Integrated Journal for Research in Arts and Humanities
ISSN (Online): 2583-1712
Volume-5 Issue-1 || January 2025 || PP. 24-29 https://doi.org/10.55544/ijrah.5.1.4

Drowning in Our Progress? Tackling the Growing Menace of Urban Floods in India

Panna Chandra Nath[1] and Aditya K. Joshi[2]
[1,2]Mobius Foundation, Connaught Place, New Delhi, INDIA

[1]Corresponding Author: pcnath722@gmail.com

ORCiD

https://orcid.org/0000-0002-9983-9564

www.ijrah.com || Vol. 5 No. 1 (2025): January Issue

Date of Submission: 21-12-2024	**Date of Acceptance:** 31-12-2024	**Date of Publication:** 12-01-2025

ABSTRACT

A recent key challenge called urban flooding has grasped Indian cities, collectively impacted by climate change and unsustainable infrastructural developments. Major cities throughout the country e.g., Mumbai, Delhi, Kolkata and Chennai, as well as smaller cities like Vadodara and Guwahati, are facing increased frequency and intensity of floods. Extreme rainfall events, urban sprawl, and inadequate infrastructure drive this. Further, this can solely be a consequence of heavy rainfall but, is intricately linked to man-made alterations like encroachment on water bodies, antiquated drainage systems, and a surge in population leading to higher waste production. The fast-paced urbanisation in the last few decades has resulted in the decline of natural water bodies that once soaked the excess downpours of monsoon seasons. Additionally, drainage systems in many cities were designed for lesser rainfall, and are incapable of coping with the increased intense rainfall in shorter spells. Accumulation of waste and siltation in the drainage systems have further multi-folded the urban inundation issues in India. Due to this the incurred economic losses and human fatalities in the country remain difficult to believe. Collective awakening of stakeholders for climate-resilient urban infrastructure, proper waste management, and upgrading drainage outdated systems can reduce the inflated risks of urban flooding in India.

Keywords- Urban deluge, Climate change, Infrastructure, Drainage systems, Urbanisation.

I. INTRODUCTION

Gujrat has received 108% of its annual rainfall, with the heaviest in the month of August 2024, which is 23% of its total seasonal rain in just three days [1–2]. The resulting floods took around 49 lives in the last week of August, around 2600 livestock perished and more than 40 thousand people had to be relocated. Cities like Vadodara, Valsad, Jamnagar, Morbi, Devbhumi Dwarka and Rajkot experienced heavy rainfall between 20-29 August 2024 leading to complete water logging [1,3].

Increasing instances of submerged streets, vehicles, and houses have become commonplace, extending from the south to the north and from the west to the northeast of the country. Urban flooding in India has been on the rise in recent years, severely affecting major cities such as Vadodara, Valsad, Pune, Bangalore, Hyderabad, Ahmedabad, Delhi, Chennai, Mumbai, Surat, and Kolkata, as well as smaller cities like Guwahati and Silchar. These cities are considered the country's economic growth hub. India expects the urban area's population to rise from 31% (Population Census of India 2011) to 52% by 2050 [4]. Since the beginning of the 21st century, built-up areas in developing countries like India have experienced unsustainable growth and development. Furthermore, elevated levels of pollution and waste are primary factors contributing to the

Integrated Journal for Research in Arts and Humanities
ISSN (Online): 2583-1712
Volume-5 Issue-1 || January 2025 || PP. 24-29 https://doi.org/10.55544/ijrah.5.1.4

increasing fragility of urban settlements. While India's agroecology and climate naturally benefit from heavy and prolonged rainfall, unsustainable urbanisation and development, coupled with environmental negligence, are turning the benefits of monsoons into catastrophic events in urban areas.

