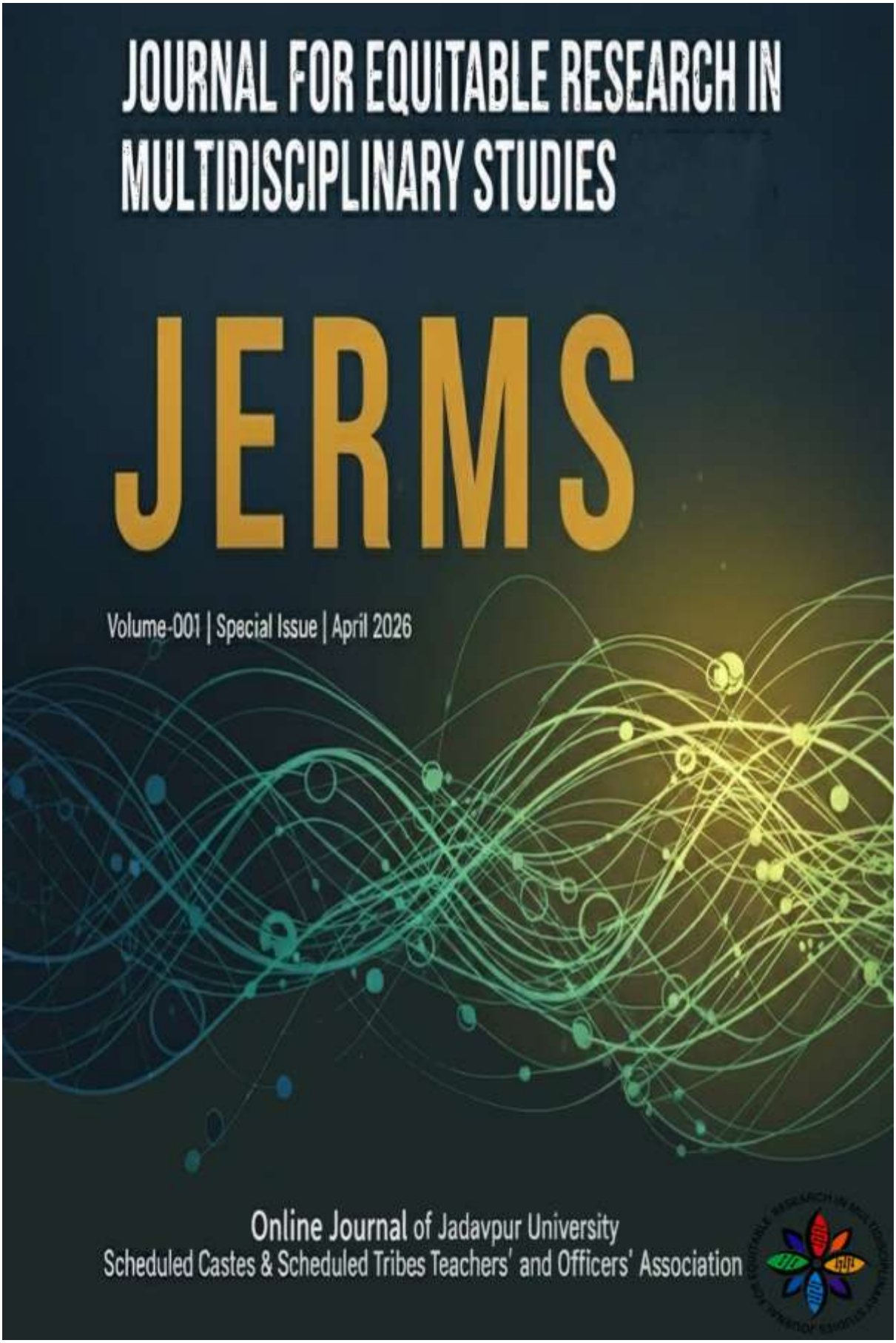
JOURNAL FOR EQUITABLE RESEARCH IN MULTIDISCIPLINARY STUDIES
JERMS
Volume-001 | Special Issue | April 2026
Online Journal of Jadavpur University
Scheduled Castes & Scheduled Tribes Teachers' and Officers' Association

Contents

Editorial Note

We are delighted to bring out the inaugural issue of the *Journal for Equitable Research in Multidisciplinary Studies*, published by the Jadavpur University Scheduled Castes and Scheduled Tribes Teachers' and Officers' Association. This marks the Association's first venture into academic publishing, offering a multidisciplinary platform for scholarly engagement across diverse thematic areas.

The Journal, received seven submissions between August and December 2025. All manuscripts underwent a rigorous double-blind peer-review process. The journal adopts a fully online submission and management system through Open Journal Systems (OJS), supported by the Public Knowledge Project, ensuring transparency and efficiency in the editorial workflow.

This first issue features four carefully selected papers that reflect a wide range of interdisciplinary concerns.

Together, these contributions reflect the journal's commitment to fostering equitable, inclusive, and socially relevant research. We hope this inaugural issue will serve as a foundation for future scholarly dialogue and collaboration.

Dr Atanu Saha

Chief Editor

Gross freshwater availability and accessibility in the delta plain of Indian Sundarbans

Chandralekha Bandyopadhyay
Adamas University

Suman Chatterjee[1]
Loreto College, Kolkata

Tuhin Bhadra
Adamas University

Date of submission 26-09-2025
Date of Acceptance 11-03-2026
Date of Publication 17-04-2026

Abstract

The Indian Sundarbans Delta is experiencing severe water scarcity that has affected 4.5 million people due to increased salinity levels, restricting access to drinking and irrigation water. Areal surface-water coverage has been obtained through use of MNDWI from Landsat with subsequent classification and determination of zonal-statistics estimation, surface-water quality data (2019–2022) from the NWMP portal and groundwater levels-reports and groundwater quality data from current CGWB reports then used to prepare surface and groundwater quality maps employing Empirical Bayesian Kriging. The central part of the delta had better water quality than Sagar Island, which was observed to have WQI values in the range of 203.98–255.6 in the Water Quality Map produced in this study. Groundwater levels diminished from 3.3 meters BGL in 1996 to 7.67 meters BGL in 2022. Freshwater scarcity and seawater intrusion are affecting agriculture and food security.

[1] Corresponding Author's email suman.chatterjee27@yahoo.in

Keywords: Water Demand, Ground water availability, water quality, salinity, Green economy

1.**Introduction**

Groundwater is a vital source of water worldwide, with an estimated 25% of water consumption globally that relies on groundwater sources (although this varies by region and development)(Mishra, 2023). As to Southeast Asia and the Pacific, in particular, groundwater supplies drinking water to 66% of urban households and 60% of rural households, or 79% of the populations in those countries(Carrard et al., 2019).

In the Sundarbans region, access to fresh drinking water is a critical issue due to the predominance of brackish water. Despite receiving abundant rainfall, the region fails to adequately utilize it to meet the needs of its 4.43 million residents across 19 administrative blocks (Bhadra & Hazra, 2012). The region's terrain frequently changes due to floods, cyclones, beach erosion, and sea level rise, causing significant disruptions to local livelihoods (I. Mondal & Bandyopadhyay, 2014).

After Cyclone Aila in 2009, water quality measurements at three stations in the Sundarbans showed sharp increases in COD, BOD, nitrate, and phosphate levels (Bhattacharya et al., 2014). Six blocks close to river estuaries (Gosaba, Hinjalganj, Patharpratima, Basanti, Namkhana, and Sagar) face severe water problems in agricultural areas due to high salinity. Despite surface water supply, potable water availability is nearly nonexistent, forcing reliance on groundwater located below 300m (Zaman & Gayen, 2008).

During the COVID-19 pandemic, surface water quality in rivers improved by 40-50%, with notable decreases in TDS and BOD levels, demonstrating the potential for natural water quality recovery (Chakraborty et al., 2021). The urgent need for a fresh water supply to protect the Sundarbans' landscape and mangrove ecosystem is evident, considering the region's high salinity levels(Saha, 2024; Wahid et al., 2025). Mangrove forests play a crucial role in

providing habitat, preventing erosion, and protecting against natural disasters, making the assessment of surface water quality and temporal changes essential (Rahman et al., 2013).Sagar Island, with its numerous tidal creeks, presents opportunities for large-scale aquaculture. Studies have been conducted to investigate the surface water quality in these creeks, revealing the potential for sustainable aquaculture practices (Basu et al., 2021).In low-lying areas like Sagar and Basanti blocks, fish farming ponds are vulnerable to saltwater flooding, prompting farmers to raise the height of pond dikes to reduce salinity intrusion (Chand et al., 2012).

Global climate patterns such as the El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) significantly affect water quality and recharge patterns. Continuous monitoring and adaptation strategies are necessary to mitigate these impacts (Das, Mukherjee, et al., 2021).Studies have modeled the Water-Energy-Food (WEF) nexus in India using various data sources, including the Community Land Model v4.0, to estimate groundwater storage changes and validate satellite-derived groundwater data (Barik et al., 2017).Research has also explored nexus modeling of water, energy, and food subsystems, considering variables such as agricultural water withdrawal and electricity consumption. This approach underscores the importance of integrated resource management to ensure sustainable development (Ravar et al., 2020).Given the high population pressure in the Sundarbans, it is crucial to assess water availability and production for aquaculture and agriculture, alongside addressing the knowledge gap regarding dry season irrigation (Humphreys et al., 2014).The urgent need to improve water management practices in the Sundarbans is clear. This includes enhancing rainwater harvesting, developing sustainable aquaculture practices, and implementing integrated water resource management (IWRM) approaches. Addressing these challenges requires a comprehensive understanding of the region's hydrology, climate impacts, and socio-economic conditions.

The Sundarbans region's water scarcity issues are multifaceted and require a holistic approach to address. By leveraging scientific research, technological advancements, and community engagement, it is possible to develop sustainable solutions that ensure water security for the region's residents. This will not only improve their quality of life but also contribute to the resilience and sustainability of the Sundarbans' unique ecosystem.

2. **Study area**

The Sundarbans are situated in the lower Gangetic delta (≈21°43′–21°55′N, 88°42′–89°04′E), comprising a complex estuarine system of tidal channels that is supported by seven major rivers draining southward into the Bay of Bengal. Tidal channels and channel banks, along with the dynamic tidal processes, help regulate freshwater–saltwater exchange, sediment deposition, and the patterns of salinity throughout the landscape (Das, Mishra, et al., 2021).

Salinity is the most important driver of hydrological and ecological change: research and monitoring reports illustrate that salinity levels have increased throughout the Sundarbans from north to south, and have accelerated amid storm surges and sea level rise. Studies report episodic salinization following cyclones (e.g. Sidr 2007, Aila 2009, Amphan 2020). Sea-surface temperature and estuarine temperatures have also increased in the region (0.019 °C yr^{-1} in the Bay of Bengal and ~0.06 °C from 1980–2007), further adding stress to freshwater species and biogeochemical processes Ghosh, 2015; (Abul & Mallik, 2016; Ghosh, 2015). The submergence of mangroves and salinization of agricultural lands has already led to reductions in paddy cultivation and sharp declines in freshwater fish catches and hatchling survival in some areas (Ghosh, 2015).

The availability of groundwater is highly limited: useable fresh groundwater is reported only at significant depth (~160–400 m) in many parts of the Sundarbans, beyond the capability of shallow wells for potable supply, while communities are left relying on limited surface -

freshwater sources and deep aquifers(Abul & Mallik, 2016; Bhadra et al., 2020; M. Mondal et al., 2024). Collectively, the estuarine salinity regime, disrupted surface-water quality after extreme events, and deep, spatially variable aquifers will create significant challenges to drinking-water security, irrigation, and aquaculture. Because of this, hydrological responses will depend on controlling freshwater inputs (capture and storage), limiting saltwater intrusion, and continuous monitoring of channel dimensions, salinity gradients, and aquifer recharge.

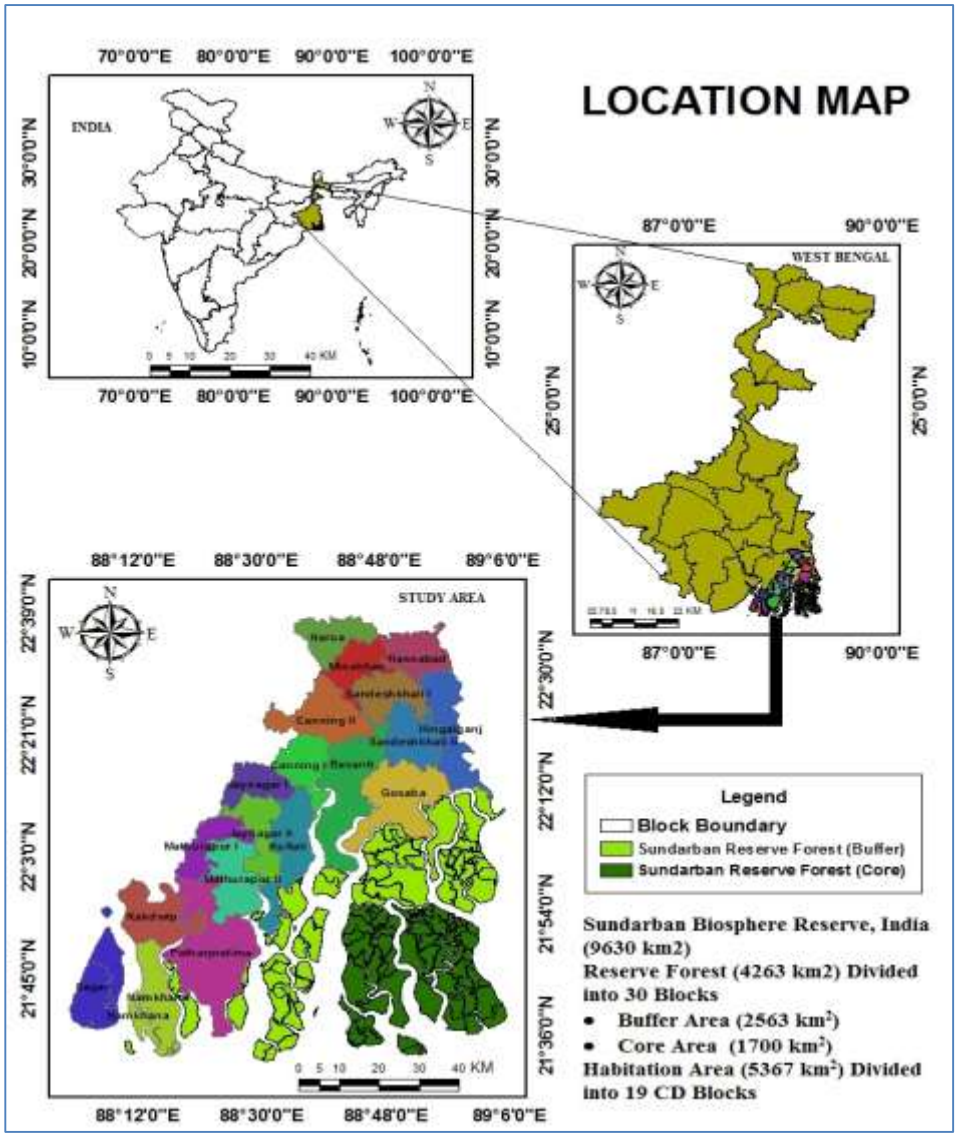

Fig1: *Study area of Indian Sundarban (West Bengal)*

3. **Methodology**

A map of the available water resources and their accessibility was produced by combining four essential parameters that defined the water supply, the water quality, the ground water levels and the ground water quality. The four parameters described above were combined into one composite layer by using the Weighted Overlay Method. The surface water supply was calculated from MNDWI values that were generated from Landsat images that were pre-processed. The mapping of the surface water quality was completed by using a combination of weighted overlays and spatial interpolation from secondary data from the CPCB. Ground water levels were mapped using interpolation from data collected by the Central Ground Water Board (CGWB). The assessment of the ground water quality was completed with weighted overlays and spatial interpolations from datasets of CGWB. The temporal range of the analysis encompasses the period from 2019 through 2022 (Figure 2).

Surface water, which includes rivers, canals, ponds, wetlands, and other bodies, is assessed and quantified using the Modified Normalized Difference Water Index (MNDWI). The MNDWI formula is (Green – SWIR)/(Green + SWIR) (Xu, 2006). MNDWI values greater than zero indicate the presence of water, while negative values denote non-water features in the Sundarban region.

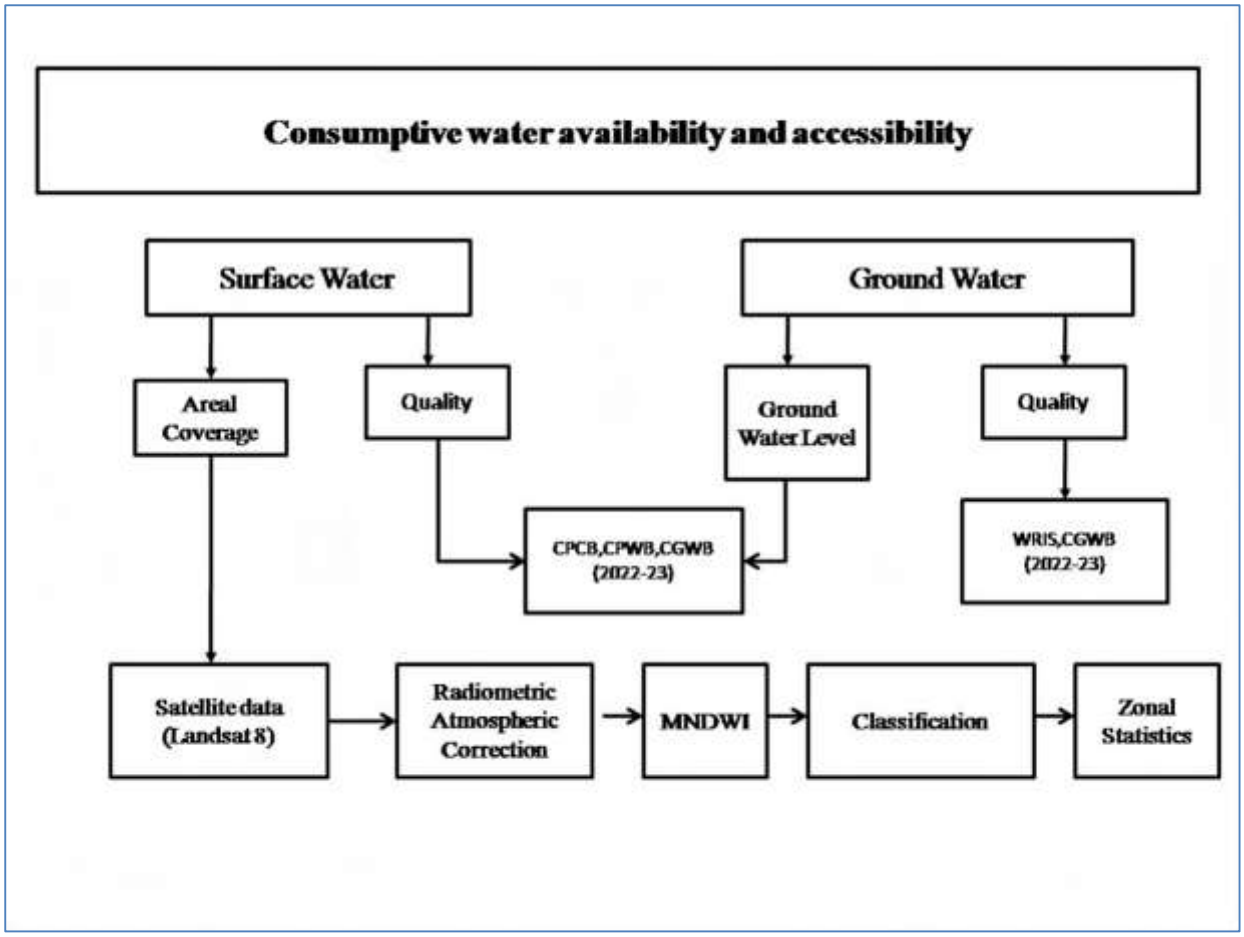

Fig 2: Methodological framework

Surface water quality is evaluated by computing the Water Quality Index using a weighted averaging method that includes parameters such as pH, salinity, dissolved oxygen (DO), turbidity, and chlorophyll (CHL). Groundwater quality and level data are obtained from the Central Ground Water Board report and the Global Groundwater Information System (GGIS) developed by the International Groundwater Resources Assessment Centre. Parameters for groundwater quality assessment include pH, electrical conductivity (EC), carbonate (CO3), bicarbonate (HCO3), chloride (Cl), sulfate (SO4), nitrate (NO3), phosphate (PO4), total hardness (TH), calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), fluoride (F), and total dissolved solids (TDS). Continuous surface maps for both surface water and groundwater quality and levels are generated using spatial interpolation techniques, specifically the

Empirical Bayesian Kriging method and the Inverse Distance Weighting (IDW) method, selected based on their accuracy reports. These spatial continuous surfaces are then used to assess water availability and accessibility on a zonal or block-wise basis.Finally, a Consumable Water Availability and Accessibility Map has been produced using the weighted overlay method, incorporating all four previously mentioned parameters of water availability and accessibility.All the parameters have been assigned equal weightage.

