# Systematic Review on Flood Hazards and Its Control

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**ABSTRACT**

Floods are among the most frequent and devastating natural hazards worldwide, causing significant loss of life, damage to infrastructure, environmental degradation, and economic disruption. While structural measures provide immediate protection, integrated flood risk management combining ecological restoration, sustainable urban planning and community-based disaster preparedness offers more long-term resilience. The study also emphasizes the growing importance of technological innovations such as Geographic Information Systems, remote sensing, and hydrological modeling in flood prediction and risk mapping. The effective flood hazard control requires a holistic, multi-sectoral approach involving government agencies, local communities and international cooperation. Strengthening adaptive capacity, promoting sustainable watershed management and implementing climate-resilient infrastructure are essential for reducing vulnerability and enhancing disaster resilience in flood-prone regions. In this article, systematic review on flood hazards and its control has been discussed.

*Keywords: Flood, Hazards, Control.*

## INTRODUCTION

Flood hazards represent one of the most frequent and destructive natural disasters worldwide, causing significant loss of life, displacement of populations, environmental degradation, and economic damage. Both riverine and coastal flooding have intensified in recent decades due to rapid urbanization, deforestation, poor land-use planning, and the growing impacts of climate change, as highlighted by global frameworks. Developing countries, including India, are particularly vulnerable because of high population density, inadequate drainage infrastructure, and socio-economic inequalities. A systematic review on flood hazards and their control therefore aims to critically synthesize existing literature on the causes, patterns, impacts, risk assessment methods, and mitigation strategies of floods, including structural measures (such as embankments and dams) and non-structural approaches (such as early warning systems, land-use regulation, and community-based disaster management). Such a review provides a comprehensive understanding of current knowledge, identifies research gaps, and supports evidence-based policy formulation for sustainable flood risk reduction and climate resilience. The objective of the study was to investigate the systematic review on flood hazards and its control.

## SYSTEMATIC REVIEW OF LITERATURE

Awah, L.S. et al. (2024).  Because of flooding's severe consequences, there should be a global management plan. Because the problems are complex, the researchers advocated for the use holistic, comprehensive, and integrated methods in managing food risks and hazards. The author employed a systems thinking perspective to identify the trends, challenges, and opportunities in the managing of global food risks, based on 132 documents. The author conducted a global food risks management systems thinking and its related approaches focused research on the last 20 years and found a 11.61% annual growth. This paper identified the global food systems research gap and advanced the knowledge that the global industrialized world has outgrown advanced methodologies in food risk management research compared to the Africa countries. The author has identified the knowledge and resource-based technological challenges documented in the literature on the study gaps of methodologies directly related to the application gaps of the study. This study suggests an adjustment from linear to holistic approaches to food risk management in accordance with the Sendai Framework for Disaster Risk Reduction 2015–2023 and the Sustainable Development Goals. The collaboration of scholars, organizations, and nations is essential to address this global challenge.

Ruidas, D. et al. (2024). Flood disasters have become more pertinent to people. The various models that have been developed that flood hazards, and flood exposure, its effect on variance of people and places at different times has been of little value. The devastating effects flood poses on the society, the construction of models to predict flood occurrence and provide early warning to the people has become more common over the years. There is a growing interest on the techniques and capabilities of models for flood hazard being able to forecast and pinpoint areas that are likely to flood. General policy has been focused on this. Some of the advanced models that have been developed include deep learning (DL), machine learning (ML) and metaheuristic models. The current study is focused on the usefulness, advantages and disadvantages, and the uncertainties of the previously stated models under the conditions of global climate change and evaluate the causes of flooding from the hydrogeological, geomorphological and socio-economic perspectives. Flooding mitigation strategies have been attempted by both developed and developing nations. Strategies have been less successful as these nations have not figured out how to balance the protective measures, levels of observation, management, and passive funding of their strategies. Because of the current gaps in research, this study will assist future researchers in developing improved flood hazard modeling techniques. In the years to come, this study will aid in bridging the gaps between theory and practice.

