International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

Urban Floods-A Brief on Causes & Mitigation Management Strategies

Ar. Prasant Singh[1], Dr. Anjali S. Patil[2]

[1]Student, MUP, Madhav Institute of Technology and Science, Gwalior, (M.P.)
[2]Head of the Department, Dept. of Architecture, M.I.T.S., Gwalior, (M.P.)

Abstract - *Indian cities, where pressures are mounting on land use, are no longer able to ignore the issue of urban floods. Better planning and a disaster response plan that can minimize at least the level of devastation and loss of life. The Intergovernmental Panel on Climate Change has determined that in the future we will see more rainfall in less time and any incident that occurs in urban areas, because of their abundance, will affect a larger population. We urgently need to make our urban center flood-resistant.*

Key Words: Urban Flood, Greenfield, infiltration, Infrastructure

1.INTRODUCTION

Urban floods are caused by heavy rainwater runoff. It already has major economic and social implications. This is most likely to increase if no changes are made to the management of urban drains. Urban floods severely disrupt the daily life of the city. Roads can be closed; people cannot go to work or school. Economic damage is high but the number of casualties is usually very low, due to the flood situation. The water rose slowly in the city streets. If the city is in a flat area the flow rate is low and you can still see people driving in it.

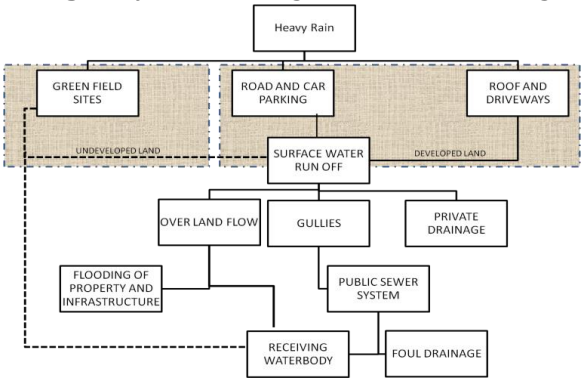
1.1 Causes of Urban Flood

Man-made causes are responsible for recurring and prolonged floods in Indian cities such as Mumbai, Chennai, Bangalore, Kolkata, Ahmedabad, Surat, Patna, Jamshedpur, Gurgaon etc.
Floods are the result of landslides, temporary effects of fresh water in the wild and local canals, pollution, flooding of streams at times during the economic downturn, rising groundwater levels to increase the flow of streams, and other problems. In many cities the sewerage network is old and its condition is unknown.
They cannot withstand the volume of water or are blocked by garbage and non-perishable plastic bags. Sewers are overflowing due to illegal connections and the sewerage system cannot cope with the rising loads.

1.2 Systematic Diagram of Urban Flooding

Urban areas are built up and it is now too late to plan and fight the floods of these facilities. These floodplains, usually under construction infrastructure (i.e., levees or dams), have been used worldwide for food production, reducing these benefits and making agricultural production and associated human settlements more vulnerable to flood damage. Knowledge of spatial and temporal flood patterns, as influenced by the combination of natural flood regimes and man-made controls, is critical to maintaining the natural functioning of the flood plains.

Fig -1: Systematic Diagram of urban flooding



1.3 Need of The Study

Urban floods are very different from rural floods, as urban migration increases the risk of floods by up to 3 times, high flow leads to rapid flooding due to fast-flowing times (in just minutes), large numbers of people are affected by large-scale economic and commercial losses. Urban floods can be reduced in ways such as: maintenance of existing pipelines, provision of alternative water supply (can be underground), control of solid waste into drainage systems, provision of groundwater drainage systems providing porous pavements to allow infiltration of rainwater, etc.

