BANGLADESH UNDERWATER: EXPLORING THE GLOBAL AND NATIONAL PERSPECTIVES ON FLOODING

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Floods have become an alarming regularity in the riverine areas of Bangladesh, resulting in loss of life, collapsed agriculture, and damage to property. The purpose of the urgent measures required in Bangladesh's flood crisis is to minimize floods and reduce health hazards, and economic impacts. Available data highlight the widespread occurrence and associated risk factors for the flood crisis in Bangladesh. According to WHO (2020), the global impact of floods between 1998 and 2017 affected more than 2 billion people, underscoring the severity and widespread nature of this natural disaster. Bangladesh experiences four types of floods: flash floods, local rainfall floods, monsoon river floods, and storm-surge floods. Drawing on lessons from past flood events, the article explores adaptation mechanisms and policy interventions aimed at enhancing resilience and sustainable development. The governments, local authorities and youth are urged to address the current crisis by coordinating and integrating multiple effective efforts to prevent flood-related economic losses and deaths.

Keywords: *climate change, disaster management, flood control, vulnerability, economic loss.*

Natural disasters are devastating catastrophes that cause property damage, agricultural collapse, and human casualties. Disasters are inherent occurrences that destroy homes, infrastructure, and agricultural production and can lead to human casualties. Disasters force people to become internally displaced, abandoning their homes or usual places of residence and seeking temporary or extended duration refuge elsewhere. The Internal Displacement Monitoring Centre reports that between 2008 and 2018, natural disasters forced the evacuation of approximately 26.4 million people annually, of which

Recommended citation: Islam J., Sarkar D., Mim F. Bangladesh Underwater: Exploring the Global and National Perspectives on Flooding. *Journal of Globalization Studies*, Vol. 16 No. 1, May 2025, pp. 99–106. DOI: 10.30884/jogs/2025.01.07.

26.14 per cent were from South Asia (Torres and Casey 2017). Since 2018, storms (34.54 %), earthquakes and tsunamis (12.23 %), and wildfires (0.61 %) have been the leading causes of population displacement, with floods accounting for 50.62 % per cent of this total (Uddin and Matin 2021). One of the most prevalent and catastrophic forms of natural disaster on Earth is flooding.

Flooding is a natural disaster that involves a massive amount of water in a particular place due to natural causes such as heavy rainfall, river overflows, tidal surges, or other causes like dam leaks, poor drainage systems, poor housing, and global warming. Floods result in the destruction of a nation's physical and social infrastructure, transport systems, and assets, which are commonly referred to as 'direct damages', and such damages cause disruptions in economic activities (Haque and Jahan 2015). Although floods do occur naturally, however, some that have taken a heavy toll on lives and property are man-made failures such as dam bursting, urban flooding and debris flows in densely populated areas.

According to the World Health Organization (WHO 2020), more than 2 billion people worldwide were affected by floods between 1998 and 2017. In addition, the World Meteorological Organization reports that between 1970 and 2012, storms and floods caused more than one million deaths (WHO 2020; WMO 2020). Floods have caused numerous fatalities worldwide over the past decade. Asia, particularly countries like India, Nepal, and Bangladesh, has experienced a significant number of flood-related deaths, with more than 5,000 deaths since 1985 (Petrucci 2021).

In 2010, approximately one-fifth of Pakistan's territory was flooded, affecting 20 million people and causing nearly 2,000 deaths, with economic losses estimated at around US$ 43 billion (Riaz *et al.* 2023). A year later, another monster flood hit South-East Asia. The flood event extended across several countries and several separate limited flood events affected parts of the same countries: Thailand, Cambodia, Myanmar and Viet Nam. Meanwhile, the Lao People's Democratic Republic also suffered flood damage, with the death toll approaching 3,000 (UNDRR 2017). If we consider Thailand alone in terms of economic losses, this flood ranks the fourth costliest disaster in the world as of 2011, with a total loss of $14.7 billion and a reduction in the country's GDP of 4.81 per cent (Taguchi *et al.* 2022). The economic costs associated with floods in Zimbabwe is $274 million, while the Cyclone Kenneth caused costs of up to $300 million (Nhundu *et al.* 2021). Additionally, floods have had a significant impact on urban economic activity, affecting jobs and transport infrastructure. Over the period from 2000 to 2021, there were 225 relevant natural disasters in EU countries, causing an estimated total direct damage of US$ 186 billion (Dottori *et al.* 2023). Among these, floods were the most prevalent type of disaster, accounting for 40 per cent of all disasters. Moreover, they caused more than half of the recorded damages, accounting for 59.2 per cent of the losses (Steinhausen *et al.* 2020). In particular, the 2014 floods in south-eastern Europe killed 80 people and caused over US$ 3.8 billion in economic losses (Paprotny *et al.* 2018). The map in Figure 1 shows the extent of flooding around the world and the countries affected by major floods in 2021–2022.

