Extreme rainfall leaves cities floundering

indiaclimatedialogue.net/2017/08/28/extreme-rainfall-leaves-cities-floundering/

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Sharp, heavy cloudbursts that inundate cities across India are occurring with increasing frequency, testing the country's urban resilience

Children using a flooded playground as a swimming pool in Chennai. (Photo by Ben Robinson)

Independence Day was unusually wet and waterlogged for residents of Bengaluru in Karnataka. Heavy rains started near midnight when they were asleep, and by morning, it had poured 128 mm. Localities in and around Koramangala in the southern part of the city went under water, with parked vehicles nearly submerging.

On the morning of August 21, a similar event happened in Chandigarh. While residents were going to work on Monday, heavy, sharp showers descended. By afternoon, the city had received 112 mm of rainfall. Commuters found it difficult to reach their destinations, some had to abandon their cars and motorbikes on the roads. These vehicles floated in the water, reminder of similar images from Chennai during the November-December 2015 floods. Water entered buildings and the urban administration of the best-planned city in the country descended into chaos.

On July 26-27, the downpour was in Ahmedabad, Gujarat, where within 24 hours the city received 200 mm of rainfall. To make matters worse, due to heavy rainfall in the upper part of the Sabarmati river catchment, the authorities had to release water from the Dharoi dam. With the river built in on both sides with perpendicular walls as it flows through Ahmedabad, there were serious threats of heavy flooding and the administration reportedly evacuated more than 10,000 people.

On August 11 and 12, a heavy downpour drowned Agartala, the capital of Tripura in northeastern India. While the city received 102 mm of rainfall in one day, on the next there was 94 mm, and 196 mm in two days was more than what the city could take. The city systems collapsed and normal life was disrupted.

With such cloudbursts coming one after the other across the country, questions are being asked. Is the prognosis of extreme weather events becoming more frequent and intense due to climate change starting to come true? Are Indian cities designed to withstand such events? What can be done to make them more resilient?

Increased intensity

Recent research is indicating that the intensity of these extreme weather events is increasing, according to Pradeep Mujumdar, chairman, Interdisciplinary Centre for Water Research (ICWaR) at the Indian Institute of Science, Bengaluru. Also, the intensity of urban events vis-à-vis non-urban ones is increasing.

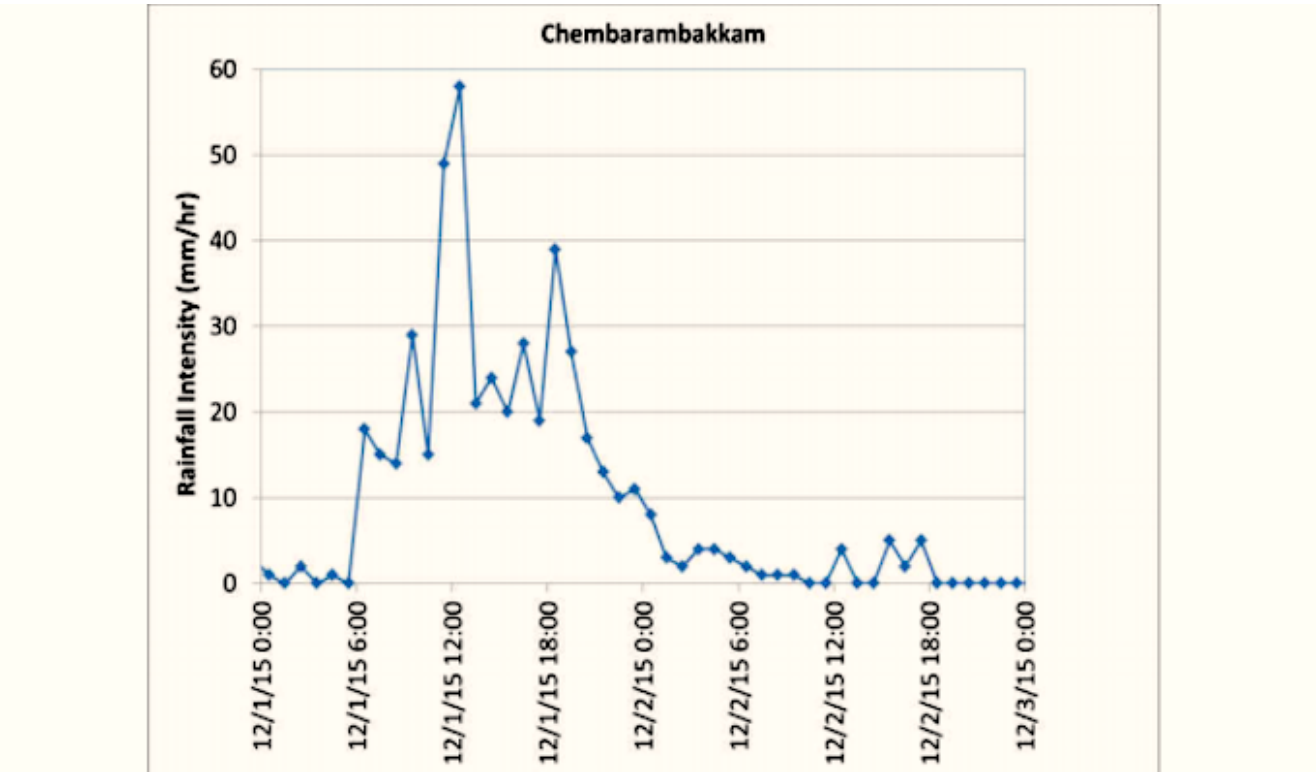
“Though it is difficult to attribute any one event to climate change, there is much research results from across the world that is showing that the pattern of multiple extreme events in a season is happening due to the changing climate,” Mujumdar told indiaclimatedialogue.net.