II. UNVEILING THE DELUGE: BEYOND THE MONSOON DOWNPOUR

Heavy rainfall alone is a gross oversimplification for understanding the flood crisis in India's urban localities. This complex issue is closely linked to numerous unchecked man-made disturbances to the natural cycles. In the last five to seven decades, the duration and timings of rainfall have changed [5], with a non-significant reduction in average annual rainfall during summer (https://www.data.gov.in/catalog/rainfall-india), monsoon and post-monsoon periods in the country (https://hydro.imd.gov.in/hydrometweb/(S(0dmn4eftbxfi20ffx5aj4b55))/landing.aspx). The monsoon spells which were relatively steady across the season have now become more segregated into active and lean spells of short duration [6], leading to extreme rainfall events in shorter periods.

Global Warming has caused increased Sea Surface Temperatures (SST) impacting water evaporation and atmospheric pressure depression. These factors are increasing the Sea water evaporation levels, accumulation of beyond-carrying capacity moisture in clouds, and irregular distribution of clouds in the sky, resulting in extreme rainfall and cloud burst instances. This has had a significant impact on the monsoon-led precipitation patterns in major cities across the country. Alongside, rapid and unsustainable urbanisation and infrastructural developments have particularly made Indian cities more vulnerable to heavy rain, and the situation is becoming unprecedented due to the effects of climate change. Cities like Mumbai, Pune, Delhi, Vadodara, Valsad, Jamnagar, Morbi, Devbhumi Dwarka, Rajkot, Khammam, Warangal, Nalgonda, Guwahati, and Silchar faced devastating flood incidents in 2024 [7–9], which submerged major roads and disrupted normal functioning for several days.

2.1. Urbanisation and Encroachment

Another crucial factor for Indian cities is the change in land use due to urban sprawl. This has alarmingly led to the concretisation of critical natural water bodies. Bengaluru, once known for its abundant lakes, has experienced a drastic reduction from 1452 to 194 in the last six decades [10]. In the National Capital city of Delhi, around 50% of the total official water bodies have disappeared in the process of urbanisation. The ground reality reveals the absence of 635 out of the 1291 total assessed water bodies in and around the city [11]. Similarly, in the east, Kolkata has seen a 46% reduction in its water bodies from 3874 to 1670 in just one decade, including a Ramsar Site (1208) [12]. According to India's 2022–23 water body census, there are approximately 70,311 urban water bodies [13]. The other major cities, like Mumbai, Chennai, and Hyderabad, have respectively witnessed a decline in 71%, 90%, and 55% of their water bodies since 1970 [13].

Floodplains can significantly reduce the flow rate of rivers by storing excess water during the monsoon season, helping to reduce the excess flow and recharge groundwater. The Delhi Development Authority reports that approximately 75% of the total 9700 hectares of Yamuna flood plains has been encroached [14], thereby diminishing their capacity to withstand the intense downpours in and around Delhi. In the last three decades, India, as a whole, lost around 30% of its water bodies due to encroachment and unsustainable urbanisation [13], most of which were located in and around urban areas. The impact of extensive urban development became a reason for grief in the cities of Gujrat this year [7]. Natural water bodies serve as sponges, absorbing excess water during the monsoon season and directing it towards replenishing the underground water table. The process of concretisation due to city expansion and urbanisation has wiped out these sponges, resulting in retention of most of the rainwater in urban areas, leading to inundation.

2.2. Antiquated Drainage

Drainage systems in India are under serious strain and cannot cope with the excess rainfall and increased rain intensity in shorter spells. The existing drainage systems in major Indian cities are significantly outdated [15]. For example, present-day Mumbai's stormwater drainage system was built almost a century ago and was designed to handle a maximum of 25 mm of rainfall per hour [16]. Similarly, Chennai can withstand a rainfall of 30 mm per hour. During the intense monsoon, rainfall doubles the per-hour carrying capacity of the drainage systems, thereby retaining the whole spell for days in submerged conditions. Around five decades ago, Delhi designed its drainage system to handle a downpour of 50 mm for 24 hours [17]. Currently, sewage mixes with around 50% of the drainage systems, further straining the already stressed drains [17]. Over a century ago, Kolkata constructed its latest drainage network, designed to handle a maximum rainfall of 100 mm in a single day during an intense season [18]. The city's single-day intense rainfall has averaged twice as much [19]. Heavy rains in shorter spells have surpassed the urban drainage system's potential in India, failing to channel the excess flow out of the locality.

