



GLOBAL WARMING IMPACTS TO FRESHWATER RESOURCES IN CARIBBEAN SIDS

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Water, by its continuous movement within the Earth and the atmosphere is the primary medium through which climate change influences this planet's natural, physical, chemical and biological systems and processes. Global warming is affecting seasonal rainfall variabilities, precipitation rates, and resulting in uncertainties of freshwater supplies. Fresh water¹ including both surface and ground is a finite resource and essential to sustaining human health, economic, environmental and ecosystem services (UN 2021). The Caribbean small island developing States (SIDS) are highly vulnerable to the impacts of climate change due to global warming. With respect to climate change impacts to freshwater resources, the Intergovernmental Panel on Climate Change (IPCC) in its Sixth Assessment report² presented that there is a medium to high level of confidence that with increasing global warming above 1.5 °C, the Caribbean will become drier due to decreases in precipitation levels. This reduced precipitation and aridity will severely affect the safe availability and accessibility of freshwater resources (IPCC 2021).³

This article focuses on the inter-connectivity of the global warming and climate change impacts on freshwater resources. In demonstration of this relationship, it will discuss evidence of freshwater distribution and the natural water cycle. With a focus on the Caribbean, the article will present the impacts of global warming to the precipitation patterns and other climate change drivers contributing to reduced freshwater availability in this region. It concludes with recommendations that water resources management should be integrated into climate change adaptation policies, and institutional frameworks.

GLOBAL DISTRIBUTION OF WATER RESOURCES

It is estimated that two-thirds of the Earth's surface is covered with water. Of this amount, around 97.5 percent is held in the oceans as salt water.

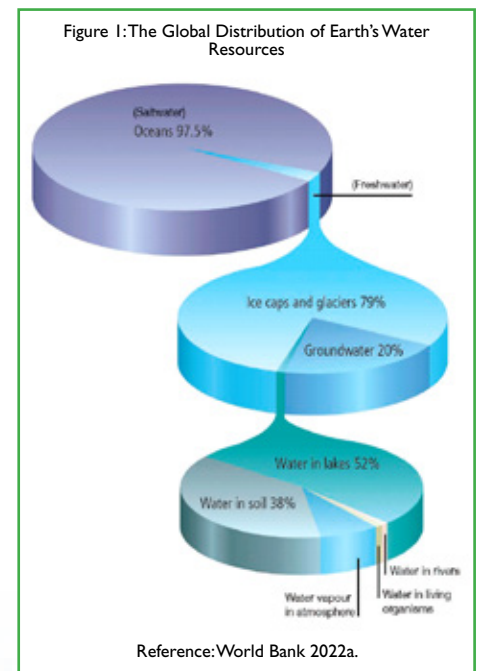
The remaining 2.5 percent is fresh water found in glaciers and ice, as groundwater, and in rivers and lakes. Less than 1% of Earth's water is fresh water supply accessible for human consumption. This proportional distribution of Earth's water is illustrated in Figure 1.

The Water Cycle⁴ and Climate Change: The water cycle is the continuous circulation

of water between the atmosphere, land and the ocean. This distribution and the changing physical states⁵ of water is a vehicle for redistribution of Earth's energy, and influences the behaviour of the planet's weather, climate, and other environmental systems (WorldBank 2022b). It is one of the main planetary systems regulating all life on earth (Sohoulande et al., 2016) . This is illustrated through the water-cycle (see Figure 2- the natural water-cycle).

Climate change impacts on the water cycle: Rising global temperatures and climate change intensify the movement of water through the water-cycle. As air temperature increases due to global warming, more water evaporates. Warmer air holds more water vapour thereby further amplifying the global warming effects.⁶ Climate change and climate variability have impacts on precipitation patterns,⁷ snow cover and increased frequency of flooding and droughts.⁸ These impacts result in freshwater scarcity to meet ecological, social, and economic needs (UNICEF 2022).