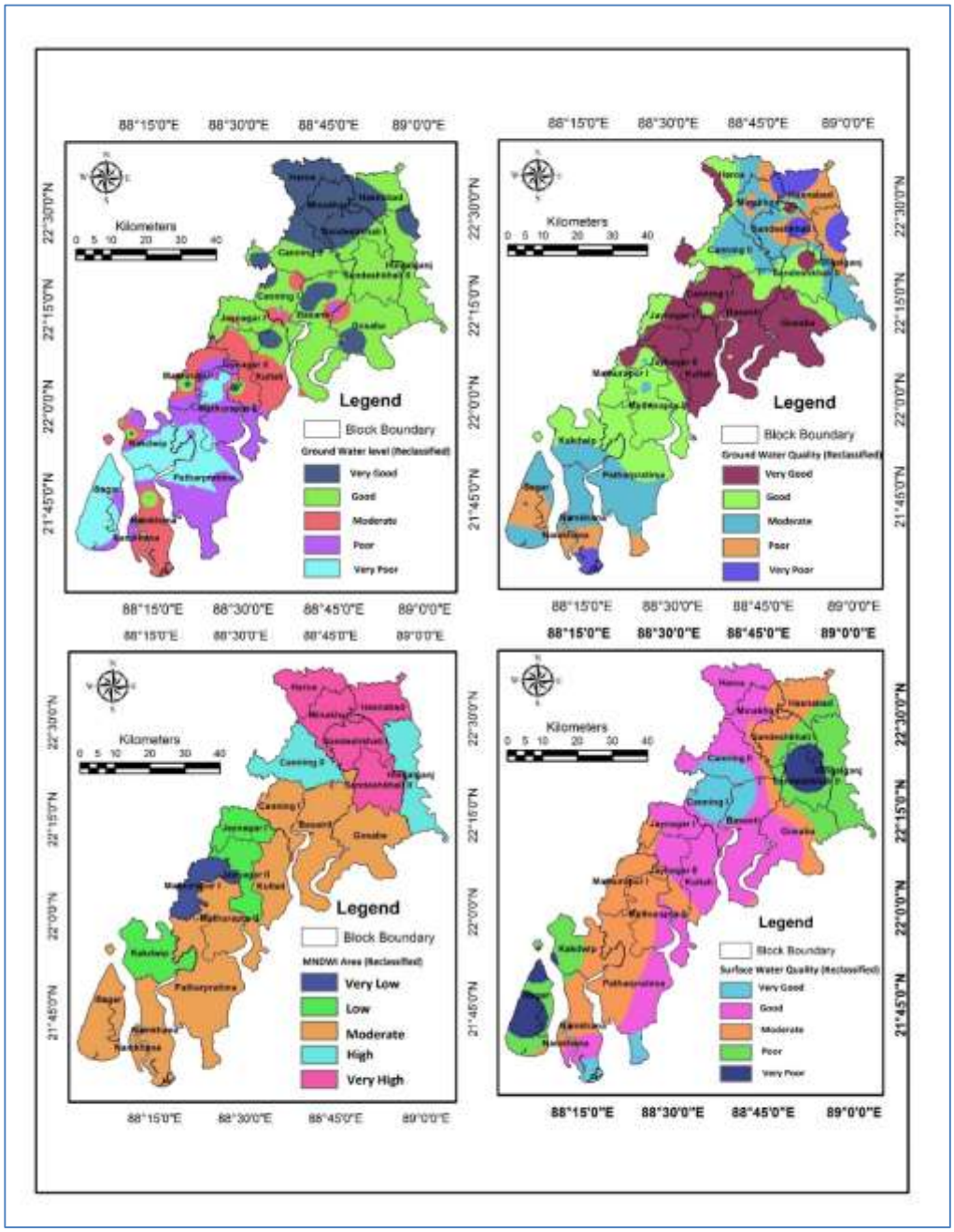

Fig 3: Reclassified Parameters of Consumable Water availability and accessibility Map

4. **Result and Discussion: The result and discussion section is presented in three main segments: the assessment of surface water, the assessment of groundwater and Consumable Water availability and accessibility mapping.**
    a. **Assessment of surface water:**

A comprehensive study of surface water quality was conducted across 19 blocks in the Sundarbans region during pre-monsoon, monsoon, and post-monsoon periods (Figure 3). The analysis focused on ten parameters, of which five—pH, Salinity, Dissolved Oxygen (DO), Turbidity, and Chlorophyll (CHL)—showed continuous variation. Data primarily from the post-monsoon period (August) were utilized for consistency.The pH levels ranged from neutral to alkaline (pH > 7.0) during the post-monsoon period. Salinity in the Sundarbans varied, with the highest recorded at 29.7 ppm and the lowest at 7.4 ppm. The region's ambient temperature during this time (28°C - 31°C) influenced salinity, which generally increased post-monsoon.

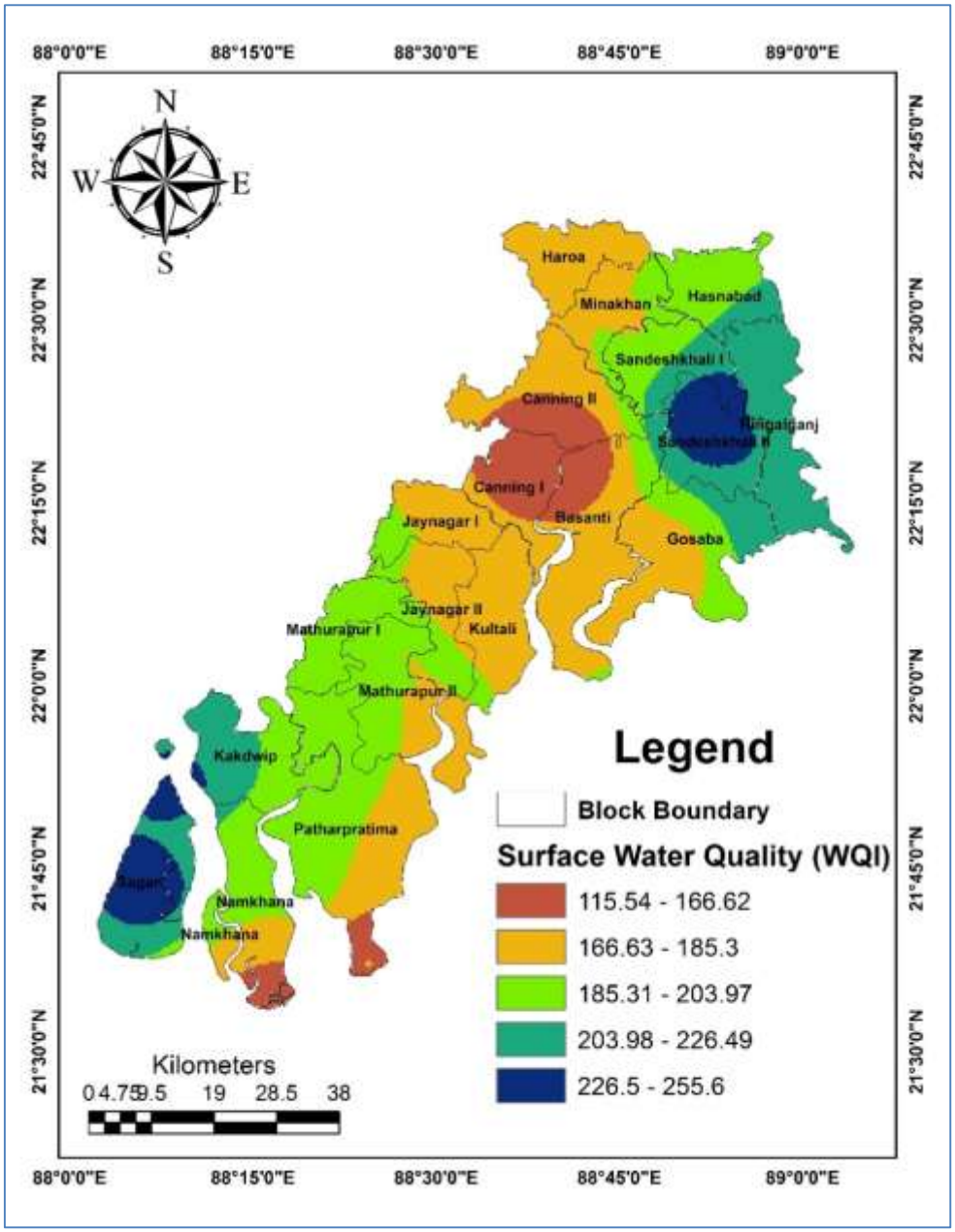

Fig 4: Surface water Quality

Areas between 115.54 to 166.62 WQI are classified as Good. The surface water quality in Canning I & II and Vasanthi blocks is relatively good, indicating limited pollution and adequate natural recharge. Areas of 166.63 to 203.97 WQI are in the Medium category. Canning II, Vasanthi, Gosaba, Jaynagar I & II, Mathurapur I & II, Kultali, Sandeshkhali I, Lebukhali, Malancha, Bakkhali and Hemnagar fall under this category. Moderate levels of surface water

pollution are observed in these areas, which may be due to agricultural runoff, gravel-mud transport, tidal effects, and waste runoff from residential areas.

Areas between 203.98 to 255.6 are in the Poor category. Surface water is highly polluted in Sagar, Kachuberia, Sandeshkhali II, Hingalganj and Bhagwatpur areas. Industrial effluents, tidal mixing, organic pollution and increased sediment load may be responsible for these values. Surface water in these areas is not safe for use without treatment.Surface water availability is highest in Haroa, Minakha and Sandeshkhali blocks as per the MNDWI zonal statistics values. These blocks having MNDWI values between 0.03 and 0.21indicating the presence of open water bodies, river/canal networks and adequate surface water storage. These areas are generally wetland-rich, tidally dependent and close to riverine areas, so water availability is relatively high. Hasanabad, Basanti, Canning, Gosaba, Patharpratima and Namkhana have MNDWI values ranging from 0.17 to 0.02. Although water availability in this region is moderate, the natural water holding capacity varies from year to year. Mathurapur I block has MNDWI value of 0.40 to 0.18, which is significantly lower. It indicates that the amount of open water bodies is extremely low, most of the land is used for agriculture or settlement, and Surface water capacity is limited due to geological conditions. (Figure 4& 5).

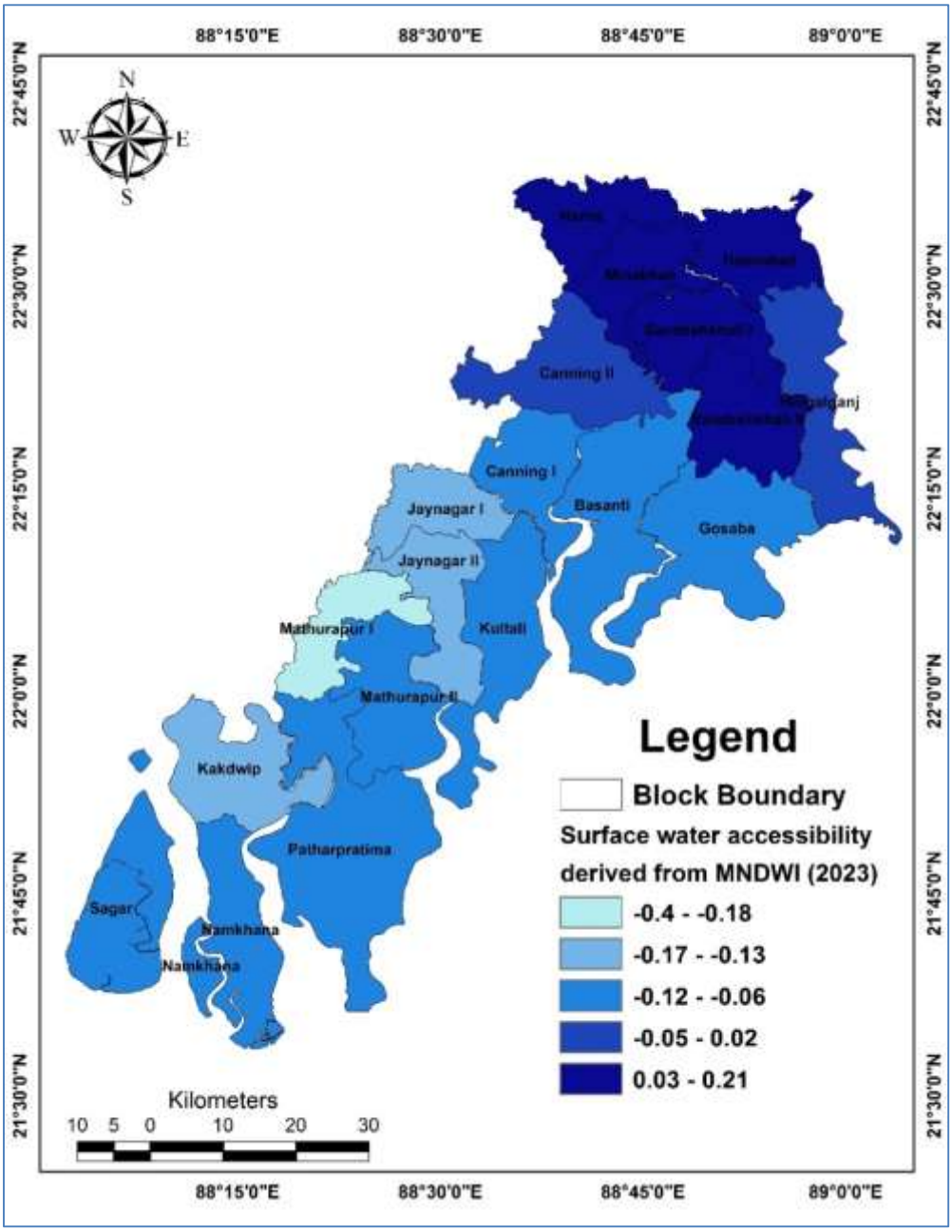

Fig5: Spatial Distribution of Surface water

b. **Assessment of Groundwater**

The groundwater quality assessment focused on both deep and shallow water during the post-monsoon period, considering various parameters (pH, EC, CO3, HCO3, Cl, SO^3, NO3, PO^3, TH, Ca, Mg, Na, K, F, and TDS).Shallow water exhibited higher salinity compared to deep water due to significant sea water intrusion.Deep water was more alkaline (pH > 7.0) due to

higher bicarbonate concentrations.These values indicated that shallow water, affected by seawater intrusion, was unsuitable for drinking. Some deeper groundwater sources were found suitable for drinking.

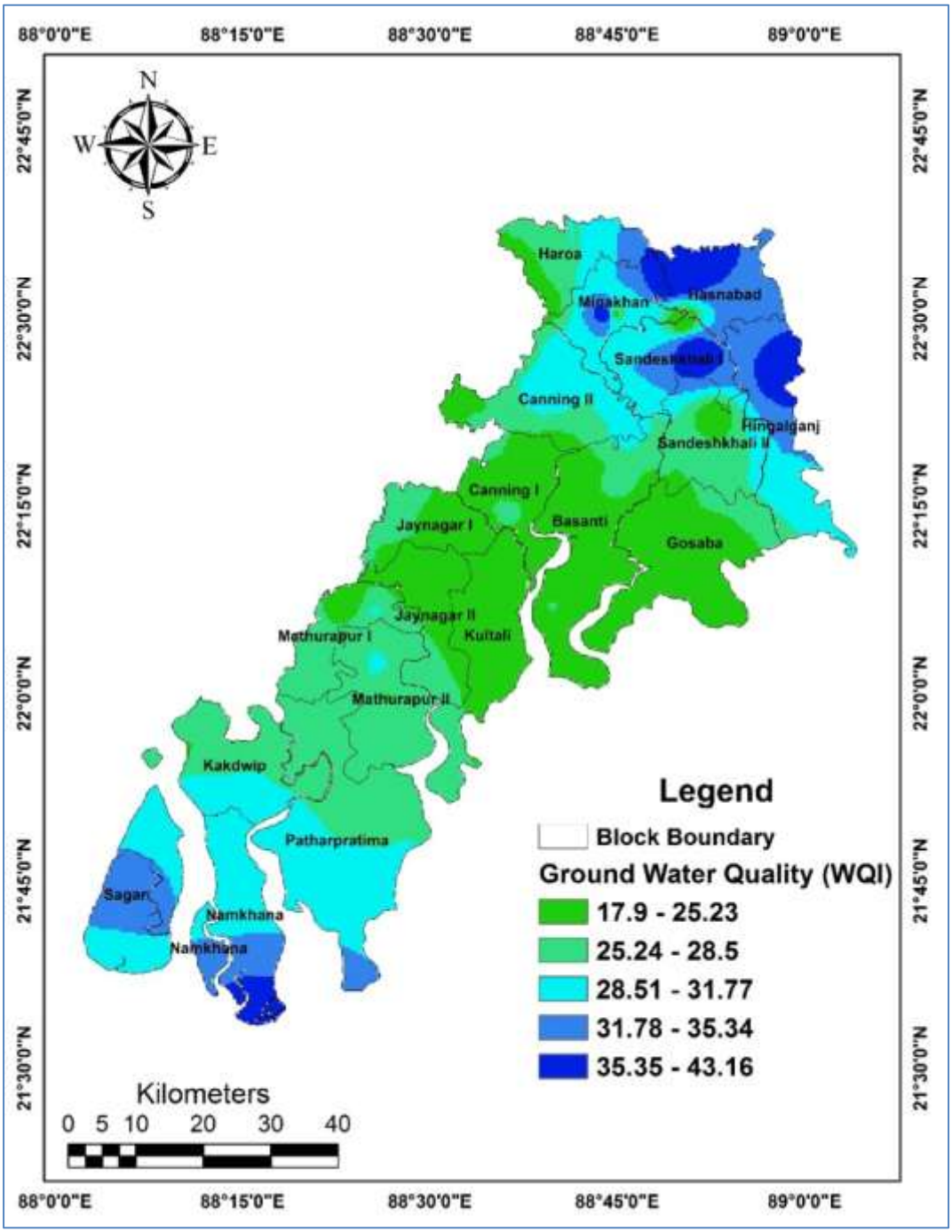

Fig6: Groundwater Quality

Qualitative differences between regions are clearly discernible in terms of WQI values for groundwater. Areas between 17.9 to 25.23 WQI are classified as Good. Jayanagar I and II, Kultali, Canning I, Sandeshkhali II, Vasanthi and Gosaba belong to this category. Groundwater contamination in these areas is relatively low and water quality is within acceptable limits, indicating safe drinking. 25.24 to 31.77 WQI populated areas fall into the Medium category. Hasnabad, Meenkhan, Patharapratima, Kakdwip, Sandeshkhali II, Hingalganj, Canning II and Mathurapur I and II fall under this category. The pollution pressure in these areas is moderate and the water quality is somewhat compromised but can still be usable with minor purification.Areas between 31.78 to 43.16 WQI value are of Poor category. Water quality is poor in Sandeshkhali I, Meenakh, Hasnabad, Hingalganj, Namkhana and Sagar blocks. High levels of contamination are present, which may pose a health hazard and the water is not suitable for direct consumption without proper purification. The depth of the groundwater sampled in this study indicated the average groundwater depth in each respective year. The year by year average depth of groundwater was 3.3m bgl in 1996 and decreased to 6.5m in 2017 and again down to 7.67m bgl in 2022.(Das, Mishra, et al., 2021).This suggests that the groundwater level decreased by about 3 m between 1996 and 2017 and approached near-normal conditions by 2022. Observations indicate that groundwater levels in the Sundarbans drop markedly during the pre-monsoon period, rise during the monsoon, and stabilize to normal levels in the post-monsoon period. The temporal pattern of groundwater-level (GWL) fluctuations is similar in both shallow (15 mbgl) and deep (115 mbgl) aquifers. Shallow groundwater level (below 0.33-4.54 m) in the study area includes the following blocks: Haroa, Meenakhan, Sandeshkhali I, Hasnabad, Basanti and Canning I. Blocks designated as shallow groundwater level indicate maximum availability of groundwater in these areas and these "natural zones" are the most "efficient". Where groundwater is between 4.55 and 10.52 m below ground level, these represent groundwater conditions for medium to high groundwater

levels. The following blocks are found within this range of groundwater levels: Basanti, Mathurapur I, II, Hingalganj, Canning II, Namkhana, Kakdwip, Jayanagar I In Gosaba and Basanti, many residents must travel long distances to collect drinking water using the Vat system.