2.3. Population and Garbage Glut

Rapid population growth and increasing waste production and accumulation in most major Indian cities

also lead to urban flooding. As cities grow and expand, the migration of people to urban settlements intensifies the pressure on the existing infrastructure. The increasing population density leads to an increase in waste generation; in the absence of adequate waste disposal measures, these wastes accumulate in and around the drainage systems. The design of these systems fails to channel the waste, leading to continuous accumulation that clogs the drains and diminishes their capacity to handle normal rainfall. A glut of waste burdens most Indian cities causing the canals and drains to choke and reduce their hydraulic capacity [20]. Mumbai's drainage systems receive a daily dump of 80-110 MMT of plastic waste, the majority of which is single-use [21]. Reports suggest that around 85% of the sewage overflow in Chennai was because of the solid waste clogging the drains [22]. Solid waste accumulation in Kolkata and Delhi drainage systems is reportedly choking the normal discharge of water and sewage [23]. This has led to congestion and stagnation of rainwater in these cities.

III. THE PRICE WE PAY

In India, urban floods cause a significant loss of human life and property each year. Annually, lakhs of people are affected by urban floods in India, and almost all major cities like Mumbai, Delhi, Bangalore, Hyderabad, Chennai, Kolkata, and Guwahati face the problem. From 2011 to 2020, floods in India claimed approximately 1500 human lives annually [24]. In the year 2023 alone, monsoon-related disruptions in Delhi caused an economic cost of 10000–15000 crore; and urban floods have taken 28 lives so far in Delhi in the year 2024 [25–26]. The 2005 flood, widely regarded as one of the most significant in Mumbai's history, claimed the lives of approximately 1000 people and resulted in an economic cost of INR 2800 crore [27–28]. Nearly every year, the city experiences flooding, with four floods in the last decade (2015, 2017, 2019, 2023) [29]. According to records, the Hyderabad floods of 2020 took around 33 lives and caused an estimated INR 670 crore property loss and damage [30]. Chennai experienced intense floods in 1976, 1996, 1998, 2005, and 2015. The increasing severity of successive deluges claimed around 484 lives and led to an economic loss of INR 14602 crore [31]. In 2022, a dyke breach caused around 90% of Silchar, a town in Northeast India, to submerge resulting in approximately 32 fatalities [32].

The stagnant water in the urban floods becomes the breeding ground for several disease-causing vectors and leads to the outbreak of waterborne diseases like dengue, malaria, and cholera. Studies show that single-day intense rainfall and subsequent urban flooding are likely to increase in the country's future, with a surge in intensity of 19–60% by the year 2050 compared to 2015 [33–34].

IV. TURNING THE TIDE

In India, different missions and schemes have been introduced from time to time. However, the scenario of urban inundation and associated life and property loss has remained as acute. One of the reasons is that even flagship missions like the Jawaharlal Nehru Urban Renewal Mission and the Smart Cities Mission did not prioritise floods and urban flooding in their strategies. In 2015, the AMRUT (Atal Mission for Rejuvenation and Urban Transformation) mission was launched, which addressed the lack of proper drainage in urban planning. However, its functioning has not rigorously been implemented, and only 719 projects costing INR 1.6 thousand crore have been completed in seven years [27]. Implementation of these missions need to be fast-paced and proper action is required to address all aspects of urban floods. Urban flooding is becoming common in India, and collective awakening is required to mitigate the issue at the earliest.

