

Public Lecture on “Rising Phenomenon of Urban Flooding: Causes, Consequences & Sustainable Solutions”



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Flooding in urban areas is a growing concern worldwide as it is causing significant damage to human lives, the environment and economy. The damage is more evident in India because of the growing density of population in urban areas, including in Tier-1, 2, 3 and 4 cities. Cities come to a halt from a few hours to a few days, while those living in the low-lying areas are forced to shift to makeshift shelters and come back when the water recedes to build a house that is their own till the next flood. Electrocutation deaths and spread of epidemics apart, flooding also ruin the pecuniary reserves of the underprivileged.

Urban flooding is different from coastal and riverine flooding. It has local impact, is more frequent and is caused by excessive runoff in areas where the water doesn't have anywhere to go. In recent years, there has been a change in the intensity, duration and distribution of monsoon rains causing more and more instances of urban flooding. Heavy or prolonged rainfall paralyses the urban drainage system eventually bringing the city to a standstill and in extreme conditions also causing deaths.

Recognising the need for a discourse on this growing concern, Toxics link in collaboration with India International Centre organised a Public Lecture on **“Rising Phenomenon of Urban Flooding: Causes, Consequences & Sustainable Solutions”** on September 11, 2024 at India International Centre, New Delhi.

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In the panel were Dr Mrutyunjay Mohapatra, Director General of Meteorology, India Meteorological Department; Dr Syamal Sarkar (Retired IAS), Distinguished Fellow and Director, Water Resources Division, The Energy and Resources Institute (TERI); Dr Jaideep Chatterjee, Dean, Jindal School of Art and Architecture; and Mr Manu Bhatnagar, Principal Director, Indian National Trust for Art and Cultural Heritage (INTACH). The session was moderated by Mr Ravi Agarwal, Founding Director, Toxics Link.

The lecture began with Toxics Link Founding Director Mr Ravi Agarwal, who moderated the session, introducing the topic of urban flooding as a phenomenon on the rise across India, particularly in the monsoon and still not in the disaster management map of the country. He said the rise in urban floods in the major cities like Chennai and Jaipur, compels us to rethink about urban infrastructure, planning, and water management. A polycrisis is in play and we blame poor governance, inadequate drainage systems, lack of urban planning and climate change but the fact is urban flooding is a phenomenon which is on the rise, and we need to rethink our role in governance and city building. “It needs to be addressed differently and worked upon collectively,” he said.



Ravi Agarwal moderating the session

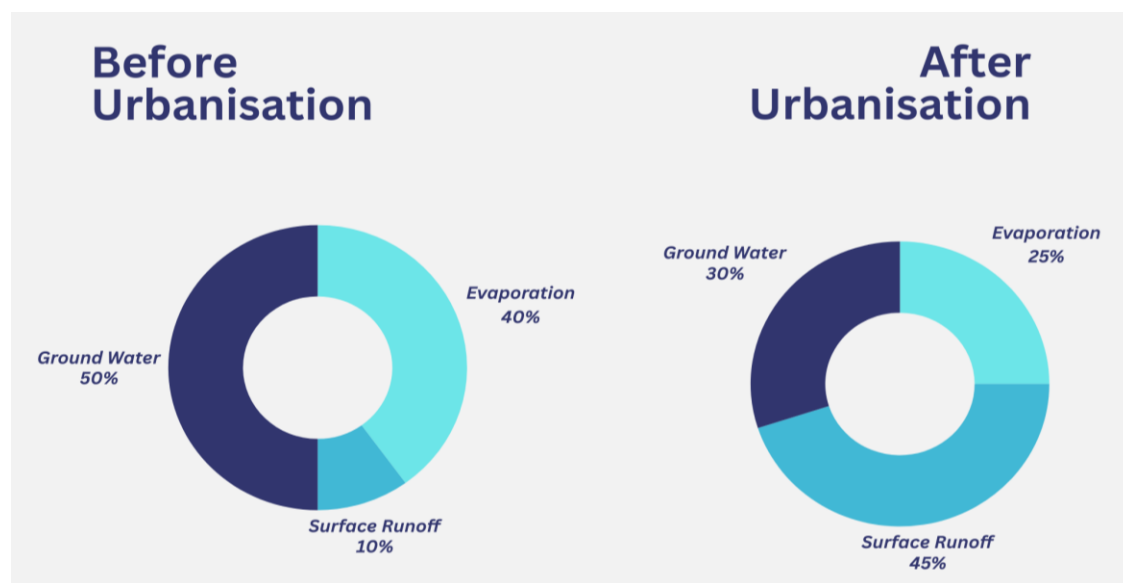
Dr Syamal Sarkar, a retired IAS and Distinguished Fellow and Director, Water Resources Division, The Energy and Resources Institute (TERI) was invited to the dais as the first speaker.