While these were the events of the southwest monsoon of 2017, the city of Chennai in southern India had a series of five extreme precipitation events between November 8 and December 4, 2015. Even before the city could recover from one event, it was battered by the next. The climax was the release of water from the Chembarambakkam reservoir upstream of the city, forcing the Adayar river to overflow its banks in Chennai.

The secondary runway of the Chennai airport, built over the Adayar river, was flooded and airport services were paralysed for days. Air connectivity, which is among the most important component of a city’s resilience inventory, was knocked off by the floods. To evacuate those who wanted to leave the city and were stuck at the airport, the Indian Navy helped operate civilian flights from the naval air base at Arkonam.

ICWaR has been studying the urban flooding events that happened in Chennai, Hyderabad and Bengaluru in recent years. For Bengaluru, the team compared 26 General Circulation Models (GCMs or global climate models) along the four Representative Concentration Pathways (RCPs or the four greenhouse gas emission scenario pathways up to year 2100

used by the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, or IPCC). The conclusion was that the climate change projections clearly indicate an increase in high intensity rainfall.



Rainfall intensity measured at Chembarambakkam during the December 2015 floods. (Source: ICWaR).

Another recent report, published by the Ashoka Trust for Research in Ecology and the Environment (ATREE), Bengaluru, confirms similar findings. In the chapter on extreme rain events, Jagdish Krishnaswamy and Srinivasan Vaidyanathan state that rain events greater than 100 mm have increased in number in the past 100 years. There is an overall increasing trend of events exceeding 100, 150 and 200 mm since the 1900s. The crux, however, is that there is an increasing variability in the recent decades.

However, attributing a single event to climate change remains problematic. Another team of researchers from Indian Institute of Technology, Delhi, and University of Oxford in Britain had said it was not possible to attribute the extreme rainfall in Chennai on December 1, 2015 to climate change.

Taken by surprise

Be that as it may, it is this variability in rainfall that takes cities by surprise. Professional weather watchers of the India Meteorological Department (IMD) and private individuals and agencies are able to say that it is going to rain over a particular city, but are unable to foresee its exact intensity and the impact it will leave on the ground.

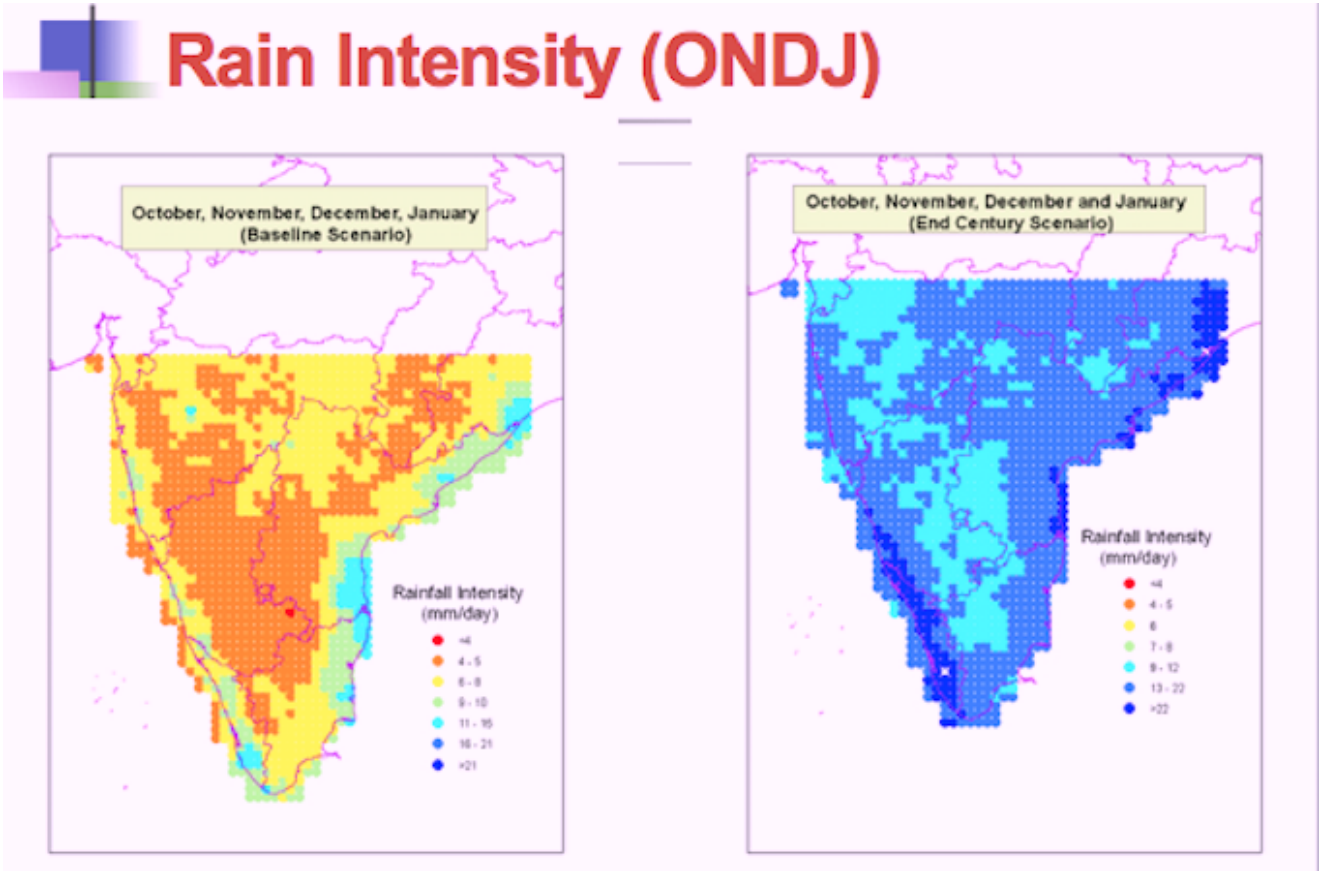
Understanding the current uncertainty is the key to realise what the future would hold for a city in a climate changed world. For this, global climate models developed by the IPCC have to be duly reconstructed for the city level, and the impact of rains in different parts of the city understood.

