INTERNATIONAL JOURNAL OF SOCIAL SCIENCES BULLETIN
ISSN: (E) 3007-1917 (P) 3007-1909
Volume 1, Issue 2, 2023

HAZARD RISK OF TROPICAL CYCLONE BIPARJOY: PREPAREDNESS, EARLY RESPONSE AND POST IMPACT ASSESSMENT IN SUJAWAL, SINDH, PAKISTAN

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DOI: https://doi.org/10.5281/zenodo.23037636

Received	Accepted	Published
03 November 2023	17 December 2023	31 December 2023

ABSTRACT

Tropical cyclone Biparjoy was formed in east-central Arabian Sea on June 06, 2023. The Pakistan Meteorological department has warned to the people of Karachi, Thatta, Sujawal and Badin about the adverse impacts of Biparjoy as early as possible. The district management of Sujawal started work on the relief and rescue in Sujawal from June 08, 2023, to June 16, 2023. All possible measures were taken. Evacuation process was initiated for public from vulnerable areas. Total of 53522 people were rescued. All stakeholders worked in coordination during the event. Fishermen into the sea were imposed. A warning was widely publicized through mosque and radio announcement, mainstream and social media. 6 primary relief and medical camps established in 3 Talukas within the radius of 10-15 kilometers. District Sujawal frequently destructive by sea intrusion and river flood thus need a comprehensive Early Warning System. The district is at high-risk affecting seashores with high tidal actions, and at risk of cyclones and floods. Protection of lives and property and improve community resilience by putting the suggested strategies into practice. The study highlights the necessity of a tried-and-true strategy that integrates technical developments and community involvement. In Sujawal, squally winds ranged from 100 to 120 km/h, with peak gusts reaching 140 km/h. Cyclone Biparjoy caused massive evacuations, isolated seawater intrusion, and temporary disruptions to livelihood in the coastal talukas of Sindh's Sujawal District. Very drastic conditions were observed as due to heavy rains damaged susceptible mud and straw cottages and uprooted trees. For more than a week, fishing was entirely prohibited along the Sujawal coast. Standing Kharif crops were severely devastated by the strong winds and the floods caused by the rain that followed. Newly planted rice, sugarcane, cotton, and coastal banana plantations were among the staple regional crops that suffered lodging and physical destruction. Very few incidences happened related to the livestock, agriculture and other assets. No any unwanted incident was observed related to old age, underage and gender. This may be due to strong vigilance of Pakistan Navy, District Administration and local political leadership of the area. Though it is fact that no proper compensation was given by the responsible authorities and

related organizations to the effected coastal communities of Sujawal district Sindh. The proactive measures are necessary for the safety of vulnerable coastal communities of Sujawal Sindh Pakistan.

INTRODUCTION

The tropical cyclones are violent wind circulation which forms and travel over ocean waters having potential of huge destruction along the coasts. Pakistan being a marine country is prone to the tropical cyclone induced disasters, which impacts socioeconomic conditions of the coastal communities by devastating their crops, properties and lives. Pakistan's coastal areas have historically been affected by tropical cyclones. Several well-known but unidentified tropical cyclones have previously passed over or approached Pakistan's coast. These include June 4–9, 1948; July 1–3 and 9–18, 1959; June 20–27 and September 5–16, 1961; June 8–13, 1963; and May 28 and June 1, 1985. In recent decades, Pakistan's coast has been affected by or close to several named tropical cyclones and cyclonic storms. Heavy cyclone was drastically damages the area on 16–20 May 1999, another heavy event was observed during 21–28 May 2001), Yemyin (21–26 June 2007), Phet (31 May–26 June 2010), Nilofar (25–31 October 2014), Chapala (28 October–3 November 2015), Megh (5–10 November 2015), Sagar (16–21 May 2018), Luban (6–14 October 2018), Vayu (10–17 June 2019), Hikaa (22–25 September 2019), Kyarr (24 October–2019), and Maha (30 October–7 November 2019). Tropical cyclones do form in the North Indian Ocean, which encompasses the Arabian Sea and the Bay of Bengal (BoB). Pakistan is affected by cyclones that form or move close to the Arabian Sea (AS) in the pre-monsoon (May–June) and post-monsoon (October–November) seasons. These cyclones developed over waters under a distinct set of atmospheric conditions that were common at the sea surface, including sea surface temperature (SST), lower level convergence (LLC), and extremely moist air, as well as at the upper atmosphere, including vertical wind shear (VWS) and upper level divergence (ULD), which are known to be crucial elements of tropical cyclone formation and intensification (Bhutto, 2014). The yearly trend of powerful storms in the Arabian Sea has been shown to increase over the past three decades, even though tropical cyclone frequency in the region has historically been lower than that of cyclones in the Bay of Bengal. Several powerful cyclones, such as TC-2A (1999), TC-Gonu (2007), TC-Nilofar (2014), TC-Chapala (2015), TC-Kyarr (2019), and the most recent TC-Biparjoy (2023), made landfall close to the Arabian Sea and destroyed many coastal communities in the delta's Sujawal, Thatta, and Badin districts. The 1999 tropical cyclone (2A) severely damaged Keti Bander and Kharo Chhan when it made landfall nearby. At the time, 400 individuals were verified dead and about 60,000 residents of the delta were reported missing. A substantial amount of property and crops were lost in these areas because of the destruction and washing away of their homes, shelters, and animals. A total of about 150,000 people were impacted by the typhoon. Over the past thirty years, a number of tropical cyclones with intensities of category 4 and 5 have formed and moved close to the Arabian Sea, causing violent winds and torrential rains that have affected coastal communities in Keti Bandar, Shah Bander, Kharo Chan, and other deltaic regions, despite the fact that tropical cyclones rarely make landfall on Pakistani coasts. Tropical cyclones have become increasingly common in South Asian countries close to the Indian Ocean's edge because of human-caused climate change, which changed weather patterns and ocean-atmospheric climate systems. Madden-Julian Oscillation (MJO) and Indian Ocean Dipole (IOD). These climatic systems are expected to become larger in the future (Beal, 2019). Post-event investigation of meteorological parameters including sea surface temperature (SST), moisture content (Humidity), and prevailing winds (Convergence) are always carried out to comprehend the aftermath of the cyclone to update and evaluate existing forecasting models worldwide. This report also examines the government's necessary infrastructure maintenance and procedures, as well as Pakistan's existing early warning and