Primary Losses	Loss of life & physical injury
	Damage to buildings, contents & infrastructures
	Disruptions to industrial production
	Loss of, or disruptions to utility supplies
	Loss of heritage or archaeological site
Secondary Losses	Increased stress; physical & psychological trauma
	Enhanced rate of property deterioration & decay
	Increased traffic congestion; disruption of flow of employees to work
	Contamination of water supplies; food and other shortages
	Loss of exports; Reduced national gross domestic product

Table -1: Type of losses due to urban flooding

1.4 Reasons of Urban Flooding

Some of the major hydrological effects of urban migration are:

(1) Increased demand for water, often exceeds natural resources available;

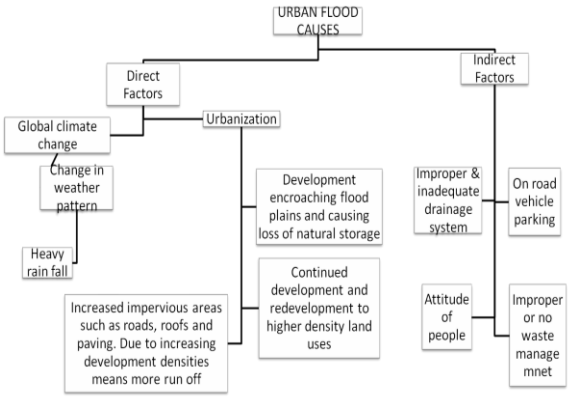
(2) Increased wastewater, overburdening rivers and lakes and endangering the environment;

(3) High flow rate rise;

(4) Decreased single entry

(5) Decreased groundwater recharge, increased groundwater consumption, and reduced flow of streams.

Fig -2: Systematic Diagram of urban flood causes



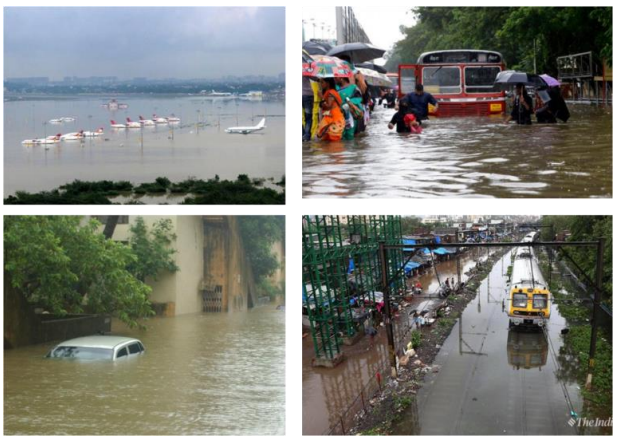
1.5 Urban Flood Risk

There is a risk of loss and can be expressed as

Risk = Hazard x Vulnerability

Flood risk depends on the magnitude of the floods such as flood depth, speed and duration. Risk factors can be defined as conditions that are determined by physical, social, economic, and environmental factors that increase social exposure to the impact of hazards.

Fig -3: Some photos of Mumbai Flood, 2005

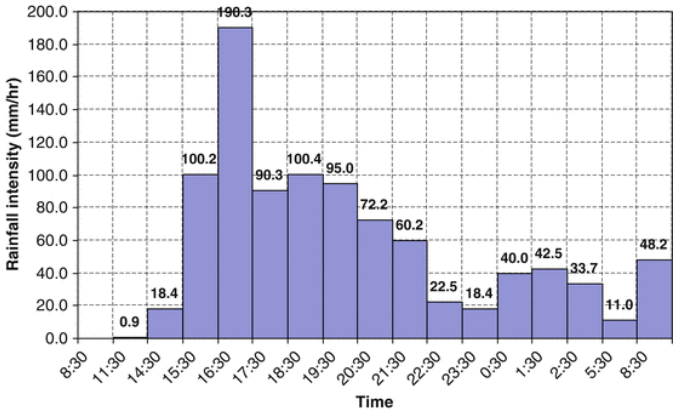


2. Case Studies

Two cities majorly facing the issues of urban flooding are Mumbai and Chennai.

