Critical Study And Review Of Cyclones: With Special Emphasis On Gangetic West Bengal From 2001 To 2020

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ABSTRACT:

Natural catastrophes such as floods, cyclones and droughts strike West Bengal frequently each year. In addition, the lower Gangetic basin of Bengal has seen an increase in the frequency and severity of disasters as a result of climate change. The Sundarbans (South 24 Parganas district) and the areas nearby of West Bengal were hit hard by worst cyclones. The provision of water supply and sanitation services is the ultimate requirement for populations affected by disasters. The occurrence of natural disasters might potentially result in the emergence of epidemics such as cholera, diarrheal illnesses, dengue, malaria, and typhoid. By implementing deliberate disaster risk reduction measures on water supply, sanitation, and hygiene, the State Government and other stakeholders might potentially minimize the negative consequences of catastrophes. This paper reflects critical study and review of cyclones in Gangetic West Bengal during the period 2001-2020.

Keywords : cyclones , population , coastal land , climate , disasters

I INTRODUCTION:

India, having a population exceeding one billion, is exceptionally vulnerable to a wide array of natural calamities, such as landslides, cyclones, floods, earthquakes, and droughts. As per the findings of the 2011 Global Climate Change and Vulnerability Index, India was positioned as the second most vulnerable nation to natural and climate change catastrophes among nations classified as "severe risk." More than 5,700 km of the nation's 7,516 km of coastline are susceptible to cyclones of differing intensities. Moreover, forty percent of the population is estimated to reside within one

hundred kilometres of the coast, rendering them potentially vulnerable to the effects of cyclones. Due to climate change-induced sea level rise and the intensification of storm surges, it is anticipated that the frequency and severity of perilous occurrences will increase. An interplay of variables has led to a significant increase in disaster-related economic losses.

First and foremost, the frequency of disaster occurrences is increasing. The average loss incurred as a result of each disaster occurrence is a second trend that is rising. Finally, an increased density of susceptible assets further amplifies the economic repercussions.

The confluence of India's substantial poverty rates, swift urban infrastructure growth, dense population, and limited community awareness further amplifies the vulnerability of its populace to the repercussions of climate change and natural calamities. Those who are newly relocated to a region, inhabitants of impoverished metropolitan areas situated on the periphery of cities, and inhabitants of informal settlements concentrated in areas prone to high-risk natural occurrences are particularly vulnerable to these dangers. Inadequate infrastructure, enforcement of construction regulations, financial and insurance systems to mitigate risk, and limited availability of essential emergency services are the primary causes of this vulnerability. It is anticipated that by 2050, nearly 200 million urban inhabitants in India will be exposed to cyclones and earthquakes (World Bank and United Nations 2010).

West Bengal is an Indian province situated between the "sub-Himalayan region in the north and the Bay of Bengal in the south". It is bordered on the west by the highlands and Gangetic plains of Jharkhand and Bihar, and on the deltas of the Ganges and the Brahmaputra rivers in Bangladesh. Due to its geographical location, West Bengal experiences a diverse climate. The state is bordered to the north by Sikkim, Bhutan, and the Himalayas; to the west by Nepal and the districts of Santhal Parganas including Deoghar, Godda, Sahebganj, Dumka, Singbhum East and Singbhum West, Dhanbad, Hazaribagh, Ranchi, Singbhum in Jharkhand, Purnea in Bihar, and the districts of Mayurbhanj and Balasore in Orissa; to the south by the Bay of Bengal; and to the east by the districts of Kamrup, Garo hills in Assam, and Bangladesh.

West Bengal comprises a variety of topographical elements,

such as the Ganges deltas and alluvial plains, alongside a restricted area of the sub-Himalayan region that is predominantly the Darjeeling district. The West Bengal region situated beyond the actual delta is situated to the west of the Bhagirathi River. Low elevation characterises the eastern portion of this region, which is predominantly composed of alluvial deposits. Moving westward, the prevalence of laterite increases, resulting in a rising and progressively more undulating and rocky terrain. This terrain ultimately converges with the elevated regions of Chhota Nagpur. The Ganges delta comprises the region of West Bengal situated to the east of the Bhagirathi and to the south of the Padma rivers. North Bengal, situated to the north of the Padma River, is predominantly composed of alluvial terrain, with the exception of the Darjeeling district's sub-Himalayan region.

