PDRI/ISSER Policy Brief 2: Climate change and hydroelectricity shortfalls in Ghana

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Key takeaways:

- Ghana's electricity supply relies highly on hydropower and thermal energy. Unfortunately, its high dependence on water makes hydropower generation vulnerable to extreme weather events associated with climate change. Intermittent floods and droughts are the main impacts on the sector.

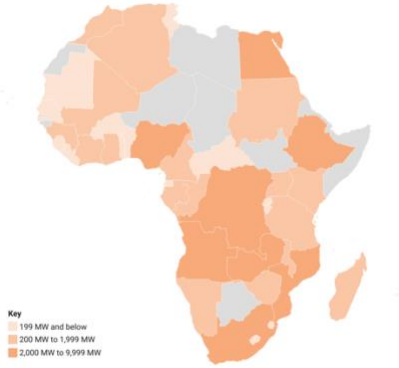
- While power supply has been relatively stable in recent years, Ghanaians have experienced power outages in the past due to either low levels of water in the dams or equipment malfunctioning caused by high levels of water. There is a high probability of more intense weather events in the near future, which can disrupt a reliable supply of energy from hydro plants.

- It is recommended that the country consider the enhanced generation of electricity from new renewables (solar, wind, tidal waves) as part of the energy mix, coupled with sustainable water management, given the unpredictable electricity supply from hydroelectricity sources.

Introduction

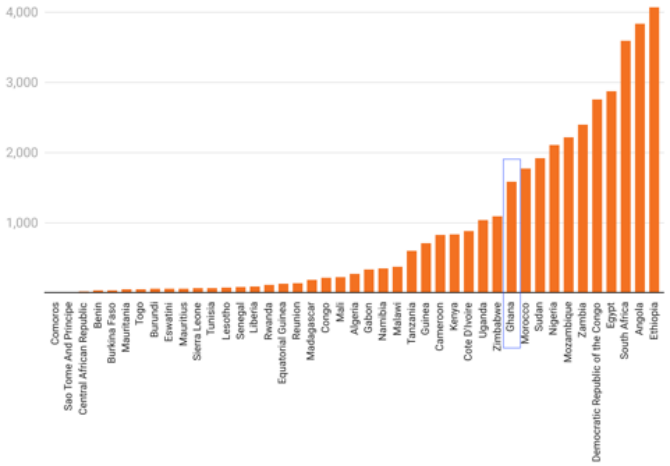
Hydroelectricity or hydroelectric power is generated from the potential energy of falling or fast-flowing water using turbines and generators (Britannica, 2021). It is an important provider of electric power in Africa with about 38GW hydropower installed capacity (iha, 2021). In West Africa, Ghana is one of the main suppliers in the region, providing electricity to its neighbouring countries.

Figure 1: Africa: Installed capacity 2020 (MW)



Source: International Hydropower Association – 2021 Hydropower Report

Figure 2: Africa: 2020 Hydropower installed capacity (MW) by country



Source: International Hydropower Association – 2021 Hydropower Report

Sadly, the country has had episodes of electricity outages since the 1990s, a situation that is exacerbated by increasing demand for electricity due to a rapid population growth. Climate change promises to be an additional challenge for hydropower supply in the country. Indeed, changes are felt in rainfall and temperature patterns in the country, raising water availability issues. This brief presents trends in hydropower

outages and extreme weather events in Ghana over the last two decades, and a short analysis of the implications for public policy.

Methodological Approach

Relevant information on hydropower and climate change in Ghana was gathered from the available databases namely Google, Google Scholar, and Elsevier. Additional statistics were obtained from specific websites such as The International Hydropower Association Website (https://www.hydropower.org), the International Disasters Database (https://www.emdat.be), the World Bank Climate Knowledge Portal (https://climateknowledgeportal.worldbank.org) and the hazard analysis tool from the Global Facility for Disaster Reduction and Recovery (https://thinkhazard.org/en/).

Trends in hydroelectricity shortfalls in Ghana: 2002 - 2022

Hydropower has been an important source of electricity for Ghana post-independence, starting with the construction of the Akosombo dam in 1965 (Brew-hammond, 1996). With increasing demand for energy, additional plants were established at Kpong (1982) and Bui (2013). Consequently, the total hydropower installed capacity in the country is about 1580 MW: 1020 MW at Akossombo, 400 MW at Bui and 160 MW at Kpong (Kuamoah, 2020). Besides hydropower, electricity is also generated in Ghana from thermal facilities and renewable sources.

Figure 3: Aerial view of the Bui generation station

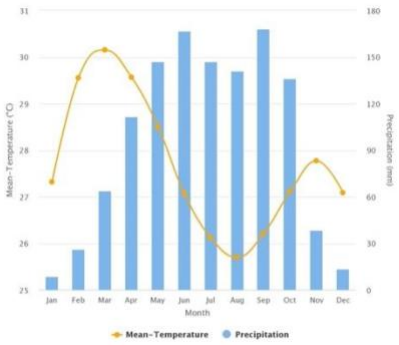
Source: https://buipower.com/bui-hydro-project/

The establishment of various energy sources in the country has made energy accessible to more people but reliability has been an issue. Power outage episodes resulted in the coining of a popular term in the Ghanaian parlance for erratic supply - *dumsor*.

The power shortage crises in the country related to hydropower started in 1983 due to low levels of water in the Akosombo dam resulting from severe droughts. Similar conditions of drought occurred in 2007-2008 and 2012-2015 with poor rains causing malfunctioning of hydropower plants.