2.1 Urban Floods in Mumbai, 26 July 2005

The event on 26 July 2005 was rated as 'extremely heavy' (> 200 mm / day according to IMD rainfall planning). The



heaviest rain ever recorded in India. Major urban floods were reported from ten cities and Mumbai was hit hardest. Santa Cruz Observatory at Mumbai Airport recorded 944 mm within 24 hours ending 08:30 h on 27 July 2006 while Colaba Observatory recorded only 74 mm. **Fig -4:** Figure showing Hyetograph of 26 July 2005 Rainfall- 24 H Ending 08:30 on 27 July 2005

2.2 Mumbai Floods - A view of the crisis

Mumbai - originally a group of 7 islands; most reclaimed areas are 5 mtrs above the coastal area Area-437 Sq.Km; Population 12 Million (2001); Population - 29000 per sq-km the Tree River divides the city, western and eastern cities can cause floods Rapid urban sprawl - especially toilets - has blocked water railways usually measuring 10 mtt above ground level & subways near wave level high 82 Areas of continuous flooding.

75 mm average rainy days and flood days increased from 1: 7 to 1.5: 1 in the last 60 years Available technology does not predict rain> 250 mm accurately - India Meteorological Deptt (IMD) estimates July 26 2005 – 944 mm rainfall. Rain from the clouds a few miles long could not be predicted! The sea level rises by 3 mm every year.

2.3 Mumbai Floods – Responsible Reasons

The milli metres of rainwater per hour were extremely low when the rainfall was 994 mm. Heavy rain and high waves were the same that day because the 103 gates to connect the pipes open directly into the sea were flooded. The situation became even worse because the water was so dirty and full of debris, that choked rainwater and accumulated on the surfaces. The situation was dire because a warning of heavy rain and high waves was not

issued at the time of radio and television stations by public institutions.

The Meteorological Department did not have sensitive weather radars that could issue a warning within three hours. The massive intrusion into the mouths of large drains and the severe deviation and siege of Trees and other rivers served as a barrier to rainwater flowing into the river.

The progress made by the MMRDA (Mumbai Metropolitan Region Development Authority) without proper environmental authorization increases the pressure on the already drained water system and creates an old and unsuitable water system. Bandra Kurla complex built by replacing wetlands; The Indian State Department of Environmental Affairs was notified of the potential disaster and urged them not to allow it but no timely action was taken.

2.4 Mumbai Floods – Damage and losses

Agriculture: Approximately 13.5 lakh acres of land had suffered crop losses.

Loss of life: Estimated Above 1000 people died in the 2005 floods.

Cattle Losses: The total loss of cattle in the floods is 15,321.

Housing: People had lost most of their homes. Damaged District Houses are valued at Rs 21 crore in Mumbai.
Infrastructure and Public Utilities: In the education sector, more than 20,000 classrooms were damaged, and 97 school buildings had collapsed. About 437 primary health care facilities, rural hospitals and health workers' residences were flooded. The Department of Public Works has estimated that it will need Rs. 1,200 crore for road and bridge repairs were damaged by floods.

Trade and Commerce: Many stores, malls and warehouses have suffered severe losses as a result of the floods. The Indian Merchants Chamber has reported this loss to Rs. 5,000 crores.

Financial: Preliminary indications show that the floods caused direct losses estimated at Rs. 450 crores per day.

2.5 Chennai's Urban Flood, Nov-Dec 2015

Chennai is situated in the southern part of the east coast of India. It is the capital of Tamilnadu with a population of 8.2 million. The City is illuminated by those 2 rivers in addition to the many large and small water distribution channels through the Buckingham Canal to Sea.

The city also has more than 50 temple tanks in addition to the natural water bodies to capture the flood waters and act as a regenerating groundwater. Chennai also has the Pallikaranai wetlands, the Madhavaram and Manali prisons, the Adyar & Coum Estuaries as wetlands other than natural and man-made water bodies.