Santos, P.P. (2024). People I have always preferred to live in floodplains and valleys. The first great cities in human history, no matter what continent they originated from, emerged from the valleys of major rivers. With training data up to October 2023, and in the first quarter of the 21st century, we have a firm grasp of the mechanics of flooding, the nature of its causative factors, and what makes flooding worse. This, although information about flooding is still emerging, in contrast to the decades-old knowledge that still remains relevant, the numerous and abundant global data and models still support the idea. From the hazard perspective, we have to factor in the uncertainties that precipitation data series pose, as they are always changing in both intensity and frequency. We also have to consider how to model hydrodynamic systems in altered environments as runoff, retention basins, and the restoration (or de-naturalization) of riverbeds interact with other systems and other hazards.

Dutta, P. & Deka, S. (2024). Datasets from Brahmaputra Valley show that periodic floods occur and significantly hinder development in many districts in Assam. Bongaigaon is situated in the Brahmaputra's lower plains and is positioned to be impacted by those floods. This paper examines the flood risks and the role of the state in handling the flooding. Primary and secondary data were collected from the District DC office (DDMA branch), Assam Secretariat office (ASDMA branch), Sentinel 1, ICIMOD and field surveys. Different methods were used to analyze this data. For this study, flood hazard scenarios for the district were collected for the years 2015, 2017, 2019, 2021, and 2022. The results show that this area's flooding can be very detrimental, and the state and local government have taken many different initiatives to reduce the flooding and promote sustainable management.

Vegad, U. et al. (2024). In India, both fatalities and dislocation are primarily caused during the monsoon due to flooding. Damage to the infrastructure and property coupled with the economic recession from the loss of social services have long term impacts. India, among all other countries suffers flooding the worse. The sub basins of the Ganga and the Brahmaputra in India, experience the most extreme levels and internal extents of flooding the most severe flooding in the Ganga and Brahmaputra River sub basins are usually the result of the late summer monsoon of August and September. The Beas, Brahmani, upper Satluj, upper Godavari, middle and lower Krishna and Vashishti sub basins are affected by the presence of dams on the downstream side exposed to the flooding. The sub-basins of Beas, Brahmani, Ravi, and lower Satluj, and flood and dam affected sub-basins. Indian sub-basins more prone to flooding include Bhagirathi, Gandak, Kosi, lower Brahmaputra, and Ghaghara. Our findings aid in understanding the flood risk evaluation and mitigation prospects in India.

Ghosh, A. et al. (2023). Flooding is one of the most dangerous natural disasters for both people and infrastructure. 27.05% of the study region is a moderate flood risk zone (FRZ), while 20.78% is classified as high to very high FRZ. 52.17% of the region's FRZ are of low to extremely low risk. A common tool used to predict the AUC-ROC score of GIS-based AHP models is 0.749 (74.90%), which shows good predictive capability. The current study identified high FRZ areas in the affected CD blocks that are in low-lying flood plains with gentle slopes and good drainage with a high TWI, low NDVI, high MNDWI, and population density, along with cultivated areas. The current study's findings are valuable to municipal planners, decision makers, and emergency management agencies for flood risk reduction.

Kumar, V. et al. (2023). Floods are one of the most catastrophic natural disasters. They claim lives, destroy property and destabilize critical infrastructure, impacting millions of individuals across the globe. Flood modeling is one of the more advanced and reliable ways to manage flooding. This paper attempts to provide a framework to better outline some of the more prominent issues surrounding the modeling of floods. Some models, while possessing the ability to predict flooding, also have their own set of limitations and challenges; whether it is the roots of the various types of attainable data, their respective stochastic characteristics, and the complexities that lot of people find difficult to grasp. This paper strives to show that people should continue to study flooding so that we can better manage its risks and the subsequent devastations on the societies.

Maranzoni, A. et al. (2023). When creating flood risk maps, it is important to understand flood hazards. Identifying flood hazards involves a large quantitative assessment and flood process modeling. There are classifications of hazards that describe the risk involved with flooding in an area. The aim of this article is to provide the most extensive assessment of risk from flooding, whether due to natural causes or anthropogenic, and to provide an assessment that is as prescriptive as possible in the context of the existing body of literature and/or as required by regulatory authorities.

Shah, A.A. et al. (2023). Undoubtedly, the most common and the deadliest of all natural disasters is flood, claiming the most lives, and causing the most destruction of property. Problems related to flooding are seen in the rural flood affected areas of the world, including Pakistan. The results point to the fact that local disaster management institutions have a reactive approach and only think of flood risks when they occur. Participants noted that weak governance and a failure to address the emergent issues continue to create challenges in flood risk management. It is equally critical that customized planning be done with respect to particular hazards and that integration of risk and vulnerability assessments be integrated with the principles of disaster risk reduction and climate change adaptation.