Trends in extreme weather events in Ghana: 2002 – 2022

Figure 4: Monthly Climatology of Mean-Temperature and Precipitation in Ghana from 1991-2020



Source: https://climateknowledgeportal.worldbank.org/country/ghana

For decades, the variations observed in the climate have been translated into extreme weather events causing natural disasters around the world. In Ghana, these changes have been felt through disturbances in temperature and rainfall patterns. Indeed, the country has had episodes of rising temperatures causing heat stress and droughts, with rains being unpredictable. There have also been intermittent and heavy rains causing water stress and floods at unusual places and time.

During the last two decades, Ghana has been exposed to extreme hazards such as riverine and flash floods, droughts, and storms. These events have caused important economic losses and displacement across the country (The World Bank Group, 2021).

type of natural disaster	subtype	count of events	total deaths	total affected	total damages ('000 US$)
flood	riverine flood	14	292	1820191	12000
	flash flood	1	13	0	0
storm	convective storm	1	20	12	0

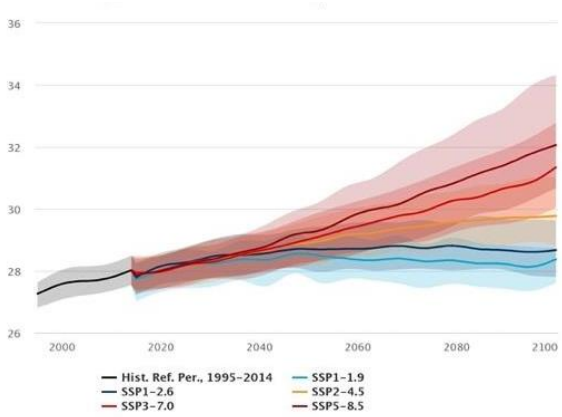
Table 1: Natural disasters in Ghana (2002-2021)

Source: Data compiled from from EM-DAT https://public.emdat.be

Climate projections for Ghana portray a continuous rising of the mean temperature (Figure 5) with lower or higher precipitations over the country (Figure 6). Whatever be

the case, extreme weather events are projected to be more frequent with increasing intensity.

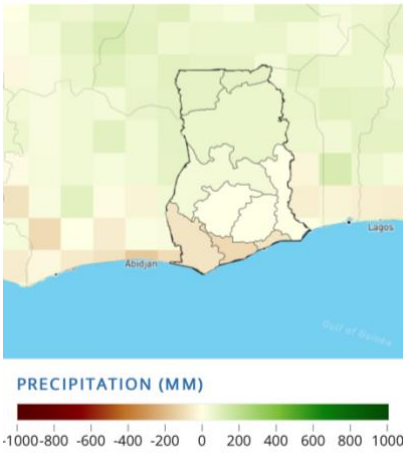
Figure 5: Projected Mean-Temperature Ghana; (Ref. Period: 1995-2014), Multi-Model Ensemble



Source: https://climateknowledgeportal.worldbank.org/country/ghana/climate-data-projections

For instance, a study by Ansah et al. (2020) analyzing the flood situation in Ghana, showing that Accra is likely to register fewer days with more heavy rains while Kumasi is likely to experience more days with less heavy rains.

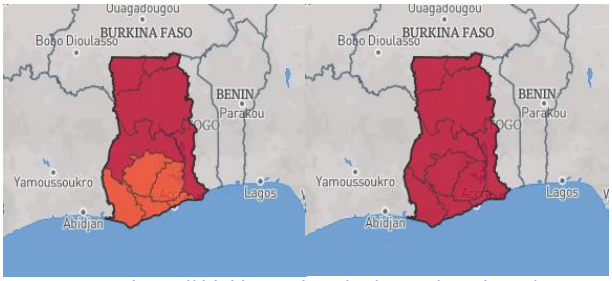
Figure 6: Projected Precipitation Anomaly for 2020-2039 (Annual) Ghana; (Ref. Period: 1995-2014), SSP5-8.5



Source: https://climateknowledgeportal.worldbank.org/country/ghana/climate-data-projections

Natural disasters due to climate change have important impacts on the economic life of a country. In Ghana, they impact food security through agriculture, energy availability and individuals' livelihood.

Figure 7: High risk of extreme heat (left) and river flood (right) at least once in the next ten years



Source: https://thinkhazard.org/en/report/94-ghana/FL

Analysing the linkages: extreme weather events vis-à-vis hydroelectricity shortfalls from 2002 – 2022 in Ghana

Hydropower generation highly depends on water availability at specific levels. Therefore, fluctuations in water supply are likely to disturb the functioning of a hydropower plant. In Ghana, extreme weather events influence generation and supply of hydroelectric power. Extreme heat and low rains decrease the level of rivers, causing low efficiency of hydropower plants, which in turn results in a reduction in electricity generation (Kayaga et al., 2021). On the other hand, heavy rains augment river flows, an advantage for the hydropower plant, but a threat for surrounding communities at risk of flooding. High temperatures cause high demand for electricity from households and industries, but they conversely alter power generation equipment (Bekoe & Logah, 2013). The nexus between climate change and hydroelectricity manifests at various levels. In 2007, Ghana had the severest electric power shortfall due to drought, which reduced power generation from 1180 MW to only 400 MW. The same year, people were displaced due to floods in the river basin.

Policy Recommendations

In the light of the above evidence, hydroelectricity shortfalls in Ghana are likely to remain or worsen as extreme weather events are predicted to be on the rise. It is imperative for the country to consider the enhanced generation of electricity from new renewables (solar, wind, tidal waves) as part of the energy mix in the wake of the unpredictable electricity supply from hydroelectricity sources coupled with sustainable water management.

Acknowledgements

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