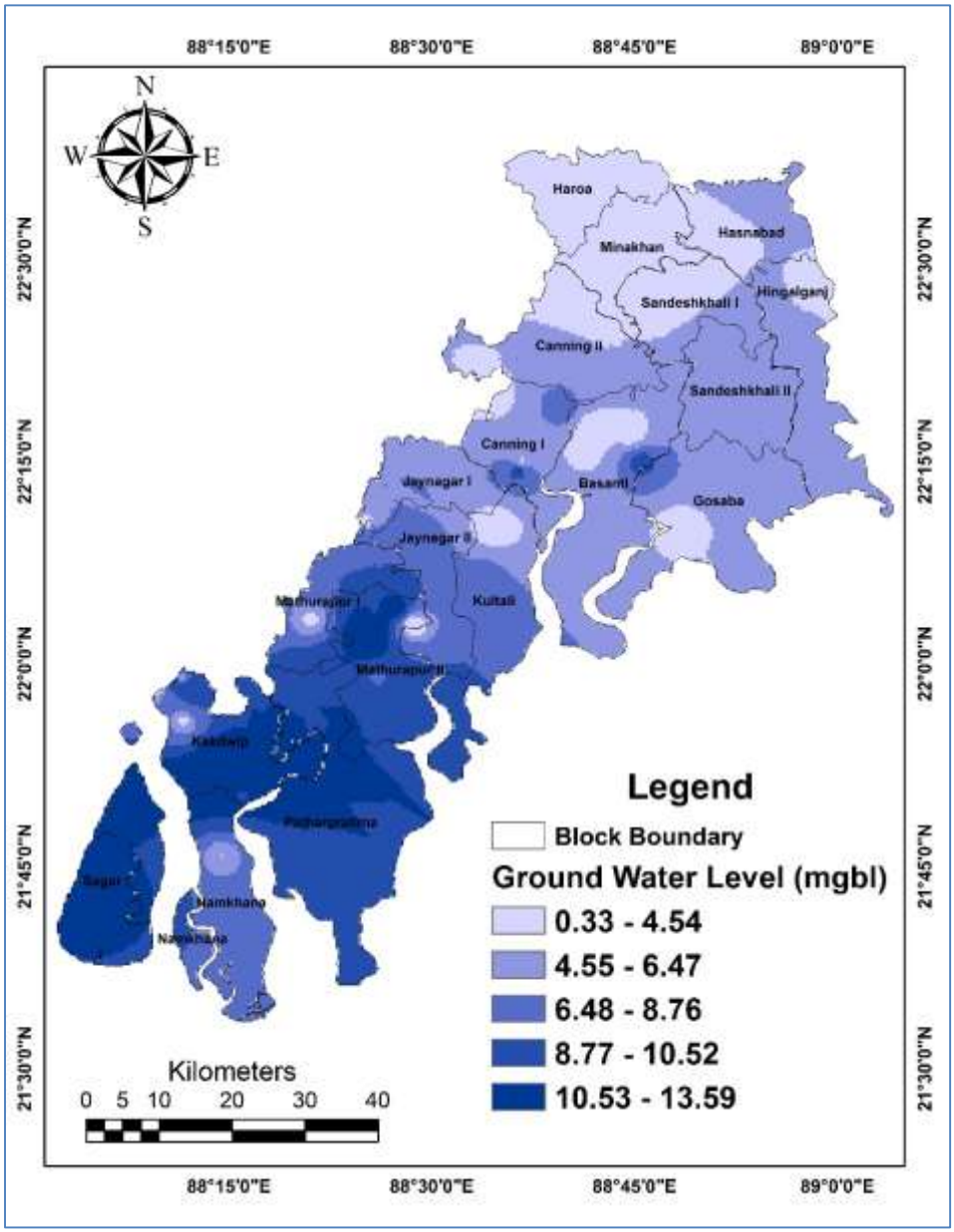

Fig7: Spatial Distribution of Groundwater level

Consumable Water availability and accessibility Mapping

The comprehensive assessment of surface and groundwater quality in the Sundarbans region highlights significant variations in water quality and availability across different periods and locations. The post-monsoon data revealed trends and regional disparities, emphasizing the need for targeted water resource management strategies to address the challenges posed by salinity, alkalinity, and water accessibility in both surface and groundwater sources.The areas with good freshwater availability and accessibility (red) are primarily concentrated in the northern and central parts of the district comprising Canning I, Basanti, Gosaba, Jaynagar I& II, Kultali, Mathurapur I blocks. This suggests that these regions have a better water supply infrastructure and natural resources compared to other areas. A significant portion of the district, particularly in the southern and eastern regions, falls under the category of moderate freshwater availability and accessibility (yellow) comprising Haroa, Minakhan, Canning II, Kakdwip, Mathurapur II, Patharpratima, Namkhana blocks. These areas may face challenges in meeting their water needs during certain periods or for specific uses.The areas with low freshwater availability and accessibility (green) are scattered throughout the district, but they are more prominent in the southern and western regions comprising the Hasnabad, Sandeshkhali I & II, Hingalgunj, And Sagar. These areas may experience water scarcity and have limited access to clean drinking water.

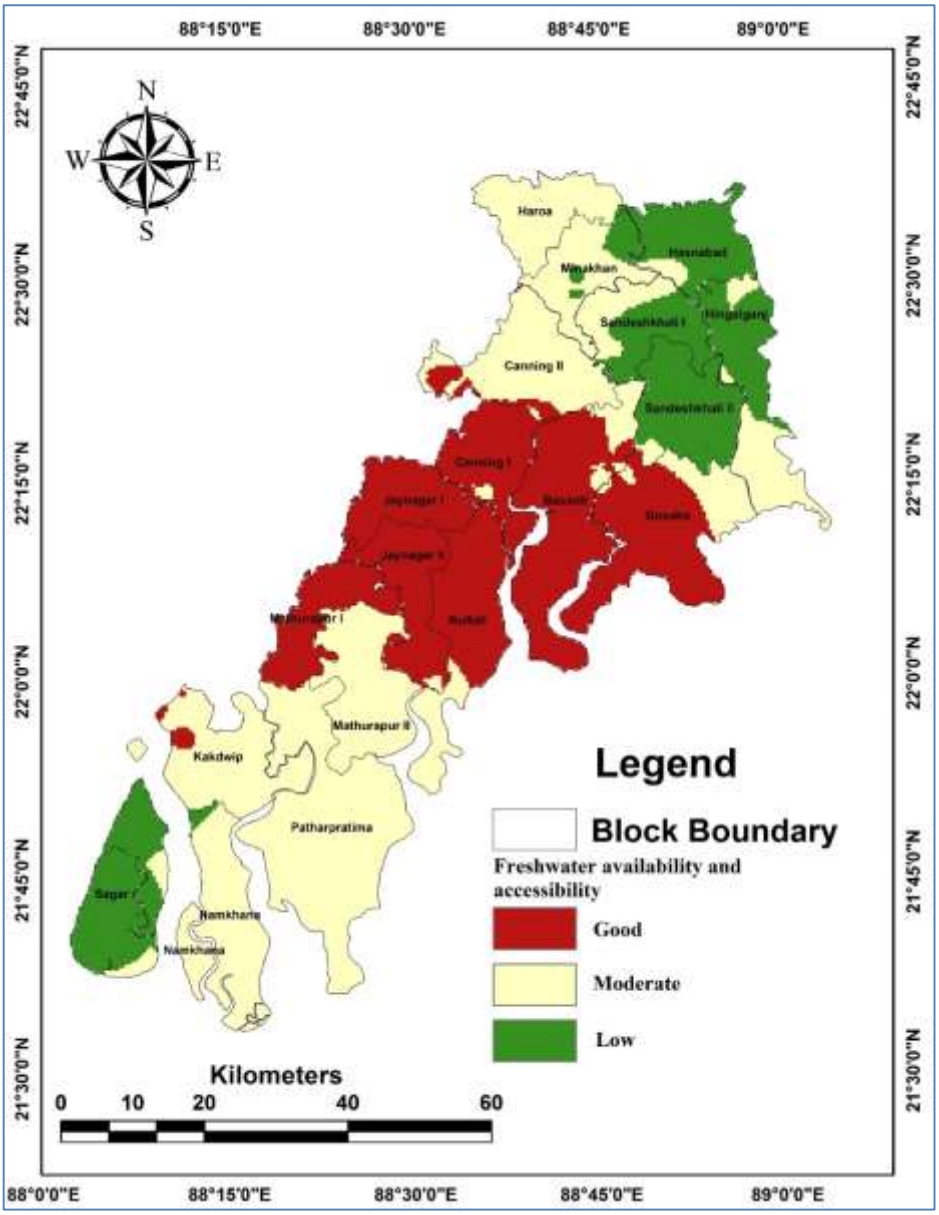

Fig 8: Consumable Fresh Water availability and accessibility Map

5. **Discussion**

Water scarcity in the Sundarbans region of India is a significant issue primarily due to high salinity levels in surface and groundwater sources along with variability caused by seasons and climate change. Our research on water quality and availability mapping through remote sensing and GIS approaches was helpful in describing the contemporary situation of water resources in this area.

In our evaluation of water surface quality over 19 blocks of the Sundarbans, we found marked seasonal and spatial variability. For pH, salinity, dissolved oxygen (DO), turbidity, and chlorophyll (CHL), there was continuous variability in pre-monsoon, monsoon, and post-monsoon periods. In particular, we saw the pH levels in post-monsoon were neutral to alkaline, so the water should not show an acidic challenge. Salinity was a prominent context with certain pockets of the study area, where salinity ranged from 7.4ppm -29.7ppm. Vacillations with references to ambient temperatures where temperatures varied between 28°C and 31°C during the time of our collection.In general, the central zone of the Sundarbans had a better quality of water than to the northern and southern zones with better management practices and less salt intrusion from the sea.

Specific areas including Sagar Island, Kachuberia, Bhagabatpur, and Namkhana were found to have poorer overall water quality, likely a result of increased salinity and pollution levels. Areas that demonstrated moderate water quality included Gosaba, Hemnagar, Sandeshkhali, Lebukhali, Malancha, and Bakkhali and suggests that localized management of water uses may be more feasible in these locations. There is also a clear distinction between shallow vs deep groundwater quality in the Sundarbans with depth being particularly relevant in post monsoon systems. Shallow water sources had elevated salinity level from strong seawater intrusion, which made them unsuitable for consumption. On the other hand, deeper groundwater sources were more alkaline, found higher concentrations of bicarbonate, and some sources were considered suitable for consumption. Still, there are distinct regional differences in the quality of groundwater. Specifically, both northern and southern locations in the Sundarbans faced poorer groundwater quality from increased salinity and seawater intrusion. These areas also had unsafe consumption from shallow and deep groundwater sources.The central parts, though also affected by seawater intrusion, had better deep-water quality, making it a more viable option for potable use.

Groundwater quality was not acceptable in certain places, such as Hasnabad, Minakha, Sandeshkhali, Hingalganj, Namkhana, and Sagar Island, requiring different types of interventions for managing water. Other blocks, like Jayanagar, Kultali, Basanti, and Gosaba, had reasonably good groundwater quality. However, the accessibility of water in these blocks was less than optimal because of the Vat system and fewer drinking water tube wells, making effective distribution difficult. Using the Modified Normalized Difference Water Index (MNDWI), we assessed surface water accessibility between blocks, and there were substantial differences:

- **High Surface Water Accessibility Zones:Haroa, Meenakha, and Sandeshkhali exhibited high accessibility with MNDWI values ranging from 0.03 to 0.21.**
- **Moderate Surface Water Accessibility Zones:Hasanabad, Basanti, Canning, Gosaba, Patharpratima, and Namkhana had moderate accessibility with MNDWI values between -0.17 and 0.02.**
- **Low Surface Water Accessibility Zones:Mathurapur I block had low accessibility with MNDWI values between -0.4 and -0.18.**

  These findings are significant for the comprehension of water resources spatial availability and the sustainable use of the water resources. The zonal detailed statistics allow for a better understanding of the area that requires immediate attention and intervention. The analysis has highlighted alarming trends of groundwater levels. The average groundwater levels decreased from 3.3 meters below ground level (mbgl) in the year 1996 to 7.67 mbgl in 2022. The decrease in groundwater levels is sharp and is an indication of over-extraction and insufficient recharge, and seasonal fluctuations have also contributed. There is a rapid decline in groundwater level from pre-monsoon to monsoon, followed by some stabilization of levels post-monsoon. Groundwater levels showed similar fluctuations in shallow (15 mbgl) and deep (115 mbgl) regions in the study area. Importantly, the northwestern slice of Sundarbans with arsenic pollution, has very

low groundwater levels. The other blocks have medium to high groundwater levels, although saline groundwater is also present.

The limited availability of freshwater supply both in terms of surface and sub-surface water storage facilities is one of the important determinants of agriculture and food security in the Sundarbans. Blocks like Gosaba, Canning, Patharprotima, Kakdip, Sagar and Namkhana are especially relevant here. For example, residents of blocks such as Gosaba and Basanti sometimes have to travel long distances to collect drinking water based on the Vat system indicating the need for improved water management and infrastructure.

6. Conclusion

The accessibility of groundwater varies spatially across the study area. There are six blocks with shallow groundwater levels (groundwater level of < 4.54 M below ground level) – these are: Haroa, Meenakhan, Sandeshkhali I, Hasnabad, Basanti and Canning I, accounting for 33% of all blocks surveyed (33%). Therefore, these six blocks represent the most concentrated area of groundwater accessibility. Eight blocks contain groundwater located at an intermediate depth (between 4.55 and 10.52 M) – these include Basanti, Mathurapur I & II, Hingalganj, Canning II, Namkhana, Kakdwip and Jayanagar I (44% of study area). They also provide moderate to high levels of groundwater accessibility for extraction, generally requiring intermediate levels of technological intervention.

In contrast to its spatial variability with respect to accessibility, the quality of groundwater exhibits a high degree of spatial deterioration, necessitating urgent attention. The classification of WQI indicates three separate ranges or classifications of groundwater quality: Groundwater of Good Quality (17.9 – 25.23 WQI) has limited availability (six blocks only; comprising 33% of surveyed blocks), and provides drinking water that is free of harmful contaminants.

Groundwater of Medium Quality (25.24 – 31.77 WQI) can be found in eight blocks (comprising 44% of surveyed blocks) and is suitable for human consumption with some degree of treatment. Groundwater classified as Poor Quality (31.78 – 43.16 WQI) contains extremely high amounts of contaminants that render it unsafe for direct human consumption, thus posing a serious threat to human health.

The availability of surface water demonstrates a strong spatial pattern consistent with the deltaic and estuarine nature of the district. The areas of highest surface water availability are located within three blocks, constituting a total area of 17% of the study area (MNDWI = 0.03–0.21), where large water bodies and extensive river networks exist in wetland-rich and tide-influenced environments. The broader region of moderate surface water availability (MNDWI = 0.02–0.17) comprises six blocks and comprises 33% of the area. For this region, natural storage capacity varies greatly depending upon the season. Mathurapur I block displays very little surface water (MNDWI = 0.18–0.4) due to its large agricultural and settlement population. Surface water quality is similarly poor. Good quality surface water (WQI = 115.54–166.62) is limited to three blocks (17% of the area). Medium quality surface water (WQI = 166.63–203.97) exists in eleven blocks (61% of the area), where pollution from agricultural runoff and urban waste diminishes the usability of water. Poor quality surface water (WQI > 203.98–255.6) exists in five blocks (28% of the area), where industries release high levels of pollutants accompanied by organic matter that require extensive treatment before any potential use.

In general, the analysis of the data presents a clear distinction between the total number of blocks with access to groundwater (77% of total blocks) and that of those maintaining good groundwater quality (33% of total blocks). In addition, we know that 83% of the surface water in blocks classified as mid/poor surface water has experienced degradation to levels considered as poor (WQI > 166.63), demonstrating the widespread extent of surface water contamination.

Regarding water systems and contaminated areas, there are some specific areas of concern. These blocks have specific aspects to consider regarding their performance, such as the Hindalganj, Sandeshkhali I, Sandeshkhali II and Meenakhan areas, where both surface water and groundwater quality deteriorate concurrently; or there may be blocks with fewer issues but better quality, such as Jayanagar I, Jayanagar II and Vasanthi blocks (where both quality systems are relatively better than the comparison zones). Thus, they can serve as model areas for protocols related to management techniques.

7. References

Abul, M., & Mallik, K. (2016). *Simulation of Intensity and Track of the Tropical Cyclones of the Bay of Bengal using MM5 Model Simulation of Intensity and Track of the Tropical Cyclones of the Bay of Bengal using MM5 Model*. *August 2020*.

Barik, B., Ghosh, S., Saheer Sahana, A., Pathak, A., & Sekhar, M. (2017). Water-food-energy nexus with changing agricultural scenarios in India during recent decades. *Hydrology and Earth System Sciences*, *21*(6), 3041–3060. https://doi.org/10.5194/hess-21-3041-2017

Basu, S., Bhattacharyya, S., Gogoi, P., Dasgupta, S., & Das, S. K. (2021). Variations of surface water quality in selected tidal creeks of Sagar Island, Indian Sundarban eco-region: a multivariate approach. *Applied Water Science*, *11*(3), 1–11. https://doi.org/10.1007/s13201-021-01391-8

Bhadra, T., & Hazra, S. (2012). *Assessment of Fresh Water Availability and Demand in the Sundarban Biosphere Area of Indian Bengal Delta*. *1998*, 2012.

Bhadra, T., Hazra, S., Sinha Ray, S. P., & Barman, B. C. (2020). Assessing the groundwater quality of the coastal aquifers of a vulnerable delta: A case study of the Sundarban Biosphere Reserve, India. *Groundwater for Sustainable Development*, *11*, 100438.

https://doi.org/10.1016/j.gsd.2020.100438

Bhattacharya, B. D., Bhattacharya, A., Rakshit, D., & Sarkar, S. K. (2014). Impact of the tropical cyclonic storm “Aila” on the water quality characteristics and mesozooplankton community structure of Sundarban mangrove wetland, India. *Indian Journal of Marine Sciences*, *43*(2), 216–223.

Carrard, N., Foster, T., & Willetts, J. (2019). Groundwater as a Source of Drinking Water in Southeast Asia and the Pacific: A Multi-Country Review of Current Reliance and Resource Concerns. *Water*, *11*(8), 1605. https://doi.org/10.3390/w11081605

Chakraborty, S., Sarkar, K., Chakraborty, S., Ojha, A., Banik, A., Chatterjee, A., Ghosh, S., & Das, M. (2021). Assessment of the surface water quality improvement during pandemic lockdown in ecologically stressed Hooghly River(Ganges) Estuary, West Bengal, India. *Marine Pollution Bulletin*, *171*(December 2020), 112711. https://doi.org/10.1016/j.marpolbul.2021.112711

Chand, B. K., Trivedi, R. K., Biswas, A., Dubey, S. K., & Beg, M. M. (2012). Study on impact of saline water inundation on freshwater aquaculture in Sundarban using risk analysis tools. *Exploratory Animal and Medical Research*, *2*(2), 170–178.

Das, K., Mishra, A. K., Singh, A., Agrahari, S., Chakrabarti, R., & Mukherjee, A. (2021). Solute exchanges between multi-depth groundwater and surface water of climatically vulnerable Gangetic delta front aquifers of Sundarbans. *Journal of Environmental Management*, *284*(February). https://doi.org/10.1016/j.jenvman.2021.112026

Das, K., Mukherjee, A., Malakar, P., Das, P., & Dey, U. (2021). Impact of global-scale hydroclimatic patterns on surface water-groundwater interactions in the climatically vulnerable Ganges river delta of the Sundarbans. *Science of the Total Environment*, *798*,

149198. https://doi.org/10.1016/j.scitotenv.2021.149198

Ghosh, N. (2015). *Indian Sundarbans Delta (ISD) in 2050 : A Vision . Economic Valuation of Costs and Benefits of the Adaptation Options Indian Sundarbans Delta (ISD) in 2050 : A Vision Economic Valuation of Costs and Benefits of the Adaptation Options Submitted by WWF-. January 2012*.

Humphreys, E., Tuong, T. P., Buisson, M. C., Pukinskis, I., & Phillips, M. (2014). *Revitalizing the Ganges Coastal Zone : Turning Science into Policy and Practices* (Issue October).

Mishra, R. K. (2023). Fresh Water availability and It's Global challenge. *Journal of Marine Science and Research*, *2*(1), 01–03. https://doi.org/10.58489/2836-5933/004

Mondal, I., & Bandyopadhyay, J. (2014). Coastal Zone Mapping through Geospatial Technology for Resource Management of Indian Sundarban, West Bengal, India. *International Journal of Remote Sensing Applications*, *4*(2), 103. https://doi.org/10.14355/ijrsa.2014.0402.04

Mondal, M., Mukherjee, A., Das, K., & Puppala, H. (2024). Understanding the susceptibility of groundwater of Sundarbans with hydroclimatic variability and anthropogenic influences. *Groundwater for Sustainable Development*, *25*, 101135. https://doi.org/10.1016/j.gsd.2024.101135

Rahman, M. M., Rahman, M. T., Rahaman, M. S., & Rahman, F. (2013). Water Quality of the World's Largest Mangrove Forest. *Canadian Chemical Transactions*, *1*(2), 141–156. https://doi.org/10.13179/canchemtrans.2013.01.02.0018

Ravar, Z., Zahraie, B., Sharifinejad, A., Gozini, H., & Jafari, S. (2020). System dynamics modeling for assessment of water–food–energy resources security and nexus in Gavkhuni basin in Iran. *Ecological Indicators*, *108*(March 2019), 105682.

https://doi.org/10.1016/j.ecolind.2019.105682

Saha, S. K. (2024). Reviewing Salinity Issues of the Sundarban Mangrove in the Light of Socio-eEnvironmental Implications and Present Initiatives. *Indian Forester*, 1232–1239. https://doi.org/10.36808/if/2024/v150i12/170106

Wahid, S., Mainuddin, M., Chiew, F., Karim, F., Nahiduzzaman, S., Alam, R., & Hasib, M. R. (2025). Salinity dynamics in the Sundarbans of Bangladesh: influence of climate, freshwater inflow, and sea level changes. *Environmental Monitoring and Assessment*, *197*(11), 1219. https://doi.org/10.1007/s10661-025-14667-2

Xu, H. (2006). Modification of normalised difference water index (NDWI) to enhance open water features in remotely sensed imagery. *International Journal of Remote Sensing*, *27*(14), 3025–3033. https://doi.org/10.1080/01431160600589179

Zaman, A., & Gayen, A. (2008). Groundwater Development and Sustainable Management in the Delta Front Area of Sundarban Islands International Journal of Emerging Technology and Advanced Engineering Groundwater Development and Sustainable Management in the Delta Front Area of Sundarban I. *Certified Journal*, *9001*(11).

Bringing Audio Description/Narration to Bengali Cinema: *Pather Panchali* and *Jamai- Babu* in Focus[2]

Arya Moitra[3]
School of Cultural Texts and Records
Jadavpur University
Kolkata 700032

Ishan Chakraborty
Department of English
Jadavpur University
Kolkata 700032

Date of submission 30-12-2025
Date of Acceptance 11-03-2026
Date of Publication 17-04-2026

Abstract

Audio description, along with other forms of assistive technology that can foster an environment for inclusive entertainment, remains largely unimplemented for making audiovisual content accessible in many commonly spoken languages, including Bengali. In this paper, we present two pioneering initiatives that aim to at least partially mitigate this lack by providing audio-described films to the Bengali-speaking visually disabled audience. Additionally, this paper explores the process of creating such accessible content with critical awareness and examines practical concerns related to making the final products widely available to the public on the internet.

