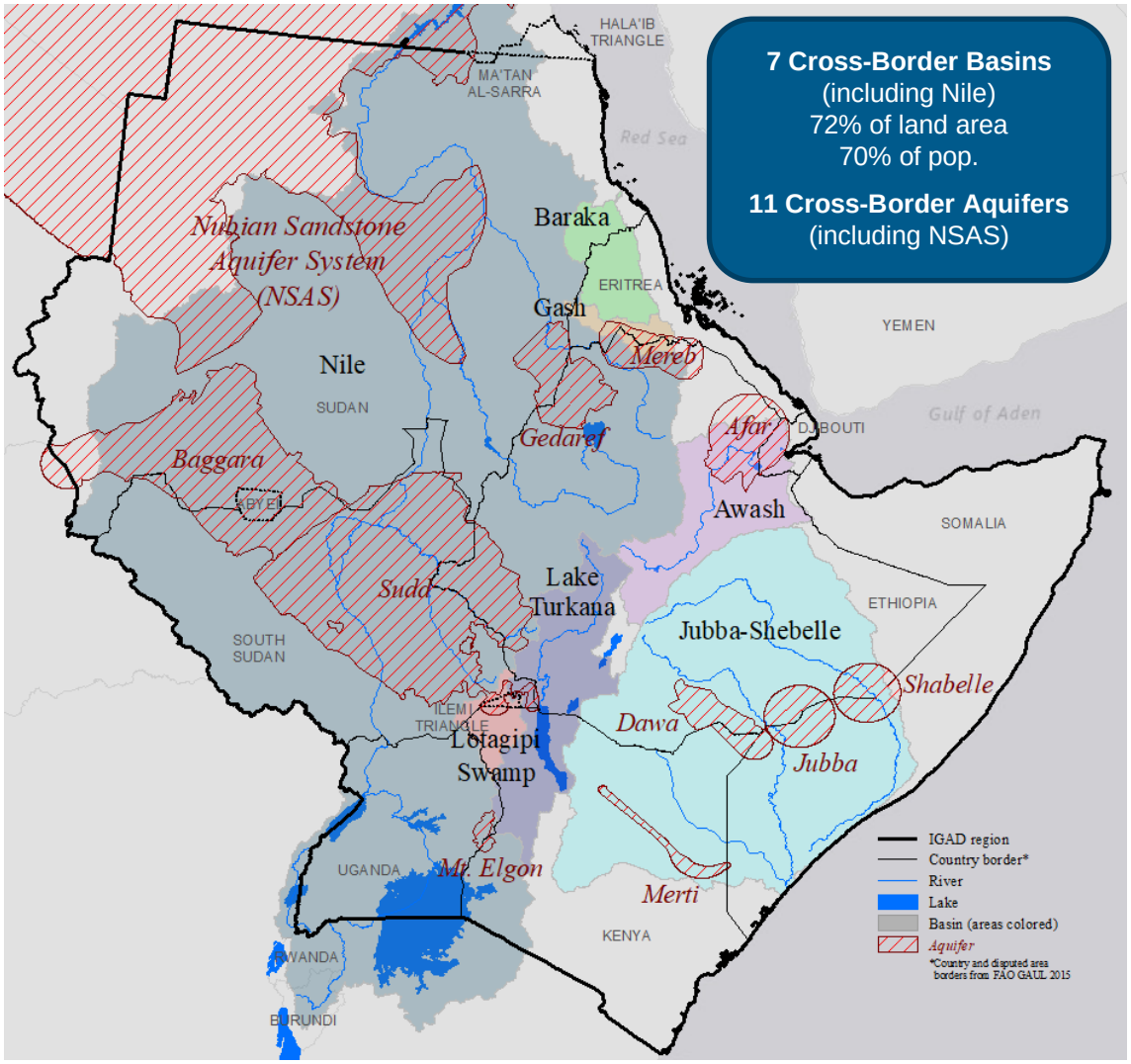


Figure 1 - Transboundary river basins and aquifers entirely contained within the IGAD region (8 countries), as well as the Nile basin and the Nubian Sandstone Aquifer System, which extend beyond the region.[1] Basins are depicted by coloured areas, and aquifers depicted by hashed red areas.

