



## Urban Flooding: A Looming Threat

This editorial is based on "[Mitigating risks, impact of flooding in the cities](#)" which was published in Hindustan Times on 07/05/2024. The article highlights the pressing issue of urban flooding in India, exacerbated by climate change and poor urban planning. It emphasizes the need for proactive, risk-informed flood management to safeguard cities from increasing flood threats.

**For Prelims:** [Urban flooding](#), [Extreme weather events](#), [Eco-sensitive zones](#), [Climate change](#), [Malaria](#), [Leptospirosis](#), [Post-Traumatic Stress Disorder](#), [Jal Shakti Abhiyan \(JSA\)](#), [Amrit Sarovar Mission](#), [Atal Bhujal Yojana](#), [Atal Mission for Rejuvenation and Urban Transformation \(AMRUT\) 2.0](#)

**For Mains:** Factors Behind Increased Urban Flooding in India, Major Impacts of Urban Flooding.

[Urban flooding](#) has become a pressing issue in India, with many states experiencing heavy rainfall and flooding that exceeds normal averages by over **20% this monsoon season**. This increase in extreme weather events is primarily attributed to the climate crisis, with over **64% of Indian sub-districts** witnessing more heavy rainfall days in the last decade compared to the previous 30 years. However, human activities exacerbate the problem through **poor land-use policies**, **inadequate [solid waste management](#)**, and **insufficient stormwater drainage systems**, all of which contribute to increased water runoff and waterlogging in urban areas.

To address this growing challenge, Indian cities must shift from **reactive measures to proactive flood risk management**. This involves regularly reassessing rainfall patterns and updating stormwater infrastructure accordingly, identifying **flood "hotspots"** through comprehensive risk assessments, and implementing a range of short, medium, and long-term interventions. By adopting a year-round, risk-informed approach to water planning, Indian cities can better protect lives, livelihoods, and urban infrastructure from the increasing threat of floods.

### What is Urban Flooding?

- Urban flooding refers to the **inundation of land or property in densely populated areas** due to **heavy rainfall, overflowing rivers, poor drainage systems**, or other water-related incidents.
- Unlike traditional floods that occur in rural or natural settings, urban flooding is exacerbated by the impervious surfaces in cities (**such as roads, pavements, and buildings**) which prevent water from being absorbed into the ground.
  - It leads to [waterlogging](#), **disrupting transportation, damaging infrastructure**, and posing health hazards to urban populations.

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# URBAN FLOODING

## MEANING

- Flooding of land/property in a built environment, particularly in cities
- Caused not just by higher precipitation but also **unplanned urbanisation**

## CAUSES OF EXACERBATION

- **Encroachments** on drainage channels (lakes, wetlands, riverbeds)
- **Climate change** (increased frequency of short duration heavy rainfall)
- Uninformed **release of water from dams** (e.g. Chennai Floods 2015)
- **Mining** activities (depletes natural riverbed and water retention capacity)
- Urban heat island effect
- **Storm surges** affecting coastal cities/ towns

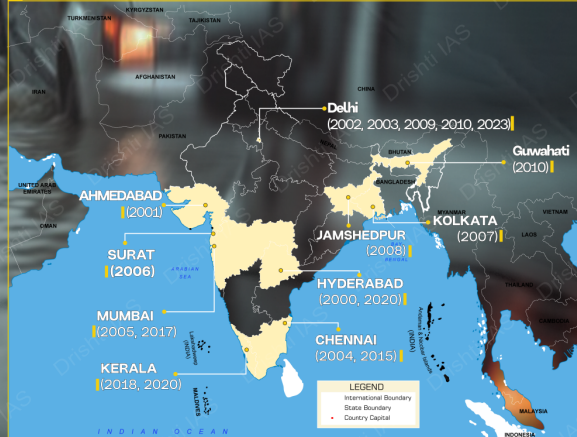
## IMPACTS

- Loss of life and property
- Spread of diseases
- Disruptions in supply of power & water and communication
- Ecological impacts

## SUGGESTIONS TO MITIGATE

- Creating a unified **flood control implementing agency**
- **Blue-Green Infra** for urban and climatic challenges
  - Blue - Water bodies such as rivers and tanks
  - Green - Trees, Parks, and Gardens
- Mapping of Flood Vulnerability
- Construction of **flood walls, raised platforms** along basins