monitoring systems. Biparjoy, the Arabian Sea's first Cat-4 tropical cyclone, formed ahead of Pakistan's summer monsoon season. This cyclone started as a depression in the southeast of the Arabian Sea on June 6, 2023, around 1500 kilometers south of the coast of Pakistan. On June 7, 2023, it became a Cyclonic Storm (CS) in the evening at 1200 Z, a Severe Cyclonic Storm (SCS) in the morning at 0000 Z, and a Very Severe Cyclonic Storm (VSCS) in the evening. During its creation phase, this rapidly intensifying cyclone stayed virtually motionless for over four days. The storm became an Extremely Severe Cyclonic Storm (ESCS) in the morning (0000Z) of June 10, 2023, and began moving northward due to favorable atmospheric conditions (sea surface temperature, moisture content, and upper air wind shear). The system moved slightly northwestward to Oman on June 12, 2023, and continued to be as intense as ESCS for two more days. This cyclone was one of the long-lasting ones that stayed in the Arabian Sea for more than 13 days (Anon, 2023). The cyclone "Biparjoy" mostly traveled northwest and tracked in a zigzag fashion during its formation phase (Fig.1).

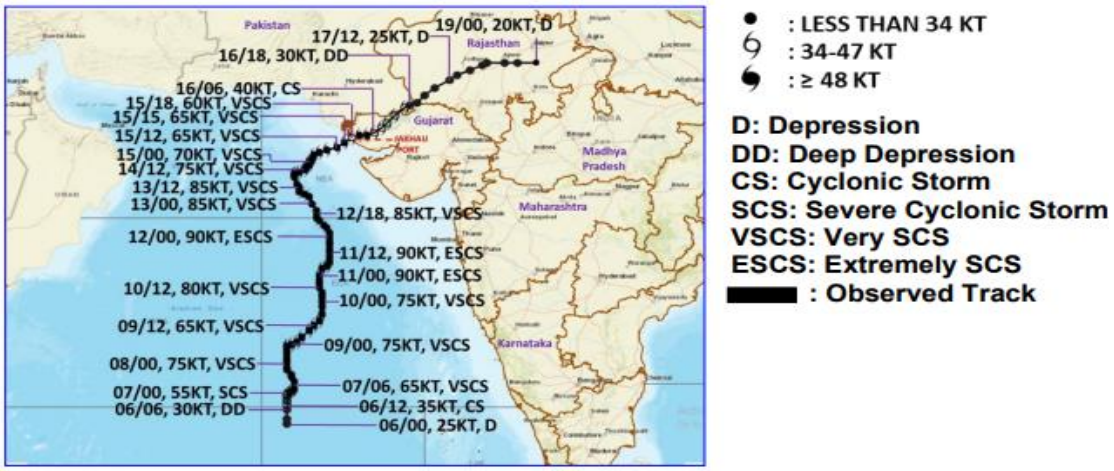


Fig 1 Observed track of TC-Biparjoy [Courtesy: IMD]

In contrast to most global climate forecasts, the system's path changed from north-northwest to northeast on June 14, 2023, close to Indian Gujarat, and its intensity decreased to a severe cyclonic storm (SCS). A cyclone's detour destroyed Pakistan's beaches, particularly in the deltaic areas of the nation. The Tropical Cyclone Warning Center (TCWC) of the Pakistan Meteorological Department (PMD) in Karachi issued the first news statement regarding the formation of a low-pressure area (LPA) or depression on June 5, 2023, and a warning or alert for a cyclonic storm on June 6, 2023. Until the system fades, the center will keep an eye on it (Anon, 2023).