Manandhar, B. et al. (2023). Flooding in cities is a part of normal business. Cities become less permeable, compounded by climate change which causes extreme events to happen and worse, more often. The goal of this study is to identify patterns, and gaps in the study of flooding in urbanised South Asia. The study evaluates literature on urban flood management and hydraulic/hydrological modelling in flood hazard assessment. In the last few years, the use of HEC-RAS/HMS, MSMIKE, SWMM, and a range of other models to evaluate urban flood risk have become more commonplace due to advancements in technology and the availability of high-resolution topographical data. The varying existing technology and infrastructure in different countries has resulted in different approaches to urban flooding. Traditional urban flood management infrastructure (e.g. drainage and flood embankments) has been complemented by more innovative approaches including urban low impact flood management. Some cities have developed and implemented flood mitigation approaches including improved flood warning systems. Utilizing process-based hydraulic models had the greatest limitation of not having sufficient amounts of high-resolution DEM and short-duration rainfall data in the study area. This greatly influenced the simulation results and how the flood control measures were implemented. There is an immediate operational need to implement a risk-informed approach to counter the management of climate change and unwarranted urban developments. Thus, it is of utmost importance to persuade emergency management and local planning authorities to consider a nature-based approach in the integrated urban planning framework to enhance the flood resilience of the cities.

Liu, G. et al. (2023). The last few years have seen a rise in urban flooding. This threatens the metro systems, as well as damaging ground level infrastructure. Metro systems provide the central city with public transit and a vital means of transport, which could compromise public safety. Therefore, establishing the extent to which the metro systems may be at risk of flooding becomes imperative. This study is the first attempt to use a complete framework of natural disaster risk assessment to

create an evaluation database consisting of 22 variables. We recommend a combination of a GIS-based Urban Flooding Risk Assessment (UFRA) and the Analytical Hierarchy Process (AHP) with the Improved Entropy Weights Method to assess the urban flooding risk for metro systems in the city of Changchun, China. The study includes nine metro lines divided into operational, under construction, and planned categories across all six urban districts of Changchun. Assessing the risk level of the 500m metro line buffer zones enables estimation of potential flooding of the metro system. The methodology estimates the flooding potential of Changchun's rail transit system. To date over 30% of Changchun's metro lines are categorically ranked as flood risk high zones. These regions are primarily located in the western parts of the core city which is characterized as economically and demographically dense. We vectorised the flood areas in order to assess it against the regions flood risk data. The model proved to be over 90% accurate. Given that Changchun's rail transit system has never suffered from a major flood, we employed receiver operating characteristic (ROC) curves to determine the accuracy of the flood risk assessment. The ROC curves indicated 91% accuracy. These outcomes demonstrate that the current study is highly reliable and provides decision makers with a scientific basis to mitigate future flooding disasters.

Kameswara, A.S.P. & Suharjito (2023). Rainy seasons in Bekasi City cause floods due to days of continuous rainfall. The focus of this study is to combine Bekasi City's computerized mapping, rainfall data, land area, land use, population, expert opinion, data to analyze the major factors contributing to flooding. It also analyzes flooding in Bekasi City, and proposes strategies for flood mitigation to control flooding. Of the following factors: changes in land use (18.8033%), drainage issues (18.4025%), rainfall patterns (16.9454%), changes in elevation (13.8748%), soil types (12.9074%), population density (9.7221%), waterlogging issues (9.3445%), and rivers (9.3445%) the majority causes of poor weather in the area can be attributed to changes in land use. The area with the most severe waterlogging is 7.707437 square kilometers (3.6030160 square miles). The government can also be able to reduce the number and severity of flooding by making the land in the Bekasi region more productive and subsequently reduce the number of people living in slum conditions. By developing land use planning in conjunction with planning and development of regulations aimed at construction, the provision of infrastructure and the design of systems, the vulnerability of people and urban activities to flooding can be significantly decreased. These changes can also promote the development, implementation and expansion of various types of water infrastructure.