Due to their higher population density, the impact of extreme weather events is higher in terms of loss of lives and property in urban centres than in villages. Chennai, for instance, has a population density of 26,553 people in a square km, according to the 2011 Census report.

Expensive events

Due to the higher concentration of infrastructural investment in cities, the loss to property is also high. According to the annual estimates compiled by global reinsurance major Munich Re, the economic loss at USD 3.5 billion in and around Chennai due to the November-December 2015 flood was the second-most expensive event in the year.

If extreme rainfall events are becoming more frequent, the situation on the ground is ensuring that any unusual event is resulting in severe flooding. According to Veena Srinivasan, Fellow at ATREE, in Bengaluru storm water networks are either unavailable or not adequate. Many of these drains also have sewage flowing into them, which should have been treated and disposed off separately. Due to the sewage getting mixed into storm water drains, it becomes difficult to channel the storm water into local lakes.



Rain intensity projections for 2100. (Source: IIT Madras)

Adding to all this is the obstruction caused by garbage, which too find their way into storm water drains. They are also dumped on the streets, and float into the storm water system when it floods.

The situation is compounded by the change in urban land use. “In a normal ground outside the city, nearly 80% of the rain would have got absorbed,” G.K. Bhat, chairman of Ahmedabad-based Taru Leading Edge, a development think tank, told indiaclimatedialogue.net. “Today, with concrete and tarmac all around, we are creating almost a near-total impervious area. Thus, the flood gets amplified in urban areas because of land use change.”

Amplified impact

Thus, while the July event in Ahmedabad was not exactly the biggest of such events in history, its impact was amplified more than in the past because the exposed soil was increasingly getting covered in the city. “Anomalous behaviour of monsoons have also become more frequent in recent years,” Bhat said.

Even in Chennai, the release of water from the Chembarambakkam reservoir on Adayar river upstream of the city on December 1, 2015, is considered to be the event that triggered massive floods along the river. However, later studies have proved that the flow from the reservoir only added to the quantum of water that was flowing in from southwestern suburbs of the city beyond Tambaram.

“The main flow in Adayar river was coming from these suburbs, and the Chembarambakkam flow only added to this,” Balaji Narasimhan, associate professor at the Indian Institute of Technology, Madras, told indiaclimatedialogue.net. “In future, when these suburbs have more buildings and roads, the amplification of the flood could be even higher.”

With the exception of planned cities such as Chandigarh and industrial townships such as Bhilai and Jamshedpur, most Indian cities grow organically from a cluster of villages and small towns. Thus, the cities grow without the infrastructure being in place. Even the existing infrastructure is not designed for the extreme rain events.

Quick collapse

“The existing infrastructure collapses quickly because they are designed for minor floods and not the kind of extreme events that we are seeing in the recent years,” observed Bhat. “Even though guidelines have been laid out by the National Disaster Management Authority (NDMA), urban planners and managers go for designs calibrated for milder events to reduce cost.”

Ironically, when Chennai was flooded in end-2015, it was the storm water infrastructure laid down by the British more than a century ago in the older parts of the city that withstood the brunt better than the systems installed in the newer parts of the city.

As the writing on the wall is getting clearer for Indian cities, they will need to design their physical and social systems to withstand extreme rain events. This would mean pegging the systems to deal with the intensity, duration and frequency of these events as they are happening in the present. In turn, this will help the cities be climate resilient for the future.