MATERIAS AND METHODS

To collect quantitative data regarding community attitudes, awareness, and preparedness for natural disasters, develop and distribute surveys. This includes inquiries regarding past experiences, knowledge of warning systems, evacuation preparations, access to resources, and community involvement. performed in-depth interviews with key stakeholders, such as government officials, community members, political leaders, NGOs, and disaster management authorities. These interviews gather qualitative data on government planning strategies, challenges faced, and potential areas of collaboration. Focus groups were set up to find out more about the opinions, experiences, and suggestions of community members on government planning and community resilience.

These discussions addressed risk perception, coping mechanisms, community organization, and the role of government agencies. The coastal communities of Sujawal were selected for in-depth research to understand their experiences, vulnerabilities, and strategies for resilience. This included observations, site inspections, and discussions with locals and officials. To find patterns, trends, and connections pertaining to community attitudes, preparation levels, and resource availability, the survey data was examined using the proper statistical techniques. To find recurring themes, difficulties, and possibilities, the focus group and interview data were transcribed and subjected to thematic analysis. This offered deep insights into the viewpoints, experiences, and suggestions of the stakeholders. The results of surveys, interviews, and case studies were compared with pertinent literature and best practices from other areas or nations with comparable risks of coastal disasters. It assisted in identifying lessons learned and transferable solutions that influenced government planning and future directions.

RESULTS

Based on information gathered from monitoring of global forecasting models, TC Biparjoy, which at the time was a Very Severe Cyclonic Storm (VSCS), was expected to develop into an Extreme Severe Cyclonic Storm (ESCS). It was moving north-northeast from 840 km south of Karachi with winds of 130–140 km/h and gusts of 150 km/h. PMD predicts that it will impact Pakistan's coastal areas in one of three ways. Beginning in the evening of June 13, south and southeast Sindh (Karachi, Thatta, Sujawal, Badin, Tharparkar, and Mirpurkhas) could experience winds, thunderstorms, and heavy rainfall. Fragile structures can be damaged by winds, storm surges, urban floods close to the shore, and rough to severely turbulent sea conditions with strong squalls that prevent fishermen from going out into the open sea. The NDMA issued guidelines and advisories to all pertinent national and provincial stakeholders to implement proactive mitigation and preparedness measures in close coordination with PMD, PDMA Sindh & Balochistan, Pakistan Navy, Pakistan Maritime Security Authority (PMSA), and Pakistan Coast Guards (PCG). NDMA's NEOC was routinely monitoring and providing information to all stakeholders and the public through webpage-based estimates of BIPARJOY's tracks and effects on coastal areas. NDMA was also asked to be informed and pay attention to the official updates and warnings provided by relevant authorities to protect themselves and their houses from the possible consequences of TC BIPARJOY.

DISSIPATION AND LANDFALL

The tropical cyclone "Biparjoy" affected coastal areas along Sindh's coast as it moved northeast after intensifying into a very strong cyclonic storm in the evening of June 12, 2023. Residents of the deltaic regions of Sujawal, Thatta, and Badin were transferred to safer areas after being informed by Pakistani government authorities. The system kept moving northeast toward the Indian Gujarat coast, eventually passing through Indian Saurashtra and the nearby Pakistani Kutch region. It vanished as a depression/low pressure area on land on June 18, 2023. Storm Biparjoy caused significant damage to coastal settlements in the Indus Delta region due to its powerful winds (115–125 km/h, with gusts exceeding 140 km/h) and heavy rains, even though it traveled northeast and made landfall at the beaches of Gujarat and the Run of Kutch.

WEATHER IMPACT REALIZATION

Strong winds and heavy to extremely severe rains were produced by the system across Keti Bandar, Kharo Chhan, Shah Bandar, and the adjacent Kutch and Indian Gujarat region between June 13–18, 2023. There was a storm surge of about 2 to 2.5 meters along Gujarat's coastline (Fig. 2).