Fresh water resources in the Caribbean: The Caribbean is heavily dependent on rainfall as its major source of freshwater, obtained from direct rain and through surface and ground water systems.⁹ The freshwater resource supplies varies across the subregion. This variation is due to such factors as climate change, rainfall pattern



and intensity, and geology., (FAO, 2011). The World Resources Institute (WRI) identified seven Caribbean countries as having "extremely high" levels of water stress.¹⁰ These countries are Dominica, Jamaica, Saint Vincent and the Grenadines, Trinidad and Tobago, Antigua and Barbuda, Barbados and Saint Kitts and Nevis. The latter three are also designated water scarce (WRI 2013).

Freshwater security is a major challenge

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¹ Freshwater does not include water located in the oceans and seas. Ocean water is normally referred to as saltwater. Freshwater is naturally occurring water that contains low concentration of salts.

² International Panel for Climate change (IPCC) have the responsibility for assessing the science related to climate change. The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation reference: see link at: https://www.ipcc.ch/site/assets/uploads/2021/07/AR6_FS_What_is_IPCC.pdf

³ Other socio-economic factors negatively affecting the availability of freshwater supplies are: pollution, the overexploitation of surface, ground and coastal waters, change in land use, saline intrusion, soil erosion, inadequate wastewater treatment and the lack thereof.

⁴ The water cycle is also called the hydrologic cycle.

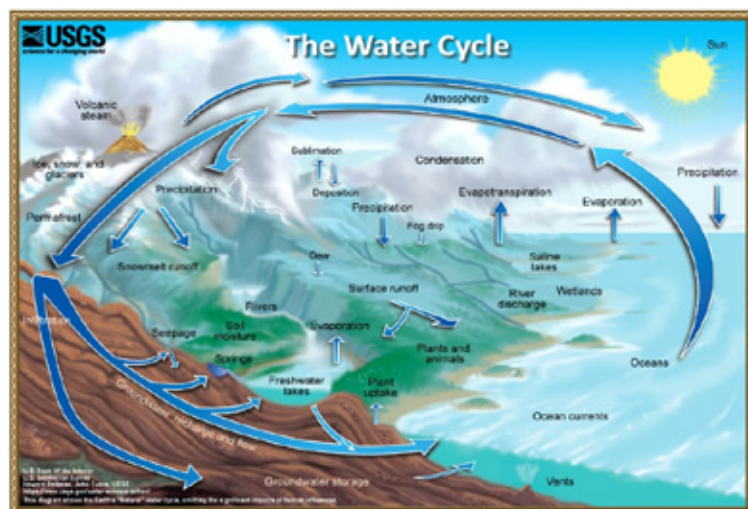
⁵ These physical states are gas, liquid and solid.

⁶ Water vapour is a greenhouse gas. Due to its heat trapping ability, it plays a key role in the global climate system.

⁷ Precipitation Patterns or rainfall patterns describes geographical, temporal and seasonal distribution of rainfall

⁸ Note that these impacts are not globally uniform.

Figure 2: The Natural Water Cycle



Reference: The natural water cycle, <https://www.usgs.gov>

for many Caribbean countries, with some having high scarcity¹¹ due to such factors as pollution, watershed degradation, salt-water intrusion, and increasing demand for potable water. Hydroclimatic impacts including floods, landslides, storms, sea-water storm surges and droughts further reduces the availability of freshwater resources (CARICOM, 2021).

CONCLUSIONS AND RECOMMENDATIONS

The increasing trend in global warming and resulting reduced precipitation due to climate change impacts, will exacerbate freshwater stress in the Caribbean. Gaining a better understanding of this vulnerability, and integrating the management of freshwater systems to climate change adaptation measures are necessary for sustainable development. Selected recommendations for this purpose are as follows:

1. **Water resources management:** Sustainable water resources management must be integrated with climate change policies, financing, legislation and institutional framework(s). This integration must be data-driven and systemized at all levels including, inter alia, the protection and restoration of watersheds, water use efficiency, forestry management,

land-use and coastal zones planning and management, pollution prevention and control, health and sanitation, human and institutional capacity building.