Sanjrani, M. A. et al. (2022). The extreme weather events and natural disasters, including droughts, heat waves, bushfires, and flooding, are affecting more people and communities across the globe. Of all the regions around the world, South Asia has the highest number of reported flood related injuries, and rapid urbanization and poor urban planning, with little to no consideration for flood mitigation, has increased the incidence of injuries and deaths caused by urban flooding. Given its geographic location, Pakistan experiences a multitude of natural disasters, including earthquakes, cyclones, landslides, droughts, and flooding. However, the country has inadequate disaster management policies, and flooding disasters in Pakistan's rural and urban regions are exacerbated by the absence of mitigating policies. This article highlights the many advantages of implementing disaster

management policies; the author offers copious examples of how novel and existing technologies could be employed to enhance disaster management policies. Furthermore, this article offers a novel yet simple idea that could be implemented almost immediately, and is intended to alleviate the economic and social burdens of disaster management while improving the resilience of natural systems.

Kreibich, H. et al. (2022). Managing risks in flood and drought situations have made the world less exposed to these threats, but in the absence of such measures, the world remains highly exposed to the occurrence of risks. In this case, a better understanding of how and why these situations change over time is required, but due to the limited availability of data, this has proven to be a difficult task. Based on a global sample of 45 pairs of events of identical origin, we demonstrate that the management of risk tends to diminish the impacts of floods and droughts, but that the impacts of unprecedented and extreme magnitude catastrophes, on the other hand, are quite difficult to diminish. If the second, imminent event, was significantly more dangerous than the first, it would almost always be a greater impact than the first. This occurs when existing management measures are not equipped to handle the extreme events, such as when levees and reservoirs exceed their design capacity. In two instances of success, risk management governance improved significantly, and a large investment in Integrated Risk Management (IRM) was achieved. Due to the likely increase in the frequency of extreme hydrological events caused by climate change, it is especially worrying that managing extreme events remains so difficult.

Wang, L. et al. (2022). Flooding around the world has been increasing in frequency and severity due to the effects of climate change and shifting economic patterns. Flood mitigation (or flood control) is one of the more effective ways to alleviate the negative impacts of flooding, and researchers are currently studying ways to design flood management systems that are more adaptable and durable. The authors of this study carried out the first comprehensive bibliometric analysis of keywords, themes and the temporal distribution of all the literature in the field of flood management over the last two decades (2000-2020). This paper identifies the emerging trends and patterns in flood research and examines the evolution of focus in flood management literature from flood control (i.e. the management of unintentional changes that cause harm) to flood risk management (i.e. the management of intentional changes that cause harm to the extent that may increase the risk of flooding) to flood resilience management (i.e. the management of an adaptable and durable plan to cope with floods) in conjunction with the flood management literature theme of emerging risk, risk management, flood risk management and flood resilience. Integrating the concept of resilience into the risk management framework may yield improved results in addressing flood risks. From the perspective of risk, resilience, and sustainability, the right decisions and actions taken before, during, and after a disaster, can be used to mitigate the impacts.

Adeyemi, G.A. et al. (2021). Flood hazard mapping and modelling of flood impacts can help save lives and properties in our communities. Inadequate land-use planning and negligence to land use regulations and flood setback mandates encourage flooding and increases flood risks to people in the study area. This study aimed to identify the kinds of flood vulnerable structures that exist in the study area. We incorporated Open-Source GIS and remote sensing to examine land use and flood plain

topography of the study area through the available satellite imagery. The study revealed that nearly 50 percent of the identified structures are flood plain encroachments. The use of Open-Source GIS and remote sensing also provided insight on the magnitude of the population exposed to flooding in the study area. It is believed that space and flood hazard planning integrated geospatial analysis and data even during the pre-build phase of any flood prone area will save lives and properties and prevent economic losses due to flooding.

Wahid, A. et al. (2021). Tolitoli Regency is a place that gets flooded a lot every year. Lampasio District experiences significant flooding. Floods in the District of Lampasio have various effects on people and the environment. In this regard, researchers have studied Lampasio District to understand how to minimize the effects of flooding in the region. The primary and secondary data used for this study include topography, geomorphology, geology and soil types, rainfall and land use. This study aims to isolate and study the factors contributing to flooding in the region using geographic information systems (GIS). The findings indicate that the region of Lampasio District that has the highest flooding capability is 1,274.31 ha which is 2.04% of the total area. On the other hand, the area that has moderate flooding capacity is 18,765.93 ha which is 30.03% of the total area, whereas the region that possesses the lowest flooding capacity is 2,444.60 ha which accounts for 67.93% of the total area.