Keywords: Audio Description, Audio Narration, Assistive Technology, Inclusivity, Marginality, Visual Disability, Accessibility

A notion of accessibility that is limited to only ramps, Braille books, handrails, and other such

[2] Some of the initial ideas for this paper, especially the ones related to *Pather Panchali*, were developed through an oral presentation, entitled *Audio Description as a Class Project: The Possibilities of Student-Led, Low Budget Initiatives for Filling the Gaps in Vernacular Assistive Technology*, delivered by Arya Moitra on October 15, 2025, at BITS-Pilani, Hyderabad Campus. It was presented during Accessible by Design, a two-day international symposium organised by the Department of Humanities and Social Sciences in collaboration with the Department of Computer Science and Information Systems.

[3] Corresponding Author's email: arya.moitra@gmail.com

visible, photographable accommodations, infrastructural fittings, and retrofittings can lead to an era ruled and dominated by spectacles. In such an environment, access to cultural texts, like films, remains largely overlooked in popular/popularised/populist discourses, hindering the path to cultural inclusivity. Audio description (AD) holds the potential to reduce this hindrance, ensuring the production of accessible cultural capital. The implementation of AD can "enhance the aesthetic experience for people who are blind or have low vision" (Chakraborty, 2018, p. 30). "[T]he most accredited" theory related to the origins of AD "is the one that places it in the United States in the 1970s" (Valero Gisbert, 2022, p. 184). Eventually, AD has "emerged as an independent field of study and a viable commercial reality in its own right" (Taylor and Perego, 2022, p. 1). Practical applications of AD have made their way into the realm of Indian cinema. At first glance, this development might seem to be fully in alignment with Section 29 of the Rights of Persons with Disabilities Act, 2016:

The appropriate Government and the local authorities shall take measures to promote and protect the rights of all persons with disabilities to have a cultural life and to participate in recreational activities equally with others which include,— …

(c) making art accessible to persons with disabilities; …

(g) developing technology, assistive devices and equipments to facilitate access and inclusion for persons with disabilities in recreational activities.

However, given the complex dimensions of language politics that inevitably spread to issues connected to disability, this introduction of AD in Indian films potentially contributes to a notion of accessible cinema that contradictorily endorses an uneven landscape for access to entertainment, giving preference to only a certain section of visually disabled people in India. The *Film and Series Title Directory*, made available through the Audio Description Project (n.d.), presents an indication of this unevenness. At the time of writing, the directory offers a list of 598 works with Hindi AD. Titles of works with AD in other major languages spoken in

India, let alone the more marginalised ones, either do not appear in the list at all or, in the case of a handful of languages, show up in a much smaller number.[4] For example, the directory currently displays merely 28 works with Tamil AD.[5] Sridhar (2020), criticising the practice of imposing the Hindi language "upon populations without recognizing their views and desires," argues for "[c]ommitting ourselves to acknowledging diverse voices and becoming aware of our own biases and assumptions . . . to create a reality where pluralities co-exist, thrive and enrich each other" (p. 65). Taking this view into account, there is an urgent need for more initiatives that go beyond addressing solely the Hindi-speaking visually disabled film audience, and this paper presents such pioneering projects.

Audio Description as a Class Project

Project-based learning "shifts the focus away from passive absorption of information and toward active engagement" (Novalia et al., 2025). A product of this approach is our first AD initiative, which was initially conceived as a class project for the Disability in Indian Literature course at Jadavpur University.[6] Offered at the Department of English, the course has become a platform for the production of several student-led projects. Thus, it provided a suitable environment for producing the first-ever Bengali AD of a film—Satyajit Ray's *Pather Panchali* (1955). With no funds to support the initiative, the work was bound to be done under tight financial constraints. The entire project was produced on a laptop. A simple pair of earphones with an in-line microphone was used for recording the vocal input and for testing the audio output. Additionally, free and open-source digital tools, such as Audacity and Kdenlive, were utilised to deal with the audiovisual content.

On April 4, 2025, beyond the four walls of the classroom, the project was publicly presented

[4] The online directory can be filtered based on language and other criteria.
[5] Despite this, the number of works featured in the directory with Tamil AD is still currently higher than that of works with AD in any other commonly spoken languages in India apart from Hindi. Other than Tamil and Hindi, works with AD in Kannada, Marathi, Punjabi, and Telegu can be found in the directory at this moment.
[6] More specifically, Arya Moitra worked on the project as a student under the supervision of Ishan Chakraborty, who coordinates the aforementioned course.

with the help of the Centre for Persons with Disabilities at Jadavpur University. The event garnered significant media attention (Das, 2025; ETV Bharat Bangla Team, 2025; Anandabazar Patrika, 2025). During the presentation, both visually disabled and able-bodied people remained seated together to experience the new iteration of a well-known film. The organisation of this event should be considered as an effort to bring discussions related to disability studies out of the academic sphere, raising general awareness regarding AD and its importance in Bengali cinema. This direct societal engagement opens up possibilities for community-engaged scholarship, which "centrally focuses on the collaborative development and application of scholarly knowledge to address pressing social issues" (da Cruz, 2018, p. 149).

Being a student-led initiative, this project certainly lacks many qualities of a well funded and professionally produced AD. However, this effort still proves that students can successfully attempt to at least partially fill the gaps in assistive technology. The project, the public presentation, the media interactions, and this paper itself should encourage similar undertakings in non-Hindi languages. The low-budget nature of the project only adds to this encouragement. Financial support can definitely enrich such a project, providing opportunities for upgrading the hardware, seeking professional help, and employing other enhancements. Nevertheless, while these possible improvements are desirable, this project proves that the lack of funds does not immediately render the production of AD impossible.

Audio Description as a Research Initiative

While the aforementioned project provided a valuable opportunity to explore the practical possibilities of AD in Bengali cinema, it lacked intentional utilisation of critical models to better understand theoretical underpinnings. A way to mitigate this lack has been presented through an opportunity funded by the Whose Knowledge? global campaign. Entitled *Accessibility/Languages/Tech: Advancing Language Justice for Persons with Visual*

Impairments, this initiative is "a collaborative effort between Whose Knowledge? and disability rights activists and researchers from Pakistan, India and Bangladesh," which seeks to "propose solutions for the creation of meaningful, safe and accessible tech-based experiences of people with impairments in South Asia" (Whose Knowledge?, n.d.). As part of this research project, we have tentatively proposed to create audio-described versions of three Bengali films: *Jamai-Babu* (1931), *Radha-Krishna or Kalanka-Bhanjan* (1933; henceforth *Radha-Krishna*), and *Annapurnar Mandir* (1936).[7] Each of these films holds a unique place in the history of Bengali cinema for different reasons. *Jamai-Babu* is "the only surviving Bengali-language film from the silent era" (Sinha, 2013, p. 43). *Radha-Krishna* is one of the several films from "the early talkie era," which, according to Gooptu (2010), "were films based on popular Bengali legends, and had been successful as theatre productions" (pp. 31–32). Chhabi Biswas, who is "[b]est-known outside Bengal for his two major performances in Satyajit Ray's J*alsaghar and Kanchanjungha*," debuted as a film actor in *Annapurnar Mandir* (Rajadhyaksha & Willemen, 1999, p. 67). With this initiative, we aim to apply different AD-related models/theories to the films, potentially opening the door to analysing and comparing the implications of the critical output in future studies within the context of Bengali cinema specifically. We have already prepared the initial version of the script for making *Jamai-Babu* accessible to a Bengali-speaking visually disabled audience.[8] So, it is the most likely candidate out of the three to be released first. The following section of the paper will highlight the ongoing process of creation.

Jamai-Babu features slapstick humour centred around the protagonist Gobardhan, who comes

[7] The title sequences of both *Jamai-Babu* and *Radha-Krishna* feature Bengali and English versions of the same titles (Dass, 1931; Chowdhury & Bose, 1933). Both English versions are set entirely in uppercase. While the Bengali and the English titles are similar due to possessing double quotation marks for emphasis, they also contain slight differences, i.e. the presence or absence of a hyphen or a gap. Apart from using title case and omitting the emphatic quotation marks for the sake of readability, we have attempted to consistently follow the format of the English titles in the films by reproducing the placement of hyphens in the title sequences. The titles have been formatted differently by some scholars (Gooptu, 2010; Sinha, 2013).

[8] It should be noted that the exact content of the script is subject to change. The excerpts produced in the paper only represent the current state of the script.

from the countryside to visit Calcutta (Dass, 1931).[9] The comic storytelling of this silent film depends on the audience's ability "to laugh *at* Gobardhan and *with* the other more cosmopolitan characters who have mastered the technologies, languages, and modes of comportment of the city" (Sinha, 2013, p. 44). The proposed audio-described version of *Jamai-Babu* explores a specific model: audio narration (AN). Kruger (2010) states that AN "seeks to provide access through an integrated narrative," making it different from "traditional AD, where the emphasis is on description," while also acknowledging that "AD will already contain narrative elements just as AN would contain descriptive elements," which creates "a descriptive-narrative continuum" (p. 233). While the existence of narrative elements in AD should come as no surprise, the very act of defining AN puts those elements in focus. The awareness of AN and the prioritisation of narrative elements might drastically change the course of making films accessible to a visually disabled audience. Kruger (2010) examines the descriptive-narrative continuum within the context of audiovisual translation (AVT) "that deals with providing access to audio (+)visual texts by means of supplementary auditory input that substitutes the visual component of the film (what we may call audio access for short)" (p. 232). An attempt to provide this audio access to a silent film, such as *Jamai-Babu*, brings particular benefits as well as challenges. Silent films and talkies offer two vastly different experiences during the creation of AD/AN tracks. As a silent film contains no recorded dialogue, it allows relatively greater flexibility in terms of framing and placing AD/AN content. This greater flexibility, however, comes with an increased reliance on visual elements in the film, for which audio access needs to be sufficiently provided. Nevertheless, one still needs to be mindful of how and how much one interrupts the film score. The fast-paced nature of *Jamai-Babu* makes this especially difficult, providing little room for pauses during the

[9] The surname of Kalipada Dass, the director of *Jamai-Babu*, is spelt differently in different sources. Gooptu (2010) writes "Dass" (p. 27). Sinha (2013), however, prefers "Das" (p. 43). The spelling used by Gooptu (2010) aligns with how the director's surname appears in the film (Dass, 1931). We have opted for maintaining this alignment in the list of references and in-text citations.

verbalisation of the lively visual elements.

The notion of AN is based on a process of re-narrativising a film for the sake of providing audio access to visually disabled people, "presenting a coherent narrative that does not disturb the audience's immersion in the story world" (Kruger, 2010, p. 234). In this context, Kruger (2010) borrows from narratology to present the notion of focalisation in films. Focalisation is defined as "the positioning and oriental restrictions of narration," referring to "not only WHAT is shown, but from which (audiovisual, psychological, emotional, ideological, etc.) angle, or HOW it is shown." (Kruger, 2010, p. 236). Kruger (2010) focuses on the written narratives to identify markers of focalisation, which "provide orientation in terms of characterisation (the qualities of the character through which we imagine experiencing events), subjectivity (interpretation of events as opposed to straightforward or objective description, use of personal pronouns), and deixis" (p. 238). This leads to a section on filmic markers of focalisation, in which Kruger (2010) declares that "it is important to understand how filmic narrative works, in order to determine the narrative effect created by filmic devices" (p. 239). With these points in mind, we prepared the AN script for *Jamai-Babu*. The next portion of the paper contains a brief analysis of the re narrativised elements in the script with a few examples.

The film starts with Gobardhan's letter, sent to his brother-in-law, Amal, announcing the protagonist's impending arrival in Calcutta (Das, 1931). As Amal laughs at the writing, his unnamed friend reminds him that he will be late if he does not leave for the train station immediately to meet Gobardhan. As the two friends get up, the film cuts to a shot of the arrival of a train at the station in question. It is possible to describe the previous scene by focusing only on the external features, disregarding the narrative effect caused by the scene that comes next. This approach can be suitable for conventional AD. Following the AN model, however, we propose the following to re-narrativise the earlier scene at Amal's room:

বিছানায় শুয়ে চিঠিটা পড়তে পড়তে অমল আর হাসি চেপে রাখতে পারেনা। তা দেখে বই পড়া থামিয়ে তার বন্ধু বলে ওঠে, "কি অমল, চিঠি পড়ে যে তোমার মুখে হাসি আর ধরেনা— ভাইরাভাইকে আনতে যাও, এদিকে যে নটা!" সে নিজের হাতঘড়ি তুলে অমলকে দেখায়। বন্ধু ঠিকই বলেছে। এখন না বেরোলে সত্যিই বড্ড দেরী হয়ে যাবে।

Lying on his bed, Amal fails to contain his laughter while reading the letter. Seeing that, his friend stops reading and says, "Hey, Amal, that letter has you in stitches— you should go receive your brother-in-law. It's already nine o'clock!" He shows his wristwatch to Amal. The friend is right. Amal will be really late if he does not leave immediately.[10]

Instead of focusing only on external details, this narration attempts to understand Amal's inner subjectivity, which Kruger (2010) considers an essential element of AN. It is assumed that Amal takes action based on the subjective notion that his friend is indeed right. Later, Amal explicitly apologises to Gobardhan for being late (Das, 1931). So, the paragraph above fits neatly within the narrative.

Looking into the influence of filmic devices on AN, Kruger (2010) emphasises that various filmic techniques, including different shots and angles, "have to be interpreted in terms of the way they allow and even direct the creation of the story world" (p. 240). At one point in *Jamai-Babu*, Gobardhan rushes through a street after bumping into multiple people (Das, 1931). A tracking shot shows Gobardhan running forward while the hustle and bustle of the city goes on behind him. Our narration puts this scene into words in the following manner: "জনমানব ও যানবাহনে পূর্ণ প্রাণবন্ত রাস্তা কলকাতার। সেই ভিড় কাটিয়ে প্রাণ হাতে করে ছোটে গোবর্দ্ধন" [Filled with people and vehicles, the roads of Calcutta are lively. Pushing through that crowd, Gobardhan runs for his life.] Instead of describing the city and the running

[10] The Bengali dialogues in our script are the same as the ones that visually appear on the screen as intertitles during the film. The film simultaneously features Bengali, English, and Hindi intertitles. Nevertheless, for the purposes of the paper, we have provided our own English translation for the Bengali excerpts.

sequence separately, we use the word "সেই" [that] to connect the two. The city is crowded, and that very crowd is the one through which Gobardhan must run in panic. In this way, we have attempted to cohesively capture and connect all the moving elements, which gain impact due to the additional on-screen movement caused by the tracking shot. Soon after, we solidify the intensification of Gobardhan's panic amidst the chaos by mentioning the cause of his trouble using a suitable exclamation: "বাড়ি যাবে কী করে তা যে সে জানেনা!" [He has no idea how to return home!] It is not any external feature but our assumption of Gobardhan's inner feelings that leads to this declaration. In conventional AD, only describing Gobardhan's actions (i.e. asking people for directions while frantically pacing through the street) should suffice, which we nevertheless do right before this exclamation.

According to Kruger (2010), a significant element of narrative impact includes the "imaginary positioning of the audience in relation to the story world" (p. 237). Sinha (2013) argues that "Gobardhan's incompetence in the city is not only the source of humor but is also a potential source of reassurance to audience members of their own cosmopolitanism" (p. 44). Thus, the positioning that allows the audience to treat Gobardhan as the object of laughter in the story world cannot be ignored. This realisation can influence the creation of AN. As an example, one can consider our treatment of a recurring comic device. Throughout the film, Gobardhan stumbles and falls in many scenes (Das, 1931). During one of these scenes, we emphasise the repetition of the supposedly humorous motif: "গোবর্দ্ধন যেন সদ্য হাঁটতে শিখেছে, কারণ সে আবার পড়ে যায়।" [It seems as if Gobardhan has only recently learnt to walk, because he falls again.] This mocking observation clearly resides outside the realm of external description. Following Sinha (2013), it can be stated that the inclusion of this remark in the AN script aligns with the visual code that incites the audience to laugh at the rural protagonist's predicament.

Audio Description as an Openly Accessible Resource

Since the beginning of our collaboration with the Whose Knowledge? campaign, we have continued to direct our attention to making our work widely, publicly, and non-commercially available on the internet. Understanding platform-specific enforcement of copyright regulations and licensing information is crucial for dealing with online content. Our increased attention to this topic has led to certain challenges. While we do not claim full expertise in the nuances of copyright law across different jurisdictions, we nevertheless acknowledge the value of reflecting on some of these practical issues that one might face during the creation and publication of AD/AN content, especially without proper frameworks in place.

Wikimedia Commons (henceforth Commons) is significant to our AD/AN-related initiatives. Commons hosts "more than 100 million freely licensed media files," which are "either in the public domain or published under a Creative Commons copyright license that allows them to be reused free of charge" (Wikimedia Foundation, n.d.). While we could access the video files for *Pather Panchali and Jamai-Babu* through Commons, we had to be cautious of the differences in information related to licensing. U.S. copyright laws heavily influence the existence of non-U.S. materials on Commons:

Commons is an international project, but its servers are located in the U.S., and its content should be maximally reusable. Uploads of non-U.S. works are normally allowed only if the work is either in the public domain or covered by a valid free license in both the U.S. and the country of origin of the work. The "country of origin" of a work is generally the country where the work was first published. ("Commons:Licensing," 2025)

At the time of writing, the *Pather Panchali* video file is marked as a work that "is in the public domain in India because its term of copyright has expired or it is ineligible for copyright," followed by a reference "to the Indian Copyright Act, 1957, as amended up to Act No. 27 of

2012 (Chapter V, Section 25)" ("File:পথের পাঁচালী–বাংলা চলচ্চিত্র (১৯৫৫).webm," 2024).[11] However, the section also states that the same "work may not be in the public domain in the United States because its U.S. copyright was restored by the URAA [Uruguay Round 12 Agreements Act] as it was still copyrighted in its source country (India) on the URAA date (1 January 1996)," along with the following statement: "If you are the copyright holder of this file, and do not wish to have it hosted on Commons, please contact our designated agent or nominate the file for deletion, explaining the situation" ("File:পথের পাঁচালী–বাংলা চলচ্চিত্র (১৯৫৫).webm," 2024). In the case of *Jamai-Babu*, the video file is labelled as a work in the public domain in both India and the United States as it meets specific requirements ("File: Jamaibabu, 1931," 2025). As we are based in India, we initially prioritised Indian copyright regulations. However, as our initiatives are gaining international recognition, we must reevaluate the implications of our sources, methods, and other considerations, including concerns about the region-specific nature of issues related to the public domain.

While we utilised Commons for procuring media files, we looked into YouTube for presenting our work. Goodrow (2017) reports that "people are spending a billion hours every day" consuming content on YouTube. Due to its popularity, the platform is a strong candidate for making AD content freely and widely available. However, similar to Commons, platform specific restrictions become relevant for YouTube as well. In the case of YouTube, video owners can automate the generation of copyright claims based on the Content ID system, giving them the opportunity to block, monetise, and/or track the claimed content (Google, n.d.-a). The claims generated through this automated system are different from manually submitted copyright removal requests (Google, n.d.-b). To test the Content ID system, we attempted to upload our audio-described version of *Pather Panchali*, and the entirety of it was

[11] Another video file version of the same film is available on a separate Commons webpage, which contains the same licensing information ("File:Pather Panchali (1955).webm," 2025). This version was not utilised for the class project.

subsequently claimed. In the case of *Jamai-Babu*, even a completely unedited file downloaded from Commons was not subjected to such restrictions. An automated claim does not result in the immediate removal of the video in question. However, as mentioned before, the potential owner can take action based on the claim. Thus, especially in the case of *Pather Panchali*, we are being cautious about publishing the full video with Bengali AD available online after looking into the aforementioned issues related to Commons and YouTube. As we currently lack the legal framework to sufficiently address this topic, a hasty decision might result in harming the longevity of the project. So, as of now, we have not published the audio described version of *Pather Panchali* on the internet.

From initial ideation to final publication, all the steps of producing audio-described content demand interactions with a multitude of interdisciplinary dimensions. Moreover, as shown in our analysis, the added questions of language politics and social hierarchies further complicate the process. Navigating through these complexities, we cannot overstate the importance of support, which can come in many forms. While the humble beginnings of audio-described *Pather Panchali* received encouragement and feedback from the public event, our current initiative is supported by a global campaign. Our efforts to increase the online presence of our initiatives can plausibly add to the formation of this supportive network. As we deal with various challenges, we aim to continue working towards sustaining discussions on Bengali AD and accessibility in general.

References

Anandabazar Patrika. (2025, April 2). পথের পাঁচালী’ ছবি ‘দেখবেন’ দৃষ্টি প্রতিবন্ধীরাও, সহায় শ্রাব্য বিবরণী [Visually disabled people will ‘watch’ the film Pather Panchali too, aided by audio description]. (2025, April 2). *Anandabazar Patrika*. https://www.anandabazar.com/west-bengal/an-audio-description-of-the-film-pather panchali-for-the-visually-impaired-will-be-available-at-jadavpur-university prnt/cid/1592743

Audio Description Project. (n.d.). *Film and series title directory*. American Council of the Blind. Retrieved December 25, 2025, from https://adp.acb.org/adp-search

Chakraborty, I. (2018). The sightless spectator: Cripping the relation between text and performance. In P. K. Mandal (Ed.), *Theatre practice: Text and performance, interpretation and experimentation* (pp. 27–36), Jadavpur University Society for American Studies.