## Some of the Most Notable Urban Floods in India



## Why are Indian Urban Cities Increasing Prone to Flooding?

- **The Impermeable Menace:** Rapid urbanization has led to extensive **concretization of Indian cities**, replacing natural permeable surfaces with impervious ones.
  - This drastic **reduction in water absorption capacity** overwhelms drainage systems during heavy rainfall.
  - For instance, Mumbai saw a **99.9% increase in built-up area** in the last 27 years. The result is **amplified surface runoff**, with some areas experiencing up to **30 times more runoff compared to natural landscapes**, significantly increasing flood risk.
- **Drain Pain:** Many Indian cities rely on **drainage systems** designed decades ago, ill-equipped to handle current population densities and rainfall intensities.
  - These outdated systems frequently become clogged with debris and waste, further reducing their capacity.
  - Delhi has retained the **same archaic structure for 42 years**, even as the population has increased four-fold.
    - The last drainage master plan for Delhi was created in 1976, leading to frequent flooding.
- **Extreme Weather Events on the Rise:** Climate change is intensifying rainfall patterns, with **more frequent and severe extreme weather events**.
  - Indian cities are experiencing unprecedented downpours that overwhelm existing infrastructure.
  - Chennai, for example, received **1,218.6mm of rainfall in November 2015**, the highest in over a century, causing catastrophic flooding.
  - Widespread extreme rain events across central India have **tripled since 1950**.
  - This trend is expected to continue, with projections indicating a **20-40% increase in monsoon rainfall intensity by the end of the century**.

- **Loss of Natural Water Bodies:** Urbanization has led to the **encroachment and destruction of natural water bodies** that once acted as flood buffers.
  - **Lakes, ponds, and wetlands** are being filled in for construction, eliminating crucial water storage and infiltration areas.
  - Bengaluru, once known for its numerous lakes, has **lost 79% of its water bodies**, reducing its flood resilience.
- **Unplanned Development in Ecologically Sensitive Areas:** Uncontrolled construction **on hillsides and in [eco-sensitive zones](#)** has increased landslide risks and altered natural water flow patterns.
  - Cities like **Dehradun and Shimla** have seen rapid expansion into surrounding hills, disrupting natural drainage systems.
  - The 2013 Kedarnath floods, exacerbated by unplanned development, resulted in massive destruction, highlighting the dangers of such encroachment.
    - Over 300 multi-storey buildings, hotels, and businesses, **illegally built on ecologically-sensitive areas near the Ganga and its tributaries**, were swept away or severely damaged by flash floods.
- **Solid Waste Spillover- Choking the Urban Arteries:** Inadequate solid waste management in Indian cities leads to **clogged drains and reduced water flow capacity**. With rapid urbanization, **waste generation has skyrocketed**, overwhelming existing disposal systems.
  - India generates over **1.5 lakh tonnes** of municipal solid waste (MSW) per day, but only 83% of waste is collected and less than 30% is treated, illustrating the magnitude of the problem.
- **Coastal Conundrum:** Many of India's major cities, such as **Mumbai, Chennai, and Kolkata**, are situated along the coast, making them vulnerable to both sea level rise and land subsidence.
  - [Climate change-induced sea level rise](#) is exacerbating flood risks in these areas.
  - In February 2021, McKinsey India had said in a report that by 2050, Mumbai will witness a 25% increase in the intensity of flash floods accompanied by a half-meter rise in the sea-level.

## What are the Major Impacts of Urban Flooding?

- **Financial Devastation in Urban Centers:** Urban flooding inflicts severe economic damage, disrupting businesses, destroying infrastructure, and causing long-term financial setbacks.
  - The 2005 Mumbai floods resulted in estimated economic losses of USD 2 billion, while the 2015 Chennai floods caused damages worth **USD 3 billion**.
  - Beyond immediate losses, urban floods can lead to **reduced foreign investment and tourism**.
  - The World Bank estimates that by 2050, flood damage in urban areas could cost **USD 1 trillion** annually worldwide if no preventive actions are taken.
- **Public Health Crisis:** Floodwaters in urban areas often mix with sewage and industrial waste, creating a **breeding ground for waterborne diseases**.
  - In the aftermath of the 2019 Patna floods, there was a **huge outbreak of [malaria](#) and [diarrhorria](#) in almost all villages of Patna**.
  - The 2005 Mumbai floods led to a **[leptospirosis](#) outbreak**.
  - The long-term health impacts can be severe, with studies showing a 50% increase in the **risk of gastrointestinal illnesses** in children exposed to urban floodwaters.
- **Urban Mobility Paralysis:** Urban floods bring cities to a standstill, **crippling transportation networks** and causing massive economic losses due to reduced productivity.
  - During the 2022 Bengaluru floods, IT companies reported losses of **₹225 crore per day** due to employees being unable to reach work.
- **Disproportionate Impact on Urban Poor:** Urban floods disproportionately affect slum dwellers and low-income communities, exacerbating existing socio-economic inequalities.
  - In Mumbai, about **41-42% of the population lives in slums**, many of which are located in low-lying areas or along flood-prone creeks.
    - During the 2005 floods, these areas were among the worst affected.
  - The long-term impacts on these communities include **increased debt, reduced access to education, and perpetuation of the poverty cycle**.
- **Psychological Toll of Recurring Floods:** The psychological impact of urban flooding is profound and often underappreciated.