The dynamic process of coastal land development along the Bay of Bengal causes the formation of additional islands. As the sediment accumulates in the waterways that divide the islands from the mainland, they ultimately merge with it. Since several centuries ago, Sagar Island, which is situated at the estuary of the Hooghly River, has been an important island.

II CYCLONIC STORMS AND DEPRESSIONS:

 In meteorological terms a cyclone is a wind system that rotates inwards (Counter-clockwise in the Northern Hemisphere and clockwise in the /southern) around a strong low-pressure centre. Simply, put, inward-spiralling winds that rotate about a low-pressure zone is known as a cyclone. Typically, a cyclone is declared when the wind speed reaches more than 118 km/hr.

The task of naming the cyclone has been assigned to "The Mausam Bhawan in Delhi by the World Meteorological Organization". Storms are classified as cyclones when their winds reach 74 miles per hour or higher, and if their speeds are 34 nautical miles per hour or more, they are referred to as cyclones in other regions. Some of the world's most tropical winding sites are India, Pakistan, Srilanka, Mayanmar, Bangladesh, Thailand, Maldives etc.

Cyclones, in meteorological terminology, are expansive air masses that revolve counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere around a powerful centre of low atmospheric pressure. This particular meteorological occurrence is designated as a cyclone due to the inward spiralling winds that encircle a

region of reduced pressure. On the synoptic scale, polar vortices and extratropical cyclones are the most sizable low-pressure systems. Moreover, tropical and subtropical cyclones, which have warm interiors, are included on the synoptic scale. Mesoscale phenomena consist of dust vortices, mesocyclones, and tornadoes.

Cyclonic storms and depressions in the Bay of Bengal, which impact the weather conditions of West Bengal, result in the occurrence of storm surges and strong gale winds in the coastal areas. The magnitude of storm surges and wind intensity along the shore escalates as the systems draw near the region.

The storm surges and gale winds, particularly linked to storms, result in significant loss of life and extensive damage to homes, properties, and crops in the low-lying agricultural areas. As the storms or depressions draw near the coast, an increasing amount of harm is inflicted against both human lives and physical assets. The catastrophic impact culminates as the storms make landfall.

III IMPACT OF CYCLONE:

In addition to strong winds and heavy rain, tropical cyclones can cause tornadoes to form, high waves, destructive storm surge, and other similar phenomena. Their development takes place in warm pools of water, and they become weak as they migrate over land. Tropical cyclones can cause a lot of damage to coastal areas, but they don't usually do much damage to interior areas. However, major coastal flooding can occur up to 40 kilometers from the shoreline due to storm surges, and heavy rainfall can cause flooding inland. Despite the catastrophic damage they can do to human populations, tropical cyclones can alleviate drought. An integral aspect of the system that circulates air across the world, they also play a role in transferring heat and energy from the tropics to more temperate regions. So, tropical cyclones keep the troposphere at a steady temperature and contribute to a generally warm climate on Earth.

IV DISASTERS:

The World Health Organization (WHO) defines disaster as "any occurrence that causes damage, economic destruction, loss of human life and deterioration in health and health services on a scale sufficient to warrant an extraordinary response from

outside the affected community or area".

Human history is littered with natural disasters. Our daily lives have become increasingly plagued by natural disasters such as flood, cyclone, drought, and earthquake. Those events have a wide range of negative effects on people's lives, causing a sudden halt in their daily routine. This has necessitated the creation of a disaster management system capable of providing immediate assistance and then facilitating the subsequent recovery and reconstruction efforts. People in the disaster- affected region need a multi-pronged approach to reduce their risks and vulnerabilities. Based on the above-mentioned topic, I've decided to conduct a geographical investigation.

