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
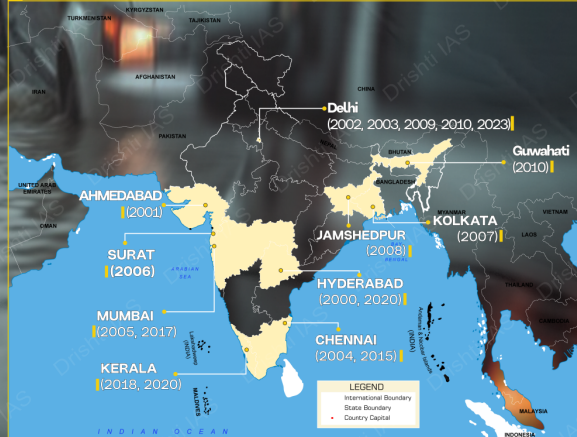- **Storm surges** affecting coastal cities/ towns

IMPACTS

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

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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

- Delhi (2002, 2003, 2009, 2010, 2023)
- Guwahati (2010)
- AHMEDABAD (2001)
- KOLKATA (2007)
- JAMSHEDPUR (2008)
- SURAT (2006)
- HYDERABAD (2000, 2020)
- MUMBAI (2005, 2017)
- CHENNAI (2004, 2015)
- KERALA (2018, 2020)

LEGEND
International Boundary
State Boundary
Country Capital

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, si**gnificantly 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, a**re 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** diarhorria **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%, s**ignificantly 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:***
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> 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)**

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