Water for sustainable development

70% of IGAD region characterized as arid or semi-arid (ASAL), characterised by erratic and unevenly distributed rainfall.[2] This aridity shapes water challenges in domestic, agricultural, and industrial water use sectors.

Most rainfall in the Horn occurs in the Ethiopian highlands and around Lake Victoria during the rainy season from June-October.[3] Because of this pattern and Ethiopia's geographically central location, all transboundary basins except two include Ethiopia.

80% of the population of the IGAD region is economically dependent on agriculture and livestock activities, and, from statistics available for Ethiopia, more than 92% of all water used is for crops and livestock.[4,5] Smallholder, rainfed agriculture and pastoralism are the predominant agriculture types; national level investments are currently on large, sedentary agriculture and hydropower schemes to produce food, jobs, and energy for the rapidly growing population. The altered water regimes from this development can cause internal and cross-border conflicts.[6,7]

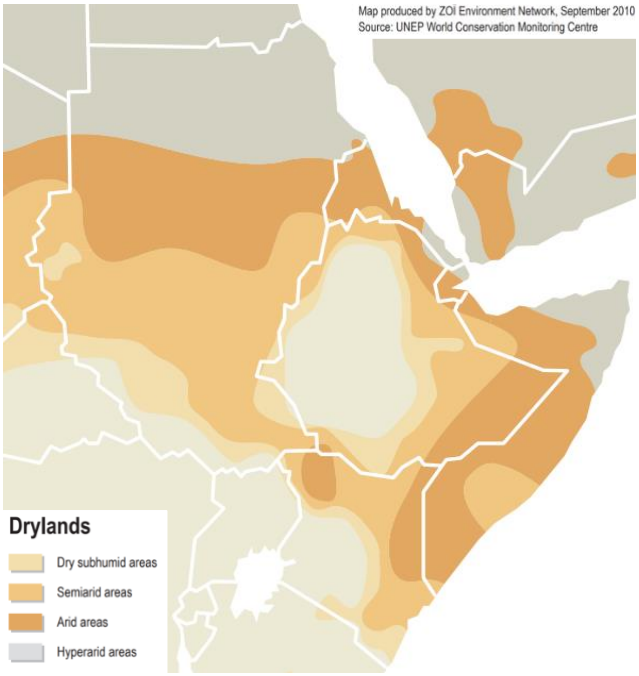


Figure 2 – Drylands based on aridity index in the IGAD region. Note that beige coloured areas are not arid, and grey areas are hyperarid.[1]

Approximately 5% of rural populations in the Horn have access to electricity,[8] and it is expected that expansion of hydropower will be used to meet growing irrigation and energy demand.[9] As of 2019, 11% of potential hydropower in Africa has been utilised, and[10] only Sudan is known to have high hydropower utilisation.[11]

Areas with groundwater aquifers derive 40-100% of their water from this source to overcome rainfall unpredictability and difficulty distributing water to marginal lands.[12] Abstraction in most deep transboundary aquifers in the Horn is below 10% of the recharge rate; there is potential for sustainable development of subsurface water resources.

Knowledge Gaps

Very little known about **groundwater resources**:

- Some aquifers are not well delineated; volume of resource unknown
- Abstraction and use data known for only 1/3 of basin-country units

Data gaps in **hydropower**:

- Impact of hydropower development on existing water resources
- Hydropower utilisation % in Djibouti, Eritrea, Ethiopia, and Somalia

Water scarcity

Land degradation, a major factor for food insecurity, occurs to a high degree in areas with very little rainfall

