

Impact of Climate Change on Water Resources in Somalia

Hüseyin Gökçekuş¹, Youssef Kassem^{1, 2,*}, Abdifatah Mohamoud Yusuf³

¹Department of Civil Engineering, Civil and Environmental Engineering Faculty, Near East University, via Mersin 10, Turkey, Nicosia 99138, Cyprus; (H. Gökçekuş) and (Y. Kassem)

²Department of Mechanical Engineering, Faculty of Engineering, Near East University, via Mersin 10, Turkey, Nicosia 99138, Cyprus;

³Department of Civil Engineering, Civil and Environmental Engineering Faculty, Mersin 10, Turkey, Nicosia 99138, Cyprus;

Abstract Climate change is described as a shift in the seasonal fluctuation of weather conditions through time. It is caused by variations in the amount of precipitation, temperature, evaporation rate, and solar radiation received by the planet. Aside from that, human activities have been identified as significant causes of climate change, also known as global warming, and all regions of the world are expected to experience a net negative impact of climate change on water resources and freshwater ecosystems, with intensity and characteristics varying significantly from region to region and city to city. It's important noting that flash floods and droughts are a global threat, and that these intricate catastrophes must be addressed. As a result, it is critical to understand the climate in order to ensure appropriate supplies of high-quality water for all people living today and in future generations, as well as to maintain ecosystem functioning. The Standardized Precipitation Index (SPI) has been used to track droughts induced by precipitation changes caused by climate change. The primary effects of climate change on water resources in Somalia have been discovered to include rising temperatures, variations in precipitation patterns, and an increase in the likelihood of floods and droughts. Climate change may have a considerable impact on seasonal variations in river flow.

Key Words: drought, flash floods, river flood, climate change, water resource.

1. INTRODUCTION

Somalia is suffering from acute water scarcity as a result of its reliance on erratic yearly precipitation. Climate change's impact on freshwater resources is a major worry, as it may exacerbate the problem of water scarcity. As a result, in order to achieve efficient management and sustainable use of available water resources, climate change must be adequately handled. In this paper, incremental climate change scenarios are used to evaluate the effects of climate change on water resources in Somalia. The most common variables are decreased yearly precipitation and temperature changes, which result in water loss through evaporation and evapotranspiration, as well as unexpected catastrophic flash floods. However, the purpose of this research is to evaluate and analyze the effects of historical and future climate change on Somalia's water resources.

Climate change affects the Earth's ecosystems, and thus people's livelihoods and well-being, primarily through the medium of water. Apart from climate change, present demographic trends, economic development, and related land use changes all have a direct impact on rising freshwater demand. When taken collectively, these supply and demand fluctuations have an impact on the vulnerability of water resources.

There is no commonly agreed approach for analyzing vulnerability, hence the concept of 'vulnerability' is complicated. Freshwater systems are part of broader ecosystems that support life as well as all social and economic activities. Freshwater availability is thus an ecosystem function that, if interrupted, poses a hazard to both the health of ecological systems and human well-being, which are intertwined. Climate change has an impact on the Earth's ecosystems, people's livelihoods, and overall human well-being through the principal medium of water.

1.1. Problem statement

1.1.1 Drought

Somalia began the decade with the worst drought in decades in the area. From then, things would only get worse. A drought began in 2015 and continues to this day. Somalia has only seen one decent rainy season since 2011, in 2013, with the subsequent years falling far short of the typical two rainy seasons per year. Despite the fact that conflict and displacement make it difficult for anybody to collect precise hunger data for Somalia, there is still cause for concern. Food availability has been restricted by fighting, and over 2.6 million people (almost 20% of the country's population) have been internally displaced as a result of conflict, floods, and food scarcity. In 2019, Somalia had the highest child mortality rate of 12.7 percent among all countries examined. One of the key elements driving all of this is Somalia's long history of drought.

1.1.2 Floods

In Somalia, there are two forms of flooding: river floods and flash floods. River floods occur in the Juba and Shebelle rivers in southern Somalia, while flash floods are common

among intermittent streams in the north. The intensity and frequency of floods in the nation have lately increased. The Deyr floods of 1961, 1977, 1997, and 2006, as well as the GU floods of 1981 and 2005, were the most recent severe floods in history, according to prior analyses. The floods resulted in the loss of human life as well as considerable economic losses. River flooding in the Juba and Shebelle rivers is mostly driven by runoff from catchment regions in the Ethiopian highlands, which get more and more frequent rainfall than Somalia.

