

# A Review of Urban Flood Response Planning and Management In Case Of Hyderabad City

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## ABSTRACT:

Climate change imposes greater challenge in increasing global climatic and rainfall behavior and on the other hand urbanization possess challenge to the dwellers in flood risk. Increase of impervious areas and reduction in lung spaces in a city lead to excess runoff allowing storm water flow into drainage systems and rivers at increased velocities. Flood management practices reduce risk and vulnerability and planning measures help cities to respond external environment changes with land use changes and make cities resilient to any disasters. The city of Hyderabad had experienced flooding in the urban areas in the year of 1908,2000,2001,2002,2006 and 2008. City is at a high altitude of 542meters above the main sea level with a area of 260 square kilometers. High intensity rainfall at less interval of time results in floods due to deficiency in drainage carrying capacity with improper storm water management and solid waste management. The paper discusses literature study on flood responsive planning with GIS and Remote Sensing and flood management techniques with thoughtful handling in urban floods and investigating the role of government along with people's participation.

**Keywords:** Climate change, urban floods, GIS, Remote sensing, Management

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## I. INTRODUCTION

The contemporary world is facing the change in socio economic and environmental challenges due to global climatic change. The greed for human activities depleted the natural resources and are prone to extinction and inattention. Urbanization can be measured as such unstoppable action that leaves pressure on nonrenewable source Land. Multiple sources of development, change through time and deviations in geography and structure of the city with the intrusion of green spaces, shrinking and depleting water resources, encroachments around water bodies are evident in any urban scenario. The adverse climatic fluctuations experienced due to concentration of infrastructure and resources, which needs to be addressed by the urban planners and urban dwellers of mega cities and fringe areas. Many cities have experienced the costal floods, urban floods and the villages are not exceptional. According to United Nations the percentage of world population expected to live in urban area by 2050 is 68 percent and as on 2018 the population is 55 percent residing in urban areas.

## II. URBANIZATION IN INDIA

### A. *Mega cities of India*

According to Ministry of Housing and Urban Affairs the percentage of urban had increased at 3.5 the country during 2001-2011. In 2001 there were about 286 million people residing in country and the projected urban population is 433 million by 2021. According to United Nations – World Cities in 2018 , Delhi and Mumbai are the two mega cities with 20 million plus population and had 200 migrants everyday come to these cities for livelihood and followed by Bengaluru, Chennai and Hyderabad with high growth rate and between 2018 to 2030 nine of the 10 cities will become mega cities and are located in developing countries like India.

### B. *Natural or Man Made Disasters*

Out of the 1,146 cities with at least 500,000 inhabitants in 2018, 679 (59 per cent) were at high risk of exposure to at least one of six types of natural disaster, namely cyclones, floods, droughts, earthquakes, landslides and volcanic eruptions. The manmade disasters like urban floods are the looming threat are posing numerous challenges in cities like Bengaluru, Chennai Delhi, Hyderabad and Mumbai and are recurrently under threat. The manmade

disasters witnessed in these in metropolitan cities is alarming from the year 2000 in the other cities like Ahmedabad, Guwahati, Jamshedpur, Srinagar and Surat which illustrates the impact on land and waterbodies. The heavy rainfall in short interval of time is experienced due to change in weather pattern and higher density of land use. In case of Hyderabad one of the major drawbacks is the existing drainage network that outreaches its threshold, leads to disaster and it's been continuously under risk.

### III. RESEARCH METODLOGY

The methodology adopted is to study the various literatures that offer knowledge on basics of urban flooding scenario in India. The land use and land cove changes and its impacts in aggravating the urban floods is studied through various papers. On the next step various case studies aided in solutions that were implemented in mitigation and control of floods with necessary technological advancements and software to study the variable aspects.

The scenario of Hyderabad is deuterating as the years pass by and various literatures will be discussed below will be inferred to find the most relevant solutions that are applicable to control the floods in Hyderabad city.

