

Impact of Natural Disasters on School Education in the Sundarban Region of West Bengal: A Study

Subhasis Manna¹, Dr. Pramod Kumar Yadav²

¹Student, Department of Teacher Education, Baba Saheb Ambedkar Education University, Kolkata, West Bengal, India

² Assistant Professor, Department of Teacher Education, Baba Saheb Ambedkar Education University [Erstwhile David Hare Training College], Kolkata, West Bengal, India
Email: 308861[at]gmail.com

Abstract: *The Sundarban of West Bengal is a globally significant area for its unique ecosystem and rich biodiversity. The coastal districts of North and South 24 Parganas, forming World's largest delta bounded by complex trajectory of rivers and the Bay of Bengal, are highly vulnerable to the cyclonic storms, flooding and soil erosion. The salt-tolerant dense Mangrove forest area can be regarded as the nature's disaster-prevention system. However, due to rapid climatic changes, irregular monsoons, weak embankments and large-scale deforestation, the frequent cyclones and storm surges create most devastating impact on the lives and livelihoods of the habitats of the Sundarban. The loss of productivity due to salt-water intrusion caused many to get displaced from their original habitats. The long-term effects of the severe cyclones, like Aila, Amphan, Yaas etc. on the school education system have immense importance in terms of the social and economic backwardness among the youths in this region. Motivated by the need to study the disaster affected education system in the Sundarban, which is, in fact, inadequately present in the literature, we have considered the qualitative method of research. Firstly, the historical background of the natural disasters in the Sundarban has been provided qualitatively. Extensive literature review on the topic of research has been carried out. The formal description of the method of research has been provided. Subsequently, the districts under the region of Sundarban are analysed in terms of educational parameters of primary, upper-primary and secondary sections of study over past few years after the census of India. The interplay between the natural disasters and school education system has been demonstrated with the emphasis on the dropouts, infrastructural insufficiencies and mental health of the students. Disaster Risk Reduction (DRR) is an integral part of the post disaster management and rehabilitation program. Both the short-term and long-term mitigation policies i.e. the school-based curriculum and beyond have been discussed. Our study is mainly focussed on the disaster affected schools in the Patharpratima Block. A short survey has been conducted there. Finally, we conclude by ascertaining the adversities of the natural disasters on the school education that, there remains scope for further improvement of the education scenario. Future directions of study is highlighted at the end.*

Keywords: Natural Disaster, School Education, Disaster Resilience

1. Introduction

The coastal area of West Bengal is vulnerable to natural disasters since the days of 1999 when super cyclone hit the districts of North & South 24 parganas. Sundarban is the largest mangrove forest area in the world situated at the lower Ganges Delta region near the Bay of Bengal formed by the confluence of the Ganges, Brahmaputra and Meghna rivers (Foundation, 2025b). Sundarban is a bengali word, which means "beautiful forest". However, "Sun-dori" (Scientific name: *Heritiera fomes*) is an abundantly found mangrove tree (Rainey, 1891). It is thought that, the nomenclature comes from the name "sundori". Indian Sundarban is predominantly river-centric plain areas situated at the lower Ganges Delta area near the Bay of Bengal by spanning over two districts of West Bengal, namely North 24 Parganas and South 24 Parganas. It is formed by the confluence of the Ganges, Brahmaputra and Meghna rivers (Department of Sundarban Affairs, 2024). Whereas, the rivers with its branches have different names at different regions, which are given below: Muriganga river, Saptamukhi river, Thakuran river, Matla river, Bidyadhari river, Bangaduni river, Gosaba river. The plain area are of two types: tidal wetlands and tidal mudlands as Sundarban gradually transforms from a decaying delta phase to the dying phase. A tropical cyclone is a rotating storm that forms over a low-pressure core of

warm tropical oceans, where strongly rotating winds from high pressure region surges with high speed, causes heavy rainfall and thunderstorms (Ghosh S., 2022). The Cyclones that hit the Sundarban region are enlisted below. Sidr (2007), Aila (2009), Phailin (2013), Hudhud (2014), Fani (2019), Bulbul (2019), Amphan (2020), Yaas (2021), Sitrang (2022), Remal (2024) & Dana (2024). During tides and storms, the lands are flooded with salt water and fresh water resources gets damaged. The agricultural lands also face devastating effects. Many islands like Suparibhanga, Lohachara, New Moore islands got vanished under water due to floods in this area and the Ghoramara island is already half-merged. Under the guidelines of UNICEF to promote safer school education framework for every children, a school environment must ensure safe drinking water, clean toilets, adequate mid-day meals, safe classroom premises, library, laboratories, playing field etc. Safety can not be compromised under any environmental hazards.