The government's commitment to transforming India into a flood-resilient nation is of utmost importance. Research indicates that investing $1 in flood-resilient infrastructure today could prevent $248 in damages in 2050 and reduce the possibility of inundation by 50% [35]. Adequate enforcement of urban planning regulations is necessary to minimize encroachment on natural water bodies. Policies must also promote climate-resilient infrastructure and green buildings in urban areas to minimize interaction with water contours [36]. Furthermore, it is crucial to upgrade and modernize the inadequate and outdated drainage infrastructure, ensuring real-time monitoring and maintenance. In addition to waste accumulation, siltation is a major concern in choking the drainage systems in India [20]. Therefore, regular de-siltation of the drainage systems is required to keep the hydraulic capacity of the drains intact. Advanced technological involvement is also required to involve GIS technologies and real-time weather forecasting systems to enable timely evacuation and engage preparedness measures to reduce the impacts of urban flooding.

Every citizen has a role to play in mitigating the urban floods. People must encourage proper waste disposal both individually and at the community level and must support urban green initiatives while also demanding accountability from authorities towards creating cleaner, greener, and more resilient cities.

Acknowledgement

The authors would like to express their gratitude to the Mobius Foundation for providing the necessary facilities and funding for this study.

Conflict of interest

The authors declare no conflict of interest.

REFERENCES

[1] The Economic Times. (2024, September 4). *Heavy rains claimed 49 lives in Gujarat over week, 37,000 rescued*. https://economictimes.indiatimes.com/news/india/heavy-rains-claimed-49-lives-in-gujarat-over-week-37000-rescued/articleshow/113064729.cms?from=mdr

[2] Shastri, P. (2024, August 27). *23% of seasons rains in 72 hours, Gujrat tally 100%*. The Times of India. https://timesofindia.indiatimes.com/city/ahmedabad/23-of-seasons-rains-in-72-hours-gujarat-tally-100/articleshow/112845151.cms

[3] The Times of India. (2024, September 4). *Extensive urban development worsened flooding in state: Study*. https://timesofindia.indiatimes.com/city/rajkot/extensive-urban-development-worsened-flooding-in-state-study/articleshow/113066956.cms

[4] Avasia, V., & Garg, A. (2020). Implications of land use transitions and climate change on local flooding in urban areas: An assessment of 42 Indian cities. *Land Use Policy*, 95, 104571. https://doi.org/10.1016/j.landusepol.2020.104571

[5] Verma, A. (2023, June 27). *Climate change impact: Reduced rain time and decreased annual rainfall show alarming trends since independence*. English Jagran. https://english.jagran.com/india/climate-change-impact-on-crops-agriculture-reduced-rainfall-alarming-trends-since-independence-10084767

[6] Rao, T. N., Saikranthi. K., Radhakrishna, B., & Rao, S. V. B. (2016). Differences in the Climatological Characteristics of Precipitation between Active and Break Spells of the Indian Summer Monsoon. *Journal of Climate*, 29, 7797–7814. https://doi.org/10.1175/JCLI-D-16-0028.1

[7] Business Standard. (2024, September 4). *Gujarat flooding worsened by extensive urban development, shows study*. Business Standard. https://www.business-standard.com/india-news/gujarat-flooding-worsened-by-extensive-urban-development-shows-study-124090400115_1.html

[8] Crisis24. (2024, September 4). *India: Disruptions due to flooding ongoing across parts of Andhra Pradesh and Telangana states as of Sept*. Crisisi24. https://crisis24.garda.com/alerts/2024/09/india-disruptions-due-to-flooding-ongoing-across-parts-of-andhra-pradesh-and-telangana-states-as-of-sept-4

[9] Prasad, K. (2024, August 27). *Urban wreck: Floods and landslides ravage India's growing cities*. Mid-Day. https://www.mid-day.com/lifestyle/nature-and-wildlife/article/mid-day-explains-urban-destruction-how-floods-and-landslides-are-devastating-indias-growing-cities-23381453

[10] Nabi, M. (2024, August 19). *From oasis to obscurity: Disappearing lakes of Bengaluru*. MIG (Media India Group). https://mediaindia.eu/society/from-oasis-to-obscurity-disappearing-lakes-of-bengaluru/#:~:text=According%20to%20Indian%20Institute%20of,can%20be%20considered%20ecologically%20healthy.