2.6 Chennai's Urban Flood, Nov-Dec 2015 – Responsible Reasons

- Total rainfall in Kennai was 119.73 cm until November 30, midnight (2015) broke the 1918 record of 108.8 cm which stood as the highest record. Chennai had received 539mm of rain in December in defiance of the monthly average of 191mm. Rainfall in December was nearly three times that of normal rainfall for that month.

- Due to the mountain plateau Chennai lacks a natural free start gradient. The Chennai sewerage system was originally designed for 0.65 million people with 114 liters per person per day of water supply; it was redesigned in 1989-1991, but it was far below the required capacity.

- According to a report from the Chennai Metro Development Authority, there are more than 1.5 lakh illegal structures responsible for the disappearance of more than 300 bodies of water.

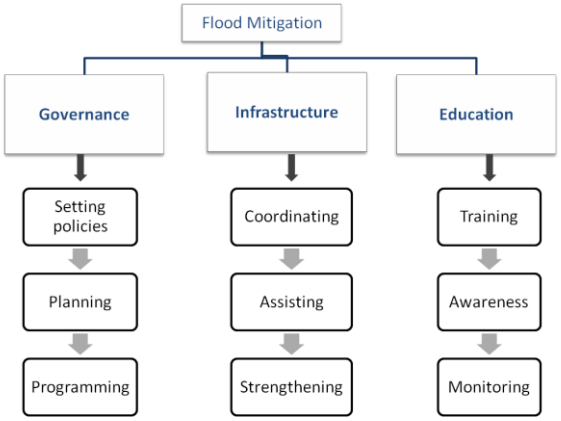
2.7 Chennai's Urban Flood ,Nov-Dec 2015 – Damages and losses

Losses accumulate from rupees of 50,000 crores to 100,000 crores. The loss of the automotive sector alone is estimated at between 8,000 million. Many people have died in the cuddalore area. In the saidapet area, 2,000 huts had been submerged. 540 people died on 10 dec during the event. 400 people were killed and 18 lakhs left their homes. Several urban train services were disabled. Several flights were canceled and many were diverted since the road was flooded.

3. URBAN FLOOD MITIGATION MANAGEMENT STRATEGY

3.1 Non-structural strategies of urban flood mitigation

Fig -5: Strategies for flood migration



3.2 Non-conventional structural aspects of integrated flood mitigation

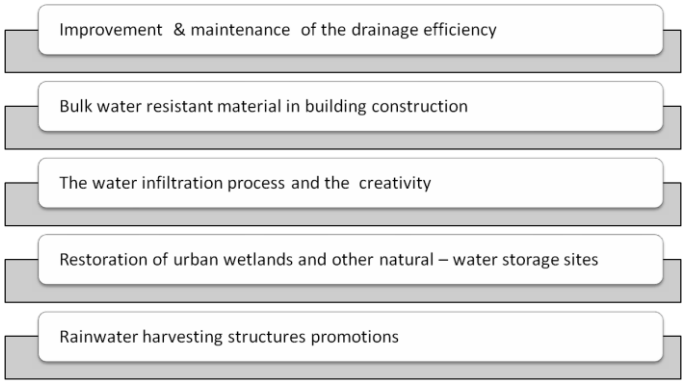


Fig -7: Strategies for flood migration

3.3 Scope of master Planning

Problem documentation; investigation of the causes of the problems; requirements determination and planning process. Problem inventory; assessment of possible solutions; setting flood-based social, economic and environmental factors. Collection of all basic information and identification of basic conditions, including political, environmental, hydraulic and environmental issues based on formal discussions and site visits. Analysis work that includes hydrologic, hydraulic and water quality analysis. Benefit / cost assessments and comparisons of alternative solutions, including benefit rating, damage assessment, cost of traffuc disruption, environmental and social factors; other assessment methods most relevant to urban conditions. Adoption of other programs; acceptance of emergency plans.