Cyclone is the region's most destructive natural disasters, wreaking havoc on property, crops, and infrastructure while also being among the deadliest. Most Asian countries have been concerned about the long-term effects of cyclone and the damage they cause. Disaster risk reduction appears to be the only long-term viable solution to reducing the impact of disasters and building the resilience of communities and nations to disasters in the Asia and Pacific region.

V CYCLONES IN GANGETIC WEST BENGAL DURING 2001 TO 2020:

Cyclonic storms and depressions that impact West Bengal develop and strengthen over the Bay of Bengal, primarily between the months of May and November. Typically, their movement direction is towards the west-northwest as they make their way over the coastline. Typically, storms and depressions lose strength when they move onto land. Therefore, due to its location on the eastern coast of India, the state frequently endures the intense force of severe storms and depressions originating from the Bay of Bengal. The state experiences the highest number of storms throughout the months of July and August. While in motion, the systems occasionally veer or deflect towards the north or northeast. The point of transition gradually moves towards the west until September. For instance, the systems in May exhibit re-curvature when they are still located in the Bay of Bengal. Consequently, only a small number of these storms that make landfall and move inland have an impact on the weather in the state throughout May.

Tropical cyclones (TCs) which are accompanied with very

heavy to extremely heavy rain, gales and storm surges are the most devastating phenomena among all natural disasters. The extensive coastal belts of India are exposed to TCs, which originate in the north Indian Ocean (NIO) including the Bay of Bengal and the Arabian Sea every year. Considering these, cyclone warning is one of the most important functions of the India Meteorological Department and it was the first service undertaken by the Department as early as in 1865.

Disaster management is the field concerned with addressing and mitigating hazards, encompassing the activities of preparing for, assisting during, and facilitating recovery from natural or human-induced calamities. Disaster management is the ongoing procedure through which individuals, groups, and communities effectively handle dangers to prevent or reduce the effects of catastrophes caused by these hazards.

The objective of disaster management activities is to exert authority over catastrophe and emergency circumstances and establish a framework for assisting individuals in danger to prevent or recuperate from the consequences of the disaster.

CYCLONE "AMPHAN (PRONOUNCED UM-PUN)" :

Super Cyclonic Storm Amphan, which occurred in May 2020, was a highly potent and devastating tropical cyclone that inflicted extensive destruction in Eastern India, particularly in West Bengal and Odisha, as well as in Bangladesh. It was the most powerful tropical cyclone to hit the Ganges Delta. Furthermore, this cyclone marked the fourth occurrence of a super cyclone striking West Bengal and Kolkata since 2015, making it one of the most powerful storms to affect the region. Amphan, with a staggering cost of over US$13 billion, has become the most expensive storm ever documented in the North Indian Ocean, exceeding the previous record set by storm Nargis in 2008.

Amphan, the inaugural tropical storm of the 2020 North Indian Ocean cyclone season, formed from a low-pressure system located approximately 300 km east of Colombo, Sri Lanka, on 13 May 2020. The disturbance moved in a northeastern direction and became more organised over abnormally high temperatures of the ocean's surface. The Joint Typhoon Warning Centre (JTWC) officially classified the system as a tropical depression on 15 May, and the India Meteorological Department (IMD) did the same the next day. Amphan had quick intensification on 17 May, transforming into an

exceedingly severe cyclonic storm in under 12 hours.

Amphan attained its maximum strength on 18 May at around 12:00 UTC, with sustained wind speeds of 240 km/h (150 mph) lasting for 3 minutes, sustained wind speeds of 270 km/h (170 mph) lasting for 1 minute, and a minimum central barometric pressure of 920 mbar (27.17 inHg). Amphan initiated an eyewall replacement cycle soon after it achieved its maximum strength. However, the persistent influence of arid air and wind shear hindered this phenomenon, resulting in a steady decline of Amphan's intensity as it moved along the eastern coast of India.