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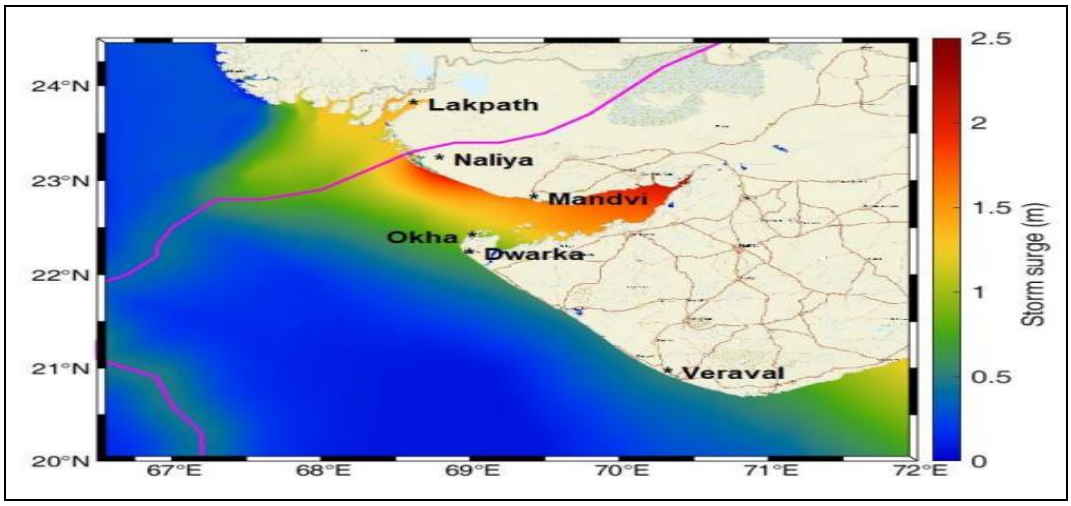
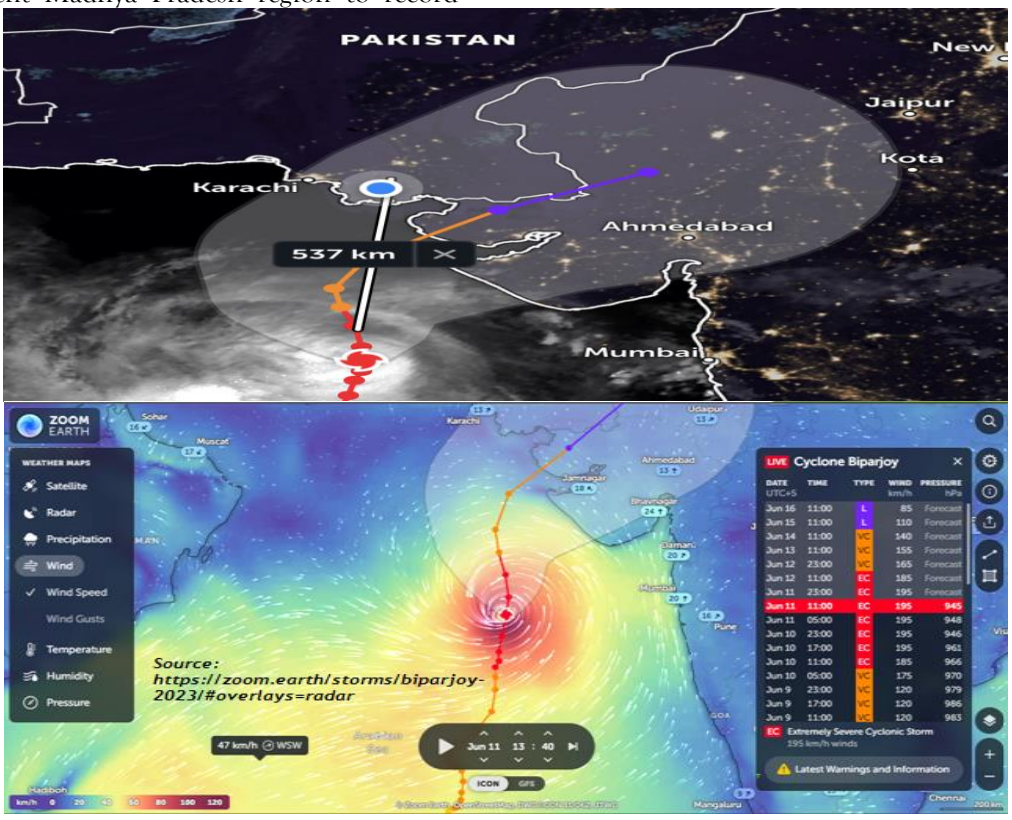


Fig 2 Storm surge recorded during landfall of TC-Biparjoy [Courtesy IMD]

The Indian Meteorological Department (IMD) maintains a huge network of meteorological observatories and rain measurement stations throughout Gujarat, Rajasthan, Saurashtra, and the adjacent Madhya Pradesh region to record rainfall and other meteorological parameters. Nevertheless, PMD only maintains two weather observatories in the districts of Thatta and Badin in the delta region that have recorded.