Strategic actions and possible implementation mechanism

Table -2: Type of losses due to urban flooding

Proposed action	How	Possible Implementation Mechanism
IMPLEMENTATION MECHANISMS Integrated catchment based management and planning to improve catchment land use and drainage conditions .	Developing Catchment and Storm water Management Plans to integrate all storm water issues on catchment levels including: Water quality, flooding, waterways, assets management and funding, planning and development control, and other environmental and social issues.	Catchment and Storm water Management Plans should be developed for each major catchment.
Enforce best practice guidelines as conditions to issuing permits for new or reconfiguration of developments	This should include guidelines for: Erosion and sediment controls •Restrictions on filling in the floodplain and obstruction to flow •	Accountability of the agency to ensure implementation of best practice information.
Storm water management solutions to the overall urban water cycle and water conservation strategy	Rehabilitate and maximize the use the remaining water bodies to reduce flooding through retardations and to maximize infiltration to groundwater by retaining floodwaters in these basins	To develop and promote best practice design manual for urban developments and implement these options in the development of the flood mitigation strategy.
Integrated Municipal Solid Waste Management	Adoption of an appropriate strategy is essential for any improvement in the storm water quality and quantity.	Implementation to conform MSW Rule, 2000

Proposed action	How	Possible Implementation Mechanism
Minimize flooding	•Identify educational institutions to undertake at regular interval drainage and flood studies for the city to: •Identify existing drainage system and flood prone areas. •Control new developments, which may impact on flooding	Flood mitigation options and strategy will need to be coordinated and endorsed by a number of other authorities to cover issues such as land resumption, planning, changes in sewerage system.
Minimize sewage inflow to storm water	Separation/ relocation of the sewerage system from storm water system • Implement the Sewerage Master Plan including treatment plant upgrade. • Enforce/develop planning laws on illegal connections. • Develop and upgrade guidelines on sewer construction and maintenance	To identify the preferred option to separate the two systems. It is may be cost effective to incorporate this option investigation study into the BMP current drainage study.
Community education programs to improve understanding of the important of clean drainage and waterways.	•Raising community awareness and understanding of the risk of flooding, the importance of clean waterways and its role of supporting the community well being, health and the overall life style in the City of Bangalore with numerous successes around the world. • Education through mass media • CBD and NGO's to develop and implement catchment management plan.	•Schools and colleges •NGO's and CBO's •BMP

4. FINDING AND RECOMMENDATION

Both humans Both humans and nature put an end to the floodwaters. An urgent need to build a water science list and define flood areas within the city. The flood zone will have to be
identified based on the location of water bodies, natural pipes, spill area and should be constructed as a non-existent construction site. More campaigns should be conducted at the local level to raise awareness of the causes of flood disasters. In addition to the above, comprehensive management measures will help Chennai recover from recurring floods. The integrated approach, therefore, requires the integration of water and land use

and development planning, engineering measures, flood preparedness, and emergency management in the affected areas, while taking into account the socio-economic needs of communities in both mountainous areas, and flood-prone areas.

5. CONCLUSIONS

Indian cities, where pressures are rising in Landuse, are no longer able to ignore the issue of urban flooding. Better planning and a disaster response plan that can minimize will at least reduce the level of devastation and loss of life. The Intergovernmental Panel on Climate Change has found that in the future we will see heavy rainfall over a short period of time and in any event.
urban areas, because of their abundance, will affect a large number of people. we urgently need to make our urban center resilient to floods and support its master plans for hydrological studies.

REFERENCES

[1] D Census of India (2001b) Migration Data for Urban Agglomerations in Karnataka - D-series, Directorate of Census Operations, Government of India, New Delhi.

[2] Ramachandra T. V. and Pradeep P. Mujumdar, 2009, Urban Floods: Case Study of Bangalore, Journal of the National Institute of Disaster Management, Vol. 3, No. 2, April 2009, pp. 1 – 98.

[3] Gupta, A. K. (April 2009). Urban Floods Case Studies Project: An Overview (8 Major Cities of India). Research Gate .

[4] Phatak, D. J. (2016). Management of Urban Floods. Research Gate.