The storm reached the coast of West Bengal about 12:00 UTC on 20 May. Currently, the JTWC approximated Amphan's 1-minute sustained winds to be 175 km/h (110 mph). Amphan quickly lost strength after moving onshore and subsequently dissipated.

A super cyclonic storm , AMPHAN, a formidable and lethal tropical storm, inflicted extensive destruction in West Bengal and Bangladesh during May 2020. This cyclone was the most powerful one to hit the Gangetic Delta since SIDR in 2007. It was also the first super cyclonic storm to occur in the Bay of Bengal since the one in 1999 that caused severe damage in Odisha. AMPHAN, with a total cost of nearly US$13 billion, has become the most expensive storm ever documented in the North Indian Ocean, exceeding the previous record set by storm Nargis in 2008.

The cyclone, which had the same intensity as a category-three hurricane, passed over densely populated regions of Southern Bengal. It hit the shoreline across Sunderbans with sustained wind speeds of 170 km per hour, gusts reaching up to 190 kmph, and storm water surges as high as 16 feet. The scenario has exacerbated the suffering of 2.856 million households that have been displaced from their homes, coinciding with the widespread outbreak of the COVID-19 pandemic in the area. The cyclone struck the coastal area of West Bengal, specifically near Digha and Sundarbans, causing severe disruption to vital services and livelihoods in the southern region of West Bengal, as well as in certain northern districts of the state.

The cyclonic storm, accompanied by intense rainfall, coincided with the astronomical tide, leading to storm surges characterised by waves reaching heights of up to 15 ft. This resulted in severe damage to Kolkata and various regions of

West Bengal. The storm uprooted trees and electric posts, demolished thousands of houses, and flooded low-lying areas of the State. The cyclone AMPHAN struck West Bengal on May 20, resulting in a current death toll of 86 and impacting over 10 million individuals in the state. A formidable tempest ravaged West Bengal and its adjacent region of Bangladesh. The storm in West Bengal resulted in extensive destruction to crops, with numerous trees being uprooted. The state, including its capital Kolkata, experienced disruptions in power and water supplies. Numerous individuals in the state have experienced the loss of their properties, including their residences, kitchen outbuildings, livestock, sanitation facilities, and water sources. The implementation of measures to contain the COVID-19 pandemic has further complicated the task of ensuring the safety of individuals from cyclone AMPHAN, particularly since migrant workers are returning to their homes from their workplaces.

The cyclonic storm, accompanied by intense rainfall, coincided with the astronomical tide, leading to storm surges with waves reaching heights of up to 15 ft. This resulted in severe damage to Kolkata and various parts of West Bengal. The storm uprooted trees and electric posts, destroyed thousands of houses, and flooded low-lying areas of the state. The cyclone has mostly affected 10 districts, including 3 coastal districts and the State Capital, Kolkata. It is predicted that roughly 13.6 million people, including over 0.544 million boys and girls, have been seriously affected by the storm.

The cyclone had a significant impact on the coastal regions of West Bengal, including West Midnapore, East Midnapore, North 24 Parganas, South 24 Parganas, Kolkata, Hooghly, and Howrah. Furthermore, it resulted in substantial devastation in Bangladesh. It caused widespread chaos and disruption in the metropolitan city of Kolkata.

CYCLONE "AILA":

On May 22, 2009, the Kolkata Meteorological Department announced the formation of a low-pressure region in the West-central Bay of Bengal and the adjoining East- central Bay of Bengal. The system was expected to further strengthen. On May 23rd, the department announced that the system had significantly strengthened and was expected to develop into a Depression. By 24 May, the system had become a Deep Depression and was located approximately 550 km south of

Kolkata. According to the meteorological agency, there is a forecast that the system will likely strengthen and become a Cyclonic Storm. It is expected to make landfall near 89° East, approximately 100 kilometres east of Sagar Island, either in West Bengal or Bangladesh, on the evening of May 25th.