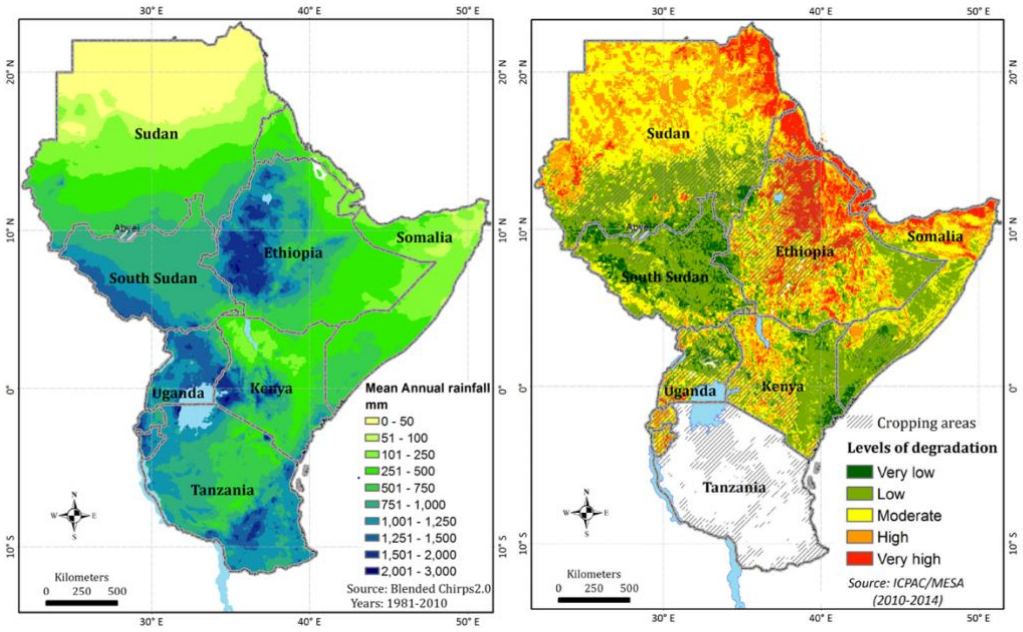


Figure 2 – Mean annual rainfall (left) and land degradation (right) in the greater Horn of Africa region (includes Burundi, Rwanda, and Tanzania).[13]

All countries in the IGAD region have chronically water scarce areas, termed arid or semi-arid lands (ASAL), which receive less than 600mm of rain per year (green and yellow areas in Figure 2, right).[14] The hyper-arid areas in Sudan and Somalia experience Moderate to Very High levels of land degradation (Figure 2, right), 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. Land productivity is a key component of food security for the region.

Drought, acute water scarcity, contributes to ASAL land degradation by affecting vegetation growth and from pastoralists concentrating livestock in remaining viable rangelands.[15] Impacts from drought and consequent land degradation are acute in ASAL areas, where 75% of all labourers are dependent upon smallholder, rain-red agriculture. All countries in the IGAD region, except South Sudan, have experienced six or more serious drought events from 1990-2016 affecting millions of 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.

Knowledge Gaps

Rainfall and temperature data is well known, but:

- **Availability** of water is less well characterized
- **Usage** and **demand**, especially from groundwater resources, is only known on a local scale

Floods

Riverine flooding affects a Medium to Extremely High proportion of the population in the Horn of Africa region.

