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PROJECT ON,
A COMPREHENSIVE STUDY OF CYCLONE GORKY (1991) AND ITS HUMANITARIAN IMPACT ON BANGLADESH

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A Comprehensive Study of Cyclone Gorky (1991) and Its Humanitarian Impact on Bangladesh

1.Abstract:

Cyclone Gorky, which struck Bangladesh on April 29, 1991, is remembered as one of the deadliest and most destructive tropical cyclones in recorded history.The cyclone killed around 138,000 people,displaced millions,and caused extensive damage to infrastructure,agriculture and livelihoods.This paper examines the humanitarian crises created by Cyclone Gorky,focusing on the meteorological conditions that fueled its intensity and the socioeconomic vulnerabilities that worsened its impact.It evaluates the immediate and long-term response measures by the government, international organizations, and humanitarian workers,with a focus on efforts to restore key services,provide shelter, and rehabilitate affected populations.

This study aims to provide a comprehensive understanding of Cyclone Gorky's humanitarian impact and the response strategies employed, offering valuable insights for improving disaster preparedness, response, and recovery efforts in Bangladesh.

2.Introduction

2.1.Background:

The Bay of Bengal is a high-risk tropical cyclone basin,with severe storms often occurring in spring and autumn[1].Bangladesh's position on the northern and eastern coasts of the Bay of Bengal, along with its unstable socioeconomic status, makes it very vulnerable to catastrophic disasters[2].Bangladesh's unfavourable geographical location,flat,low-lying terrain,reliance on climate-sensitive industries like agriculture and fisheries,and poor institutional and inadequate infrastructure make it especially vulnerable to the effects of climate change[3].

The coast of Bangladesh experiences cyclones nearly every year. Along a portion of the coastline, at least one catastrophic cyclone causes significant devastation every three years[4]. Cyclone Gorky (1991) was one of the most destructive tropical cyclones to ever strike the coast of Bangladesh.Its devastating impact highlighted the region's extreme vulnerability to hydrometeorological disasters.It caused significant damage to the southeast coast of Bangladesh, particularly the region north of Chittagong. It is estimated that as a result of the immediate impact of the cyclone, approx. 10 million people were affected with approximately 139,000 deaths and 138,000 injuries.In addition there was extensive damage to livestock,property and physical infrastructure approximately,10million cattle/poultry were lost (81% of those affected), 1,630,OOO houses was damaged (91% of those affected),764 miles of unpaved roads and 500 bridges and culverts were destroyed, 25% of tubewells were made non-functional and communications were severely disrupted[5].

2.2.Objective:

- Examine the characteristics and causes of Cyclone Gorky,focusing on the meteorological and geographical elements influencing its strength and impact.
- Review the humanitarian emergencies triggered by the cyclone,including loss of life, displacement, health crises, and economic effects.
- Analyze the responses of the government, international organizations, and humanitarian engineers in addressing the short- and long-term consequences.

3.Cyclone Gorky: Causes and Characteristics

3.1 Meteorological Background

Cyclone Gorky was one of the most powerful and devastating storms ever recorded in the Bay of Bengal.Its formation was first identified by the Bangladesh Meteorological Department (BMD) at 00:00 GMT on April 25, 1991,when the system was producing sustained winds of 55 kph.Over the next few days, the system meandered northwestward, steadily gaining strength. By 12:00 GMT on April 27, the system was upgraded to a tropical cyclone,with wind speeds reaching 130 kph and gusts up to 160 kph.Approximately 18 hours before its landfall on April 29,the cyclone recurved towards the northeast.At its peak intensity,Cyclone Gorky reached sustained wind speeds of 260 kph, with gusts of up to 315 kph,making it one of the most intense storms ever recorded in the region.The central pressure of Cyclone Gorky dropped to an estimated 938 mb.Consequently, the storm surge that followed occurring after midnight on April 29 and continuing into the early hours of April 30 exceeded six meters in height in offshore areas.Reports from various locations, including Chittagong,indicate that the surge inundated vast coastal areas, with water depths exceeding two meters at Chittagong airport. The storm surge,combined with associated waves, submerged over 160 kilometers of Bangladesh's coastline. Areas severely affected included Cox's Bazar, Bashkhali,Chakoria, and the densely populated islands of Sonadia,Matarbari, Moheshkhali, Kutubdia,Sandwip and others.Once the cyclone moved into northern Myanmar (formerly Burma), it became extratropical, rapidly losing its intensity[2].