[11] Gandhiok, J. (2024, August 13). *Half of Delhi's water bodies remain only on paper, shows revenue dept survey*. Hindustan Times. https://www.hindustantimes.com/cities/delhi-news/half-of-delhi-s-water-bodies-remain-only-on-paper-shows-revenue-dept-survey-101723484644118.html

[12] Mitra, P. (2016, February 3). *46% waterbodies in city filled up in decade*. The Times of India. https://timesofindia.indiatimes.com/city/kolkata/46-waterbodies-in-city-filled-up-in-decade/articleshow/50827651.cms

[13] Ground Report. (2024, July 20). *30% gone in 30 years, the rapid decline of India's wetlands*. Ground Report. https://groundreport.in/water/30-gone-in-30-years-the-rapid-decline-of-indias-wetlands-6501496

[14] Mathur, A. (2024, August 30). *75% of Yamuna floodplain is encroached upon: DDA*. The Times of India. https://epaper.indiatimes.com/english-news-paper-today-toi-print-edition/30th-august-2024/75-of-yamuna-floodplain-encroached-dda/printarticle/112906596.cms?redirectionSource=TOIWeb&_gl=1*rk2v5o*_gcl_au*MTAzMjQ5MTk5Ny4xNzE4NzAwOTY1*_ga*MTExMDE1Mjg0My4xNzA3MzY4Nzc1*_ga_FCN624MN68*MTcyNDk5NjMwMi40LjEuMTcyNDk5NjMzMy4yOS4wLjA.&tophead=epaper

[15] Sharma, T. (2024, August 25). *Outdated drainage system worsens Delhi's waterlogging crisis*. The Sunday Guardian. https://sundayguardianlive.com/news/outdated-drainage-system-worsens-delhis-waterlogging-crisis

[16] Srivastava, K., & Tandon, A. (2019, July 9). *India: Why the city that never stops comes to a standstill when it rains*. PreventionWeb. https://www.preventionweb.net/news/india-why-city-never-stops-comes-standstill-when-it-rains

[17] Gandhiok, J., & Singh, P. (2024, July 29). *Delhi's 48-year-old drain network, intense rains continue to cause fatalities*. Hindustan Times. https://www.hindustantimes.com/cities/delhi-news/delhis-48-year-old-drain-network-intense-rains-continue-to-cause-fatalities-101722190427808.html

[18] Patra, P., Haldar, A., & Satpati, L. N. (2017). Precipitation trends in the city of Kolkata and its implication on urban flooding. *Geographical Review of India*, 79, 335–351.

[19] Ashraff, A. (2024, May 29). *Kolkata Has Already Received 26 pc of Its Yearly Average Rainfall, Monsoon Season Yet to Begin*. Kolkata Now. https://www.timesnownews.com/kolkata/kolkata-has-already-received-26-pc-of-its-yearly-average-rainfall-monsoon-season-yet-to-begin-article-110533504

[20] Singh, H., Nielsen, M., & Greatrex, H. (2023). Causes, impacts, and mitigation strategies of urban pluvial floods in India: A systematic review. *International Journal of Disaster Risk Reduction*, 93, 103751. https://doi.org/10.1016/j.ijdrr.2023.103751

[21] Dani, R., & Mubarak, M. (2024). *One Solution To All The Environmental Problems: How Circular Economy Can Save Mumbai*. Earth5Ri. https://earth5r.org/mumbai-india-circular-economy/

[22] Padmaja, J. (2023, November 20). *Sanitary napkins, booze bottles, meat, fish bones clog sewers*. The Times of India. https://timesofindia.indiatimes.com/city/chennai/sanitary-napkins-booze-bottles-meat-fish-bones-clog-sewers/articleshow/105341312.cms

[23] Ray, S. (2024, may 16). *Plastic waste chokes sewer lines, pumping stations ahead of rains*. The Times of India. https://timesofindia.indiatimes.com/city/kolkata/plastic-waste-chokes-sewer-lines-pumping-stations-ahead-of-rains/articleshow/110159985.cms