2. Literature Review

Bhattacharya (2020), Families facing economic hardship post-disaster often pull children out of school to contribute to household income: This study shows that, girls are unevenly affected due to early marriage or domestic responsibilities. Thus, disasters indirectly accelerate

educational inequality. Chakrabarti & Basu (2021), Underscore the emotional and psychological toll natural disasters have on children: It has been found that, trauma, displacement and loss of family members or homes contribute to emotional stress, anxiety and depression, which contributes as a deterrent effect on academic engagement. Post-Amphan reports from Pratham (2021) and the Department of School Education, West Bengal (Banerjee and Banerji, 2022): This study emphasizes long-term relief initiatives under Disaster Risk Reduction (DRR) management including repairing of school buildings, distribution of books and uniforms, and setting up temporary learning centres. However, gaps remain in addressing long-term educational disruption and mental health support. Studies by UNICEF (2015) and the West Bengal State Disaster Management Department (Department, 2024): Post-disaster scenarios corresponding to the destruction of class-rooms, loss of educational materials, poor sanitation facilities, occupying school buildings as temporary shelters and delaying the resumption of classes are detrimental for school education purposes. The infrastructural breakdown severely restricts children's access to safe learning spaces.

3. Objectives of the Study

Following were the objectives in performing this study:

- To identify the types of natural disasters commonly affecting the sundarban regions.
- To assess the impact of natural disasters on school infrastructure, attendance and learning outcomes.
- To examine the availability and effectiveness of disaster management plans in schools.
- To suggest strategies for minimizing disruption in school education due to natural disasters.

4. Research Question

Based on the study objectives, this study aims to answer the following research questions

- What kind of natural disasters most commonly affect school education in Sundarbans?
- How do these disasters impact school infrastructure, students and teachers?
- Are there any school based disaster preparedness or response systems in place?
- What strategies can improve resilience in disaster prone education system?

5. Research Methodology

5.1 Research Design

The study follows a descriptive survey research. This design helps in collecting qualitative data to understand the extent, nature, and consequences of disaster-related disruptions in education. The data collection from on-site and online sources of information has been done by asking binary choice type (yes/no) questions to the stakeholders of the study. 45 participants with equal number of representatives from the students, the guardians and the teachers of different genders, castes and economic backgrounds are considered here.

5.2 Selection of study area

The research is conducted in the southern most Patharpratima block of Indian Sundarban. Poverty and hunger-stricken Patharpratima is a community development block under Kakdwip subdivision in South 24 Parganas (Foundation, 2025a), which is geographically one of the most vulnerable part to the natural calamities.

5.3 Sample

There are three types of respondents (Stakeholders) in our school-based sampling method, which are given as, (i) the students, (ii) the guardians and (iii) the teachers. Sample size is considered to be 15 corresponding to the study of each class of participants, i.e. students, guardians and teachers. Purposive sampling has been used to ensure representation from disaster prone area. The samples are chosen randomly. The school names along with their locations are given as, Shibganj Abaitanik Prathamik Vidyalaya (patharpratima GP), Kamdevpur Snehabala Milan Vidyapith H.S. (Achintyanagar GP), Kedarpur Ramananda High School H.S. (Lakshmijanardapur GP), Patharpratima Anandalal Adarsha Vidyalaya (Patharpratima GP), Banashyamnagar High School H.S. (Banashyamnagar GP).

5.4 Data Collection Methods

For the administration of tools in this research, the investigator formally sought the permission from the heads/in-charges of the schools and visited the schools and the neighbouring area to collect the data personally. Structured questionnaires was organized for students, guardians and teachers to collect data on absenteeism, infrastructure damage, academic loss impacts. The questions were culturally appropriate, clearly worded, and sensitive to the disaster context. The scaling is done by yes/no options only. Structured interviews were arranged for school administrators and education officers to gain deeper insights into policy gaps and disaster preparedness. Interviews were conducted with people involved in natural disasters. On-site schools were visited to assess physical infrastructure, availability of disaster-resilient facilities and current teaching-learning conditions post-disaster. Review of school records, government reports, attendance data, and post-disaster recovery plans were prepared.