### IV. URBAN FLOODS

A. Urban floods can be defined as the submergence of usually dry are with large amount of water that comes from sudden excessive rainfall, an overwhelming lake, melting snow or an exceptional high tide. Urban floods are significantly different from rural flooding as urbanisation leads to the development of catchment which increases the flood peaks form 1.8 to 8 times and flood volumes by upto 6 times and flooding occurs quickly due to faster flow times, in matter of minutes . The frequent challenges that exist in a flooded area is result of high density of *population and* poor maintainece of storm water, improper planning and water bodies encroachment.

#### B. Landuse and Landcover and Lakes

- Land is the most critical asset and in the perspective of population development the land use and landcover change had turned the enthusiasm in measuring the environmental change. Change detection is mainly to observe the understanding landscape and geography and human activities on land management.

- Land use and landcover change had been classified into different time periods (1993, 2000, 2008,2013 and the classification had resulted with

analysis on four parameters water body, vegetation, open spaces, built-up area.. The results have been discussed only pertaining to the built up and vegetation and water body was not much given priority.

- Lakes are the most important part of the ecosystem and in the current Indian context the lakes in major metropolitan cities were constantly being exploited resulting in diminishing of lakes. The statistics shows Bengaluru had 262 lakes and currently were 10 only. During the year 2010-11, out of 44 waterbodies 21 were dried up due to rapid urbanization. Hyderabad once the land lakes has lost many waterbodies in the name of urbanization.

- Hyderabad is once called as city of lakes, due to urban sprawl had encroached into vacant land and waterbodies with increasing pressure on the land for housing and other activities. The city had 932 tanks in 1973 and come down to 834 in 1996 with water bodies reduced form 118 square kilometers to 110 square kilometers. About 18 water bodies of over 10-hectare size and 80 tanks below 10-hectare size were lost during the period. The population and pressure on land resulted in still more reduction of water bodies to 531 in 2012.The water bodies area have come down to 8.7 square kilometer .

#### C. Urban Flood Causes and Impacts

- Frequent floods due to musli river is caused by devastation in hyderabad since 1572 A.D. According to the historians the city had expericenced 15.32cms of rainfall on september 8 1908 and about 15,000 people were killed and 80,000 rendered homeles.

In the year 1954 the recorded rainfall was 190.5mm, the rainfall recorded in the year 1970 was 140mm. and this scenario continued in the year of 2000, 2001,2002, and 2008 with due loss of lives and property, the major events occurred year wise of heavy rainfall are given below :

**TABLE -1 LOSS OF PROPOERTY AND OTHER LOSSES**

S.No	Parameter	1908 February	2000 August	2008 August
1	Rainfall	430mm	240.5mm	220.7mm
2	Property Loss/Worth	80,000 Homes	35,693 Homes, 135 Lakhs	49.2 Lakhs
3	Human Lives Lost	1500	26	NIL
4	Population Effected	6,00,000	2,00,000	1,50,000

- Urban flooding is caused by anthropogenic activities and natural events and flooding is frequent due to both human and metrological/hydrological

factors. Issues can be classified in to technical, Metrological, Planning and Policy making.

- Impacts of urban flooding include Traffic Jams, Property damage, Solid waste getting mixed in flood water, Vector and water born diseases, mixing of fecal matter in flood water due to open defecation .

#### D. Urban Flood Mapping

- Cities like Holland and Netherlands get flooded frequently due to climate change and short peak rainfall intensity may exceed the storm water drainage capacity. The method adopted is Digital elevation model maps to support the GIS data which helps the stake holders to a clear insight of ground water flow and storage for urban management.

- Cardiff, wales had notable historical floods form the year of 1946 to 2000. ArcMap and HEC-RAS (Hydrologic Engineering Center- River Analysis System) 4.1 have been used to perform flood inundation mapping and analysis. The primary data collected from Digital Terrain Model (DTM) and flood plain mapping is identified in aerial images and analysis was done by pre-processing of data and Hydraulic modelling.