3.2 Geographic and Socio-Economic Vulnerability

Bangladesh’s geographic location and socio-economic conditions make it highly vulnerable to cyclones and hydrometeorological disasters.Situated along the Bay of Bengal, its low-lying coastal regions funnel storm surges,causing widespread flooding.Districts like Chittagong,Cox’s Bazar, and offshore islands such as Sandwip and Kutubdia were severely impacted by Cyclone Gorky due to their proximity to the storm’s landfall. The socio-economic context worsened the cyclone’s effects,as many coastal communities relied on agriculture and fisheries,which the storm devastated.Widespread poverty led to poorly constructed homes in high-risk areas,while low literacy and inadequate disaster training left many unaware of evacuation procedures.Cultural

norms, such as women needing male family members to evacuate,further increased vulnerability. These factors made Cyclone Gorky one of Bangladesh's deadliest disasters.

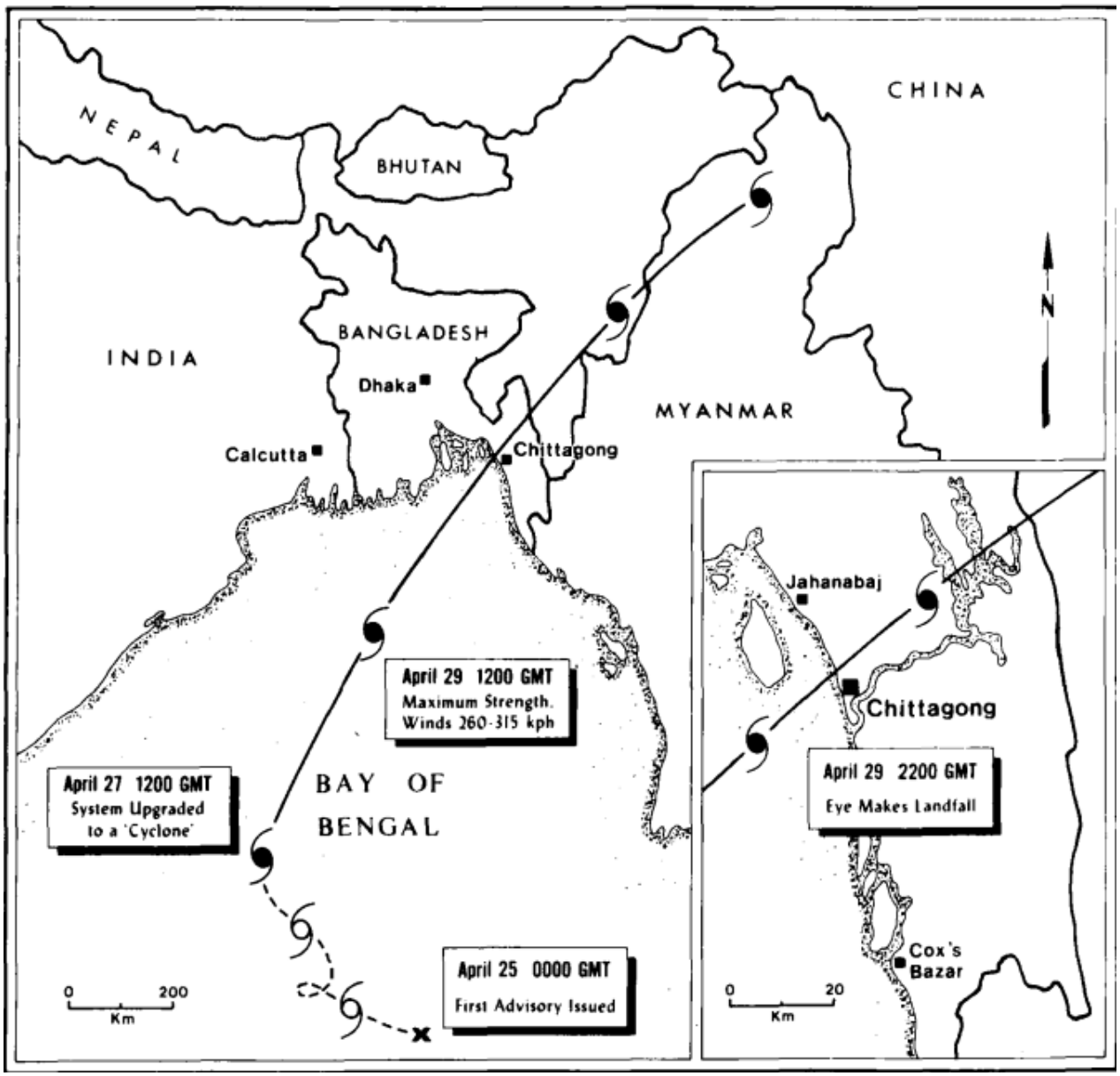

Figure 01 : Path of Cyclone Gorky (1991) across coastal Bangladesh[2]