Dr Syamal Sarkar

Expressing gratitude for conducting a talk on such an important issue, Dr Sarkar said temperature globally has already increased by 1.1-degree-centigrade compared to preindustrial level and is likely to go up by 2 degrees or more if nothing is done. “Global warming resulting in climate change is causing floods and droughts. The intensity of rain and its frequency has also changed enormously. Uncertain and excessive rain is causing loss of lives, destruction of infrastructure, contamination of water resources and displacement of mass population.”

He quoted a 1986 study by Organisation for Economic Co-operation and Development (OECD) to portray the stark contrast in rainwater consumption pre- and post-urbanisation. The study said post urbanisation, there is only 25 per cent evaporation of 100 per cent precipitation which was 40 per cent earlier. Likewise, the surface runoff of 10 per cent has increased to 45 per cent while water which goes underground has come down to 30 per cent from 50 per cent. “Urban areas have asphalt and concrete surfaces which absorb solar radiation leading to increased temperature. This increased heat can result in more precipitation and higher rainfall in these regions,” he informed.



Study by OECD

Dr Sarkar spoke on untreated wastes and how cities are struggling with runoff water management, inadequate drainage systems and obstructions in drainage canals which contribute to inefficient water management and increased risk of flooding. Proper design and maintenance of drainage infrastructure are essential to mitigate these challenges, he opined and said, “In Delhi, there are two types of drainage systems: stormwater drainage and sewage drainage. Unfortunately, these systems often get mixed, causing stormwater to be contaminated with sewage water. This leads to water pollution from pollutants like insecticides, fertilizers, lead from vehicle pollution and other harmful substances like hydrocarbons, sediments and nutrients which affects groundwater.”

Dr Sarkar said water system is never included in urban planning because not much attention is paid to the subject. In Delhi, 90 per cent of water supply is converted into sewage and about 30 per cent

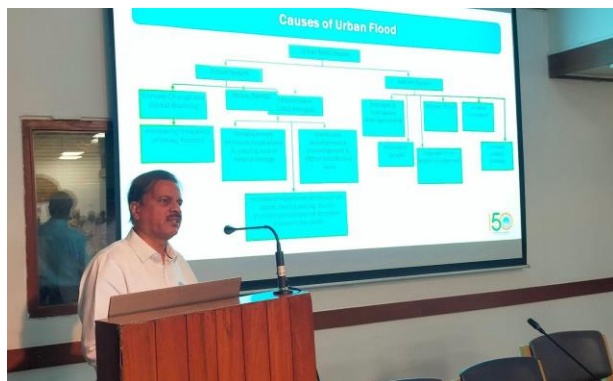
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of sewage water is not treated. He stressed on the need for an integrated approach to better urban planning and flood management. Suggesting solutions like rain gardens, absorbent roads, permeable pavements and rainwater harvesting, he gave examples of China and Singapore, countries which are effectively managing stormwater by controlling water sources and pathways. He lamented that we do not talk about floods before and after a flood and do not have the technology to map precipitation.

“Flood cannot be stopped but we can take action and minimise the consequences,” said Dr Sarkar in his concluding remarks.

The next speaker **Dr Mrutyunjay Mohapatra, Director General of Meteorology, India Meteorological Department**, discussed about the components and challenges of urban flooding. He spoke about the direct and indirect factors causing urban flooding. According to him, the direct factors are climate change and global warming, urbanisation and land cover challenges, heavy rainfall, increasing frequency of rainfall, developments encroaching floodplains and thus causing loss of natural storage. The indirect factors are improper drainage, improper waste management, attitude of people, riverine flood and improper or no waste management.