Chowdhury, A., & Bose, M. (Directors). (1933). Radha-Krishna or Kalanka-Bhanjan [Film]. Madan Theatres; Shree Bharat Lakshmi Pictures.

Commons:Licensing. (2025, December 7). In *Wikimedia Commons*. https://commons.wikimedia.org/w/index.php?title=Commons:Licensing&oldid=1127112995

da Cruz, C. G. (2018). Community-engaged scholarship: Toward a shared understanding of practice. *The Review of Higher Education, 41*(2), 147–167. https://doi.org/10.1353/rhe.2018.0000

Das, K. (Director). (1931). *Jamai-Babu* [Film]. Hira Film.

Das, R. (2025, April 2). শব্দ-স্পর্শে ‘পথের পাঁচালী,’ দৃষ্টিহীনদের বিনোদনে তাক লাগালেন যাদবপুরের ছাত্র [*Pather Panchali* through the touch of words: Jadavpur University student evokes amazement by entertaining visually impaired people]. *Sangbad Pratidin*. https://www.sangbadpratidin.in/kolkata/jadavpur-university-a-student-creates-a-unique-audio-description-of-pather-panchali-for-the-visually-impaired-during-their-studies/pid/1030670/

ETV Bharat Bangla Team. (2025, April 5). দৃষ্টিহীনদের জন্য পথের পাঁচালী, বাংলায় প্রথম ফিল্মের দৃশ্য বিবরণী তৈরি যাদবপুরের ছাত্রের [*Pather Panchali* for visually impaired people: Jadavpur University student creates description of film scenes in Bengali for the first time]. ETV Bharat. https://www.etvbharat.com/bn/!state/jadavpur-university-student-makes-satyajit-ray pather-panchali-scene-description-first-in-bengali-west-bengal-news

wbs25040502754

File:Jamaibabu, 1931. (2025, February 19). In *Wikimedia Commons*. https://commons.wikimedia.org/w/index.php?title=File:Jamaibabu,_1931.webm&oldid=1000359872

File:Pather Panchali (1955).webm. (2025, December 14). In *Wikimedia Commons*. https://commons.wikimedia.org/w/index.php?title=File:Pather_Panchali_(1955).webm&oldid=1131068213

File:পথের পাঁচালী – বাংলা চলচ্চিত্র (১৯৫৫).webm [File:Pather Panchali – Bengali Film (1955)]. (2024, January 22). In *Wikimedia Commons*. https://commons.wikimedia.org/w/index.php?title=File:পথের_পাঁচালী_-_বাংলা_চলচ্চিত্র_(১৯৫৫).webm&oldid=844247119

Goodrow, C. (2017, February 27). You know what's cool? A billion hours. *YouTube Official Blog*. https://blog.youtube/news-and-events/you-know-whats-cool-billion-hours/

Google. (n.d.-a). *Learn about Content ID claims*. YouTube Help. Retrieved December 25, 2025, from https://support.google.com/youtube/answer/6013276

Google. (n.d.-b). *What is a copyright claim?* YouTube Help. Retrieved December 25, 2025, from https://support.google.com/youtube/answer/7002106

Gooptu, S. (2010). Bengali cinema: *'An other nation'*. Routledge. https://doi.org/10.4324/9780203843345

Kruger, J. L. (2010). Audio narration: Re-narrativising film. Perspectives: *Studies in Translatology, 18*(3), 231-249. https://doi.org/10.1080/0907676X.2010.485686

Novalia, R., Marini, A., Bintoro, T., & Muawanah, U. (2025). Project-based learning for higher education students' learning independence. *Social Sciences & Humanities Open, 11*, 101530. https://doi.org/10.1016/j.ssaho.2025.101530

Rajadhyaksha, A., & Willemen, P. (1999). *Encyclopaedia of Indian cinema* (New rev. ed.).

Oxford University Press.

Rights of Persons with Disabilities Act, 2016. https://www.indiacode.nic.in/handle/123456789/2155

Sinha, B. (2013). *Cinema, transnationalism, and colonial India: Entertaining the Raj*. Routledge. https://doi.org/10.4324/9780203558997

Sridhar, J. (2020). Linguistic integration in India: A persistence of hegemony. In R. M. Leitão, L.-A. Noel, & L. Murphy (Eds.), *Proceedings of Pivot 2020: Designing a world of many centers* (pp. 56–66). Design Research Society. https://dl.designresearchsociety.org/conference-volumes/37

Taylor, C. & Perego, E. (2022). In C. Taylor & E. Perego (Eds.), *The Routledge handbook of audio description*. Routledge. https://doi.org/10.4324/9781003003052

Valero Gisbert, M. J. (2022). Audio description for the screen. In C. Taylor & E. Perego (Eds.), *The Routledge handbook of audio description*. Routledge. https://doi.org/10.4324/9781003003052

Whose Knowledge?. (n.d.). *Briefing note: Accessibility/languages/tech: Advancing language justice for persons with visual impairments*. https://whoseknowledge.org/initiatives/language-justice/alt-briefing-note/

Wikimedia Foundation. (n.d.). *Wikimedia Commons*. Retrieved December 25, 2025, from https://wikimediafoundation.org/what-we-do/wikimedia-projects/commons/

Exploring the Effects of Socio-Political Factors on Teacher Job Satisfaction and Retention in Afghanistan Case Study: Afghan High Private-Public School

Zekria Khuram[12]
Doctoral Scholar
Department of Human Resource Development, Faculty of Art, Veer Narmad South Gujarat University, Gujarat, India. (Corresponding author)
Dr Bhavesh Vanpariya
Faculty and Assistant Professor of HRD Department, Veer Narmad South Gujarat University, Surat, Gujarat, India

Date of submission 19-11-2025
Date of Acceptance 17-03-2026
Date of Publication 17-04-2026

Abstract

The lack of sustainable policies, traditional norms, and unbalanced social attitudes in Afghanistan are major socio-political challenges that significantly undermine teacher job satisfaction and retention in Afghanistan. Thus, this research aims to examine the significant role of socio-political factors in teacher job satisfaction and retention in Afghanistan among public and private schools. This study used mixed methods, and since a huge number of teachers, data were collected randomly from 300 professional educators based on an online survey. In this research, data were analysed descriptively and inferentially with the aid of SPSS.

The findings show that the socio-political factors significantly predicted teachers' job satisfaction and their leaving (Exp(B)=0.386, p=0.022). This study highlights the critical role of socio-political factors. This study emphasises social awareness and reform of government policies towards teachers. Thus, this study recommends supportive policies, job stability, the establishment of professional development programs, and the appreciation of teachers' efforts by society.

[12] Corresponding Author's email Zekriakhuram@gmail.com

Keywords: Socio-political Factors, Teacher Job Satisfaction and Retention, Educational Policy.

Introduction

The education system in Afghanistan has always been tied to the country's traditional policies and norms. As the country has witnessed the instability of various political systems, teachers in the country's education system have consistently suffered due to socio-political factors such as political instability and a traditional view of education. In addition, socio-political changes in the country have presented teachers with serious challenges, such as low salaries and wages, deprivation of political support, lack of community support, and indigenous norms that constantly threaten teacher retention. Therefore, socio-political factors in Afghanistan significantly reduce the increase in job satisfaction and retention of teachers.

The existing literature shows that social and political factors play an important role in the job satisfaction and staying of teachers in their positions. In addition, SPFs lead to shaping teachers' decisions, commitments, and goals within educational institutions. The main factors that affect the life aspect of teachers regarding their position in educational institutions involve social and political factors. Social factors include environmental culture, social support, reward, promotion, students' treatment, teachers' recognition, employee relations, and so on. Political factors included government policies, political stability, budget allocation for teachers, changing educational programs, etc.

This research deals with the significant effects of social-political factors and measures how these factors can influence the satisfaction and retention of teachers in private and public schools in Afghanistan. This research aims to understand job satisfaction and retention levels among teachers.

As we all know, in this modern era and the use of technologies, especially AI in research and studies, has caused growth and progress in research dimensions such as information gathering

and analysis. Despite all this progress in research, there are gaps and limitations in the existing studies, such as insufficient explanations, limited focus on teachers' job satisfaction and retention, and heavy reliance on quantitative methods. In addition, few researchers studied socio-political influences among teachers, while most of them investigated social and political factors as a sub-content.

By providing valuable insights, this research helps to understand the significant effects of social and political factors on teachers, to know about the perceptions and experiences of teachers regarding their current job, to provide practical solutions, and to discover major challenges and suggestions regarding the negative effects of these factors on the satisfaction and retention of teachers in Afghanistan. Ultimately, the main purpose of this research is to enhance the level of teachers' satisfaction, contribute to developing the educational system, and reduce the turnover and attrition of teachers in Afghanistan.

Literature Review

Job satisfaction and retention are two of the most important parts of human resource practices that help organisations achieve their goals, create efficiency, productivity, employee well-being, strong work commitment among employees, and create a strong relationship between employees and the organisation. Therefore, this study has examined the important role of socio-political factors on job satisfaction and retention of teachers. Therefore, this study tried to employ a literature review approach from the latest and most valuable sources to understand the concepts of job satisfaction, retention, and the impact of socio-political factors on educators in educational institutions.

Job Satisfaction: According to Meier and Spector (2015), job satisfaction covers all over an individual, whether he/she is happy or unhappy with their job, and the factors that influence their feelings about their position are the individual's characteristics and individual traits. Based on Ćulibrk et al. (2018), job satisfaction is an important part of HR practices, and the

factors that most affect and enhance job satisfaction are employee recognition, motivation, employee characteristics, work conditions, and organisational policies. In a study that exhibits positive relationships between job satisfaction and employee performance. In addition, the type of job and level of position are the elements that determine satisfaction rates. Furthermore, implementing strategies and effective programs, building supportive environments, opportunities promotion, employee engagement, and regular evaluation of satisfaction level are the factors that shape satisfaction level (Inayat &Jahanzeb Khan, 2021). According to Basumallick (2021), job satisfaction is the level of feelings and happiness of employees with their current position by considering job status, relationships between colleagues, and policies of industries. In addition, the elements that contribute to enhancing job satisfaction level involve employee recognition, challenging solutions, making a convenient workplace, better salaries, developing career opportunities, and stable work-life balance.

Quality of Work Life (QWL), positive work conditions, and regular evaluation of employee satisfaction enhance job satisfaction and employee performance (Suci et al., 2022). According to Noori (2023), by comparison between public and private schools, the most effective factors were salary, job security, environmental support, colleagues' relationships, educational policies, and work conditions. Job satisfaction is subjective and related to employees within organisations regarding their feelings that are relevant to their work, and the elements that contribute to their happiness fulfilment are compensation, colleagues' attitudes, work environment, expectations, and rewards that make employees' satisfaction within organisations (Baxi et al., 2024). School climate is an important social factor that significantly impacts the job satisfaction of teachers. In addition, demographic factors are another element that makes teachers' experiences (Noori et al., 2024).

At the end, the existing study related to job satisfaction and the factors that impact and shape

satisfaction among employees in industries show gaps and limitations such as limited understanding with insufficient exploration, cross-sectional study, which is inadequate to understand a subject comprehensively, complex measuring, lack of cultural diversity considerations, irrelevant studies to explore job satisfaction, heavy reliance on quantitative research methods, personal reporting that makes biases, specific geographical scope.

Employee Retention: Based on Gorde and Ulhas Gorde (2019), define retention as an important and valuable asset among employees within organisations and suggest that employee engagement in the workplace and the implementation of modern strategies of retention are significantly needed to align with organisations. Krishnamoorthy and Aisha (2022) Highlights the retention like this: Human resources are an important asset of organizations; thus, employees' retention is a need for staying employees in organizations and recommends positive relationships, building trust, opportunities promotion, positive job security, employee recognition, post-retirement, supervisory support, financial rewards, and destroying employees' pressure to enhance employee retention. Another research that emphasises applying HR practices and retention strategies in organisations by considering cultural differences to enhance employee retention. In addition, work-life balance, improving talents, regular communication with employees, and developing employee expectations lead to employees remaining in their current position (Wahyudi et al., 2023). According to studies, the elements that effectively enhance employee retention involve applying various retention strategies and positive relationships between employees and employers (Neena, Dinesh, and Bhat, 2023). Job satisfaction is an important reason that leads to teachers staying within their current position and reducing turnover rates. Therefore, there is a specific relationship between job satisfaction and employee turnover that, by improving job satisfaction, sufficient compensation, and a positive environment, we will be able to control employee turnover and enhance education quality (Khalid Khawrin and Shibzada, 2023). Another study with almost

the same concepts by Khawrin and Sahibzada (2023) has mentioned that job satisfaction with job security is the main cause to shape employees' turnover. Furthermore, recognition of employees' exceptions, training and development promotion opportunities, and keeping a stable work-life balance are significant factors that enhance job satisfaction rates, employees' retention rates, and high job security. The existing research shows few weaknesses, including a small sample size, using only a descriptive approach, self-reporting, a lack of longitudinal study, and relying on a quantitative approach.

Impact of Socio-Political Factors on Teacher Job Satisfaction and Retention: Based on analysis by Khazaei et al. (2016), it indicates that socio-political factors—including a lack of respect for teachers from the public, cultural perceptions that conflict with educational values, and insufficient government support—negatively affect teachers' job satisfaction and retention. Furthermore, higher education levels, increased income, and the availability of resources within institutions significantly enhance teacher job satisfaction. According to Hopkins et al. (2019), socio-political factors (SPF) are critical elements that contribute to increased job satisfaction and teacher retention within educational institutions. Evidence shows that various factors such as environmental conditions, supportive management, and the creation of mutual trust between teachers and school leadership contribute to teacher retention and increase. Meanwhile, various other factors such as participation in decision-making, educational school policies, and budget allocation also indirectly promote teacher satisfaction and retention. A study that highlights the importance of teacher retention has examined political factors on teacher retention. In this study, factors such as government educational policies, leadership style, social support, and government accountability significantly affect teacher job satisfaction and retention (Akah-Jen et al., 2022). Similarly, in another study, socio-cultural factors such as collective support and cultural acceptance significantly lead to reduced emotional exhaustion, increased employee job satisfaction, and improved well-being

in the organisation (Garmendia et al., 2023). Socio-political factors, including institutional support and educational policies, significantly influence teachers' job satisfaction and retention. Teachers' job satisfaction is closely linked to their passion for pedagogy and their professional success among well-educated individuals (Li and Wang, 2022). Specifically, socio-political elements such as educational policies and accountability measures have a considerable impact on teacher satisfaction and retention. While supportive environments and opportunities for advancement have a minimal effect on professional quality, teachers' high expectations regarding student behaviour and motivation can lead to increased attrition rates and decreased job satisfaction (Hanks and Davies, 2020). The work conditions, family dynamics (especially having children), positive attitude, stress level, and employee behaviours are critical elements that affect job satisfaction (Montuori et al., 2022). Leadership style is a political factor that contributes to enhancing job satisfaction. Thus, job satisfaction leads to employee retention, employee promotion, developing work conditions, improving employee morale, and ultimately, enhancing organisational performance. In addition, social factors such as work conditions, opportunity promotion, pay, job characteristics, and self-efficacy impact job satisfaction (Katua Ngui,2023).

In a study by Anglum et al. (2023), various socio-political factors that affect teacher retention were identified, including government unresponsiveness, societal ideologies, prejudices, and traditional attitudes. Thus, these factors increase the level of teacher deprivation in schools of education and contribute to their departure from the profession. Moreover, the research reveals ineffective relationships between public policies and teacher retention, as well as significant correlations between teacher retention and school accountability policies (Bryan, 2024). In the above, existing studies that were relevant to socio-political factors impact teacher satisfaction and retention exhibits the weak points need to be solved via researcher in their future research such as own-reported, limited generalizability, missing out of mechanisms that run correlation

between social factors and teacher job satisfaction, small sample size, relying in quantitative approach, inadequate exploration of long-term impacts on teachers' attrition with running policies in education institutions and unclearing about socio-political dimensions that importantly impact teacher satisfaction and retention, inadequate address of teacher diversity perceptions and teacher experiences, lack of discussion into social factors that impact job satisfaction and retention in the long term, inadequate focus on teacher, lack of investigation into cultural diversity that impacts job satisfaction and retention, convenience sampling method, heavy reliance only on survey method which is insufficient to gather comprehensive data about teachers' experiences and perception, lack of consideration of local opinions that importantly influence teacher satisfaction and retention, and pervasive social policy recognition that impacts teacher retention.

Hypothesis

H_1: There are no significant differences in job satisfaction levels among public and private school teachers in Afghanistan

H_2: Socio-political factors have a significant relationship with teachers' job satisfaction.

H_3: Teachers' consideration of leaving their teaching positions is significantly predicted by their job satisfaction scores and socio-political pressures.

Research Methodology

This research used a mixed method, both qualitative and quantitative research methodologies, to obtain data with a deeper understanding of teachers' perceptions, attitudes, and experiences regarding their current position or those who had teaching experiences in an Afghan school. All, the online survey was conducted with a structured questionnaire that was distributed through email, Messenger, and WhatsApp groups. Questionnaires were divided into six sections that include section one and two: demographic information such as name, age, gender, education level, teaching experiences, current position, and type of school; section three

involves a few questions about teachers' satisfaction; section four includes a few questions about the critical impact of socio-political factors on teachers; section five includes some questions about influences factors that lead teacher retention within their position; and ultimately, there is an appreciation text for those who have given time to mention their perceptions, opinions, and recommendations. The targeted population was High private and public-school teachers, generally across all schools in Afghanistan. Based on a huge population of teachers, I used random sampling to collect data from 500 teachers as a sample that all had an equal chance to answer the questionnaire. But only 300 teachers responded to share their experiences and perspectives.

Conceptual Model

The graph below shows how socio-political factors affect teachers in public and private higher education institutions in Afghanistan. The graph shows that socio-political factors significantly affect teacher job satisfaction and retention.

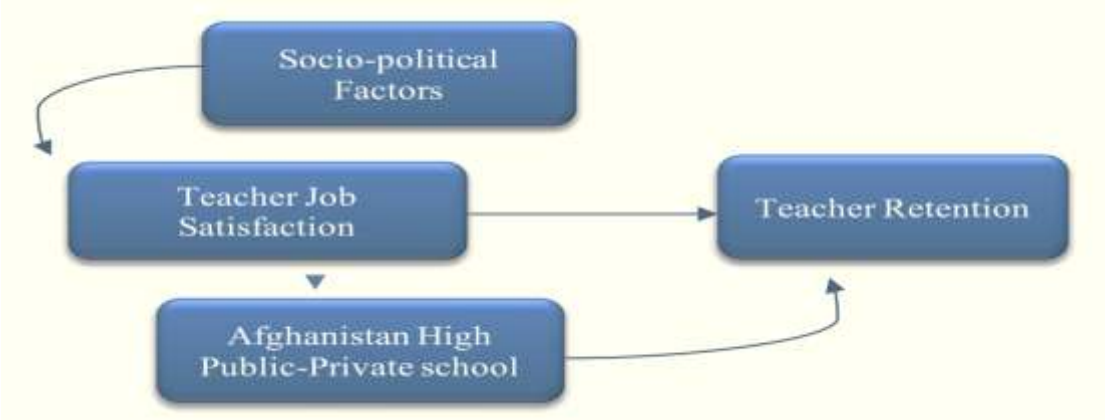

Figure 1

In this diagram, socio-political factors such as salary, government support, security and politics directly shape the level of teacher job satisfaction. Moreover, teacher retention is directly proportional to job satisfaction, wherein if job satisfaction increases, then so does the former. In this diagram, the variables are linked to each other: geographical region

Afghanistan, job satisfaction, and teacher retention. It shows how geographical conditions affect job satisfaction and teacher retention in educational institutions. Thus, geographical factors in Afghanistan, including political instability, traditional norms, lack of social support, and lack of access to facilities, substantially undermine job satisfaction and retention.

Data Analysis:

Data analysis was conducted using the IBM SPSS software program. The statistical analysis was carried out in three steps. In the first step, the descriptive statistical analysis was used to describe the frequencies of gender, type of school, and level of teacher experiences to summarise basic information of the statistical sections. In the second step, an independent sample t-test was conducted to compare the level of job satisfaction among school teachers. Ultimately, in the third step, a binary logistic regression was used to predict the probability of pressures of socio-political factors on teacher retention.

Descriptive Statistics

Reporting Frequencies

The sample consisted of 139 (66.8 %) male and 68 (32.7%) female respondents (N= 208 %).

As Statement 1: Table of frequency for gender

Gender	Frequency	Percent
Male	141	67.8%
Female	67	32.2%

Table 1

As Statement 2: Table of frequency for school type

Gender	Frequency	Percent
Public	109	52.4%

Private	99	47.6%

Table 2

Reporting summary statistics

The average experiences of teachers was14.55 (SD=139.572).

As a statement 3: Table of experiences based on year

	Mean	SD
Teachers' Experiences	14.55	139.572
Teachers Age	33.83	11.311

Table 3

H1: There are no significant differences in job satisfaction levels among public and private school teachers.

An independent sample t-test was conducted to compare the level of job satisfaction among school teachers for male and female school teachers. There was no significant difference between the mean scores of the Males and Females (t (206) = -1.686, P=0.093), with the Male mean (M= 3.02, SD= 1.13) being higher than the Female mean (M= 3.30, SD= 1.030). The magnitude of the differences in means (mean difference) was not significant either. Hence, H1 was not supported.

Difference in satisfaction level between male and female school teachers.