4.Humanitarian Impact of Cyclone Gorky:

4.1 Loss of Life and Livelihoods

Cyclone Gorky caused a catastrophic loss of life,claiming over 138,000 lives and displacing millions. The worst damage occurred in Chittagong and Cox's Bazar, with 77,792 and 39,796 deaths, respectively, by 8 May 1991, according to the RCSB. Additional fatalities were reported in Noakhali (over 8,000), Bhola, Patuakhali, Baraguna, Feni, and Lakhmipur.The storm highlighted the deadly effects of geographic vulnerability, with 40–50% of populations on unprotected islands perishing, 30–40% on embanked islands, and 20–30% on the mainland. Entire villages were destroyed by high winds and storm surges,leaving survivors with immense loss. Coastal communities, dependent on agriculture and fisheries,suffered as farmland was ruined by saltwater and fishing infrastructure was swept away, leaving many families destitute and struggling to recover.

4.2 Health Emergencies

In the aftermath of Cyclone Gorky, health crises emerged as a critical challenge for the affected communities. The inundation of drinking water sources and the lack of proper sanitation led to widespread outbreaks of waterborne diseases, including cholera and diarrhea. Overcrowded and unsanitary living conditions in makeshift shelters exacerbated the situation, contributing to the rapid spread of illnesses. Physiological problems were prevalent and varied, ranging from general infections and gangrene to respiratory diseases[6].Diarrhea alone had a devastating impact, causing more than 6,500 deaths and affecting an additional 19,350 people by mid-May.

4.3 Economic Consequences

The economic impact of Cyclone Gorky was devastating, leaving Bangladesh with severe financial challenges.The cyclone caused catastrophic damage to agriculture, destroying vast areas of cropland and wiping out standing crops, with losses estimated at US$105 million.Infrastructure such as roads, bridges, and ports sustained extensive damage, disrupting recovery efforts and trade. The national government estimated a budgetary cost of US$479 million,primarily for relief and rehabilitation, while reconstruction needs were projected at an additional US$620 million.Overall, the combined losses in the private and public sectors exceeded two billion U.S. dollars.This immense toll overwhelmed Bangladesh's limited resources, forcing heavy reliance on international aid.

Table: List of Damages Caused by 1991 Cyclone[7]

Total affected districts	19
Total affected subdistricts (thanas)	102
Total affected urban municipalities	9
Total number of affected population	10,798,275
Damage to crops (in acres)	
Fully	133,272
Partly	791,621
Total number of houses damaged	
Fully	819,608
Partly	882,750
Total number of people dead	138,882
Total number of livestock dead (cows, buffaloes, goat, sheep, poultry included)	1,061,029
Total number of people injured	139,054
Total number of educational institutions damaged	
Fully	3,865
Partly	5,801
Total earthen roads fully damaged (in miles)	764
Total number of bridges, culverts fully damaged	496
Total number of embankments damaged (in miles)	
Fully	122
Partly	585
Number of people missing	1,225

5.Response Measures:

5.1 Immediate Relief Efforts

After Cyclone Gorky, the Bangladeshi government deployed military and civil resources for rescue and relief, delivering food, water, and medical aid, evacuating stranded individuals, and setting up shelters. Despite challenges, these efforts saved lives and provided critical relief. The international community, including the Red Cross and UN, supplied food, medical aid, and technical support, coordinating large-scale assistance to supplement government efforts in overwhelmed areas.

5.2 Role of Humanitarian Engineers

Humanitarian engineers played a crucial role in addressing both immediate and long-term challenges after the cyclone. They focused on restoring essential services like clean water, sanitation, and electricity, implementing temporary solutions to meet urgent needs. Emergency shelters were quickly constructed to house displaced populations, ensuring safety and providing basic amenities. Critical infrastructure such as roads, bridges, and communication networks was repaired to facilitate the movement of relief supplies and support rescue operations.These

engineering interventions were key to stabilizing the affected areas and enabling long-term recovery.