2. **Disaster Risk Management:** Fresh-water resources management must be a defined component in the planning, mitigation, forecasting¹² and preparedness, response and recovery stages of disaster risk management. This association is necessary, considering that most of the hazards due to climate change impacts are water-related, including flooding, landslides, coastal erosion, fresh water salination, and droughts.¹³

3. **Integrating climate change research,** scientific assessments and adaptation strategies in the planning, development and operations of water resources management systems and infrastructures. This will also require the building of capacities, knowledge sharing and engagement of all stakeholders, including local and national authorities, women, youth, indigenous and community groups, academia and the private sector. ■

REFERENCES

CARICOM (2021), The Caribbean Community: CARICOM Today: Ministerial Meeting on Water Security for Small Island Developing States of the Caribbean, link: <https://today.caricom.org/2021/04/14/ministerial-meeting-on-water-security-for-small-island-developing-states-of-the-caribbean/>, cited July 20, 2022

FAO (2011), Food and Agriculture Organisation: The State of the World's Land and Water Resources for Food and Agriculture- Managing systems and risk: link: <https://www.fao.org/3/i1688e/i1688e.pdf>, cited June 1, 2022

IPCC (2021), Intergovernmental Panel on climate change, link: https://www.ipcc.ch/report/ar6/wg1/downloads/factsheets/IPCC_AR6_WGI_Regional_Fact_Sheet_Small_Islands.pdf, cited July 26, 2022

Moss, S. and Moultrie, S. (2014). Ecological Gap Analysis: GEF FSP Sustainable Network of MPAs – The Bahamas. Nassau, Bahamas: The Bahamas Environment Science and Technology Commission (BEST) Commission, cited July 26, 2022

Sohoulande, Clement & Djebou, Sohoulade & Singh, Vijay. (2016). Impact of climate change on the hydrologic cycle and implications for society. *Environment and Social Psychology*. 1. 10.18063/ESP.2016.01.002.

World Bank (2022a), Earth's water, the World Bank, link: <https://olc.worldbank.org/sites/default/files/sco/E7B1C4DE-C187-5EDB-3EF2-897802DEA3BF/Nasa/chapter1.html>, cited July 15, 2022

World Bank (2022b), Earth's water, the World Bank, link: <https://olc.worldbank.org/sites/default/files/sco/E7B1C4DE-C187-5EDB-3EF2-897802DEA3BF/Nasa/chapter1.html>, cited July 15, 2022

WRI (2013) World Resources Institute, Water stress by country available at: <https://www.wri.org/data/water-stress-country>, cited July 14, 2022

UNICEF (2022): United Nations International Children's Emergency Fund, Water and global crisis: 10 things you should know, link: <https://www.unicef.org/stories/water-and-climate-change-10-things-you-should-know>, cited July 14, 2022.

UN (2021), United Nations International Decade for Action 'Water for Life' 2005-2015, link: <https://www.un.org/waterforlifedecade/iwrm.shtml>, cited September 3, 2021.

⁹ Countries also employ salt-water desalination to meet potable water demands.

¹⁰ Water Stress occurs when the demand for water exceeds the available amount during a set period or when poor quality restricts intended use; available at: <https://www.eea.europa.eu/archived/archived-content-water-topic/wise-help-centre/glossary-definitions/water-stress#:~:text=in%20your%20browser-,HelpCenter%20Definition,%2C%20dry%20rivers%2C%20etc.>, cited July 14, 2022

¹¹ Water Scarcity is when there is a scarcity in availability due to such factors as shortages in regular supplies or due to lack of adequate infrastructure, reference UN Water, available at <https://www.unwater.org/water-facts/scarcity/>, cited July 1, 2022.

¹² See for example: Caribbean Drought and Precipitation Monitoring Network (CDPMN) being undertaken by the Caribbean Institute for Meteorology and Hydrology (CIMH Caribbean Regional Climate Center, link: <https://rcc.cimh.edu.bb/climate-monitoring/caribbean-drought-and-precipitation-monitoring-network/>, cited August 14, 2022

¹³ Global Facility for disaster Reduction and Recovery, link: <https://www.gfdrr.org/en/crews-caribbean> cited June 16, 2022