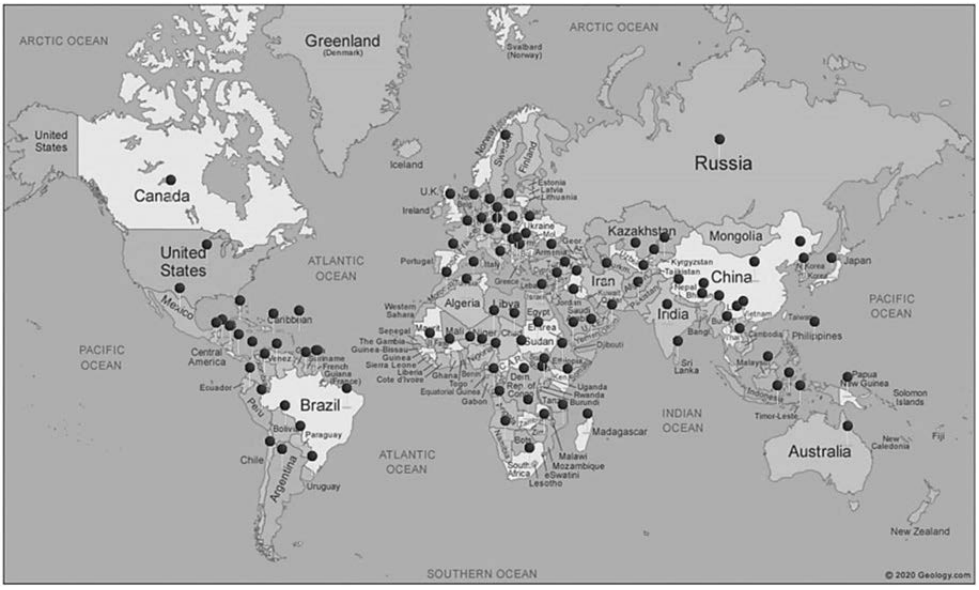

Fig. 1. Countries affected by floods across the world, 2021–2022

Source: Bouchard *et al.* 2023.

Situated in a vast river delta barely above sea level, Bangladesh faces natural challenges like river flooding and bay-borne cyclones. More than 35 million people in Bangladesh's coastal zone are at risk of losing their lives and livelihoods due to increasing flood risks, salinization, and waterlogging (Barbour *et al.* 2022). Tragically, death by flood has been a recurring theme in Bangladesh's history. Since 1972, a total of 86 floods have occurred in Bangladesh, resulting in the loss of 42,279 lives (Baten *et al*. 2018). The devastating flood that hit Bangladesh in 1998 covered 68 per cent of the country, impacted 77,700 square kilometers, killed 2,379 people, washed away 3.2 million tons of crops and cost the country 40,000 million Taka in financial losses. It was a disaster that showed how vulnerable Bangladesh is to the forces of nature (Uddin and Matin 2021). The higher catchment areas of the north-eastern wetland regions of Bangladesh, commonly known as Haor, had unusually significant rainfall during the pre-monsoon period in 2017, leading to the flash flood that year. About 90 % of the crops and fish productivity in the Sunamganj district were destroyed by this early monsoon flash flood (Chakraborty *et al.* 2021). The 2017 flood in Bangladesh was the worst flood loss this century, damaging crops and infrastructure at a cost of 2.44 per cent of people's income and reducing annual income by 21.4 per cent (Shubho *et al.* 2022). The earlier flash floods in 2022 inundated approximately 90 per cent of the total area of Sylhet division. Heavy rainfall, hill slopes descending from upstream, sedimentation of canals and rivers, improper digging of canals and rivers, and poor management of the drainage system in Sylhet city effectively contributed to this flood (Shamsul and Kashima 2022).