Flooding began across the country in late April. On May 7, 2021, heavy rains in Mogadishu produced devastating flash floods, destroying structures in the Wadajir District and killing nine people. By mid-May, impacting hundreds of people. Floods in Jowhar district have displaced 66,000 people from 27 towns, ruined over 40,000 hectares of crops, interrupted learning in 12 schools, and damaged breakages along the Shebelle river's banks near Jowhar had caused catastrophic flooding in the region, 82 percent of WASH facilities, according to the UN Office for the Coordination of Humanitarian Affairs. River breakages have resulted in flooding. Over 22,000 people were displaced in Belet Weyne town, and 1,235 hectares of crops were destroyed.

1.2. Purpose of the study

After this study the people of Somalia will get a place to read about the effects of the climate change on their water resources which will rise their awareness of water conservation and environment in general To identify and consider the benefits of possible mitigation measures and developing different scenarios and policy options

To increase awareness of and promote research on how water sources are affected by climate change in terms of quality and quantity Considering drought affects water availability to many sectors, resulting in environmental, health, social, and economic consequences, one of the goals of this study is to provide a convenient, concrete proof resource or utility that can be utilized in drought risk management decision-making.

2. METHODOLOGY

2.1. Study Area

Somalia is a country in Africa's Horn. Ethiopia to the west, Djibouti to the northwest, the Gulf of Aden to the north, the Indian Ocean to the east, and Kenya to the southwest form the country's borders. Somalia has the longest coastline on the continent of Africa. Plateaus, plains, and highlands make up the majority of the topography. Year-round, hot weather prevails, with monsoon winds and sporadic rains.

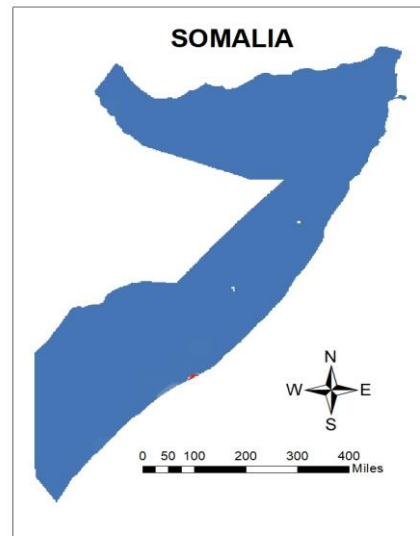


Fig -1: map of Somalia.

2.2. Standard Precipitation Index (SPI)

The SPI (Standard Precipitation Index) is a new drought index that is only dependent on precipitation. Positive SPI numbers indicate more precipitation than the median (i.e. wet circumstances), whereas negative values suggest less precipitation than the median (i.e. dry conditions). (SPI), has been used to monitor drought caused by climate due to precipitation differences.

SPI Index values	Drought Category
2.0+	Extremely wet
1.5 to 1.99	Very wet
1 to 1.49	Moderately wet
0 to 0.99	Normal wet
0 to -0.99	Normal drought
-1.0 to -1.49	Moderately dry
-1.5 to -1.99	Severely dry
-2 and less	Extremely dry

Table-1: SPI values.

2.3. Data availability and analysis

The data in this research is Satellite data for the Temperature and Actual data of the precipitation. In the research we evaluated the impact of climate change on water in Somalia from 2009 to 2017 using data collected from different sources, Data is analyzed using Excel spread sheet for graphs, tables and charts and for the comparison of rainfall with temperature variations.

3. FINDINGS AND DISCUSSION

As a result of climate change, intense precipitation and flash floods are becoming increasingly relevant. They are intimately connected and are recognized as a global threat. As a result, it's necessary to track and assess how climate has changed in the past in order to safeguard people and critical infrastructure. Table 2 shows average monthly temperature (°C) for 9 years' data in Mogadishu. It may be seen that 2012 was the hottest year with an average temperature of 27.158 °C and the lowest was 2013 at 26.74 °C. Throughout these 9 years, temperature varies by 0.418 °C. The wettest year was 2013 with an average of 40.308 mm of rain. Rainfall is at its lowest, with an average of 11.28 mm. the difference in precipitation is 29.028 mm between the driest and wettest years.