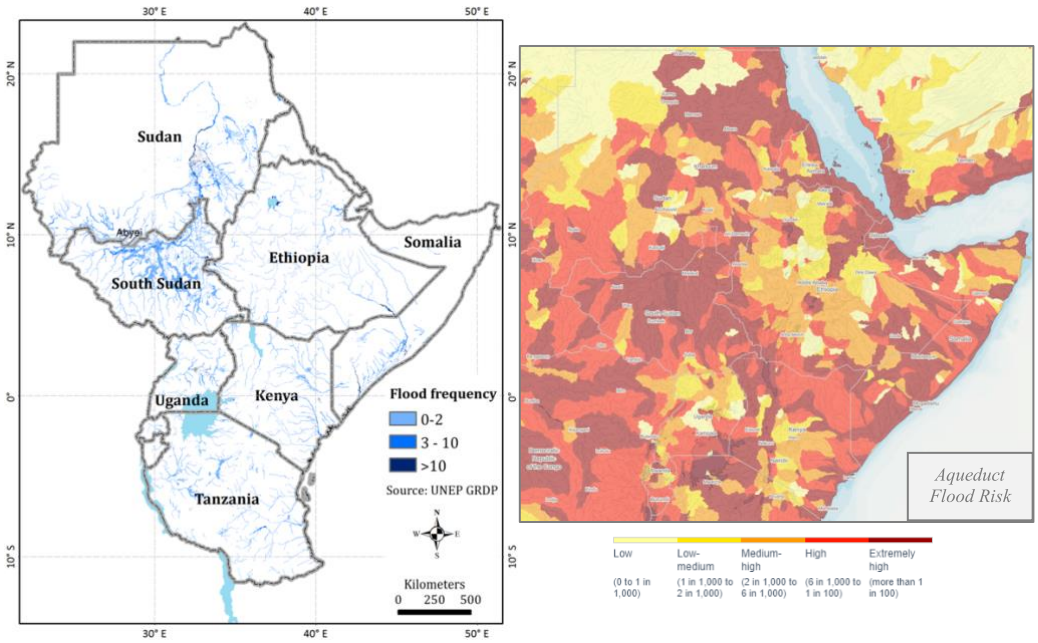


Figure 3 – Left: Riverine flood risk locations and frequency (number of events between 1999-2007) for the greater Horn of Africa.[16] Right: average proportion of population expected to be affected by riverine flooding, accounting for existing flood-protection standards, as assessed by river overflow and population in flooded zone.[17]

Floods occur along all major waterways, especially in low-lying drainage areas (Figure 3, left) as extremely dry periods are followed by intense rainfall.[18] Between 1990 and 2016, each country in the Horn experienced an average of 13 floods – about one every other year. Both a large area and high proportion of the population is impacted in South Sudan (Figure 3).

Damage from flooding acutely affects populations, and flooding can become worsened by openings made on river embankments for irrigation during the dry season.[19] During flood events in Spring 2020, hundreds have lost their lives and hundreds of thousands have been displaced in Kenya alone.[20] Rainfall forecasts that predict extreme events are issued by ICPAC,[21] and in Somalia, disaster prevention initiatives seek to also predict flooding based on areas with riverbank breakages.[22]

Knowledge Gaps

Little water use data is currently known or shared, but it is essential to modelling and predicting river discharge and flooding.

- Reservoir levels, use in irrigation, and capacity for flood mitigation
- Hydropower generation needs and use
- Other infrastructure or human intervention (irrigation channels, dredging)

Projections

Climate and socioeconomic projections are typically produced for mid- to end-century timeframes. This section also analyses changes that are occurring based on current measured growth rates and changes derived from recent historical data.

Knowledge Gaps

Changes in **water demand** related to development aspects, including population growth, migration, and agricultural and industrial development.

Changes in **availability and quality of water resources** from both climate and socioeconomic changes. Information on water quality and groundwater aquifers are particularly wide knowledge gaps.

Climate Changes

Rainfall is predicted to increase in some areas in the region by 20-30% by the end of the century, but change is already impacting farming and food security.

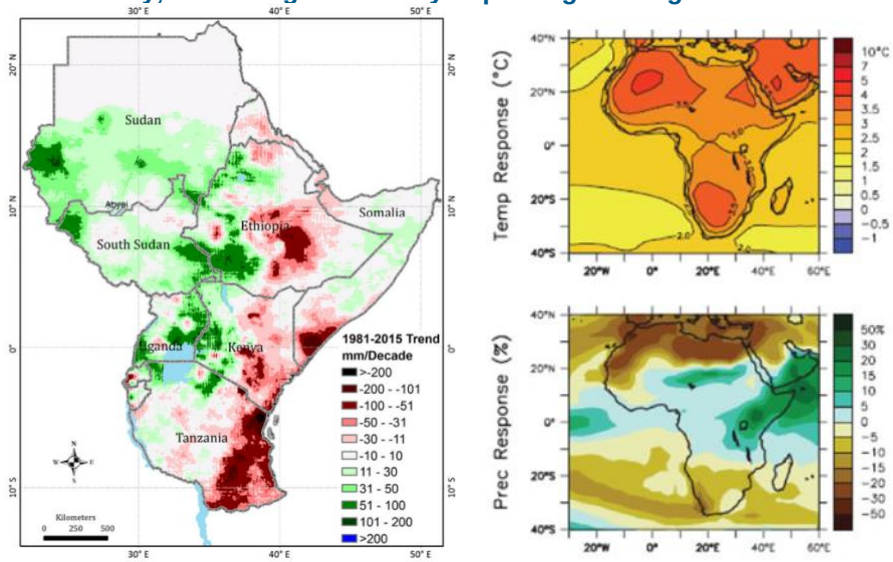


Figure 4 – Left: Precipitation changes in the period from 1981-2015 for the Greater Horn of Africa, hotspots of increased precipitation identified in green, decreased precipitation in red.[23] Right: % difference between historic (1980-1999) and projected (2080-2099) annual temperature and precipitation for the African continent.[24]