Floods can be classified into different types based on the source of water and the processes involved. Among them, Bangladesh experiences four types of floods: flash floods, local rainfall floods, monsoon river floods, and storm-surge floods. Flash floods

are floods that occur rapidly, rising and falling within a short period of time, typically within six hours or even as little as three hours; river floods are the result of river water overflowing its banks; and coastal floods occur as a result of surges caused by both extratropical and tropical cyclones. Compared to other types of floods, flash floods caused the most deaths per event. The Ganges, Brahmaputra, and Meghna rivers and their distributaries and tributaries contribute to the high vulnerability of Bangladesh to flooding. The country is especially prone to flooding due to its complex riverine systems, monsoonal climate, and low-lying terrain that make it one of the world's most flood-prone regions. To combat this, the country has developed defenses over time. These measures include warning systems, storm shelters, salt-tolerant crops and a network of 139 coastal polders – 5,700 kilometers of protective walls that protect farmland from inundation. These challenges threaten not only lives but also the sustenance of livelihoods within these vulnerable areas (Cornwall 2018).

The financial implications of floods are significant, with losses to infrastructure, agriculture, and housing estimated to exceed billions of dollars each year. Between 1998 and 2017, the total economic impact of floods was US$ 656 billion, according to the United Nations Office for Disaster Risk Reduction (UNDRR 2018). According to Munich-Re, a reinsurance business based in Germany, economic losses from floods in Europe reached 54 billion euros in 2021, making it the costliest natural disaster in German history; extreme rainfall and flash floods in Europe caused losses of US$ 54 billion (€46 billion) (Munich Re 2022). Furthermore, it is worth noting that in some cases, such as the 2011 floods in Thailand, the financial impact of business interruption (BI) can be just as significant as the destruction of physical assets. For instance, the floods resulted in a staggering US$ 13.3 billion (2005 purchase power parity, PPP) in BI losses, in addition to the US$ 12 billion in asset damage (Taguchi *et al.* 2022). Bangladesh's frequent and severe floods pose a serious threat to the nation's socio-economic and environmental stability. Economic losses due to flooding are high. So, it was the most damaging climate extreme, followed by drought and hailstorms in Bangladesh. From 2009 to 2014, the highest economic losses were recorded in Barisal division at $613 million, followed by Dhaka division at $198.7 million (Biswas *et al.* 2019). The total economic impact of cyclones and floods in Bangladesh is estimated to be about $3.2 billion per year, or 2.2 % of the country's GDP (Haque and Jahan 2015). These expenses include both emergency relief and long-term rehabilitation initiatives.

Floods are highly destructive natural phenomena that cause significant devastation and loss of life in communities around the world. Over the 61 years, there were a total of 6,478 flood-related deaths in the contiguous United States, or approximately 106 deaths per year (Han and Sharif 2021). Floods in Bangladesh in 1988 were particularly destructive, with 2,000–6,500 people losing their lives. In 1998, floods affected nearly 100,000 km^2 of land and resulted in the deaths of 1,100 people (Biswas 2018). However, due to the development of disaster management programs has reduced the number of flood victims in recent years. For example, the death toll from cyclone Sidr in 2007 was 3,363, compared to 250,000 and 140,000 deaths from cyclones in 1970 and 1991, respectively (Shoji and Murata 2018). However, the lack of healthcare facilities and transport, with boats being the only means of transport during floods, still contributes to maternal deaths occurring during transfer from community to hospital. The contamination of water supplies by floods can cause a variety of health problems, including wa-

terborne infections like cholera and typhoid, injuries, mental health problems and the spread of vector-borne diseases like malaria. Flood-induced displacement can exacerbate existing health risks, such as malnutrition and limited access to health care.