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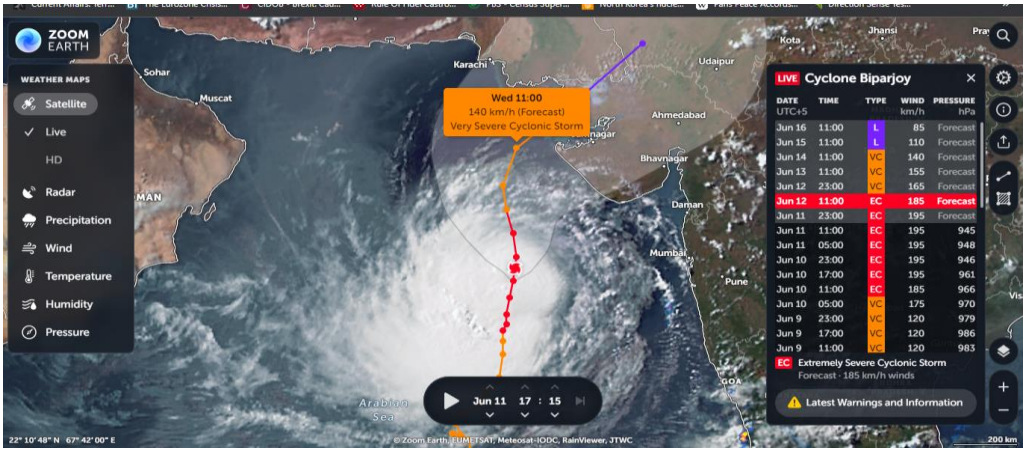


Fig 3-5 Intensity of Biparjoy moving towards the Sindh Pakistan and Gujirat India

Additionally, as part of the PMD's "Drought/Environment Monitoring and Early Warning System" project, roughly twelve standard rain measuring stations were set up in different Tehsils in the Sindhi districts of Thatta, Sujawal, and Badin (Table 1). To improve meteorological condition monitoring in these areas, almost all the rain measuring stations need to be rehabilitated and have their general equipment replaced. The National Disaster Management Authority (NDMA) and Pakistan Meteorological Department (PMD) classified the system as a very severe cyclonic storm. Due to the cyclone's wide path, Sujawal and the nearby coastal districts were directly hit by powerful dust storms, torrential thundershowers, and high-speed coastal winds even though the cyclone's center made landfall near Jakhau Port in the Indian state of Gujarat (which is next to Keti Bandar in Sindh).

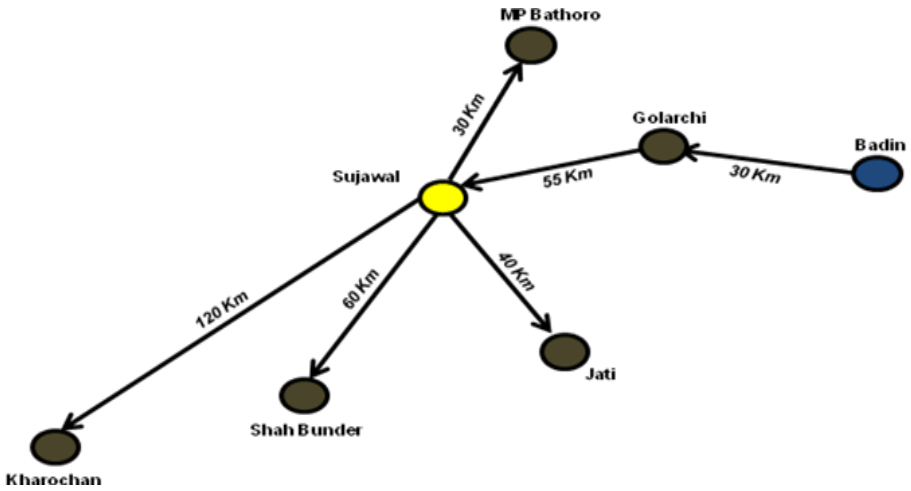
PREPARATION AND PREVENTIVE MEASURES

The coastal area of Sujawal is susceptible to the devastating effects of cyclones and other natural disasters. Coastal towns in the area face significant challenges in terms of preparedness, response, and recovery during a disaster. Biparjoy cyclones, which are known for their powerful winds, torrential rain, storm surges, and flooding, seriously endanger people's lives and means of subsistence. Three towns in the Sujawal district—Jati, Shah Bandar, and Kharo Chan—were the most susceptible. There were 41 affected dehs overall throughout three towns, followed by 105 villages and 9194 households. There were 6120 domestic livestock and a total of 53522 people.

Table 1. Vulnerable area and human population in coastal zone of Sujawal district.