On 25 May, the Cyclonic Storm "Aila" over North West Bay, moved northwards and intensified further and lay centred at 0830 hrs IST within half a degree of latitude 20.5=B0N/Longitude 88.0=B0E, about 250 Km south of Kolkata with estimated central pressure 984 HPA and move in a near northerly direction and cross West Bengal Coast near latitude 88.0 Deg East (near Sagar Islands).

By 26 May, Cyclone Aila had moved northward and weakened into a deep depression over Sub-Himalayan West Bengal and adjoining Bangladesh. At 0830 hours IST, it was centred over Sub-Himalayan West Bengal, approximately 50 km north of Malda. The system is expected to shift towards the north and gradually diminish in intensity, transforming into a depression within the following six hours. Due to its impact, there will be rainfall in most areas, with heavy to very heavy rainfall in a few spots and isolated extremely heavy rainfall (equal to or greater than 25 cm) in Sub-Himalayan West Bengal & Sikkim and Assam & Meghalaya in the next 24 hours. There is a high probability of rain and thundershowers occurring in multiple locations in Arunachal Pradesh and Nagaland, Manipur, Mizoram, and Tripura over the next 24 hours. Some areas may see heavy rainfall. There is a high probability of strong winds with speeds of 50-60 kmph occurring over Sub-Himalayan West Bengal & Sikkim, Assam & Meghalaya, and Arunachal Pradesh within the next 12 hours.

The severe cyclone 'Aila' struck the coastal areas of West Bengal, specifically South 24-Parganas and North 24-Parganas, at approximately 14:00 hours on May 25, 2009. It had wind speeds ranging from 120 to 130 kmph and continued its destructive path northwards, impacting the districts of North 24-Parganas, Purba Medinipur, Kolkata, Howrah, Hooghly, Burdwan, Birbhum, Uttar Dinajpur, Dakshin Dinajpur, and Darjeeling with gradually diminishing intensity. The tidal surge at Sagar Island was seen to be almost 3.3 times higher than the projected level due to the combination of a swelled sea and the advent of a new moon the next day. Embankments experienced overtopping at multiple sites, resulting in either complete failure or significant destruction. Tsunamis

infiltrated the rural areas by surpassing or breaking through the protective barrier and caused extensive destruction to numerous residences and huts, swept away roadways, and submerged vast regions of Sundarban and the neighbouring districts of North & South 24-Parganas. Among the 3122 km of embankments maintained by the Irrigation & Waterways Department, approximately 177 km experienced washouts or breaches, while an additional 601 km sustained significant damage in many sections. If the repair efforts are not initiated promptly following the monsoon season, the entire 778 km stretch of embankments, which have either been swept away or seriously damaged by the storm 'Aila', will remain vulnerable to failure in the event of a future cyclone, even if it is of a much lower intensity than 'Aila'.

As to media reports, the Sundarbans national park suffered the worst, with a population of up to three million people residing in the jungles. The government is currently conducting rescue operations, having successfully rescued and housed some 60,000 individuals in official relief camps. According to local media reports, military helicopters are delivering food packets to the impacted districts.

CYCLONE "TITLI" :

In the second week of October, 2018, cyclonic storm "Titli" made landfall in south west coast of Gopalpur near Palasa in Andhra Pradesh. NDRF as part of proactive measures deployed 25 teams in the coastal parts of the Andhra Pradesh, Odisha and West Bengal.

Cyclonic storm Titli left a trail of destruction in two districts of West Bengal on Friday, killing one person and injuring 10 others, even as it weakened into a deep depression while moving northeast-ward.

The meteorological department has warned of heavy to very heavy rainfall in the Gangetic West Bengal till Saturday.

Paschim Medinipur and neighbouring Jhargram districts in West Bengal have been witnessing incessant rain since Thursday night.