Levene's Test for

Equality of

Variances

T-test for equality of means

NO		mean	SD	F	Sig	t	df	Sig(2-tailed)	Mean differences	Std. Error Difference	95% confidence interval of the difference	
											Lower	Upper
DV	G1	3,02	1.143	.040	0.842	-1.686	206	.047	-.227	.164	-.601	.047
	G2	3.30	1.030									

Table 4

An independent sample t-test was conducted to compare the level of job satisfaction among school teachers for public and private schools. Scores were not significantly different (t (206) = 0.853, P=0.395) between Public and Private, with Public's mean score (M= 3.17, SD= 1.148) being higher/lower than Private's (M= 3.04, SD= 1.074). Because the magnitude of the differences between the means (0132, 95% CI: -0.173 to 0.437) was quite small, H1 had no support.

Difference in satisfaction level between Public and Private school teachers.

Levene’s Test for

Equality of

Variances

T-test for equality of means

NO		mean	SD	F	Sig	t	df	Sig(2-tailed)	Mean differences	Std. Error Difference	95% confidence interval of the difference	
											Lower	Upper
DV	School 1	3,17	1.148	3.368	.068	.853	206	.395	1.132	.155	-0.173	.0437
	School 2	3,04	1.074									

Table 5

H2: Socio-political factors are significantly correlated with teachers' job satisfaction.

Reporting Pearson correlation

Pearson product correlation of Socio-political (SP) factors and job satisfaction (JS) among teachers was found to be a very low positive correlation and statistically significant (r=.242, $p < 0.001$). Thus, H1 was supported. This shows that higher socio-political pressures would lead to lower satisfaction.

Correlation Analysis

	PS	JS	RM	TR	SEP	RT
PS	1					
JS	.242	1				
RM	.299	.319	1			
TR	.222	.351	.340	1		
SEP	.382	.156	.159	.052	1	
RT	.385	.338	.387	.405	.405	1

Table 6

Correlation is significant at the 0.01 level (2-tailed). Correlation is significant at the 0.05 level (2-tailed).

H3: Teachers' consideration of leaving their teaching positions is significantly predicted by their job satisfaction scores and socio-political pressures.

Reporting Logistic Regression

In the table, logistic regression analysis indicated the probability of teacher consideration leaving their position significantly predicted by socio-political pressures (factors) under a 61.4% pressure level. According to the results of this table, the overall job satisfaction (Ex (B) = 0.722, P = 0.168) was a significant predictor. Resource availability (Ex (B) = 0.044, P = 0.817) was not significantly related to job satisfaction. Thus, there is no significant power based on the teachers being in their position.

A Logistic Regression to predict teachers' probability considering in leaving their job.

The predictor variables	BE	SE	P-Value	Exp(B)	95% CI for Exp(B)
Job Satisfaction	-0.325	0.178	0.068	0.722	(0.509, 1.025)
Resources Satisfaction	0.044	0.192	0.817	1.045	(0.718, 1.522)
Socio-Political Pressure=Yes	0.044	0.415	0.022	0.386	(0.171, 0.872)

Table 7

Note: Odds ratios (Exp (B)) show the probability of considering leaving their position. P-value < 0.05= significance.

By analysing Exp (B) (odds ratio) as a logistic regression result, I found the impact of job satisfaction and socio-political factors on teacher likelihood prediction in staying in their position. It shows that socio-political factor is a more significant predictor than job satisfaction and resource satisfaction that influence teachers' decisions to stay in their position

Government's Role in Teacher Job Satisfaction and Retention

The teacher recommendations that I collected from the online survey indicate governments can play a crucial role in enhancing teachers' fulfilment, satisfaction, retention, and shape all other aspects of their lives. The participants from both public and private schools emphasised the supportive role of the government regarding teachers and the education system in Afghanistan. The policymakers with a positive policy and strategies for financial stability can improve the education system, teachers' skills, teachers' knowledge, and the ability of teachers.

The government should create a safe environment with all basic infrastructure and resources, such as internet access, teaching equipment, and reduced class size. In improving teachers' quality, the governments should prepare opportunities such as scholarships for teachers, preparing training and workshops, familiarising them with modern technologies for teaching, having partnerships with international educational institutions to exchange teachers' abilities, sponsoring teachers attending educational conferences and seminars, and providing grants for classroom projects.

In encouraging teachers to have a good performance and remain in their positions, the governments should regularly recognize teachers' efforts, specifically women, and consider them as an important asset of the communities and provide both monetary and non-monetary incentives such as life insurance, competitive salaries and benefits, improve retirement policy,

trips opportunities, limit tax, rewards, compensation, and retention bonuses.

Building positive work conditions by governments supporting such as establishing teachers' unions and encouraging teachers to be collaborative, and forcing the population to respect and support teachers, and building a transparent with accountable system between teachers and government. The government enhances academic freedom and teacher autonomy in decision-making, considering cultural diversity among teachers.

The government should support the teachers who are in rural or underserved areas because they do not have access to facilities and equipment. Some of the participants recommended giving more chances for the young generation to teach and enhance students' abilities. As currently there is an education restriction with the education institution doors closed for girls and women in Afghanistan, the teachers requested to open all levels of education for girls and women in public and private institutions. Untimely, the governments should support all aspects of teachers' lives.

Results

After statistical analysis and interpretation, the following tips are the findings:

- There was no significant difference between male and female teachers in their satisfaction status. The comparison shows that the mean values of variables between males and females are at approximately equal rates in their satisfaction level.
- There was no significant and distinct difference between public and private school teachers. T-test analysis was used to compare the differences between public and private school teachers.
- There is a very low positive correlation between socio-political factors and job satisfaction. It means that by increasing socio-political pressures satisfaction level will decrease, but very low.
- There is a significant prediction likelihood of teachers staying in their position due to

socio-political pressures, while job satisfaction was not a significant predictor.

In data analysis, which was conducted using the IBM SPSS statistical analysis program, shows an equal satisfaction level among both genders, male and female. It was the same between public and private schools. In this analysis, socio-political factors impact teachers' satisfaction level, but to a very low extent. At the end, socio-political factors were the main reason for teacher staying within their positions.

Discussion and Conclusion

Based on detailed data analysis, Socio-political factors significantly impact teachers' retention within their professional positions, while teachers' job satisfaction is not affected to this extent. In addition, the level of satisfaction and retention was not different between male and female, or public and private schools. The existing studies that I have reviewed had a significant impact on job satisfaction and retention, particularly among teachers. But the level of impact is different in high, moderate, and low to minimal.

The socio-political factors' role is vital in all aspects of teachers' lives that can shape and change their performance. Therefore, this is the government and people's responsibility to play a positive and well-being role in teachers.

In existing studies, weaknesses and challenges include limited exploration, lack of in-depth investigations, lack of longitudinal studies, reliance on quantitative methods only, failure to consider cultural and social differences, failure to provide effective recommendations and solutions for policy mechanisms on teacher support, and lack of comprehensive and detailed research specifically on socio-political factors affecting teachers.

In this research, participants of chosen from public and private school teachers, and were supposed to assess their job satisfaction and retention level, and the impacts of socio-political factors on teachers' satisfaction and retention. The result shows teachers continuously face challenges like a lack of job security, cultural conflicts, and a lack of government support. The

analysis shows there are no important differences in the satisfaction level of teachers' gender and type of school. Additionally, socio-political factors significantly predict teachers' remaining in their positions, while teachers' satisfaction is not significantly affected by socio-political factors.

By investigating the critical role of socio-political factors, this research contributes to providing valuable insights and recommendations for governments, policymakers, and all educational stakeholders to consider these issues to improve and support their education systems, especially teachers. Thus, this research highlights all the challenges teachers always face. By offering a practical solution to maintain teacher satisfaction and diminish attrition rates, this study emphasised the tips, such as government supportive policies and professional opportunities to improve teacher skills, abilities, and knowledge. This study has recommended long-term and across all different regions studies in Afghanistan to deeper understand the socio-political effects in this country.

References

Ackah-Jnr, F. R., Appiah, J., Abedi, E. A., Opoku-Nkoom, I., & Salaam, M. A. (2022). Quality education: Critical policy considerations that impact teacher retention in schools. *European Journal of Education and Pedagogy*, *3*(3), 26–32. https://doi.org/10.24018/ejedu.2022.3.3.345

Anglum, J. C., Manion, A., & Varkey, S. (2023). 9. In Search of Teachers and Data: Four-Day School Weeks and School Staffing Shortages, *Research Blog*. https://static1.squarespace.com/static/5c8a78c9e5f7d15aab22c61c/t/6536d99ec853f1678959847f/1698093473992/4DSW+Teachers+and+Data%2C+Final.pdf

Basumallick, C. (n.d.). What is job satisfaction? Definition, factors, importance, statistics, and examples. *Spiceworks*. Retrieved from https://www.spiceworks.com/hr/engagement-retention/articles/what-is-job-satisfaction/

Baxi, B., & Atre, D. (2024). Job Satisfaction: Understanding the Meaning, Importance, and Dimensions. *Journal Of Management and Entrepreneurship, 18*(2), 34-40.

Bryan, C. (2024). Teachers' perceptions of public policy and their impact on teacher retention. *The Interactive Journal of Global Leadership and Learning, 3*(2). https://doi.org/10.55354/2692-3394.1052

Ćulibrk, J., Delić, M., Mitrović, S., & Ćulibrk, D. (2018). Job satisfaction, organizational commitment and job involvement: The mediating role of job involvement. *Frontiers in Psychology, 9*(FEB). https://doi.org/10.3389/fpsyg.2018.00132

Garmendia, P., Fernández-Salinero, S., Holgueras González, A. I., & Topa, G. (2023). Social support and its impact on job satisfaction and emotional exhaustion. *European Journal of Investigation in Health, Psychology and Education, 13*(12), 2827–2840. https://doi.org/10.3390/ejihpe13120195

Hanks, J. H., & Davies, R. S. (2020). Law and policy impacts on teacher attrition in public education: Data suggesting a new focus beyond the silver bullets of targeted STEM and other salary increases. *ResearchGate*. Retrieved from https://www.researchgate.net/publication/349831108

Hopkins, M., Bjorklund, P., & Spillane, J. P. (2019). The social side of teacher turnover: Closeness and trust among general and special education teachers in the United States. *Elsevier*. Retrieved from https://www.elsevier.com/open-access/userlicense/1.0/

Inayat, W., & Khan, M. J. (2021). A study of job satisfaction and its effect on the performance of employees working in private sector organisations, Peshawar. *Education Research International, 2021*(1). https://doi.org/10.1155/2021/1751495

Khawrin, M. K., & Sahibzada, A. (2023). The mediating role of job satisfaction at selected public universities in Afghanistan: The effect of job security on turnover intention. *Journal of Management and Business Education, 6*(3), 244–256.

https://doi.org/10.35564/jmbe.2023.0013

Khawrin, M. K., & Shibzada, A. (2023). [Article Title Missing]. International Journal of Management Studies. https://doi.org/10.32890/ijms.2023.4.2.1

Khazaei, M. R., Radin, P., & Anbarlou, R. A. (2016). Study of social factors on job satisfaction of teachers in Nahavand city. *Mediterranean Journal of Social Sciences, 7*(3). https://doi.org/10.5901/mjss.2016.v7n3s3p186

Krishnamoorthy, N., & Aisha, A. (2022). An empirical study of employee retention in the information technology sector in Bangalore city. *East Asian Journal of Multidisciplinary Research (EAJMR), 1*(7), 1333–1342. https://journal.formosapublisher.org/index.php/eajmr/index

Li, Y., & Wang, X. (2022). Chinese ideological and political teachers' job satisfaction, loving pedagogy, and their professional success. *Frontiers in Psychology, 13*. https://doi.org/10.3389/fpsyg.2022.976397

Meier, L. L., & Spector, P. E. (2015). Job satisfaction. In *Wiley Encyclopedia of Management* (pp. 1–3). Wiley. https://doi.org/10.1002/9781118785317.weom050093

Montuori, P., Sorrentino, M., Sarnacchiaro, P., Di Duca, F., Nardo, A., Ferrante, B., D'Angelo, D., et al. (2022). Job satisfaction: Knowledge, attitudes, and practices analysis in a well-educated population. *International Journal of Environmental Research and Public Health, 19*(21). https://doi.org/10.3390/ijerph192114214

Neena, P. C., Dinesh, N., & Bhat, V. A. (2023). 3.2. *Journal of Contemporary Issues in Business and Government, 29*(11). https://doi.org/10.47750/cibg.2022.29.01.037

Ngui, K. T. (2023). Determinants of job satisfaction: A review of empirical literature. *International Journal of Research and Innovation in Social Science, 6*(2), 7-30. https://doi.org/10.47772/IJRISS

Noori, A. Q. (2023). Job satisfaction variance among public and private school teachers: A

case study. *Cogent Education*, *10*(1). https://doi.org/10.1080/2331186X.2023.2189425

Noori, A. Q., Said, H., Orfan, S. N., & Anis, S. N. M. (2024). The influence of school climate on high school teachers' job satisfaction in a conflict-affected country. *International Journal of Evaluation and Research in Education*, *13*(1), 321–328. https://doi.org/10.11591/ijere.v13i1.22890

Suci, R. P., Mas, N., & Risky, M. (2022). The role of job satisfaction in mediating the quality of work life effect on employee performance. *Journal of Economics, Business, & Accountancy Ventura*, *25*(2), 217–228. https://doi.org/10.14414/jebav.v25i2.3094

Wahyudi, A. S., Syauki, A. Y., Sunaeni., Judijanto, L., & Irfan, M. (2023). Strategies for Enhancing Employee Retention: A Qualitative Study on Modern Human Resource Management Practices. *International Journal of Science and Society*, *5*(5). 566-573. https://doi.org/10.54783/ijsoc.v5i5.917

Innovative Business Models for Plastics Reuse and Recycling: A Study of West Bengal

Atikur Rahman[13] and Joydeep Mukherjee
School of Environmental Studies
Jadavpur University, Kolkata 700032, India

Date of submission 16-01-2026
Date of Acceptance 11-03-2026
Date of Publication 17-04-2026

Abstract

The plastics sector in West Bengal is undergoing a significant structural transformation, driven by tightening environmental regulations, extended producer responsibility (EPR) norms, and a growing market demand for sustainable materials. This paper examines emerging business models in plastics reuse and recycling in West Bengal within the evolving framework of the circular economy. The study situates its analysis against recent policy developments, particularly the Government of India's mandate requiring a minimum of 25 per cent recycled plastic content in packaging from April 2025, which is expected to catalyze large-scale investments in recycling infrastructure. Drawing on secondary data from industry reports, government publications, and stakeholder insights, the paper identifies and analyses key business models such as organized collection and aggregation systems, decentralized recycling enterprises, producer-led take-back mechanisms, public–private partnerships, and value-added applications of recycled plastics in manufacturing and infrastructure. The findings indicate that supportive state-level initiatives, investor incentives, and the availability of skilled labour are positioning West Bengal as an emerging hub for plastics recycling and sustainable manufacturing. The study highlights how regulatory compliance, innovation, and entrepreneurship are collectively reshaping the plastics value chain, creating opportunities for economic growth while addressing

[13] Corresponding Author's email connect2atikur@gmail.com

environmental challenges. The paper concludes that the convergence of policy support, industry participation, and market demand is critical for scaling viable reuse and recycling business models and advancing a sustainable plastics economy in West Bengal.

Keywords

Plastic reuse and recycling, Emerging business models, Circular economy, Extended Producer Responsibility (EPR), Plastic waste management.

Introduction

The rapid growth of plastic consumption has become a defining feature of modern economies, owing to plastics' versatility, durability, and cost-effectiveness. However, the extensive use of plastic materials has led to serious environmental challenges, including waste accumulation, ecosystem degradation, and public health concerns. In India, plastic waste management has emerged as a critical policy and developmental issue, particularly in densely populated and industrially active states such as West Bengal. Addressing these challenges requires a transition from the traditional linear model of "produce–use–dispose" towards a circular economy that emphasizes reuse, recycling, and resource efficiency. In recent years, regulatory interventions have played a decisive role in reshaping the plastics sector. The introduction of Extended Producer Responsibility (EPR) under India's Plastic Waste Management Rules has placed greater accountability on producers, importers, and brand owners for the post-consumer phase of plastic products. The mandate to incorporate a minimum of 25 per cent recycled plastic content in packaging from April 2025 represents a significant policy shift aimed at promoting recycling, reducing dependence on virgin plastics, and minimizing environmental impact. These regulatory measures are expected to stimulate substantial investments in recycling infrastructure and innovation across the plastics value chain.

West Bengal occupies a strategic position in India's plastics industry due to its strong manufacturing base, access to ports and logistics networks, and a large pool of skilled and semi-skilled labour. The state government has increasingly emphasized sustainable industrial development by promoting investor-friendly policies, infrastructure expansion, and skill development initiatives. Recent industry–government interactions, including investment promotion seminars, reflect a growing commitment to making West Bengal a hub for plastics manufacturing and recycling. This evolving industrial ecosystem provides fertile ground for the emergence of innovative business models focused on plastics reuse and recycling. Against this backdrop, new business models are emerging that integrate environmental sustainability with economic viability. These include organized collection and aggregation networks, decentralized recycling units, producer-led take-back systems, public–private partnerships, and value-added applications of recycled plastics in sectors such as packaging, construction, and infrastructure. Such models not only enhance resource recovery and compliance with EPR norms but also create entrepreneurial opportunities, employment generation, and inclusive growth, particularly within the MSME sector.

This paper seeks to examine the nature, drivers, and implications of emerging business models in plastics reuse and recycling in West Bengal. By analyzing policy frameworks, industry practices, and market dynamics, the study aims to highlight how regulatory pressure, investment inflows, and innovation are collectively transforming the plastics value chain. The findings are expected to contribute to the existing literature on circular economy practices and provide policy-relevant insights for stakeholders seeking to promote sustainable plastic waste management and green entrepreneurship in the state.

Literature Review

Plastics have become ubiquitous in modern economies because of their versatility, low cost, and durability. Existing literature highlights that developing nations such as India face

persistent structural inefficiencies in waste collection, segregation, recycling, and disposal due to inadequate infrastructure, limited funding, and high dependence on manual labour. Early work on plastic pollution, such as Hossain et al. (2022) aims to examine the present status of plastic production, consumption patterns, and plastic waste generation in India. It seeks to critically assess existing data and practices related to plastic waste management, with particular emphasis on key challenges such as reverse supply chains, source-specific waste recovery, regulatory frameworks, and the implementation of plastic waste management rules. The study further intends to identify practical and policy-relevant strategies to strengthen plastic waste management systems and to highlight future research directions that support circular economy principles and the achievement of sustainable development goals in India. Singh and Ruj (2016) in his study emphasize the importance of improved product and packaging design to reduce dependence on virgin raw materials and support efficient resource utilization in businesses. It also seeks to examine the feasibility and limitations of existing alternatives to conventional plastics. Furthermore, the objective is to assess the economic challenges associated with the higher cost of recycled plastics while highlighting their environmental and social benefits as a sustainable substitute to virgin-grade plastics. Dijkstra et al. (2020) highlighted that most business models emphasize recycling initiatives and value creation from plastic waste, along with efforts toward the development of bioplastics. However, only a limited number of cases demonstrated true triple bottom line performance, as the majority highlighted environmental and economic gains while giving less attention to social benefits. Circular economy–oriented business models were identified in approximately one-fourth of the cases analyzed. Additionally, this study synthesizes the key challenges and emerging opportunities faced by private sector actors in advancing sustainable plastic management practices. Bazienė *et al.* (2024) in their study, the authors examine how emerging waste recycling technologies contribute to the transition toward a circular economy. These

innovations are gradually replacing conventional linear production models based on “take, make, and dispose” by minimizing waste generation, prolonging the useful life of products, and enabling efficient recovery of valuable resources from end-of-life materials. Ombis et al. (2015) highlighted the adoption of environmental innovation strategies to address plastic waste challenges in Kenyan cities, focusing on the interaction between solid waste management systems and plastic production processes. Using the Multi-Level Perspective on Technological Transitions as the analytical framework, the paper evaluates seven innovation pathways aimed at preventing plastic waste and promoting its reuse and recycling. In the Indian context, Kale and Jain (2024) emphasize the pivotal role of the informal sector in plastic-waste recovery, noting that informal waste pickers often outperform formal municipal systems in segregation efficiency and cost-effectiveness. According to Kale and Jain (2024) the informal sector plays a pivotal role in plastic-waste recovery across India. Informal waste pickers contribute significantly to material segregation and recycling rates, often outperforming formal municipal systems in efficiency and cost-effectiveness. Dennis Ike (2025) argue in his study that sustainable urban development requires the integration of informal settlements into formal urban planning frameworks, along with increased investment in basic infrastructure such as roads, electricity, and water services. The authors further emphasize the importance of including residents of informal communities in local governance processes, formulating adaptable policies that recognize and support informal enterprises, and expanding access to financial services and social security mechanisms. Collectively, these measures are expected to improve livelihood opportunities and overall well-being of informal workers while promoting more inclusive and sustainable urban growth. Abramenko et al. (2021) in their study aims to examine how the use of recycled plastics in garment manufacturing can help reduce plastic waste entering the world’s oceans and lower the release of harmful pollutants into the atmosphere. It also seeks to assess the potential for cost

reduction in clothing production through the substitution of virgin materials with recycled plastic inputs, thereby supporting environmentally sustainable and economically efficient apparel manufacturing practices. Singh and Sharma (2016) in their study aims to address the growing challenge of plastic waste management arising from the large-scale production and short life cycle of plastic products. It seeks to examine the environmental impacts of plastic waste on ecosystems, particularly its effects on soil and groundwater quality in dump-site areas. The objective also includes exploring the need for planned disposal and sustainable design of advanced polymer-based products, such as adhesives and biomedical implants, that are durable, biocompatible, and environmentally responsible, thereby minimizing pollution while meeting future technological and healthcare demands. Banerjee and Srivastava (2012) point out that plastic waste management in India depends a lot on informal recyclers, who often find creative ways to recover resources even though they face health risks and lack recognition. Their work shows the paradox that this sector is both essential and yet insecure. The same situation is seen in Kolkata, where recycling workers are central to turning waste into useful materials but remain outside formal policy and regulation. Poyai et al. (2024) in their study aims to evaluate the environmental performance of the prevailing plastic waste management approach, which prioritizes the recycling of recyclable plastics and the incineration of non-recyclable plastics with energy recovery, in comparison to traditional practices such as landfilling and conventional incineration. The objective is to generate evidence-based insights to support the formulation of practical guidelines and policy interventions for sustainable plastic waste management and efficient resource utilization in urban areas of Thailand. Additionally, the study seeks to identify the scope for extending and validating these management practices across different urban contexts beyond Bangkok to ensure their long-term applicability and effectiveness.