S. No	Vulnerable Town/ Taluka	Jati	Shah Bandar	Kharo Chan	Total
1	No. of Dehs	23	10	8	41
2	No. of Villages	51	31	23	105
3	No. of Households	7321	1020	853	9194
4	Human Population	36560	90	735	53522
5	Livestock	3200	1140	1780	6120

Source: Deputy Commissioner Office Sujawal.



EMERGENCY IMPOSED IN REGION

Deputy Commissioner Sujawal implemented Section 144 Cr.P.C. against fishermen's maritime attempts. All operations and activities in coastal streams were forbidden due to the district-level emergency. Each officer and staff member of the associated agencies was assigned specific tasks and deputed. Due to an emergency, government employees' leaves were canceled.

RELIEF AND MEDICAL CAMPS

Within ten to fifteen kilometers, six main relief and hospital camps were set up in three Talukas. major camps for aid in the area (Jati and Shah Bander). Every medical facility was put on red alert. Placement instructions were given for medical camps and mobile ambulances. With a radius of ten to twelve kilometers, six main relief and hospital camps were set up for Shah Bunder. A major relief and medical camp were set up for Kharo Chan 1. Due to Jati's dispersed population, nearly twelve primary and medical relief camps were set up. Government Higher Secondary School Jati, Government Girls Higher Secondary School Main Jati, and Government Primary School Jati were the locations of the relief camps. The sports complex in Jati was designated as a tent site.

Table 2. Sites identified for relief and medical camps in Sujawal district.

S. No.	Site name	Rooms/ Capacity	No. of persons accommodated
1	Government higher secondary school, Jati	12	150
2	Government girls higher secondary school, main Jati	10	130
3	Government primary school, Jati	4	155
4	Area for tent: Sports complex JATI	50	500
5	Primary School Chuhar Jamali Old	4	140
6	Girls Middle School Chuhar Jamali	4	150
7	GBHS Ladiun	7	170
8	GPS Ladiun	4	140
9	GBHS Chach Jehan Khan	6	162
10	GPS Chach Jehan Khan	4	146
11	Middle School Hussian Dal	5	155
12	GPS Juman Sanghar	2	115
13	GPS Goongani	5	145

14	Govt, Girls Primary School Goongani	6	155
15	Govt Middle School Ageedino Shah	4	140
16	GPS Ageedino Shah	2	115
17	Gps Qadir Dino Shah	4	135
18	Middle School Qadir Dino Shah	6	167

Source: Deputy Commissioner Office Sujawal.

TRANSPORTATION MECHANISM FOR RESCUING

The Pakistan Navy saved 64 fishermen from 18 fishing boats. The Pakistan Navy has identified six fishing boats carrying thirty-one fishermen in the sea near Othano Darya. For transportation, luggage, and cattle, FWD cars, trucks, and tractors have been scheduled.

EVACUATION AND RESCUE PLAN

The public was evacuated from high-risk areas. To facilitate the population's timely evacuation, local stakeholders were involved in this process. 16451 people in all were spared. The detail is given in following table 3.

Table 3. Total population rescued and evacuated from vulnerable area of Sujawal district.

S. No.	Town/ Taluka	Total Coastal Population	Total Vulnerable Population	Total Evacuated	Percentage Evacuated
1	Jati	9027	8070	5165	64
2	Shah Bandar	36560	6537	8118	100
3	Kharo Chan	7935	7935	3168	40
	Grand total	53522	22542	16451	72. 97

DISCUSSION

In relation to early warning systems, rescue efforts, and relief efforts, studies were conducted on Biparjoy, a natural disaster impact assessment on marginalized coastal communities. An open-ended questionnaire was utilized to gather information from migrant families and local populations residing in coastal and marine areas through KII and focus group discussions. Local stakeholders were on board as well. The studies' observations are listed below. Prior to the detrimental effects of the cyclone, the district government acted. In Taluka Jati, Chach Jehan Khan, Shah Bandar, Chohar Jamali, and Taluka Sujawal, among other things, they clear and clean elevated mudflats, make space for tents, and evacuate government buildings. activated the vendors at each camp station to supply food, drink, medicine, and other necessities. The Pakistan Navy, Coast Guards, local political parties, media representatives, civil society, and activists from non-governmental organizations were all in constant communication with district management (Chaudhry and Rahim, 2006). The district administration provided camp stations for migrant families in shuttered schools and other government buildings. The district government provided food, water, and all other necessities three times. The Deputy Commissioner himself periodically checked the food and drinking water quality at most of the camp stations. The status of coastal populations during the Biparjoy storm was examined using key information interviews, focus groups, and direct observations. The coastal communities voiced their positive opinions and offered gratitude for the district administration, political leadership, Pakistan Army Navy, Coast Guard, and other stakeholders' outstanding efforts to assist and relocate to safe locations. The camp stations were equipped with water, power, and drainage systems. To save the families before the cyclone's effects, the district authorities promptly prepared a transportation system. To prevent the affected children from experiencing