Years	Average Rainfall (mm)	Average Temperature (°C)
2009	33.00833	27.03833
2010	19.6	26.91083
2011	20.50833	26.90667
2012	11.28333	27.15833
2013	40.30833	26.74417
2014	21.7	26.8075
2015	19.7667	27.12417
2016	29.425	26.87917
2017	27.45833	27.0325

Table-2: Mogadishu Average Annually Rainfall and Temperature variation

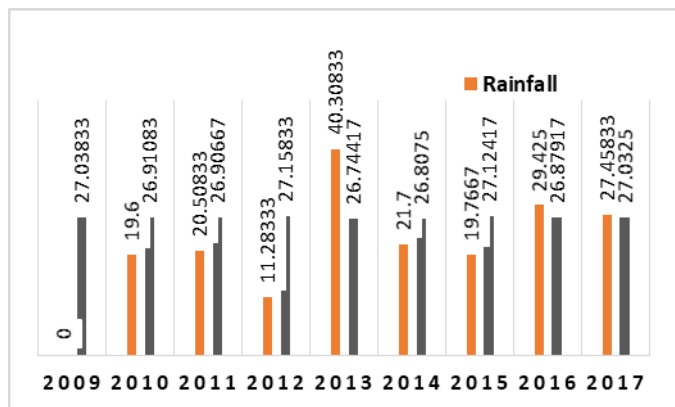


Fig -2: Comparing average Annually Rainfall and Temperature.

Drought comprises a water shortage due to an imbalance in water supply caused by decreased precipitation, Table-3 shows SPI results of four cities. Based on different time periods. SPI based on precipitation data from 2009 to 2017 of Bosaso and Berbera estimates the severity of drought, while SPI calculated based on precipitation data from 2009 to 2017 estimates the wetness situation. In addition Figure-1 shows that 2012 was the driest year in Somalia between the years of 2009 to 2017

City SPI	Drought Category
	Extremely wet
	Very wet
	Moderately wet
Garowe (0.084404), Mogadishu (0.3)	Normal wet
Bosaso (-0.144), Berbera (-0.249)	Normal drought
	Moderately dry
	Severely dry
	Extremely dry

Table-3: drought categories in four cities

4. CONCLUSIONS

Climate change became a progressive concern in the globe in last decades due to it is an impact on environmental, social and economic which is varies depending on site. Recent climatic trends are consistent with future projections in Somalia in terms of

Temperature increase in the coastal area, as well as precipitation reduction. Such impact is highly relevant since most of the population in Somalia depend on productive activities, such as Agriculture and Livestock. In this study I presented one approach which resulted to be suitable for evaluating drought which is one of the worst results of climate change.

REFERENCES

- [1] Somalia National Adaptation Programme of Action to ClimateChange<https://unfccc.int/resource/docs/napa/om01.pdf>
- [2] "Impacts of Climate Change on Water Resources inChile",December2020. https://www.researchgate.net/publication/346953587_Impacts_of_Climate_Change_on_Water_Resources_in_Chile
- [3] Nasser Rostam Afshar and Hedayet Fahmi, "Impact of climate change on water resources in Iran", <https://link.springer.com/article/10.1007/s42108-019-00013-z>.
- [4] Vulnerability Assessment of Water Resources Systems in the Eastern Nile Basin. <https://link.springer.com/article/10.1007/s11269-009-9404-7>
- [5] Saroj Shrestha "Impacts of Climate Change on Water": A Review Article, December 2020.
- [6] Ahmed and Mohamed E Community Perception Study on the Impact of Shebelle River Floods on Livelihoods in

Baled Wayne District, Hirsh Belle State in Somalia
<http://erepository.uonbi.ac.ke/handle/11295/154251>

- [7] Analysis of flood magnitude and inundation mapping: case study of beledwayne town the wabi shebele river basin.
- [8] Hüseyin Gökçekuş, Youssef Kassem and Abdifatah Mohamoud Yusuf. "Sustainable Flood Retention Basin in Beledweyne City Somalia", December 2021. <https://www.irjet.net/archives/V8/i12/IRJET-V8I12242.pdf>
- [9] Arjumand "Hydrologic impact of climate change in semi-urban watersheds, 2012" Thesis for the degree of master of applied science, Bangladesh Univ. of Engineering and Technology.