The reviewed literature collectively highlights the complex and multifaceted nature of

plastic waste management, particularly in developing economies such as India, where structural inefficiencies coexist with innovative practices. While policy frameworks, improved product design, circular business models, and emerging recycling technologies offer promising pathways toward sustainability, their effectiveness is often constrained by economic, social, and institutional challenges. A recurring theme across studies is the critical yet under-recognized role of the informal sector in plastic waste recovery and recycling, which significantly contributes to material efficiency despite precarious working conditions. International experiences further demonstrate the potential of environmental innovation and integrated waste management approaches in reducing ecological impacts. Overall, the literature underscores the need for inclusive, technology-enabled, and policy-supported strategies that align circular economy principles with various business models.

Research Gap

An extensive review of existing literature reveals a growing body of research on plastic waste management, circular economy frameworks, and recycling technologies at global and national levels. However, several critical gaps remain, particularly in relation to region-specific business models and policy–industry linkages in emerging economies like India.

First, while numerous studies discuss circular economy principles and recycling strategies in a broad context, there is a **lack of state-level empirical research** focusing on how these concepts are operationalized through business models in specific regions such as West Bengal. Most Indian studies remain national in scope and do not adequately capture regional variations in industrial structure, governance capacity, and market dynamics.

Second, although Extended Producer Responsibility (EPR) has been widely analyzed as a regulatory tool, **limited research examines its direct impact on business model innovation** in plastics reuse and recycling, particularly under newly introduced recycled-content mandates. The implications of stricter EPR norms on investment patterns,

entrepreneurial responses, and value-chain restructuring in West Bengal remain underexplored.

Third, existing literature recognizes the importance of the informal sector in plastic waste recovery; however, there is **insufficient analysis of integrated business models** that formally link informal actors with organized recyclers, producers, and government institutions. Empirical evidence on scalable and inclusive models that combine environmental compliance with livelihood security in the West Bengal context is scarce.

Fourth, studies on plastics recycling largely emphasize technological processes or environmental outcomes, with **relatively little focus on economic viability, market mechanisms, and value creation** through reuse and upcycling. The role of emerging business models in generating sustainable revenue streams, employment, and MSME growth has not been adequately documented.

Finally, there is a noticeable gap in understanding the **interaction between state-level industrial policies, investment promotion initiatives, and circular economy objectives**. How infrastructure development, incentives, and skill-building efforts in West Bengal influence the growth of plastics reuse and recycling enterprises has received limited scholarly attention.

Addressing these gaps, the present study seeks to provide a region-specific, policy-relevant analysis of emerging business models in plastics reuse and recycling in West Bengal, thereby contributing to both academic discourse and practical decision-making in sustainable industrial development.

Research Objective

The overarching objective of this research is to undertake a comprehensive analysis of the emerging business models in plastics reuse and recycling in West Bengal within the evolving paradigm of the circular economy. The study seeks to examine how recent regulatory

developments, particularly the implementation of Extended Producer Responsibility (EPR) norms and mandatory recycled-content requirements, are reshaping the plastics value chain and influencing business strategies across collection, segregation, processing, and value-added manufacturing activities. By situating the analysis within West Bengal's industrial and institutional context, the research aims to evaluate the extent to which policy interventions, investment incentives, infrastructure development, and skill availability are facilitating or constraining the growth of sustainable recycling and reuse enterprises.

Furthermore, the study intends to assess the economic viability and environmental effectiveness of these emerging business models, with specific attention to their potential for resource efficiency, waste reduction, and emissions mitigation. An important objective is to explore the integration of informal sector participants—such as waste pickers and small aggregators—into formalized business ecosystems, and to examine how inclusive models can contribute to both regulatory compliance and livelihood enhancement. The research also aims to identify key challenges, risks, and operational barriers faced by entrepreneurs and firms operating in the plastics reuse and recycling sector, including market volatility, technology adoption, and supply-chain constraints. Ultimately, the study seeks to generate policy-relevant insights and strategic recommendations that can support the scaling of viable, inclusive, and environmentally sustainable business models, thereby contributing to the long-term development of a circular plastics economy in West Bengal.

Research Methodology

The present study adopts a mixed-method research design to analyze emerging business models in plastics reuse and recycling in West Bengal within the framework of the circular economy and Extended Producer Responsibility (EPR) regulations. The methodology integrates both qualitative and quantitative approaches in order to capture the structural, economic, regulatory, and operational dimensions of the plastics recycling ecosystem. The

study is primarily descriptive and analytical in nature. It seeks to examine existing practices, identify evolving business models, and assess their economic and environmental implications rather than testing a narrowly defined causal hypothesis. A regional focus on West Bengal is adopted to enable an in-depth understanding of state-specific industrial policies, market dynamics, and institutional arrangements.

Research Approach

The research focuses on the entire plastics reuse and recycling value chain, encompassing collection, aggregation, sorting, recycling, and value-added manufacturing activities. Enterprises operating at different stages of this value chain are identified and studied to ensure a holistic perspective on business model evolution. This value-chain-wide focus allows for the examination of interdependencies among actors and highlights how regulatory frameworks such as Extended Producer Responsibility (EPR) influence business practices across multiple levels. Exploratory desk-based research is conducted to identify emerging plastic reuse and recycling enterprises in West Bengal. This stage involves the examination of company reports, industry publications, government databases, and digital platforms to document business activities and preliminary business model characteristics. Based on this mapping exercise, selected enterprises are categorized according to their position within the value chain and the nature of their business operations.

In-depth, semi-structured interviews are then conducted with entrepreneurs, managers, and key stakeholders associated with selected enterprises at each stage of the plastics value chain. These interviews are designed to elicit detailed information on business model structure, revenue mechanisms, compliance with EPR norms, investment requirements, technological adoption, and perceived challenges and opportunities. The interview-based approach facilitates the generation of new insights that can be further examined and interpreted within the broader theoretical framework.

Data Collection and Analysis

Data Collection

Data for the present study were collected in two sequential phases, combining desk-based research with in-depth qualitative interviews in order to develop a comprehensive understanding of emerging business models in plastics reuse and recycling in West Bengal. The first phase involved an extensive online and document-based search to identify emerging enterprises engaged in plastic reuse and recycling. Multiple sources were consulted to ensure broad coverage and reliability. These included sustainability rankings, reports and websites of organizations working on industrial sustainability and circular economy initiatives, and systematic Google searches using predefined keywords such as plastic waste startups, sustainable plastic packaging enterprises, circular economy plastic initiatives, and plastic recycling businesses in West Bengal. Industry portals, government databases, and publications of national and international organizations working in waste management and sustainability were also reviewed. This process resulted in the identification of a large pool of enterprises engaged in plastics reuse and recycling activities.

From the initial pool, enterprises were screened based on relevance to the scope of the study. Firms that were not directly involved in plastic reuse or recycling, or for which sufficient and reliable information was not available, were excluded. After this screening process, a final set of selected enterprises was retained for detailed analysis. Information on these enterprises was primarily collected from company websites, industry reports, policy documents, and supplementary sources where available. In cases where information gaps existed, partial descriptions were retained with appropriate acknowledgement of data limitations. Each selected enterprise was then systematically described using a predefined analytical framework, with particular attention to its position in the plastics value chain—such as reuse, collection, aggregation, sorting, mechanical recycling, chemical recycling, and

intermediary services. This value-chain-based classification enabled structured comparison across business models and facilitated the identification of distinctive operational and strategic characteristics.

In the second phase, in-depth semi-structured interviews were conducted with selected enterprises to gain deeper insights into their business models, operational practices, and regulatory experiences. Interviewees were purposively selected to ensure representation across different stages of the plastics reuse and recycling value chain. A limited but focused number of interviews was considered appropriate given the exploratory nature of the research and its emphasis on depth rather than statistical generalization. Interviews were conducted with enterprise owners, senior managers, and key decision-makers, and each interview lasted between approximately 45 and 90 minutes.

Data Analysis

The analysis of data followed a qualitative, inductive approach. Secondary data collected during the desk research phase were first analyzed to compare business models across enterprises and to refine their categorization within the plastics value chain. This comparative analysis helped in identifying common patterns as well as unique features across different types of business models.

Primary data from interviews were transcribed and systematically examined to identify recurring themes related to business model structure, regulatory compliance (particularly EPR norms), investment requirements, technological adoption, and market challenges. Key statements and narratives from the interviews were coded and compared across respondents to identify shared experiences, barriers, enabling factors, and perceived change requirements within the plastics reuse and recycling ecosystem.

The interview findings were then integrated with insights from the secondary analysis to deepen the understanding of how emerging business models operate in practice and how

they respond to regulatory and market pressures. Particular emphasis was placed on identifying enabling conditions, operational constraints, and strategic adaptations that influence business sustainability and scalability. The findings were interpreted in light of existing literature to assess consistency with previous research and to highlight context-specific insights relevant to West Bengal.

The objective of the analysis was not to statistically generalize findings but to build analytical depth and conceptual understanding of emerging business models in plastics reuse and recycling. The convergence of findings across interviews and secondary sources enhances the credibility of the results and provides a robust basis for drawing conclusions regarding the opportunities and challenges shaping the sector in West Bengal.

Empirical Findings

The empirical investigation reveals that emerging business models in plastics reuse and recycling in West Bengal are diverse and interconnected, reflecting the complexity of the plastic waste value chain. The findings highlight multiple business model typologies operating across reuse, recycling, intermediary services, and logistics, each shaped by regulatory requirements, market forces, and infrastructural conditions.

Reuse-Oriented Business Models:

Reuse-based business models focus on extending the life cycle of plastic products through refill systems, returnable packaging, and durable container solutions. These models are primarily concentrated in urban and institutional markets, including hospitality, retail, and corporate supply chains. Empirical evidence suggests that reuse models reduce dependency on virgin plastics but face operational challenges related to reverse logistics, consumer participation, and standardization of packaging formats. Despite these challenges, firms adopting reuse strategies report long-term cost efficiency and strong alignment with circular economy goals.

Collection and Aggregation Models:

Collection and aggregation models form the foundation of the plastics recycling ecosystem. The study finds that organized aggregators increasingly collaborate with informal waste collectors to ensure material recovery at scale. Digital platforms, buy-back centers, and contractual arrangements with municipalities are commonly used to stabilize supply. Enterprises that integrate informal actors through incentive-based or cooperative structures demonstrate higher collection efficiency, though income volatility and occupational risks remain key concerns.

Transportation and Logistics Models:

Transportation has emerged as a critical standalone business model within the plastics reuse and recycling value chain. Empirical findings indicate that specialized transportation enterprises facilitate the movement of segregated plastic waste from collection points to sorting centers, recycling units, and manufacturing hubs. These models operate through hub-and-spoke systems, bulk aggregation routes, and route-optimized logistics services to reduce transportation costs and emissions. Several recycling enterprises outsource transportation to third-party logistics providers, while larger firms maintain in-house fleets to ensure material quality and timely delivery. However, high fuel costs, fragmented waste sources, and inadequate transfer stations increase operational expenses, particularly for low-value plastics. The study finds that transportation inefficiencies significantly affect the economic viability of recycling operations. Emerging solutions include decentralized processing units, shared logistics platforms, and public–private partnerships aimed at improving last-mile connectivity and reducing material leakage during transit.

Sorting and Pre-Processing Models:

Sorting and pre-processing enterprises enhance the value of plastic waste by improving material purity and consistency. The findings show a gradual shift towards semi-mechanized

and mechanized sorting systems, driven by EPR compliance requirements and quality standards demanded by recyclers. However, inconsistent source segregation and high capital investment requirements limit widespread adoption, especially among small enterprises.

Mechanical Recycling Models:

Mechanical recycling remains the dominant processing model in West Bengal. These enterprises convert plastic waste into flakes, granules, or pellets for downstream manufacturing. The recycled-content mandate under EPR norms has increased demand for recycled plastics, encouraging capacity expansion. Nonetheless, recyclers face challenges such as feedstock contamination, energy costs, and price volatility, which affect profitability and scalability.

Chemical Recycling and Advanced Processing Models:

Chemical recycling enterprises represent an emerging but limited segment, primarily targeting multi-layered and contaminated plastics unsuitable for mechanical recycling. Empirical evidence suggests that while these models offer long-term potential for closing material loops, they are constrained by high capital requirements, technological complexity, and regulatory uncertainty.

Intermediary and Compliance-Based Business Models:

Intermediary models, including Producer Responsibility Organizations (PROs) and compliance management firms, have expanded significantly following the formalization of EPR norms. These entities coordinate collection, recycling, transportation, and reporting activities on behalf of producers. While they improve traceability and regulatory compliance, smaller recyclers report increased dependency on intermediaries and additional transaction costs.

Conclusion

The present study provides a comprehensive examination of emerging business models in plastics reuse and recycling in West Bengal within the evolving framework of the circular economy and Extended Producer Responsibility (EPR) regulations. The findings demonstrate that the plastics sector in the state is undergoing a significant transformation, driven by regulatory mandates, increasing demand for recycled materials, and growing investment interest in sustainable industrial practices. The transition from a linear to a circular plastics economy has encouraged the emergence of diverse and interconnected business models spanning reuse, collection, transportation, sorting, recycling, and compliance-oriented services.

Empirical evidence suggests that no single business model is sufficient to address the complexity of plastic waste management. Instead, an integrated ecosystem has emerged in which reuse-oriented enterprises reduce material consumption at source, collection and aggregation models ensure feedstock availability, transportation and logistics models enable value-chain connectivity, and recycling enterprises convert waste into economically valuable secondary resources. Intermediary and compliance-based models, particularly Producer Responsibility Organizations, play a critical coordinating role by linking producers with recyclers and facilitating EPR compliance. The effectiveness of this ecosystem is strongly influenced by the efficiency of transportation networks, quality of waste segregation, and the degree of coordination among stakeholders.

The study further highlights the continued importance of the informal sector in plastic waste recovery, particularly in collection and preliminary sorting activities. Business models that actively integrate informal actors through partnerships, incentive mechanisms, and formal contracts demonstrate higher operational efficiency and social inclusivity. At the same time, persistent challenges—such as inconsistent segregation at source, high logistics costs, market

volatility for recycled plastics, and limited access to finance—continue to constrain the scalability and long-term sustainability of many enterprises, especially MSMEs.

Overall, the research underscores that regulatory interventions such as EPR and recycled-content mandates have acted as strong catalysts for business model innovation and investment in West Bengal's plastics recycling sector. However, the success of these models depends on supportive policy implementation, infrastructure development, technological upgrading, and effective governance across the entire value chain. The study concludes that strengthening collaboration among government agencies, industry players, and informal-sector stakeholders is essential for fostering a resilient, inclusive, and economically viable circular plastics economy in West Bengal. By providing region-specific insights, this research contributes to the broader discourse on sustainable waste management and offers practical implications for policymakers and entrepreneurs seeking to scale plastics reuse and recycling initiatives in emerging industrial regions.

Future Scope

The present study opens several avenues for future research on plastics reuse and recycling within the broader framework of the circular economy. As regulatory frameworks such as Extended Producer Responsibility (EPR) and mandatory recycled-content requirements continue to evolve, future studies can undertake longitudinal analyses to assess how business models adapt over time and how regulatory enforcement influences investment, technological adoption, and market stability in the plastics recycling sector. Further research may focus on quantitative assessments of the economic, environmental, and social impacts of different business models identified in this study. Detailed cost–benefit analyses, life cycle assessments (LCA), and carbon footprint evaluations can provide empirical evidence on the relative efficiency and sustainability of reuse, mechanical recycling, chemical recycling, and transportation-based models. Such studies would strengthen the evidence base for policy

formulation and private-sector decision-making. There is also significant scope for exploring technological innovation in plastics reuse and recycling, particularly in the areas of advanced sorting technologies, chemical recycling processes, and digital platforms for waste tracking and logistics optimization. Future research can examine the scalability and commercial feasibility of these technologies in the context of small and medium enterprises in West Bengal.

Another important direction for future research lies in examining inclusive and socially sustainable business models that integrate informal-sector actors into formal recycling systems. In-depth studies on livelihood outcomes, occupational health, gender dimensions, and skill development within plastics recycling value chains would contribute to a more holistic understanding of sustainability beyond environmental and economic metrics. Comparative studies across Indian states or between India and other emerging economies could further enrich the literature by identifying best practices, policy innovations, and institutional arrangements that support successful circular economy transitions. Additionally, future research may investigate the role of financial instruments, green investments, and public–private partnerships in accelerating the growth of plastics reuse and recycling enterprises.

Overall, expanding research along these dimensions will not only enhance academic understanding of circular business models but also support the development of robust, inclusive, and scalable strategies for plastic waste management and sustainable industrial development in West Bengal and beyond.

References

Abramenko, I., Boyeva, K., Dubskaya, O., Gubachev, V., & Murzin, A. (2021). Innovative approaches to plastic waste recycling using the example of the textile industry. *Amazonia Investiga*, *10*(46), 234-243. https://doi.org/10.34069/AI/2021.46.10.24

Banerjee, T., & Srivastava, R. K. (2012). Plastics waste management and resource recovery in India. *International Journal of Environment and Waste Management, 10*(1), 90-111. https://doi.org/10.1504/IJEWM.2012.048153

Bazienė, K., Gargasas, J., Rajendran, S., & Solomon, J. N. (2024). Towards circular economy through novel waste recycling technologies. *Entrepreneurship and Sustainability Issues, 12*(2), 460-472. 10.9770/m5297249738

Dijkstra, H., Beukering, P. V., & Brouwer,R. (2020). Business models and sustainable plastic management: A systematic review of the literature. *Journal of Cleaner Production, 258*, 1-14. https://doi.org/10.1016/j.jclepro.2020.120967

Hossain, R. Islam, M. T., Shanker, R., Khan, D., Locock, Katherine E. S., Ghosh, A., Schandl, H., Dhodapkar, R., Sahajwalla, V. (2022). Plastic Waste Management in India: Challenges, Opportunities and Roadmap for Circular Economy. *Sustainability, 14*(8), 4425-4444. https://doi.org/10.3390/su14084425

Ike, D. (2025). The role of Informal Economies in Sustainable Livelihoods. *International Journal of Developing Country Studies, 7*(1), 71-86. https://doi.org/10.47941/ijdcs.2643

Kale, R. C., & Jain, M. S. (2024). A review study on plastic waste management: an Indian perspective. *Solid waste management for resource-eflcient systems*, 233–253. 10.1016/B978-0-443-23775-1.00019-9

Ombis, L. O., Bas J.M. van Vliet., & Arthur P.J. Mol. (2015). Managing plastic waste in East Africa: Niche innovations in plastic production and solid waste. *Habitat International, 48*, 188-197. https://doi.org/10.1016/j.habitatint.2015.03.019

Poyai, T., Pongpunpurt, P., Leknoi, U., Painmanakul, P., Chawaloesphonsiya, N. (2024). Plastic waste management in urban areas: Key takeaways from the “Send Plastic Home” project in Bangkok, Thailand. *Process Safety and Environmental Protection, 190*(A), 1222-1232. https://doi.org/10.1016/j.psep.2024.08.013

Singh, P., & Sharma, V.P. (2016). Integrated Plastic Waste Management: Environmental and Improved Health Approaches. *Procedia Environmental Sciences, 35*, 692–700. https://doi.org/10.1016/j.proenv.2016.07.068

Singh, R. K., & Ruj, B. (2016). Plastic waste management and disposal techniques-Indian scenario. *International Journal of Plastics Technology*, *19*(2), 211-226. 10.1007/s12588-015-9120-5

Analysing Disaster-induced Internal Displacement: Drivers, Vulnerabilities and Protection Framework

Aishik Bag[14]

Date of submission 15-04- 2026
Date of Acceptance 27-04-2026
Date of Publication 29-04-2026

Abstract

This paper examines disaster-induced internal displacement with an emphasis on its causes, consequences and protection mechanism. In doing so, it begins by exploring the concept of displacement and resettlement, thereby highlighting the difference between internally displaced persons and refugees. Then, it analyses the complex interrelation between natural disasters and climate change that shapes the forms of forced migration, frequently fading the distinction between voluntary and involuntary movement. It asserts that notwithstanding heightened global attention, the lack of a binding legal framework undermines the attempts to guarantee effective protection for IDPs. Drawing on international human rights and humanitarian law, the article highlights the need for a more coherent and comprehensive approach to addressing internal displacement.

Keywords: Internal Displacement, Disaster-Induced Migration, Climate Change, IDPs, Protection Framework.