any suffering because of this stress, safe and hygienic shelters, food, water, medications, other necessities, and even toys are provided. To rescue the lives and property of neglected coastal communities, the district management staff carried out their responsibilities with the utmost respect and sincerity (PDMA SINDH, 2016a). The Pakistan Navy, line departments, local political leadership, NGOs, and the media all made constructive contributions to the best of their abilities. District management officers, the Pakistan Army, political leadership, non-governmental organizations, and research organizations all deserve recognition for their dedicated services and diligence in providing safety measures, rescue, and relief to marginalized coastal communities with extremely limited resources. To make everyone aware of the changes in the Arabian Sea brought on by increased temperatures, pressure, wind direction, humidity, and cyclone strength, timely information and deliverables were distributed via GIS, state light systems, and pictures. The infrastructure of roads and transportation systems, information technology, communication networks, and the voices of media representatives saved people's lives and belongings (PDMA SINDH, 2016b). The coastal families returned to their hometowns with awards and dedication after thanking the district government.

POST IMPACTS OF TROPICAL CYCLONE BIPARJOY

Cyclone Biparjoy physically turned toward the Gujarati Indian locations at the right moment. The cyclone did not directly cause any significant accidents or fatalities in the Sujawal district. However, research using key informative interviews (KII), focus group discussions (FGD), on-site investigations, and observations revealed that the post-cyclone effects were inversely correlated with poor handling, negligent behavior, assets left behind, robberies, illnesses, and a lack of support from any source. It was also noted that the ecological parameters varied.

Warnings are widely disseminated by radio announcements, mosques, mainstream media, social media, the Pakistan Navy and Pakistan Coast Guards, local political activists, town committee members, social workers, and media representatives. At the DC office, a centralized control room was established with personnel from all pertinent offices. A final report was made available on the Japan International Cooperation Agency's (JICA) website.

Under the guidance of NDMA, the study was conducted in Pakistan in 2013 (DDMP SINDH, 2018). Along with best practices for early warning systems, the document makes recommendations for what information should be disseminated on radio and television. First and foremost, basic communication techniques should be used by PMD organizations, end user groups, and vulnerable individuals to spread information about disasters.

There should be access to a phone, fax, siren, media, radio, television, SMS, virtual private networks, public speaker systems, civil defense, police, municipal committees, fire departments, ambulances, and revenue departments. The strategy was developed in collaboration with the Thatta district government, the Provincial Disaster Management Authority, and other organizations. In accordance with this approach, the National Disaster Management Act was put into effect countrywide in 2010 and all districts were directed to establish DDRMPs and early warning systems (PDMA SINDH, 2023c).

While most plans do not include the early warning suggestions, others do. The district government was given guidelines on how to manage disasters and catastrophes in a planned manner under the Thatta District Disaster Management Plan (DDMP). In 2008, the NDMA established the initial DDMP for District Thatta. To make District Thatta disaster-resilient, the District Government recognized that the DDMP needed to be updated and revised immediately.

The well-informed disaster management plan for Multi-Hazard Vulnerability Risk District Thatta was developed in 2023 with a focus on 2032 (PDMA SINDH, 2018). With taluka-level emergency operations centers managed by assistant commissioners in coordination with many line departments, this plan incorporates UC-wise risk. Thatta, the most vulnerable district, is under several threats. This plan was also

developed using high-resolution satellite photography.

Basic information from the district office was modified to reflect the current situation (PDMA SINDH, 2023). The hazard and vulnerability data are explained using maps at the UC level. Very little of the data was altered using traditional methods and human comprehension. The early warning system used in this proposal to notify vulnerable areas is currently poorly understood.

The district-level catastrophe and contingency plans were developed using human knowledge and conventional methods. However, because they are based on modern techniques and a range of data sources, the MHVRA-based disaster management plans are more authentic and reliable for the district's catastrophic planning and management (NDMA SINDH, 2013). Between 2022 and 2023, the Sindh province saw an average of 245.5 to 443 mm of rainfall in July and August, which was 3.7 to 726% more than the month's usual rainfall records. The average number of affected individuals was 12,256860; there were 1045 fatalities, 8422 injuries, 2087186 dwelling damages, 436435 livestock deaths, 3777272 agricultural area, and 7383023 human population relocation (DDMP Thatta, 2017).