- A study found a **67% increase in mental health issues** among urban residents in flood-affected areas.
- [Post-Traumatic Stress Disorder \(PTSD\)](#) rates in flood-affected urban populations can be as high as 30-40%, persisting for years after the event.
- This psychological toll has broader societal impacts, affecting productivity, social cohesion, and overall quality of life in urban areas.
- **Cultural Heritage Havoc:** Urban flooding poses a significant threat to cultural heritage sites, many of which are integral to a city's identity and tourism economy.
- The 2019 floods in Hampi, a UNESCO World Heritage Site and popular urban tourist destination, caused massive damage.
- Beyond physical damage, the loss or degradation of cultural sites can have long-lasting impacts on urban identity and tourism.

## What are the Government Initiatives Related to Urban Flooding?

- [Jal Shakti Abhiyan \(JSA\)](#)
- [Amrit Sarovar Mission](#)
- [Atal Bhujal Yojana](#)
- [Atal Mission for Rejuvenation and Urban Transformation \(AMRUT\) 2.0](#)

## What Measures can be Adopted to Enhance the Flood Resilience of Indian Cities?

- **Sponge City Revolution:** Implementing the "**Sponge City**" concept can significantly enhance urban flood resilience by mimicking natural water cycles.
  - This approach involves creating permeable surfaces, rain gardens, and bioswales to absorb and filter rainwater.
  - China's Sponge City program has shown promising results, with pilot cities **retaining 70-90% of average annual rain water**.
  - Implementing sponge city principles across **30% of urban areas could reduce peak runoff by up to 50%**, significantly mitigating flood risks. This approach not only manages floods but also recharges groundwater and improves urban biodiversity.
- **Smart Stormwater Systems:** Integrating Internet of Things (IoT) technology into stormwater management can revolutionize flood prediction and response.
  - **Smart sensors** in drainage systems can provide real-time data on water levels and flow rates, enabling proactive flood management.
  - **Singapore's Smart Water Assessment Network (SWAN)** uses sensors to monitor water quality and flooding, reducing flood-prone areas.
  - Implementing similar systems across major Indian cities could improve flood prediction accuracy and reduce flood damage costs.
- **Urban Wetland Revival:** Restoring and protecting urban wetlands can significantly enhance a city's capacity to absorb excess water during heavy rainfall.
  - Wetlands act as natural sponges, absorbing up to 1 million gallons of water per acre.
  - **Kolkata's East Kolkata Wetlands**, naturally **treat 750 million liters of wastewater daily** and provide flood protection.
  - Implementing comprehensive wetland restoration programs in the top 10 flood-prone Indian cities could provide flood protection for millions of urban residents and save crores annually in flood damages.
- **Skyscrapers as Green Flood Barriers:** Incorporating vertical forests into urban architecture can significantly reduce stormwater runoff while improving air quality and biodiversity.
  - These green buildings can absorb up to **70% of rainwater that falls on them**, reducing pressure on drainage systems.
  - Milan's Bosco Verticale, with 800-900 trees on two residential towers, absorbs **tons of CO2 annually and significantly reduces runoff**.
- **Flood-Resilient Architecture:** Adopting flood-resilient architectural principles can transform urban areas from flood victims to flood adapters.

- This includes **elevated structures, amphibious buildings, and water-permeable designs.**
- The **FLOAT House in New Orleans** showcases how architecture can adapt to flood risks.
- Implementing these principles in new constructions in flood-prone urban areas could protect millions of households from flood damage annually, saving billions in reconstruction costs.
- **Community-Led Micro-Interventions:** Engaging communities in micro-level flood management can significantly enhance urban flood resilience.
  - This approach involves training local groups to implement small-scale interventions like **rainwater harvesting and permeable pavements.**
  - For instance, to address flooding issues, **Rotterdam has designed multifunctional public spaces called “water squares.”**
    - These spaces collect and store excess rainwater during heavy downpours, mitigating flood risks while providing recreational areas for residents.
  - The success story of **Nagdarwadi, Maharashtra,** showcases the potential of this approach. This small village transformed from water-scarce to water-sufficient through comprehensive rainwater harvesting

## Conclusion

Urban flooding in India, **driven by rapid urbanization and climate change,** causes significant economic, health, and infrastructure damage. Effective measures include adopting "**Sponge City**" **concepts,** integrating smart stormwater systems, reviving urban wetlands, and implementing flood-resilient architecture. Community-led initiatives can further enhance resilience and protect urban areas.

### **Drishti Mains Question:**

Urban flooding has become a recurring problem in Indian cities due to rapid urbanization and climate change. Discuss the key factors contributing to urban flooding and suggest measures for effective flood management.

## UPSC Civil Services Examination, Previous Years Questions (PYQs)

### **Mains:**

**Q.** The interlinking of rivers can provide viable solutions to the multi-dimensional inter-related problems of droughts, floods, and interrupted navigation. Critically examine. **(2020)**

**Q.** Account for the huge flooding of million cities in India including the smart ones like Hyderabad and Pune. Suggest lasting remedial measures. **(2020)**