CYCLONE "FANI":

The extremely severe cyclonic storm 'Fani' of the 'Hood of the Snake' was the strongest tropical cyclone to strike Odisha since Phailin in 2013. Cyclone Fani made landfall at about 8:30 am on

3 May 2019 between Satapada and Puri with a sustained surface wind speed of 175-180 kilometres per hour (kmph). The severe cyclonic storm Fani entered Bengal at 12:30 am through Odisha's Balasore. It crossed Kharagpur packing a wind of 70-80 kmph, gusting to 90 kmph," Fani lashed cities and towns in coastal Bengal including Digha, Mandarmani, Tajpur, Sandehskhali . In the coastal town of Digha, the wind speed reached 70 kmph.

The cyclone had triggered heavy rainfall in West Bengal. The cities that were mostly affected are Digha, Mandarmani, Tajpur, Sandehskhali, and Contai. No loss of life or any injury has been reported so far. According to the Meteorological department, the extremely severe cyclonic storm relatively weakened after entering coastal Odisha and transformed into "very severe" as it approached Bengal.

VI REVIEW OF RELATED LITERATURE:

Ujjal Adhikary (2022) found that the Indian Sundarbans are home to the magnificent Royal Bengal Tiger and are recognised as a World Heritage Mangrove Forest. An island known as the Gosaba C.D. Block is located on the eastern bank of the Bidyadhari River. In the Indian Sundarbans, cyclonic phenomena are a frequent occurrence. The frequency of cyclone occurrences is once every 2.61 years. At Gosaba, cyclonic storms and the saltwater floods and river bank erosion they cause are also frequent occurrences. The cyclonic disaster has severely damaged many villages, causing harm to their homes, crops, transportation, and communication systems, and—most significantly—salinizing their agricultural land, which has prevented farming for at least two to three years. Many villagers have also lost their jobs and are forced to live in poverty. A portion of the inhabitants have relocated to another area of Gosaba Block and even to another state due to bank erosion. Many stakeholders changed their jobs from cultivators to migrant labourers in other parts of the state and country due to damage to agricultural crops and the salinization of farming land. Although we are powerless to stop a cyclone, we can lessen its effects by implementing certain strategies, such as hazard mapping, land use planning, engineered structure retrofitting, non-engineered structure construction, cyclone shelter construction, flood control, green pitch improvement, mangrove plantation development, and raising public awareness. (Adhikary U, 2022, pp. 79-92)

Yadav, A.K. (2022) found that India has been prone to numerous natural and man- made calamities, because of its diverse geoclimatic and socioeconomic circumstances. It is extremely susceptible to landslides, avalanches, earthquakes, cyclones, floods, and forest fires. 28 of the 37 states and union territories in the Union are vulnerable to natural disasters. Approximately 58.6% of the land is vulnerable to extremely powerful earthquakes. Twelve percent of the land is vulnerable to flooding and river erosion; 5700 km of the 7516 km long coastline is vulnerable to cyclones and tsunamis; 68% of the cultivable territory is vulnerable to drought; and in hilly regions, there is potential threat of avalanches and landslides. India is among the top ten nations in the world in terms of vulnerability to disasters. Numerous variables, including unfavourable geoclimatic conditions, topographical features, environmental degradation, population increase, urbanisation, industrialization, and non-scientific development practices, contribute to the nation's vulnerability to natural and man- made disasters. The likelihood of disasters in India is further increased by growing susceptibilities to factors such as shifting socioeconomic and demographic patterns, unplanned urbanisation, and development in high-risk areas, environmental degradation, climate change, geological hazards, epidemics, and pandemics. Undoubtedly, each of these factors plays a part in making disasters a major threat to India's population, economy, and sustainable development. (Yadav, A.K., 2022, pp. 1- 10).