The Sindh Disaster Management Policy was developed by the PDMA. The authority is committed to building Sindh's resilience, disaster preparedness, and risk reduction to give the people of Sindh a safer and more sustainable future (PDMA SINDH, 2023d). The rescued people were kept in relief camps for four days. They received cooked meals, Jerry cans, mosquito netting, a post-disaster tent supply, hand torches and solar lights, life jackets, dewatering equipment, and pumps. It was discovered that variations in the terrestrial atmosphere affected local physical attributes such as wind speed, precipitation, temperature, humidity, and solar radiation waves. Coastal biodiversity changed under stress due to these changes in terrestrial physical variables. The vast migration of aquatic animals was caused by rising temperatures, rising sea levels, and wave action. the changes in air temperature, humidity, wind speed, rainfall, sunlight, and visual clues.

CONCLUSION

The main conclusions of humanitarian, governmental, and environmental post-impact evaluations about Sujawal coastal settlements (with a focus on Shah Bandar, Jati, and Kharo Chhaan) show a few different effects. 24,978 people (about 4,996 families) were evacuated in advance of the severe cyclonic storm from Sujawal coastline talukas thanks to an extremely effective early warning campaign (WHO, 2023). Evacuees were temporarily housed at government schools and colleges that were converted into emergency shelters. After the threat passed, most of these families (17,552 people) were safely returned to their villages (OCHA, 2023). The severe gusts (up to 120 km/h) and rainfall caused full and partial damages of hundreds of thatched mud and straw huts of the local fishermen often lived in. A multi-day restriction on entering the sea was enforced by the authorities. Although this prevented fatalities, it immediately reduced daily income and forced households to temporarily rely on rations. The storm surge and rising sea levels temporarily pushed seawater farther into coastal streams. This made a long-standing environmental issue worse in the Indus Deltaic region of Sujawal and Badin, where constant seawater intrusion damages groundwater and turns fertile agricultural land into desolate, salt-dense terrain. To prevent malaria vectors and waterborne infections, the district administration had to make targeted deployments in the immediate aftermath to supply food packages, clean drinking water, and mosquito nets. Post-impact data indicates that although the institutional response was successful in lowering high fatality rates. Cyclone Biparjoy eventually revealed the severe, baseline multidimensional poverty and acute climatic vulnerability of Sujawal deltaic people. Many people were not availed and received any compensation for the heavy damage in the form of assets, livestock, fisheries, agriculture and infrastructure even illness. There is immediate need for preplanning and proactive measures with a detailed contingency plan in the close coordination of all the stakeholders.

RECOMMENDATIONS

Evaluate the degree of community preparedness and resilience to cyclones and other natural disasters in Sindh, Pakistan's coastal regions.

Assess how well the government's current plans and tactics are handling natural catastrophes in Sindh's coastal regions.

Determine the main obstacles and weaknesses in government preparedness and community resilience for natural disasters in coastal regions.

To improve disaster management plans, investigate ways that NGOs, community organizations, and government agencies can work together and coordinate.

Make recommendations for improving government planning in coastal areas and community resilience to natural disasters.

Examine the effects of previous natural disasters on coastal towns and their recovery.

Assess community members' understanding of the dangers of natural disasters and how to prepare for them.

Evaluate the effectiveness of early warning systems and evacuation preparations in coastal areas.

Consider how community-based organizations and local leaders might promote readiness and resilience.

Look for successful case studies and best practices from other regions or countries with similar risks of coastal disasters that might be applied in the research area.

Examine the infrastructure, human, and financial resources that are accessible for programs aimed at resilience-building and catastrophe management.

Examine how innovation and technology could enhance community resilience and government preparedness for natural disasters.

Evaluate the degree of community involvement and participation in disaster risk reduction and management decision-making processes.

Examine how social, economic, and environmental factors affect the resilience and vulnerability of coastal communities.

Examine the possibility of combining conventional wisdom and methods with contemporary approaches to catastrophe management.

ACKNOWLEDGEMENT

The Petroleum Marine Development Committee Sujawal and District Administration Sujawal highly acknowledged for financial support to conduct this research study in the umbrella of a marine research project Establishment of Marine Research Laboratory and Survey Unit: Population Dynamics, Pollution Impact Assessments, and Way-Forward of Coastal and Marine Biodiversity in Creeks of Sujawal Sindh Pakistan.

High gratitude is for Syed Ayaz Ali Shah Sheerazi MNA Sujawal, Syed Shah Hussain Shah Sheerazi, Honourable Muhammad Ali Malkani MPA, Madam Rehana Laghari MPA, Madam Heer Sohoo MPA for necessary help and support of coastal communities of Sujawal during this difficult moment at all stages.

Regards are for research members Mr. Imtiaz Ali Lohar, Mr. Shakeel Ahmed Mallah, Muhammad Ramzan, Mumtaz Wangai and Muhammad Ali Thaheem who performed field work, data collection to complete task.

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