- Surat city had a history of flood event since 1883 to till 2006 and data for the study had been taken with in the same time period. The data collected from Geo-coded Indian Remote sensing, toposheet form survey of India, google earth images, and contour maps for various zones. The data had been integrated with TIN modelling and 3D Analyst and Flood hazard had been integrated with DEM and delineation of areas under various degree of flood potential were worked out .

- In a country like India, flood plains are encroached by dwellers with high population concentration in small areas. Greater Hyderabad Municipal Corporation Zone XII of Hyderabad is chosen for flood mapping due to its complexity of existing drainage network. A coupled 1D and 2D flood modelling approach was used to identify the flood prone areas and develop flood inundation and flood risk maps and 1D modeling for pilot area is developed using Storm Water Management Model and coupled with 2D Personal Computer Storm Water Management Model (PCSWMM). Data driven is georeferenced and analyzed the inundation risk areas.

- Extreme rainfall in short time interval can cause devastation in Hyderabad city. Flood level simulation along the Musi river of Hyderabad is studied to make the city flood resilient with geospatial technological tools and hydrological models. These tools are useful for decision support systems, Flood risk zonation map for preparedness and early warning systems, mitigation and decision

making. The slums occupied along the river had been studies with elevation and area in square kilometers. The data thus analyzed concludes the number of slums that are prone to risk when the water rises to 490 meters with 250 slums likely to be submerged.

- Urban flood modelling for Hyderabad city had been analyzed by three software simulation models. The modelling approach is studied by PCSWMM (Personal Computer Strom Water Management Model) that helps in identifying the spatial decision support system for storm water management combined with 1D and 2d modelling and HEC-RAS (Hydrologic Engineering Centre- River Analysis System) Model to identify the discharge of water at time interval specified result in obtaining the Discharge Hydrograph in and HAND (Height above Nearest Drain ) Model for identification of low lying areas of Hyderabad.

- The city of municipal corporation of Hyderabad was divided into 16 storm water zones and zone 12 was Fig-1: Location of Zone -12 of Hyderabad City

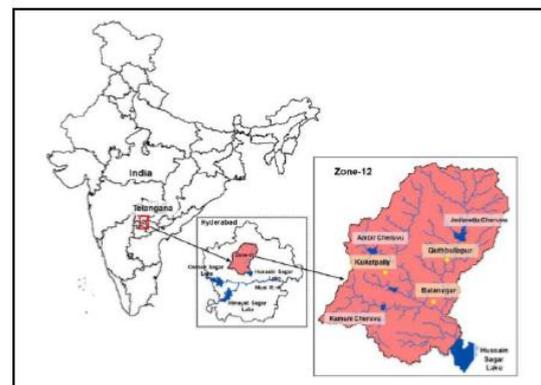


Fig-1: Location of Zone -12 of Hyderabad City

the low-lying area and most vulnerable to floods. The concretization and urbanization had led to loss of property and life. The study carried out with help of HAND (height above nearest drainage) and geospatial analysis were utilized to demarcate the effected areas . In the year of 2016 on September 20<sup>th</sup> the city had experienced heavy rains and aggravated the floods that made the city stood still for four days with loss of property and water contamination.

Rainfall runoff models HEC-HMS (Hydrological Engineers Center – Hydrological Modelling system) and HEC-RAS (Hydrological engineers Centre-River Analysis System) were used to study the frequent occurrence of floods in Hyderabad city. The 2D modelling importance in flood mapping have been discussed to project the probable flood events and tackling future flood events .

In the city of Hyderabad extreme rainfall and floods events were making the city uninhabitable especially during monsoons. The extreme rainfall with current capacity of storm water network and flood risk analysis and inundation mapping was addressed by the author. The storm water management model was used to calculate the runoff catchment with data analyzed with historic rainfall events and future climatic changes had been calculated with global climatic model. The inference made to understand the current capacity of storm water drains may experience in increase of 25-30 percent increase in runoff is estimated .