Dr Mrutyunjay Mohapatra

He said the vulnerability of a city to urban flooding depends on the amount of rainfall and the capacity of the city to hold the rainfall. The size, density, infrastructural growth, inefficient drainage system, encroachments and decrease in runoff area are among several factors that determine the capacity of the city to withstand heavy rainfall. Giving the example of recent flooding that caused deaths in Delhi, he said even a small amount of rainfall (58 mm) can cause such incidents.

Besides rising temperature and global warming causing uncertain rainfall conditions leading to floods, Dr Mohapatra said people’s lack of sensitivity and improper waste management is also a reason for rising floods. “Coastal inundation and parking of vehicles on the roads and reckless driving are the other factors,” he said.

The causes of flood differ in different areas, said Dr Mohapatra. In coastal areas, heavy rainfall and cyclones can cause flooding while in hilly regions, heavy rainfall cause landslides. Giving the example of Guwahati in 2004 when the general election in April was cancelled due to a flood, he said even a thunderstorm can cause a flood-like situation in northeastern states. Likewise, the Kedarnath disaster

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was not only due to heavy rainfall but also because of melting of ice due to high temperatures. Flooding can also be caused due to untimely release of water from dams in some areas.

Dr Mohapatra informed climate change affects urban climates, causing city centres to be three to five degrees Celsius more than the outskirts. This urban heat island effect also cause increased rainfall in the city centres, with 10-15 per cent more precipitation as compared to the outskirts. This heightened rainfall contributes to a greater risk of flooding, making it crucial to consider both urban heat and climate change impacts in flood management and urban planning.

Speaking about management of urban flooding, he said a flood model is required with early warning, disaster preparedness and prevention mitigation measures. IMD provides weather forecasts and is not mandated for flood warning which is done by Central Water Commission and city municipal corporation. Historical data from all sources--metro-physical and hydro-physical-- serve as a guide to know what had happened in the past when there was that amount of rainfall. Flood maps and flood alerts are derived from flood models and are crucial in management of floods. The flood maps are sent to emergency operation centres and if a city does not have one, it cannot act. He stressed on need for high-resolution geospatial data and urban flooding system which requires huge investment.

The IMD chief said urban flooding are more complex in hill areas. The amount of rainfall highly varies in western Himalayan region and so predictability becomes difficult. It is not influenced by rainfall but also melting of snow. In the central, eastern and western coast, the variability is less and so predictability becomes easier.

He explained that the IMD forecasts is done in four stages--nowcast which is valid for 3-6 hours, short- to medium-range forecasting valid up to seven days, extended range forecasting valid up to 1-4 weeks and seasonal range forecasting valid up to 1-4 months. "The forecast offices connect every morning at 10:30 and discuss the forecast which is then disseminated downwards to the city and district level," he informed.

Dr Mohapatra informed that since 2019, IMD has also been doing hazard and impact analysis to understand if there will be a flood-like situation or landslide and whether there would be the need to shift people from the affected area. The message is passed on to emergency operation centres. "It's a new science and IMD is leading in the region. IMD tries to reach out to each and every person so that each and every household is prepared. We inform and alert through YouTube, mass media, social media and mobile application," said Dr Mohapatra.

He ended his lecture with the statement, "Along with a seamless forecast, action should also be seamless."

The next speaker **Dr Jaideep Chatterjee, Dean, Jindal School of Art and Architecture, O P Jindal Global University**, who is an anthropologist, historian and architect, wanted the audience to view

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urban flooding from a different perspective. He questioned, “Is ‘urban flooding’ the problem or we the ‘humans’ are the problem?”



Dr Jaideep Chatterjee

He mentioned 27 different Central and state-level government and non-government organisations work on water, and wondered how so they divide their jurisdiction. “Think how do they imagine. Did the river emerge prior to their action on it or the river emerged because of their action on it? Is the jurisdiction from the top, is jurisdiction in plan, is jurisdiction in section and where does the jurisdiction of one end and another start? How systems overlap, is it a problem of intersectionality that we do not understand and how do we see knowledge. How we look at it is the problem, he questioned.