6. Data Analysis

The literacy gap is highest (approx. 21%) in Canning-II block in terms of the comparison with the literacy of the state average of West Bengal. Whereas, the literacy of Namkhana is remarkable in the Sundarban region although it still lags behind the state average. It shows that, males are quantitatively more literate than females in Sundarban. Many schools have been shut down in the Sundarban region due to natural disasters, and declining student enrolment due to rapid privatisation. Thousands of primary schools have closed with the highest figure in South 24 Parganas, including many blocks in the Sundarban. there exist different ethnic groups, scheduled tribes, scheduled castes/sub-castes, e.g. Namahshudra, Kaibarta, Bhunia, Bagdi, Dhopa, Muchi, Turi, Munda, Maal, Tiyaor, Bedia, Haari, Kandra, Pundra etc. The

most of the people of Sundarban can not bear the cost of education on their own without any help from the Government bodies and NGOs. Inadequate cleanliness of ground water supply and sanitation services cause a significant number of children to die every year (Ghosh, 2012b). Among the diseases, the diarrheal mortality and the infectious diseases is significantly high. The arsenic poisoning, Leishmaniasis (kalaazar), pulmonary tuberculosis and high prevalence of *Plasmodium falciparum* are other important causes of child mortality in the region (Kanjilal et al., 2013). Additionally, the threat of animal bites (from tigers, crocodiles, and dogs). Accurate inference can not be drawn for the PTR in the schools of Sundarban without sufficient knowledge on it. Sufficient recruitment of the teachers is necessary to lower the PTR in the region through the approval of competent authorities under the state Government. As per the reports on UDISE+ (Ministry of Education, 2024), the overall GER of West Bengal is quite satisfactory irrespective of castes and creeds. In South 24 Parganas, the enrolment has gradually decreased from pre-primary to the secondary level irrespective of gender, which is reasonably alarming for the progress of the students. The dropout rate of the girls are, in general, higher than that of the boys due to societal bias for the boys. Even the trend of child marriage for the girls is another alarming reason of our society for such dropouts which needs strong administrative action for elimination. Despite the insignificant growth of online connectivity from 15% to 21.7% in North 24 Parganas and from 10% to 14.6% in South 24 Parganas over the period of 2024-2025, the overall infrastructure for online education in the region of Sundarban has been miserable for the students with economically poor family background. The scientific laboratory facilities in the schools of Sundarban vary notably from well-equipped labs to limited resources depending on the location of the schools. Modernised computer labs, and the labs of physical science, chemical science, biological science and geography are rare to be found, while traditional and orthodox laboratory set-ups without sufficient funding are adequately present in the schools of rural areas which are short of such facilities. The Mid-Day Meal Scheme (also known as PM POSHAN) comes under community health initiative of the government (Ministry of Education, 2025) that provides free, cooked meals to the children in the government and government-aided schools to enhance their nutritional level and thus their participation in school education system.

7. Results and Discussions

Tropical cyclones

Cyclones typically form due to a combination of oceanic and atmospheric conditions that generates a self-sustaining system of spiralling winds around the eye of low-pressure centre (Foundation, 2025c). The low-pressure centre is the manifestation of the increasingly warm, moist air over the oceans due to the larger effect of global warming. The Cyclones that hit the Sundarban region are enlisted below. Sidr (2007), Aila (2009), Phailin (2013), Hudhud (2014), Fani (2019), Bulbul (2019), Amphan (2020), Yaas (2021), Sitrang (2022), Remal (2024) & Dana (2024). Apart from the tropical cyclones, there are other forms of natural disasters in the region of Sundarban (India; Roy, 2019) i.e. Rise of sea-level, Monsoon flooding, Coastal erosion & Salt-water

intrusion & Artificial hazards.

7.1 Impact of natural disasters on school education in Sundarban:

As per RTE Act, 2009 of the Government of India (Ministry of Education, 2009) and United Nation's 17 Sustainable Development Goals (SDGs) for 2030 (OECD, 2025), the pro-motion of inclusive and equitable quality of education has been lacking in the disaster-prone areas. The age group of the students being dropped out with highest frequency is within 15-17 years. This implies that, the dropouts have increased after they passed class 9. The scheme provides annual scholarships of Rs. 1000 and one time grant of Rs. 25000 to the unmarried girls aged 13-18 years. Despite of its initial success, the number of girls taking up the scholarship has fallen down since the cyclones Amphan and Yaas. It has also been shown that, the attendance of the girls has been fallen to 77% for the age group of 15-17 years while 99% of the girls attend school for the age group of 6-10 years in West Bengal. The attendance of the boys is even lower than girls with 67% for the age group of 15-17 years. The educational goods have been washed away by the storms. The infrastructural damage was of worth Rs. 7 billion for the schools in the Sundarban during the cyclone Amphan (Mondal and Chowdhury, 2021). During this period, the school-going students of Sundarban faced a sharp decline in academic performances. Many of them have been discontinued their education (Ministry of Education, 2024). The schools were generally used as cyclone shelters and safe homes for quarantine services during COVID-19 for the migrants of the lower sea-level islands. The surge was optimum during cyclone Amphan as the schools in Sundarban were converted into the disaster relief centres as announced by the government. The loss of classroom materials like textbooks, stationery items, project materials, audio-visual aids, projectors, screens and the uniforms of school students remained unaccounted during the course of natural disasters. Due to the consequent natural disasters, innumerable electric poles, distribution transformers have been dismantled, fell down and lost into rivers. Thus the digital classrooms, libraries, laboratories of the schools stopped functioning without lights, fans and other appliances. The insufficiency in terms of only 10-15% availability of internet facilities in the schools of Sundarban has been improved upto 20% which is still not enough to cope with the future disasters.