#### *E. Urban Flood Disaster Management and Guidelines*

- Human settlements have developed along the rivers for ease of navigation and trade and livelihood. Fertile lands flood plains offer a successful agriculture; however, they increased the flood risk. Cities are experiencing the flood heavy precipitation due to heavy impervious areas so that the rain flood water and waste water do not infiltrate in in to the ground, produce large run off which drainage network cannot accommodate are potentially exposed to floods.

Risk=Function (Hazard x Exposure x Vulnerability)  
Risk Management Process involves Assessment of Risk and Planning measures, Implementing Measures, Evaluate Measures and risk reassessment. The steps involve in reduction of surface run off in absolute terms are-

Reduce surface runoff by increasing infiltration and evapotranspiration; • Filter the percolating water;

- Recharge groundwater resources; Reduce air pollution and improve the urban microclimate; Can be used for recreational purposes in the form of parks and gardens. Preservation of Natural Water Bodies.

- Among natural catastrophes flood, windstorms and earthquake, a greater number of events happened from 1985 and floods are high in number and had increased by 2000. Flood Disaster Management is an end to end process recognizing and effectively combating the risk and process involves –

1. Pre-Disaster- Preventive Measure and Preparedness.
2. During the flood – Disaster relief response and mitigative actions
3. Post Disaster – economic recovery, and effort to assess and fine tune preventive measures

- National Disaster Management Guidelines of India concentrates on prevention, preparedness, mitigation, rehabilitation, reconstruction recovery, and formulates appropriate policy guidelines for natural disaster response and relief. Institutional framework had been set in National Disaster response force and state disaster response force.

Urban flood disaster risk management follows the strategies of watershed as basis for management of urban floods, Vulnerable analysis and risk assessment, estimation of possible inundation levels and flood damage estimation. .

#### **V. RESULTS AND DISCUSSION**

Urban floods are manmade disasters that needs attention by the government authorities. The cities like Holland, Netherlands and Cardiff were also facing the similar catastrophic event in the past. The methods followed by authorities like flood mapping and analysis for storage of urban water needs to well-thought-out. The Indian city Surat located in Gujarat sets as an example in understanding the flood inundation mapping and areas under threat were identified for management of loss of human life.

Hyderabad can improvise the situation by bringing awareness about the situation caused due to floods and in the public. Watershed management and lake protection act have to be strictly enforced. Urban planners also can make use of the current technology to identify the vulnerable areas and necessary measures can be taken up to control the urban flood issues. Strict policy measures for unauthorized encroachments and solid waste management and people's participation can only give better results.

#### **VI. CONCLUSION**

Urban floods have become most frequent around the world. The developing countries should critical analysis the causes, impacts and measure to mitigate the disaster. The uncontrolled urbanization impact in the name of development especially in the metropolitan cities made the urban dwellers life miserable. The paper had tried to collate the level of urbanization in world and in focus to major metropolitan cities in India especially in city of Hyderabad.

- The guidelines suggested by World Metrological Department, United Nations and National Disaster management were about Pre - Disaster, During and after disaster. The preparedness should be more appropriate to the current situations and expert on various software-based analyzers should be made utilized in creating the storm water management plan for entire city and had to be implemented with help of urban planners.

- The study pertain to the urban flood mapping throws a light to the stakeholders to work intricately towards the resilience by studying the examples of various flood effected cities and their systematic analysis through GIS, Remote Sensing, PCSWMM, HECRAS, HAND model based softwares to

conservation of water bodies for future and invigilate the unauthorized constructions around the lakes.

- Risk Reduction Mapping should be made mandatory with available technology and land use and landcover maps have to be updated for future use and analysis for risk assessment.
- The Municipal authorities of Hyderabad and governing bodies should rework on the policy making in rainwater harvesting solutions, ground water recharge, lake conservation, lake management and improvising the water shed areas for percolation of water and pathways. Open ground parking spaces can be more pervious to cut off the surface runoff.
- People's participation is much essential in solid waste management, vacate the unauthorized areas, and relocation of the people living in slums.
- Awareness to the public on town planning laws and public opinion in master plan revision to be made mandatory for public participation.

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