5.3 Community Involvement

The affected communities played a crucial role in the disaster response.Local volunteers worked tirelessly to distribute aid, support vulnerable groups, and assist in rebuilding.Their grassroots contributions were vital in addressing immediate needs and fostering resilience.This collective effort emphasized the importance of community participation in disaster recovery, ensuring responses were inclusive and effective in addressing local challenges.

6.Challenges in Disaster Response:

6.1 Co-ordination Issue

One major challenge during Cyclone Gorky's response was the lack of effective coordination among governmental agencies, NGOs, and international aid organizations.Despite multiple entities participating, the absence of a unified command structure led to overlapping roles, resource misallocation, and delays in aid delivery.Local government institutions, already severely affected by the cyclone, struggled to coordinate effectively.Communication gaps between national agencies and local responders worsened inefficiencies,especially in remote coastal areas.Relief supplies were sometimes delayed or unevenly distributed, leaving many survivors without timely access to food, water, and medical care.This lack of centralized coordination highlighted the need for improved disaster management policies in Bangladesh.

6.2 Inadequate Early Warning System:

Cyclone Gorky exposed major failures in Bangladesh's early warning and disaster preparedness systems, causing a severe humanitarian crisis. Despite warnings issued 15 hours before landfall, many failed to evacuate due to fear, skepticism, and logistical issues. The complex cyclone signal system caused confusion, with misinterpreted downgrades leading to complacency. While offshore islands received alerts,many mainland communities remained uninformed, leaving women, children, and the elderly at greater risk.

A shortage of cyclone shelters worsened the crisis.With only 302 shelters for 500,000 people, millions were left unprotected. Many were too far, had flooded access roads, or lacked clean water and sanitation, discouraging use.Cultural barriers also restricted women from evacuating. Poor coordination and delayed evacuations left families without timely aid.

6.3 Resource Constraint:

The disaster overwhelmed Bangladesh's limited resources,hindering response and recovery.The government lacked the financial and logistical capacity to provide immediate relief, and 4.5 million affected,many lacked safe refuge.Destroyed roads and bridges further delayed aid to remote coastal areas.

Medical facilities were overrun, causing shortages of medicine, clean water, and sanitation, leading to cholera and diarrhea outbreaks.The crisis underscored the need for better disaster preparedness, improved logistics, and a stronger emergency response. A resilience-focused approach integrating engineering solutions, community engagement, and policy improvements is essential to protect vulnerable populations.

7.Lessons and Improvements in Cyclone Management

7.1 Lessons Learned from the 1991 Cyclone Disaster

The lessons from Cyclone Gorky (1991) highlight gaps in disaster preparedness, response, and recovery, stressing the need for stronger resilience in cyclone-prone regions. A better early warning system and communication could have saved lives, while disaster-resilient infrastructure like cyclone-proof housing, embankments, and storm shelters is crucial. Community awareness is vital, as many failed to evacuate due to misunderstanding the cyclone's severity. Coastal protection measures, safe water access, and pre-positioned emergency supplies can prevent disease and speed relief. Strengthening livelihoods through flood-resistant crops and alternative income sources aids recovery, while long-term policies like the Cyclone Preparedness Programme (CPP) enhance disaster management. These lessons underscore proactive, multi-faceted risk reduction.

7.2 Resilience Building: Key Measures Implemented After 1991

Since Cyclone Gorky (1991), Bangladesh has significantly improved disaster preparedness. The early warning system now uses advanced technology, and local volunteers play a key role in response efforts. The number of cyclone shelters has grown to over 14,000, accommodating 2.4 million people. Women's safety has improved, with female volunteers making up half of CPP's 76,000 members. Coastal protection has strengthened through embankments and mangrove restoration. Community awareness programs have further enhanced preparedness. These measures have cut cyclone fatalities by 75% over 25 years, with Cyclone Sidr (2007) causing approximately 3,500 deaths far fewer than Gorky's toll of 138,000[8].

8.Conclusion:

Cyclone Gorky (1991) was one of the deadliest cyclones in Bangladesh's history, revealing critical gaps in disaster preparedness, response, and infrastructure. The massive loss of life and widespread devastation underscored the need for stronger early warning systems, cyclone-resilient infrastructure, community preparedness programs, and sustainable recovery mechanisms. The lessons learned have shaped national policies, driving improvements in cyclone shelters, embankments, and disaster response frameworks. However, continued investment in humanitarian engineering, coastal protection, and climate resilience is crucial to minimizing the impact of future cyclones. By combining innovative engineering solutions with community-driven disaster risk reduction, Bangladesh can strengthen its resilience to extreme weather events, safeguarding lives and livelihoods for generations.

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