Introduction

Approximately 70 million people are currently living outside their home or are forced to leave their homes in order to secure minimum safety from threats and subjugation (IDMC 2023). This large-scale movement of people is rarely voluntary and is often shaped by conditions that compel individuals to leave their habitual place of residence. Forced migration can take place because of various reasons such as human rights violations, political repression, civil war, natural and human-made disasters, and various development projects, particularly dams,

[14] email: bg.aishik@gmail.com

drilling of oil, coal, and minerals, and often by militant groups (IOM 2019). Often the terms 'Migrants', 'Refugees', and 'Internally Displaced Persons' are used synonymously. International organizations associated with migration crises are more concerned with the vulnerabilities of the victims rather than defining their status. One of the biggest obstacles is a generalised perspective among scholars and practitioners about migrants. In many cases, migrants are comprehended as an indiscriminate multitude. People displaced due to conflicts might have different impetuses based on socio-cultural, economic, political, and geographical considerations, which are often understudied and neglected. As it is not possible to focus broadly on 'Migration' as a whole, this effort is made to bring the issue of 'Internal Displacement' under scrutiny in order to have a detailed account on whether there is any existing legal framework for the protection of Internally Displaced Persons (IDPs) and, if yes, then what standards of protection it provides to them. In doing so, the first part of this paper deals with the notion of 'Displacement' and 'Resettlement'. In the second part, it details disaster-induced displacement and its effects. In the last two parts, it deals with the conceptual understanding of 'Internally Displaced Persons' and the protection framework for IDPs, respectively.

Conceptualising 'Displacement' and 'Resettlement'

Displacement of population is a consequence of various factors such as political and religious persecution, climate degradation, natural or human-made disasters and so on. People are displaced when a number of push and pull factors leave them in a position where there are more risks than opportunities. According to Hyndman, displacement is by definition forced and involuntary and involves some form of de-territorialisation. It can take place within and across internationally recognised borders. Crossing an international border designates them as 'Refugees', whereas fleeing within national boundaries recognises them as 'Internally Displaced Persons' (IDPs). These IDPs were not included in the international legal framework for the protection of displaced persons, as they fall under national jurisdiction and the UN Charter does not permit infringement upon states. Although, given the changing political situations, consequences of internal conflicts and the increasing effects of climate degradation, IDPs have gained importance in international discourses. This has raised genuine concerns over the practice of sovereign power and has also fanned the interest of the international community to intervene on their behalf. But a definitional problem remains: 'Who constitutes IDPs?' 'The time frame of the displacement?' 'Where does the displacement take place and what are the solutions to these displacements?' Resettlement of the IDPs has become central in migration

studies (Cernea 2000). Yet, confusion persists between ‘Displacement’ and ‘Migration’ and ‘Voluntary’ and ‘Involuntary’ movement while discussing the resettlement issue of the IDPs. People move voluntarily because of new opportunities and prospects. While involuntary movements may also include new opportunities due to the subjective nature of ‘choice’, the ‘Choice of Movement’ remains central to this dichotomy. Whether displacement is caused by dam building, natural disaster, or conflict, resettlement often entails planned movement of population from one area to another. Nonetheless, resettlement is not a unified category. Different legal and normative guidelines govern different forms of displacement. But there remains very little interchange between them even after periodic solicitations by scholars and practitioners.

Relocating the concept of IDPs from the Refugee

The term “Internally Displaced Persons” (IDPs) gained its importance in the late twentieth century within the migration discourse. This shift calls for a certain delimitation between IDPs and refugees. Refugees fall under a well-defined legal regime whereas, IDPs are still in search of a binding legal status. The pioneering step to define IDPs emerged with the United Nations’ 1998 ‘Guiding Principles on Internal Displacement’ applicable to:

> *“persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters and who have not crossed an internationally recognized State border.” (United Nations 1998)*

This definition broadly focuses on two key characteristics of the IDPs. Firstly, their displacement is forced and secondly, they stay within their own country. However, the definition remains descriptive rather than legally binding, thereby limiting its enforceability within international law (Kälin 2008; Cohen and Deng 1998).

Being a refugee enables greater access to international protection and facilities (Human Rights Committee 2011), which is largely absent in the case of IDPs. Such an impediment needs to be taken into consideration while making the legal protection framework exclusively for the IDPs, because the conditions, causes, and characteristics of both kinds of displacement are fundamentally different from each other. As E. Mooney argues that the concept of internal displacement encompasses a broader range of causes than refugee flows and that internally

displaced persons are often incorrectly described as ‘internal refugees’. While both groups share certain characteristics, such as forced displacement and the experience of displacement, IDPs remain within the borders of their state of origin. Importantly, the definition of IDPs is descriptive rather than legal, and therefore does not confer a distinct legal status comparable to that of refugees in the international legal system (Mooney 2005).

However, there are similarities as well between these two types of displacement. Both are uprooted from their own communities, cultural environment, and linguistic settings, resulting in deep socio-economic and psychological instability. This has led to a growing debate among scholars and practitioners over whether a common legal framework should be developed to protect the rights of refugees and IDPs. There is also increasing concern regarding the urgency of protecting IDPs. Nevertheless, some counterarguments emphasise the need to maintain a clear demarcation between refugees and IDPs, because immediately after crossing an internationally recognised border, refugees are protected by specific international legal norms, which is different in the case of IDPs. IDPs remain within the national territory and thus applying the same measures to protect their rights as refugees would not have the same value (Silska, 2014).

United Nations High Commissioner for Refugees (UNHCR) has increasingly been engaged in dealing with rights and the protection of IDPs. It recognises that IDPs are as vulnerable as refugees and therefore guarantees protective measures for IDPs aligned with the guiding norms of International Human Rights Law (IHRL), International Humanitarian Law (IHL), and the United Nation’s Guiding Principles. Although, it is noteworthy that such engagement of UNHCR is confined to conflict-induced displacement and not yet stretched to disaster-induced IDPs. In such cases, UNHCR, instead of acting as a primary donor, shares its role with other UN bodies such as Office of the High Commissioner for Human Rights (OHCHR), United Nations Children’s Fund (UNICEF), and International Organization for Migration (IOM). Therefore, despite having a clear conceptual distinction between refugees and IDPs, the absence of a binding legal framework remains a challenge. Such lacuna becomes even more prominent with the growing complexities and number of internal movements due to disaster-induced displacement.

There are a considerable number of factors that are responsible for the creation of internal displacement. In this article, among several categories, natural disasters are discussed below to examine how they influence migration and shape the lives of the displaced.

Natural Disasters and Displacement: Patterns and Dynamics

Among the various reasons and their different modes and categories, climate change is one of the most detrimental determinants of human mobilization (IPCC 2022). There is no single definition of disaster-induced migration, but roughly it refers to people's movement driven by sudden or progressive changes in the climate or weather. A disaster can be more precisely defined as an occurrence of widespread, severe damage, injury, or loss of life or property that exceeds a community's capacity to cope and results in severe social disruption (Perez et al. 1994). The United Nations has defined a disaster as:

> *"A serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of the affected society to cope using its own resources (UNDRO, 1992)".*

In the realm of migration literature, climate-induced or natural disaster-induced displacement has long been discussed, yet it still lacks a universally agreed precise definition (Black et al. 2011). This highlights the need for reconceptualisation of the interrelation between natural disasters and migration. As per the definition provided by the International Organization for Migration (IOM), environmentally displaced people are:

> *"Persons or groups of persons who, for reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their territory or abroad (IOM, 2007)".*

Environmental change often blurs the difference between voluntary and involuntary migration. However, in many instances, fear of physical harm, breakdown of livelihoods, and loss of life force people to relocate, situating such movements within the broader category of forced displacement. This shows the complex and contextual nature of disaster-induced migration (Adger et al. 2014). Globally, disasters triggered 45.8 million new internal displacements in 2024 alone, highlighting the scale and urgency of disaster-induced migration (Internal Displacement Monitoring Centre 2025).

This complicated relationship between natural disasters and migration is central to the present discussion. Recent years have witnessed an increased number of cyclones, heavy rainfall, and droughts. Densely populated areas are more vulnerable to climate change, with the poorest communities facing the most severe impacts on their livelihoods. Sudden onset events like cyclones and floods are the key determinants of forced migration, as they damage the means of life of the affected communities and leave them with no alternatives but to relocate. For instance, Cyclone Amphan (2020) in India and Bangladesh triggered approximately 2.4 million new displacements, making it one of the largest disaster-induced displacement events in South Asia (Internal Displacement Monitoring Centre 2021).

On the other hand, slow onset events, such as droughts, result in gradual and complex patterns of displacement and are often responsible for economic or voluntary migration. For example, recurrent flooding and riverine hazards in Bangladesh continue to drive large-scale internal displacement, with disasters displacing an average of around one million people annually, particularly during the monsoon season (IDMC 2026). However, a sudden drought can also result in forced migration when survival becomes impossible. This depicts a varying pattern of disaster-induced displacement that is shaped by the intensity of destruction, duration of the disaster, and socio-economic context of the affected communities (McLeman 2014).

This intricate interrelation between climate change and migration makes it even more challenging to address disaster-induced displacement within the existing legal and policy framework. A key limitation is the absence of a developed model to study these different patterns, thereby exposing the lacunae of existing mechanisms to protect IDPs and complicating the understanding of actual ‘push’ and ‘pull’ factors behind migration.

Gauging the Framework of Protection for the IDPs

The preceding discussion demonstrates the absence of a binding legal framework dedicated to the protection of IDPs. Although, in situations such as natural or man-made disasters and armed conflict, IHRL and IHL are applicable to IDPs, they remain insufficient in addressing their specific needs. Consequently, existing protection measures are often characterised as ‘soft law’, which is not legally binding upon states (Cohen and Deng 1998). Instead of addressing the gaps in the current arrangements and developing an exclusive legal structure, the UN has relied heavily on established legal frameworks and guiding principles to address the unique needs of IDPs. As these principles are not legally binding upon states, their implementation

and effectiveness vary across contexts. This reflects the limitations of existing protection frameworks for IDPs. Although the application of human rights law to situations of displacement is broadly acknowledged, it remains limited in scope. In this view, the United Nations Human Rights Committee (UNHRC) observed that:

> *"The ICCPR applies also in situations of armed conflict to which the rules of IHL are applicable. While, in respect of certain rights of ICCPR, more specific rules of IHL may be especially relevant for the purposes of the interpretation of ICCPR rights, both spheres of law are complementary, not mutually exclusive (UNHRC, 2004)".*

The protection mechanism cannot be wholly understood without referring to its relation with International Human Rights Law (IHRL), which is reflected in the 1992 resolution of UNHCR that recognised 'Human Rights' as a fundamental element in the protection framework of IDPs (UNHCR, 1992). Such an approach was further strengthened in UNHCR's 2004 resolution that introduced an amendment to include the reference of Human Rights in the existing mandate for IDPs. Nevertheless, IHRL has drawn criticism due to its 'lex specialis' approach in this context. As the protection of the rights of internally displaced persons and International Human Rights Law operate in different contexts, there is a need for context-sensitive mechanisms, which are largely absent in the existing protection framework.

There is a consensus that IHRL is not fully capable of providing adequate protection of human rights, as it might derogate at the time of national emergency and strife. However, there are areas where such derogation is not applicable. For instance, the prohibition of torture, cruel and inhuman treatment, arbitrary detention, forced deportation, and genocide, as mentioned in Article 4 of the ICCPR. Along with that, the ICCPR also identifies Articles 6, 7, 8, 11, 15, 16, and 18 as fundamental rights that cannot be derogated from, even at the time of crisis or situations that threaten national life (Silska 2014). It is important to note that the degree of derogation varries across regimes. As L. T. Lee observed that:

> *"To the extent that their basic human rights have been violated, all human beings are entitled to protection and assistance whether as refugees abroad or as IDPs within their own countries. Equal rights for all individuals, be they nationals or aliens, refugees or IDPs is implied in all universal and regional human rights instruments through the use of such expressions as 'all human beings', 'everyone', 'no one' or 'all'. Hence, not a*

> *single 'right' in the UDHR, for example, is specified or implied as belonging only to 'refugees', and not to 'internally displaced persons'" (Lee, 1996).*

Along with IHRL, International Humanitarian Law (IHL) also guarantees protection during emergency situations, which is applicable to IDPs as well. However, IHL is primarily developed to regulate activities during armed conflict and thus does not encompass the wider needs and conditions of IDPs. Though International Humanitarian Law, primarily derived from the four Geneva Conventions and their two Protocols, as well as the Hague Conventions of 1899 and 1907, mainly focuses on the protection of victims of armed conflict and hardly addresses the specific needs of IDPs, who are often a result of internal conflicts (ICRC, 2010). Given the non-international nature of most contemporary armed conflicts, Article 3 of the Geneva Convention (1949) and its Protocol II (1977), which provide assistance and protection to victims of non-international conflicts, could to some extent be applied to the protection of IDPs (ICRC, 2010). However, these legal provisions become applicable only after the outbreak of armed conflict. Therefore, they neglect the deterioration of human rights and livelihoods prior to conflict. The legal structure of IHL has very limited provisions addressing IDPs specifically, although it provides protection to civilians during armed conflict. Thus, IHL offers humanitarian legal support to IDPs not on the basis of their specific status as IDPs but as civilians involved in conflict situations.

Having the understanding that there are many aspects of the internal displacement crisis that are not covered or addressed by the existing frameworks related to the protection of IDPs, a brief discussion of International Refugee Law (IRL) becomes necessary. Though not applied directly, an account of IRL is indispensable for developing a standard for the protection of IDPs. IRL is applicable to those displaced people who have crossed an internationally recognised border due to a well-founded fear of persecution and thus cannot be applied directly to IDPs, as they, by definition, are those who have fled due to conflict, disasters, or other threats within their country of origin. The issue is that the focus of the international community in developing legal protection frameworks has been more on the typification of displacement rather than on 'forced displacement' as a whole. The absence of such a comprehensive approach prevents policymakers from uncovering the real interplay between the two types of migration, namely 'Refugee' and 'Internally Displaced Person'. Being a refugee entitles individuals to specific rights and protections under international refugee law, which are largely absent in the case of IDPs, as there is no cross-border movement involved and they remain

under the jurisdiction of national governments. In this context, an analogous protection framework for IDPs may risk undermining their existing rights as citizens of their state of origin. However, even if a fully analogous structure is not adopted, guidelines could be drawn from IRL, as the conditions of internally displaced persons are often similar to those of refugees, particularly in terms of their sense of displacement and marginalisation, and their frequent characterisation as potential refugees.

Closing Thoughts

This paper aims to uncover the existing legal protection framework for IDPs and demonstrates the absence of a binding legal framework that exclusively addresses their protection. This analysis highlights the growing need for an international legal structure that is obligatory upon states, as the legal provisions that are currently available are often not respected by states. One of the reasons behind this absence is the unwillingness of the international community, as IDPs fall under the jurisdiction of national governments and the UN Charter mandates non-interference in state sovereignty.

However, the failure of national regimes to adequately address the needs and demands of IDPs has prompted growing concern within the international community regarding their protection. Unfortunately, the current reality shows little progress towards the development of comprehensive standards for the protection of IDPs. People often remain trapped in conflict situations involuntarily due to their inability to flee their state of origin, thereby becoming IDPs without adequate protection under existing refugee law.

This reflects a failure to adopt clear and effective standards for the protection of IDPs, leaving them insufficiently protected under national and regional frameworks. A precise and universally accepted definition of IDPs is crucial for achieving a durable solution to the internal displacement crisis, especially considering the growing number of displaced persons. In this context, a more holistic approach to understanding forced migration is essential.

It can be argued that despite the different causes of internal displacement, whether conflict-induced, disaster-induced, or voluntary and involuntary migration, there are significant similarities in the conditions experienced by displaced populations. IDPs represent a distinct category of displaced persons who, while remaining within their country, are still entitled to protection from their state of origin. The challenge lies in identifying and addressing the needs of those most vulnerable, which exposes a visible gap in the existing protection framework.

What distinguishes IDPs from other categories of displaced persons is both the factors driving their displacement and the continued violation of their rights despite remaining within national borders. Although there is an increasing theoretical consensus on their protection, this has not translated into effective policy implementation. This gap between normative frameworks and practical application remains a central challenge.

International legal frameworks have historically focused more on refugees than on IDPs, thereby reinforcing the gap between theory and practice. Unlike refugees, IDPs are still not recognised through a specific and binding set of international laws. Although regional arrangements exist through various conventions and treaties, these remain limited in scope and geographically confined, allowing for variations in protection standards. As a result, the rights enshrined in major human rights conventions are not always guaranteed to internally displaced persons, particularly in cases where the state itself is responsible for displacement.

The UN Guiding Principles on Internal Displacement recognise the protection of IDPs as the primary responsibility of national authorities. However, due to their non-binding nature, it remains difficult to ensure effective protection under state responsibility. Therefore, the development of a dedicated international legal framework for IDPs, similar to that for refugees, could significantly improve the current situation. Such a framework would provide protection to those who fall within the gaps of existing legal and institutional arrangements, thereby contributing to a more durable and comprehensive solution to the internal displacement crisis.

References

Adger, W. Neil, Jon Barnett, Katrina Brown, Nadine Marshall, and Karen O'Brien. 2013. "Cultural Dimensions of Climate Change Impacts and Adaptation." *Nature Climate Change* 3 (2): 112–17. https://doi.org/10.1038/nclimate1666.

Black, Richard, Stephen R. G. Bennett, Sandy M. Thomas, and John R. Beddington. 2011. "Climate Change: Migration as Adaptation." *Nature* 478 (7370): 447–49. https://doi.org/10.1038/478447a.

Cernea, Michael M. 2000. "Risks, Safeguards and Reconstruction: A Model for Population Displacement and Resettlement." In *Risks and Reconstruction: Experiences of Resettlers and Refugees*, edited by Michael M. Cernea and Christopher McDowell, 11–55. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/15227.

Cohen, Roberta, and Francis M. Deng. 1998. *Masses in Flight: The Global Crisis of Internal Displacement*. Washington, DC: Brookings Institution. https://www.brookings.edu/book/masses-in-flight/.

Hyndman, Jennifer. 2000. *Managing Displacement: Refugees and the Politics of Humanitarianism*. Minneapolis: University of Minnesota Press. https://doi.org/10.5749/j.ctttsq8.

Internal Displacement Monitoring Centre (IDMC). 2021. *Global Report on Internal Displacement 2021*. Geneva: IDMC. https://www.internal-displacement.org/global-report/grid2021/.

———. 2023. *Global Report on Internal Displacement 2023*. Geneva: IDMC. https://www.internal-displacement.org/global-report/grid2023/.

———. 2025. *Global Report on Internal Displacement 2025*. Geneva: IDMC. https://www.internal-displacement.org/global-report/grid2025/.

Intergovernmental Panel on Climate Change (IPCC). 2022. *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Cambridge: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/.

International Committee of the Red Cross (ICRC). 2010. *How Does Law Protect in War?* Geneva: ICRC. https://casebook.icrc.org/.

International Organization for Migration (IOM). 2007. *Discussion Note: Migration and the Environment*. Geneva: IOM. https://publications.iom.int/system/files/pdf/migration_and_environment.pdf.

———. 2019. *World Migration Report 2020*. Geneva: IOM. https://publications.iom.int/books/world-migration-report-2020.

Kälin, Walter. 2008. *Guiding Principles on Internal Displacement: Annotations*. Washington, DC: American Society of International Law. https://www.asil.org/sites/default/files/GuidingPrinciplesAnnotations.pdf.

Lee, Luke T. 1996. "Internally Displaced Persons and Refugees: Toward a Legal Synthesis?" *Journal of Refugee Studies* 9 (1): 27–42. https://doi.org/10.1093/jrs/9.1.27.

McLeman, Robert. 2014. *Climate and Human Migration: Past Experiences, Future Challenges*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9781139136938.

Mooney, Erin. 2005. "The Concept of Internal Displacement and the Case for Internally Displaced Persons as a Category of Concern." *Refugee Survey Quarterly* 24 (3): 9–26. https://doi.org/10.1093/rsq/hdi037.

Office for the Coordination of Humanitarian Affairs (OCHA). 2004. *Guiding Principles on Internal Displacement*. https://www.internal-displacement.org/publications/guiding-principles-on-internal-displacement.

Sassòli, Marco. 2005. "The Role of Human Rights and International Humanitarian Law in New Types of Armed Conflicts." In *International Humanitarian Law and Human Rights Law*, edited by Orna Ben-Naftali, 34–94. Oxford: Oxford University Press.

Silska, Monika. 2014. "International Protection of Internally Displaced Persons." *Adam Mickiewicz University Law Review* 4: 145–60. https://doi.org/10.14746/ppuam.2014.4.10.

United Nations. 1998. *Guiding Principles on Internal Displacement*. https://www.unhcr.org/43ce1cff2.pdf.

United Nations Disaster Relief Organization (UNDRO). 1992. *Internationally Agreed Glossary of Basic Terms Related to Disaster Management*. Geneva: United Nations. https://digitallibrary.un.org/record/204877.

United Nations High Commissioner for Refugees (UNHCR). 1951. *Convention Relating to the Status of Refugees*. https://www.unhcr.org/3b66c2aa10.

———. 1992. *Internally Displaced Persons: The Role of UNHCR*. https://www.unhcr.org/excom/exconc/3ae68cce4.

———. 2004. *UNHCR and Internally Displaced Persons*. https://www.unhcr.org/protection/idps.html.

———. 2011. *Handbook for the Protection of Internally Displaced Persons*. https://www.unhcr.org/4794a4c02.html.

United Nations Human Rights Committee. 2004. *General Comment No. 31: The Nature of the General Legal Obligation Imposed on States Parties to the Covenant*. https://www.refworld.org/docid/478b26ae2.html.

Acknowledgement

This study was supported by the RUSA 2.0 Programme, Department of International Relations, Jadavpur University, under the project "Disaster-Induced Displacement: Developing a Normative Framework and International Policy." The author gratefully acknowledges the guidance of Principle Investigator Prof. Omprakash Mishra and joint Investigator Dr. Urbi Das. The author also extends sincere thanks to Prof. Imankalyan Lahiri for his constant support throughout the project tenure.