ICPAC and the WFP have conducted an extensive analysis of current climate trends in the Greater Horn of Africa region for each month and for each of the three rainy seasons experienced by the region.[25] Areas of decreased precipitation in Ethiopia (Figure 4, left) correspond with areas of increased degradation (Figure 2, right) due to continued agriculture. This decreased productivity contributes to food insecurity in the region. [26] 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.[27] Somalia has already documented increased frequency of extreme rainfall events and flooding.[28]

Mid- and end-of-century projections are varied and uncertain. Consistent predictions include that the number of very wet days, extremely wet days, and warm nights will

increase. 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.[29,30] CIWA reports predicted annual rainfall changes of ±30% in the region by the end of the current century.[31]

Socioeconomic Changes

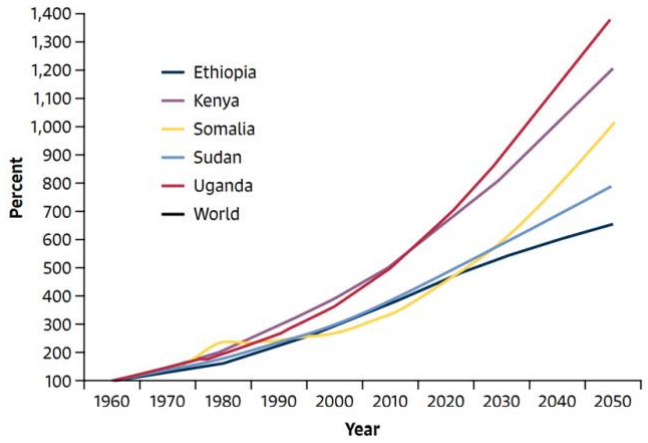


Figure 5 – Projected population growth in the Horn of Africa, total by country as a percentage of the population in 1960 projected until 2060.[32]

At 3%, the population growth rate in the Horn of Africa is among the highest in the world,[34] and all IGAD countries are growing more quickly than the world average.[35]

The population is projected to double every 23 years and grow from the current 240 million to more than 500 million by 2050. This rapid growth is accompanied by an expanding youth demographic – 50% of the Horn is categorized as youth.[36] The youth bulge and rapid growth places pressure on the region to provide adequate jobs, food, and water for the growing population.

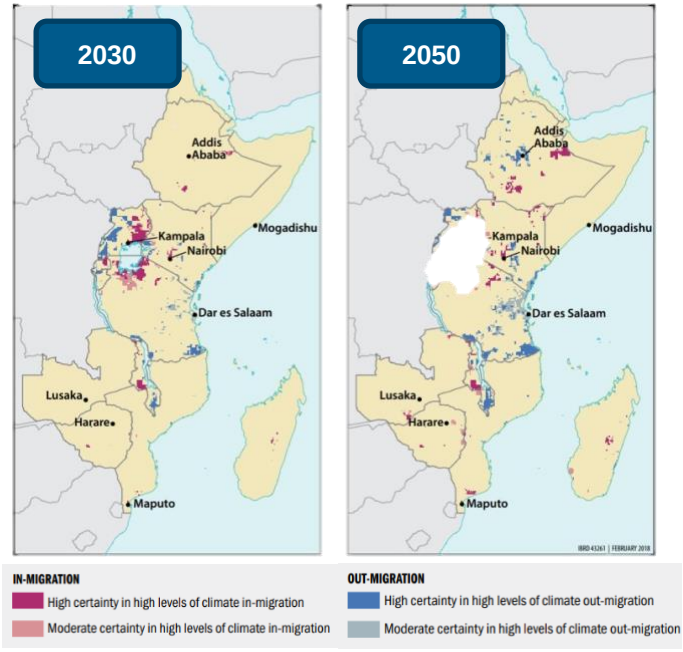


Figure 6 – Migration due to climate change projections for parts of the Horn of Africa region for 2030 (left) and 2050 (right).[33]