Sibanda W. et al. (2022), crises and disasters have always existed in human history. Even though they might be unpredictably occurring, significant actions can be taken to reduce the risk of damage in advance of a disaster. Through women's participation in the Water, Sanitation, and Hygiene (WASH) programme during Cyclone Idai at the Tongogara Refugee Camp (TRC) in Chipinge, Zimbabwe, this study aims to investigate the extent of disaster (un)preparedness. The study contends that because the camp's few WASH facilities were distributed unevenly, refugee women were more susceptible than males to Cyclone Idai's consequences. Based on the results of a qualitative study using participant observations, focus groups, and in-depth interviews, it was discovered that women were disproportionately vulnerable to the effects of Cyclone Idai because of unequal resource allocation. The study examined how women respond to and are prepared for disasters using a feminist political ecology structure. Gender

equality, health, decision-making, participation, and access to WASH were the five topics that emerged from the analysis. Since practically little was done at TRC in terms of training and information dissemination prior to the Cyclone Idai disaster, the results show a high level of government incompetence in putting disaster mitigation measures into place. The study comes to the conclusion that women are more vulnerable than men in emergency situations, which is why a gender-sensitive response approach is required (Sibanda W, Mukwada G, Hansen M.M., 2022, p. 2137964)

According to information gathered by the Emergency Events Database (EM-DAT), Vasileios, L. et al. (2022) investigated those recent years included the world's hottest year, although they have been characterized mostly, aside from the COVID-19 pandemic, by climate-related calamities. In addition to taking lives, disasters have a major and frequently disastrous socioeconomic toll, which includes financial losses. The application of recent advances in artificial intelligence (AI), particularly in machine learning (ML) and deep learning (DL), has made it possible to more effectively manage the severe and frequently catastrophic effects of disasters. The goal of this study is to give a summary of the research studies that have been presented since 2017 that concentrate on ML and DL-developed approaches for disaster management. Studies in the fields of disaster and hazard prediction, risk and vulnerability assessment, disaster detection, early warning systems, monitoring, damage assessment, post-disaster response, and case studies have received special attention. Additionally, an analysis has been conducted on a few newly created ML and DL disaster management applications. Directions for more research are given, along with a discussion of the results. (Vasileios, L. et al., 2022, p. 446-473)

Gayen, Sumita et al. (2022) investigated that thousands of people are impacted by floods each year in West Bengal, India's coastal areas, which are one of the most frequent quasi-natural disasters. Floods have the power to completely destroy an area, causing damage to structures and agricultural land, upsetting the natural equilibrium of the ecosystem, and spreading illness. The severity, frequency, and duration of floods, as well as people's vulnerability, all affect the risk of flooding. The micro-level research on the spatiality of flood risk is still inadequate for resource catastrophe management. Consequently, the current research on "flood risk mapping" is carried out in Purba Medinipur, one of West Bengal's coastal

districts, India, taking into account both human susceptibility and the frequency of flooding as components of flood risk. In order to determine the susceptibility of the local population, twenty-five key indicators are used, with the frequency of floods from 2002 to 2019 being taken into consideration as an assessment variable. According to the data, Contai-I is the district's least flood-prone block, whereas Moyna has the highest flood risk. The outcomes can aid in reducing the likelihood of harm, loss, injury, or death and in creating a strong flood disaster management strategy. (Gayen, S et al., 2022, p. 1049)

According to Mainuddin M et al. (2021), seawater flooding in coastal areas can completely destroy cropping, and recovery from the effects can take a long time. Utilising a polder water and salt balance model, we looked into the effects of flooding caused by seawater and the process of recovering from it. We used the model on three polders in the Ganges delta: Dacope, which has an intermediate salinity and rainfall; Amtali, which has a high salinity and rainfall; and Gosaba, which has a lower salinity and more rainfall. The model calibration is relevant to the recovery time because Dacope and Gosaba were submerged a few years before our investigation began. Following inundation, the calculated salt concentration in the soil water and shallow groundwater significantly increased, whereas the calculated evapotranspiration from the polder—a measure of crop growth—was drastically reduced. The model simulations demonstrated that a number of factors, including the polder's soil drainage and subsequent salt flushing efficiency, affect recovery. Our simulations indicate that the polders and islands of the Ganges delta might recover from inundation episodes rather quickly if infrastructure was properly maintained and managed, especially with regard to soil drainage. (Mainuddin, M., & Kirby, J. M., 2021, p. 105740).

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