The destruction of the embankments of the rivers and salination of the paddy fields caused a huge loss of the lower income group of people in the Sundarban. The workers are migrated in other states and in abroad. Integrated Child Development Services (ICDS) program through community-level Anganwadi centers remained restless to preserve the deteriorating health of the students of Sundarban after the disasters (Kanjilal et al., 2013). The World Bank identified the factors behind the worsening of student health in Sundarban after the disasters. Natural disasters in the Sundarban disrupted infrastructures like roads, bridges, electric poles etc and the rise of water level during floods made the islands to shrink. It led to severe immobility and prolonged isolation for the residents of Sundarban. The disturbance to agricultural, hydrological parameters due to frequent cyclones and erratic

monsoon raining pattern has disastrous effect on ecology and humanity. To prevent environmental pollution, several laws

have been litigated in India (Mahadevia Ghimire and Vikas, 2012).

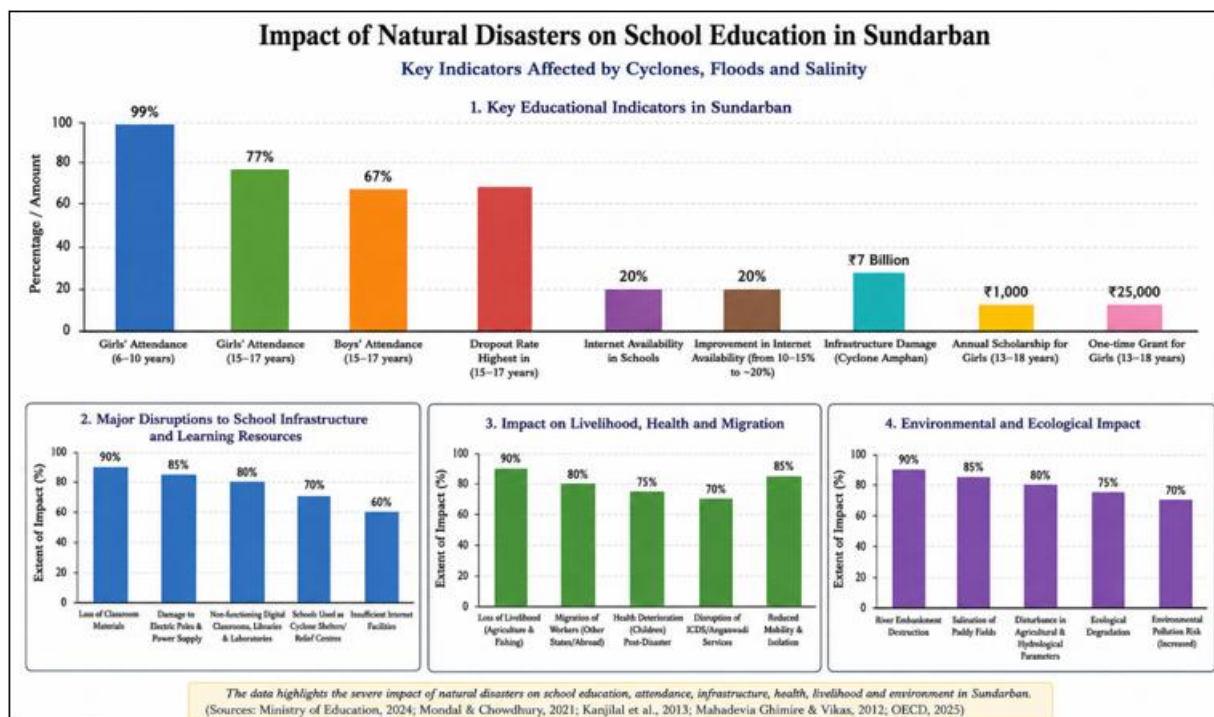


Figure 1: Impact of Natural Disasters on School Education in the Sundarban Region