[24] Sharma, S. (2021, October 21). *Water graves: Over 1,500 Indians lost lives to floods every year in last decade*. India Today. https://www.indiatoday.in/diu/story/water-graves-over-1-500-indians-lost-lives-floods-every-year-last-decade-1867634-2021-10-21

[25] Mitra, A. (2023, July 18). *Monsoon disruptions: Delhi, north India floods cause estimated economic loss worth ₹10000-15000 crore*. Mint. https://www.livemint.com/news/india/delhi-north-india-floods-cause-estimated-economic-loss-worth-rs-10000-15000-crore-11689597686835.html

[26] Kumari, S. (2024, September 2). *Monsoon-related incidents lead to 28+ deaths in Delhi over 2 months*. Millennium Post. https://www.millenniumpost.in/delhi/monsoon-related-incidents-lead-to-28-deaths-in-delhi-over-2-months-577997#:~:text=New%20Delhi%3A%20Since%20the%20onset,over%20the%20past%20two%20months.

[27] Aiyar S. (2024, December 10). *Flooded cities: Urban India drowns in political apathy*. The New Indian Express. https://www.newindianexpress.com/opinions/2024/Jul/27/flooded-cities-urban-india-drownsin-political-apathy

[28] Singh, D. (2018, August 8). *Mumbai: the "rain ready" city that floods every year*. PreventionWeb. https://www.preventionweb.net/news/mumbai-rain-ready-city-floods-every-year

[29] Hagare, D. (2024, June 20). *Climate Change May Worsen Flooding in Mumbai and Chennai*. The Diplomat. https://thediplomat.com/2024/06/climate-change-may-worsen-flooding-in-mumbai-and-chennai/#:~:text=Although%20the%20metropolis%20has%20been,2017%2C%202019%2C%20and%202023.

[30] Somasekhar, M. (2020, November 2). *Hyderabad floods highlight the need for a disaster mitigation and climate resilience plan*. Mongabay. https://india.mongabay.com/2020/11/hyderabad-floods-highlight-the-need-for-a-disaster-mitigation-and-climate-resilience-plan/

[31] Bandyopadhyay, C., Bindal, M. K., & Manna, M. (2021). *Chennai floods 2015*. National Institute of Disaster Management (NIDM), Ministry of Home Affairs. (https://nidm.gov.in/PDF/pubs/ChennailFlood_NIDM2021.pdf)

[32] Jaiswal, U. (2022, July 4). *Assam: Three more held for damaging Silchar dyke*. The Telegraph. https://www.telegraphindia.com/north-east/assam-three-more-held-for-damaging-silchar-dyke/cid/1872982

[33] Ali, H., Modi, P., & Mishra, V. (2019). Increased flood risk in Indian sub-continent under the warming climate. *Weather and Climate Extremes*, 25, 100212. https://doi.org/10.1016/j.wace.2019.100212

[34] Anuthaman, S. N., Ramasamy, S., Ramasubbu, B., & Lakshminarayanan, B. (2023). Modelling and forecasting of urban flood under changing climate and land use land cover. *Journal of Water and Climate Change*, 14, 4314–4335. https://doi.org/10.2166/wcc.2023.164

[35] Ward, P.J., Winsemius, H. C., Kuzma, S., Bierkens, M. F. P., Bouwman, A., & et al. (2020, April 23). *Aqueduct Floods Methodology*. World Resources Institute. https://www.wri.org/research/aqueduct-floods-methodology

[36] Chachra, S., & Panwar, T. S. (2023, September 4). *Our cities need to adapt to prevent urban flooding*. ActionAid Association (India). https://www.actionaidindia.org/our-cities-need-to-adapt-to-prevent-urban-flooding/#:~:text=Sustainable%20Urban%20Planning&text=This%20includes%20preserving%20natural%20water,engagement%20with%20the%20water%20contours