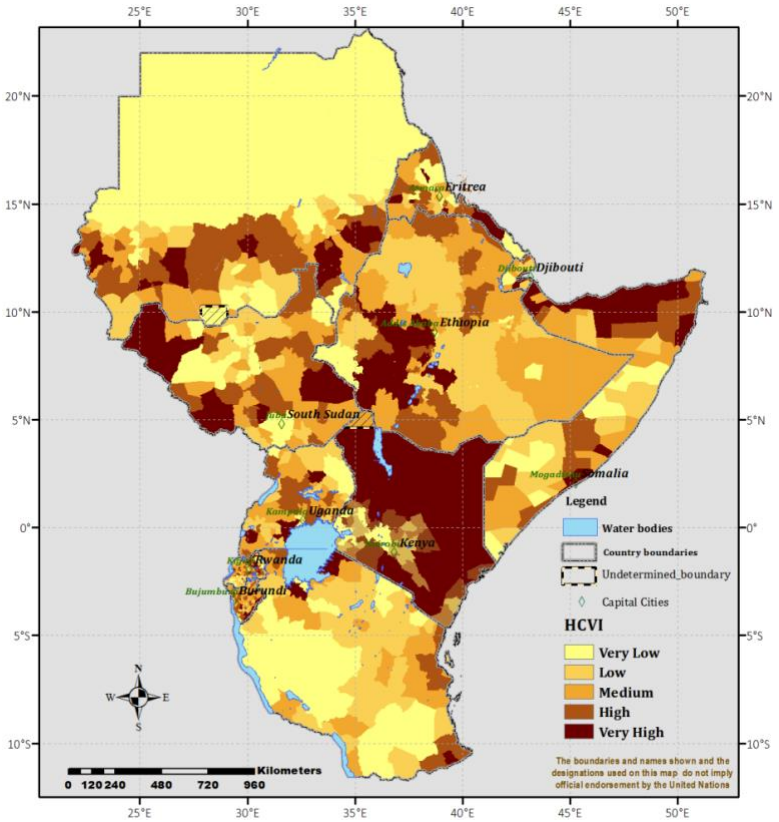
Millions are predicted to migrate within the East African region, which overlaps the IGAD region excepting Sudan and South Sudan, by the middle of the 21st century.[37]

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.[38]

Natural resource intensive agricultural and industrial developments create competition for water between users. Dams are constructed and water is used for irrigation for large plantations and for oil extraction.[39] 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.[40,41]

Natural resources management for resilience

The HCVI, a multidimensional analysis of vulnerability, shows that much of the IGAD region is vulnerable to impacts from changing climate and food insecurity.[42]



Hunger and Climate Vulnerability Index:

$$\text{HCVI} = \frac{Exposure \times Sensitivity}{Adaptive\ Capacity}$$

Indicators Used:

***Exposure*:**

- Frequency of droughts
- Frequency of Floods
- Mean annual temperature

***Sensitivity*:**

- Forest cover area
- Rain-fed agriculture area

***Adaptive Capacity*:**

- Market access
- Total population below poverty line
- Rural population

Figure 4 – Hunger and Climate Vulnerability Index (HCVI) in the Greater Horn of Africa Region. Based on IPCC definitions.[43]

The Hunger and Climate Vulnerability Index (HCVI) 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). Large portions of the Horn are vulnerable to a Medium to Very High degree, and increasing resilience is an important target for the IGAD region.

Good ecosystem management practices and restoration initiatives, such as the Great Green Wall, increase the capacity of the environment to withstand climate change and shock events.[44] IDDRSI and ICPALD both use this comprehensive approach and include water resources in their resilience initiatives.[45,46]

Knowledge Gaps

Information on **water quality** of surface and subsurface water resources and **ecosystem services** is lacking and can therefore not be used in management strategies.

There is a need for better management, which relies on better governance arrangements, and data and analyses (see Management document).

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