7.2 Purpose of Disaster Risk Reduction (DRR)

Disaster Risk Reduction and Management (DRRM) encloses the proactive strategies to prevent or minimize the risk of future disasters by organising effective response-based measures. It acts as a bridge between climate change and humanitarian responses. DRRM makes a systemic and critical review of vulnerability depending on the anticipation of possible hazard and the ability of the habitats to cope with the situation. By supplying sustenance and freshwater by means of deep tube well or harvested rainwater resources, the climate-smart livelihoods can be assured. Another reason for DRRM is to improve climate resilience among the community. National Disaster Management Plan aims for ecosystem-based approaches in the Sundarban under international framework of carbon emission. Hence, the school buildings must not be located at the low-lying areas which are vulnerable during flooding and earthquakes.

7.3 Short-term DRR strategies

The high-risk zones of cyclones can be demarcated as weather forecast is given by IMD. The framework for DRR focuses on the bottom-to-top preparedness module in a decentralized manner (for Socio-Economic and Development (SEED), 1996). DRR must be included in school activities to form morning assembly, sports day functions, science exhibitions etc. which will help them to gather practical knowledge. National Cadet Corps (NCC), National Social Services (NSS), Nehru Yuva Kendra Sangathan, Civil Defence, WBSEDCL is responsible to restore the broken assets of electrical commodities and perform break-down maintenance activities during emergency situation (Ministry of Power, 2007).

7.4 Long-term DRR Strategies

Comprehensive Climate Education Programs needs to be implemented to protect the ecosystems of the mangrove forests and tiger reserves as natural buffers against climate changes. Mangroves absorb the high velocity winds and tidal surges and act as the first line of defence. The fragile economic insecurities of the population in the post-disaster period in the climate-sensitive regions of Sundarban may be addressed by creation and diversification of the jobs, climate-resilient income sources that can withstand future disasters. Besides, the bridges and embankments near the school buildings need modernisations for smooth transportation activities. The books stored in the libraries must be positioned above the ground floor. Students of the Sundarban can enter DRR training program through the online courses provided by National Institute of Disaster Management (NIDM) (Mondal and Chowdhury, 2021; Naik and Saha Roy, 2022). The district inspectors (DI) from every district are responsible to form a Student Safety and Security Monitoring committee (SSSMC). According to school safety mock exercise framework under the Directorate of Disaster Management, every student of the disaster-prone schools must participate in the mock drills organised by the DRR committee as a part of their curriculum (Department of School Education and for every child). Regular updation of comprehensive school safety & security programme is necessary through the website of UNICEF under the Sendai framework of DRR management (for Disaster Risk Reduction). On top of that, the risk maps and preparedness plans need to be prepared at Panchayat level, otherwise it will become just a project-driven or paperwork-based proposition.

8. Conclusions & Recommendations

The main findings of our research has been discussed here. The natural disasters affecting the Sundarban are demonstrated with emphasis on the significant period of 2020-2024. The enrolment, attendance, the reception of the Government scholarships for the students have been significantly reduced due to such natural disasters. The financial instabilities induced high dropout rates and migration of the pupils. The closure of schools, loss of educational resources and connectivity are the immediate effect of the disasters. DRR comprises a set of strategies to combat with the natural disasters. This has now been included in the school curriculum. Several short-term and long-term policies have to be adapted to mitigate the crisis, e.g. training and mock-drill sessions, periodical review of the preparedness, citizen centric approaches, raising of funds etc. A special merit scholarship for the exceptionally talented students of the Sundarban can help them to reach the global field of academia. Establishment of more number of schools, recruitment of local teaching representatives, planning of many outreach programs may be useful to revamp the dreams of many children. Several other aspects of education, for instance, making of career decisions, impression of government policies on the education, studies of disaster resilience in school curriculum, the tendencies to take up vocational, skill-based training for industries and entrepreneurship among the students etc. may be explored in future investigations. In this line of study, prolonged sustainability analysis of DRR management may be a useful direction for further research. Mangrove conservation techniques (Hafiz Iqbal and Nur Mozahid, 2022) may be explored to find its link with the education ecosystem. Finally, all the ecological, social and economic indicators may be exploited to have the clear depiction of Sundarban's education system by the way of multi-disciplinary perspective (Majumder, 2024).

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