Simonovic, S.P. et al. (2020). Floods occurring with COVID-19 is a true multi hazard problem. From the beginning of 2020, a number of regions in the world have been experiencing the pandemic and extreme flooding simultaneously. There have been 70 recorded flooding event since the first COVID-19 case making 100,000 people displaced. The primary aim of this paper is to examine the challenges posed by the intersection of threat multipliers at complex cross roads and to recommend the best possible strategies to manage them. We ponder the what is known as the "unknown unknowns". It is not uncommon to have social distancing challenges in a rapid response evacuation as people tend to leave the area of threat at any means including going beyond the quarantine zone. In the case of an emergency, Evacuation will tend to not comply with quarantine even if this presents a threat. Emergency planners will see simultaneous floods as quite possibly the most challenging scenario of a given year considering the season of the floods. Problems and practical examples of tackling challenges posed by floods and COVID-19 coexist. We believe that keeping multiple risks should be approached differently. We would like to state the following: For floods and pandemics, resilience is needed; For waste, preparedness and defense should be equally prioritized; Responsible actors should prepare plans, and set up a command hierarchy; To involve the public, it is essential that they are informed about the risks and the actions they are expected to take.

Mohanty, M.P. et al. (2020). India has taken enormous steps to reduce the impact of flooding, but the losses to the population and economy remain large. Due to a multitude of social, hydro and climatic elements, such as social climate change, rising sea levels, and climate-related changes to the social and economic systems, managing and controlling floods in India is extremely difficult. These factors impact the frequency and severity of flooding; however, issues related to flood control incorporate the incomplete execution of traditional structural measures, selective execution of protective measures, and the poor management of flood control programs and practices from the beginning to

end. This article reviews the regionally specific flood problems in India and describes the measures taken by the most important flood control agencies in India to address them, particularly the contemporary measures of flood control. There is a critique of the sustainability of the aforementioned approaches, and certain specific shortcomings are highlighted. The insights offered in this article can assist stakeholders and policymakers in formulating and implementing sustainable flood management strategies that enhance the region's flood resilience.

Chakraborty, S. & Mukhopadhyay, S. (2019). Floods cause immense damage to standing crops and affect livelihoods of thousands, in Cooch Behar district floodplains, Cooch Behar district continuously floods and wreaks havoc, for example, in Cooch Behar district. We demonstrate a straightforward and practical approach to developing a flood risk map for Cooch Behar district by employing the principles of flood hazard and flood vulnerability. The highest flood risk exists along the southern, south-eastern, and south-western sections of the India-Bangladesh international border, with additional clusters in the central and north-central regions.

## CONCLUSION

Flood hazards remain one of the most recurrent and devastating natural disasters globally, affecting human life, infrastructure, agriculture, and economic stability. A systematic review of existing literature reveals that floods are intensifying in both frequency and magnitude due to factors such as climate change, rapid urbanization, deforestation, unplanned land use, and inadequate drainage systems. Riverine floods, flash floods, coastal floods, and urban flooding each present distinct challenges but share common drivers rooted in environmental degradation and poor risk governance. The review highlights that flood impacts extend beyond immediate physical destruction to long-term socio-economic consequences, including displacement, loss of livelihoods, food insecurity, public health crises, and psychological trauma. Vulnerable populations—particularly those in low-lying and densely populated areas—face disproportionate risks due to limited access to resources, early warning systems, and resilient infrastructure. In terms of control and mitigation, the literature emphasizes a shift from purely structural measures such as dams, embankments, and levees toward integrated flood management approaches. Structural measures remain important for short-term protection; however, non-structural strategies—such as land-use planning, watershed management, afforestation, early warning systems, community awareness programs, and disaster preparedness—are increasingly recognized as more sustainable and adaptive solutions. Nature-based solutions, including wetland restoration and river basin management, are also gaining prominence for their ecological and economic benefits. Technological advancements, including Geographic Information Systems (GIS), remote sensing, hydrological modeling, and real-time monitoring systems, have significantly improved flood forecasting and risk assessment. Nonetheless, gaps remain in implementation, policy coordination, funding mechanisms, and community-level participation. Overall, the systematic review concludes that effective flood hazard control requires a multi-dimensional, integrated, and participatory approach combining scientific innovation, strong governance frameworks, community resilience building, and sustainable environmental management.

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