Stating that the audience would be conversant with the ‘Anthropocene’ time, he said human beings are no longer outside the environment and the human species has become an agential force on the planet. Flooding, rain and climate should not be seen as if they existed independent of human influence. Instead of seeing ourselves as separate entities, we should recognise that we are involved in their occurrence and management. This shift in thinking could transform how we design systems, acquire knowledge, and act as a human being, he opined.

He further said, “We need to think of infrastructure beyond the mechanical, we need to make systems and think of jurisdiction and the idea of oppositional thinking. Without that we turn it into a corpus, a Latin word taken from corpse meaning dead body.”

Giving the example of post-Enlightenment division of land and river control in Europe, Dr Chatterjee said in cities like Delhi, similar divisions exist between departments managing land and flood control, leaving floodplains without clear oversight.

“There's this post-enlightenment idea of control of rivers where the idea between the land and river as sharp boundaries was divided institutionally. In Europe, land was controlled by the land agency, rivers were controlled by the flood irrigation bodies. The same thing happens in Delhi. The Flood and Irrigation Department controls the river and the Delhi Development Authority (DDA) controls the land, leaving the floodplains with no onlookers.

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“The traditional idea of sharp boundaries between land and water does not adequately address the complexities of floodplains and intertidal zones. The lack of institutional control over these areas highlights the need to rethink how we manage and understand these spaces. New ideas about space and boundaries, like the idea of distributed agencies, are challenging old ways of thinking. These new ideas suggest that nature and organizations are connected in more intricate and detailed ways than we used to think.”

Dr Chatterjee concluded by highlighting the need of looking at the problem from these perspectives and their implications for knowledge, pedagogy, and institutional practices.



The Panel: Mr Manu Bhatnagar (extreme left), Dr Syamal Sarkar, Dr Mrutyunjay Mohapatra and Dr Jaideep Chatterjee

The last speaker was **Mr Manu Bhatnagar, Principal Director, Indian National Trust for Art and Cultural Heritage (IINTACH)**

Mr Bhatnagar through a visual representation of topography of Delhi showed how it is being overlooked in our planning process. He said the rainfall and flooding pattern in Delhi has changed in the last few decades and along with it the extent of concretisation. “Floodplains are meant for the river but with increasing urbanisation, people rush in to occupy and build there. The powers that be lead in the race,” he said and added with the drastic loss of water bodies in most cities, the receptacles for the flood waters are not available causing flooding.

With drains getting clogged with solid waste and plastics causing clogging and water logging in the monsoon season, he said municipalities need to function more efficiently if we want the waterways to be cleared and perform the function they are meant for. He said cities are being overwhelmed by very rapid urbanization but our planning is far behind. He gave the example of Bengaluru where residents faced severe water scarcity in the summer and are now facing waterlogging and flooding mostly due to clogged drains. He also gave the examples of Chennai and Srinagar, where in just a decade the land around the Cocum and Jhelum rivers has been occupied by humans, leaving no buffer space in the floodplains.

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Showing an old and current picture of Sector 36 B, Gurgaon, he said the hunger for land is so strong that nobody wants to spare any land for natural phenomena. He said the greenfield areas which are yet to be developed can have solutions for urban flooding, but in already overcrowded cities like Delhi, deconcretisation could significantly improve water absorption and management.

Utilising paleochannels (the old river pathways) that have shifted over time as absorption areas can facilitate better groundwater recharge by connecting to aquifers and removing (dredging) sediments from elevated riverbeds, he said can be helpful in controlling flood in cities established near rivers. He said lowering the level of riverbed would create more space for managing city floodwaters, allowing rivers to expand horizontally into floodplains rather than causing vertical flooding.

As solutions to already built-up areas, Mr Bhatnagar said buffer space should be created around large drains so that those can be expanded when needed while pumping grids should be used to pump out clogged water.

The public lecture ended with a question and answer (Q&A) session where the audience comprising students, researchers, academicians and subject matter experts raised questions, expressed their concerns and also suggested possible solutions.