Overall, the recent decades have witnessed a steady increase in the frequency and economic losses from flood events worldwide. This raises the question of what factors contribute to the changes in flood impacts, with possible causes including increases in the exogenous flood hazards (*e.g.*, extreme precipitation or high streamflow events) or increased vulnerability of populations and assets to flood hazards. However, studies have showed that future climate change, altered precipitation patterns and sea level rise are expected to increase the frequency and intensity of floods in many regions of the world (IPCC 2001). Increases in global mean surface temperature due to climate change may lead to changes in flood risk. Studies have shown that higher temperatures can intensify rainfall, resulting in increased flood risk (Mandal *et al.* 2022). Unofficial records for the hottest global monthly and daily temperatures were broken in July. According to the United Nations, 2024 was officially confirmed as the hottest year on record, with global average temperatures reaching 1.55°C above pre-industrial levels (UN 2025). Based on National Weather Service (NWS) data on weather-related deaths and injuries, flooding was responsible for the second highest number of weather-related deaths in the United States. The only weather phenomenon that caused more fatalities was heat waves (NWS 2021). The ability of the atmosphere to retain and redistribute water is enhanced as a result of atmospheric warming, which in turn causes more severe rainfall episodes. Deforestation and urbanization are two examples of land-use changes that reduce the ability of the land to store water and make flooding more likely. Floods disproportionately affect low-income communities, especially those located in low-lying coastal regions. Research shows that households of lower socio-economic status are disproportionately vulnerable to flood risks. Economic inequality within countries, including unequal income distribution, can affect the ability of populations to withstand flood hazards. The impact of a weak economic class on flood mortality varies depending on the level of economic development. These demographic groups were found to be particularly vulnerable to flood hazards, indicating critical areas of vulnerability that warrant focused attention on flood risk management strategies. Moreover, good governance and appropriate environmental laws, acts, and regulations are necessary to achieve sustainable economic development and reduce environmental degradation. Nevertheless, there has been criticism of the government's handling of these difficulties, emphasizing the significance of a well-functioning democracy for effective emergency response. The government now needs to adopt a comprehensive approach to flood management including both structural and non-structural solutions while giving priority to community-based vulnerability and adaptation programs. Furthermore, it is necessary to reassess the practicality and cost-effectiveness of comprehensive flood and water control systems, taking into account the increased hazards associated with climate change. The government should also recognize the need to address the variables that contribute to flooding, such as changes in land use, climate variability, and the implementation of flood vulnerability mapping and management programs.

Bangladesh has developed strategies and plans to reduce the risk of floods following past catastrophic floods, including the concept of ‘living with the floods’ and its integration into the country's Flood Action Plan. In response to the 2017 floods, adaptation

mechanisms have been implemented, such as measures to provide support and assistance to flood victims, which is an essential step towards building resilience and sustainable development in the face of recurring natural disasters. Every country has its own way of dealing with disasters.

The problems caused by floods are not unique to Bangladesh. The devastating impact of floods on human populations and the tragic loss of life caused by extreme weather events is highlighted by global data, including that of the World Health Organization (WHO). According to the WHO (2020), floods cause more than 6,000 deaths per year on a global scale. In low-and middle-income countries, the impact tends to be greater since their infrastructure is less resilient and they have limited resources for disaster prevention and response. In light of the increasing weather-related hazards, societies need to adapt quickly and make climate protection a priority. In order to properly tackle the global flooding catastrophe, policy makers, government agencies, and international organizations need to engage in close collaboration. Global agencies need to come together to support the development of a global Digital Elevation Model (DEM) with higher resolution and accuracy for flood modelling and forecasting. Current global DEMs from satellite images are too coarse to simulate floods and their associated risks. A more effective approach would be to obtain high-resolution stereo images from satellites and combine them with advanced flood modelling using supercomputers. To facilitate national economic and social development, disaster management efforts should be considered a priority: Legislation should be drafted; disaster response plans should be prepared at all levels, from national to community; and relevant institutional and technical preparedness and financial mobilization mechanisms should be established. In addition, the youth need to develop specific indigenous practices to protect the civilian population from floods by engaging in volunteer work to overcome financial damages. Various interventions, such as river management, construction of defenses, creation of bypass channels, and construction of reservoirs, have the potential to modify the local flood risk landscape.

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