



# Rapidly growing Chennai submerged by rare extreme rainfall event

## Human impact summary

## Key messages

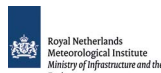
- On 1 December 2015, a very rare extreme rainfall event in Chennai, India, led to devastating floods that killed over 470 people and brought the city to a standstill.
- No measurable effect of human-caused emissions was detected in the extreme one-day rainfall in Chennai on 1 December 2015, highlighting the need for more effective management of the built environment to prevent such impacts in the future.
- The country's Parliamentary Standing Committee on Home Affairs acknowledged the lack of timely desilting, the inadequate flood zone planning, and large-scale settlements in low-lying areas as major contributors to the impacts on the city.<sup>1</sup>

## Authors

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<sup>1</sup> Ramani, S. & Srinivasan, V. (2015) 'A wrong call that sank Chennai', *The Hindu*, 25 March. ([www.thenewsminute.com/article/union-govt-report-chennai-floods-puts-chennai-corporation-sewerage-board-dock-48416](http://www.thenewsminute.com/article/union-govt-report-chennai-floods-puts-chennai-corporation-sewerage-board-dock-48416)).

This factsheet is produced by the Raising Risk Awareness project, a partnership between the World Weather Attribution initiative and the Climate and Development Knowledge Network, which seeks to deepen understanding of the role of climate change in extreme weather events and how decision-makers can use this information to increase societies' resilience to climate change. This factsheet aims to provide the practical information on vulnerability and exposure of local populations to specific extreme weather events and is a companion to the scientific analysis on the role of climate change in extreme heat in northwest India in May 2016. Find the deeper scientific analysis of this extreme event on our project website [www.cdkn.org/climaterisk](http://www.cdkn.org/climaterisk)



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**Lower floors of tenements became completely uninhabitable**

### Background

Chennai is a coastal mega-city that has encountered explosive and largely unplanned growth over the past 15 years. The city of 8.2 million is one of the largest in South India and has a booming IT sector. Chennai is topographically flat with two rivers, the Adyar and Cooum, running through the Chennai Metropolitan Area (CMA).<sup>2</sup> The majority of rainfall occurs during the north-east monsoon from October to December, which is followed by a dry winter.

#### Impacts of the 1 December 2015 flood

- 4.92 lakh houses (one lakh is 100,000) destroyed or damaged and 3.83 lakh hectares of crops destroyed
- Chennai Airport was closed for 5 days at the start of December 2015
- Most of the 101,000 tenements in Chennai City had been built in low-lying areas, replacing earlier slums, so lower floors became completely uninhabitable
- Extensive damage occurred to physical and social infrastructure such as roads, drinking water, sewerage, drainage systems, health centres, schools and colleges.

### Vulnerability and exposure to floods

As population and development have increased in Chennai, the Adyar and Cooum rivers and surrounding water bodies have seen increasing encroachment by buildings and other infrastructure.

Land use issues, including decreased natural areas, loss of water bodies, and uncontrolled spread of built-up areas, have been identified as factors contributing to the high vulnerability and exposure to floods in Chennai. In the last 20 years, floods have occurred with increasing frequency, in contrast to rainfall trends that have decreased.<sup>3</sup> This implies that human factors play a significant role in increasing vulnerability and exposure to floods and should therefore be the focus of risk-management strategies.

People living near rivers and canals, or on former riverbeds, are at the highest risk of impacts from floods, including damage to housing, and water and vector-borne diseases.<sup>4</sup>

2 Suriya, S., Mudgal, B.V. & Nelliya, P. (2012) 'Flood damage assessment of an urban area in Chennai, India, part I: methodology' *Natural Hazards* 62: 149. doi:10.1007/s11069-011-9985-3.

3 Gupta, A. K., & Nair, S. S. (2010) 'Flood risk and context of land-uses: Chennai city case' *Journal of Geography and Regional Planning* 3(12): 365–372 ([www.academicjournals.org/journal/JGRP/article-full-text-pdf/18C62DC40738](http://www.academicjournals.org/journal/JGRP/article-full-text-pdf/18C62DC40738)).

4 Joerin, J., Shaw, R., Takeuchi, Y., & Krishnamurthy, R. (2012) 'Assessing community resilience to climate-related disasters in Chennai, India' *International Journal of Disaster Risk Reduction* 1: 44–54 (<http://dx.doi.org/10.1016/j.ijdr.2012.05.006>).

### Why did Chennai flood?

To avoid the risk of the reservoir being breached, engineers had to release water from the reservoir

On 1 December 2015, the extreme rainfall brought nearly-full reservoirs<sup>5</sup> to capacity, prompting local authorities from the Chennai Metropolitan Water Supply and Sewerage to release water from the Chembarambakkam reservoir into the Adyar and Kosasthalayar rivers, which subsequently overflowed, flooding low-lying areas. Chembarambakkam is an artificial lake that supplies water for Chennai. It has in recent years faced water deficits due to the lack of consistent freshwater sources and a growing population. Managers typically fill reservoirs during the October to December season in Chennai, to provide water for drinking and other uses during the upcoming dry, winter season. Chembarambakkam is typically maintained at two feet lower than the maximum level during the rainy season,<sup>6</sup> so it was not unusual for it to be near capacity at this time of year. To avoid the risk of it being breached by the large addition of rainwater, engineers had to release water from the reservoir.<sup>7</sup> An uncontrolled flow of water would otherwise have endangered an even greater proportion of the population.<sup>8</sup>

Many questioned the timing of the release, however, because it left residents unexpectedly flooded in the middle of the night. While district collectors issued warnings to people to move to higher ground, and while the public address system on the Adyar River was employed,<sup>9</sup> many did not receive the warning or were unprepared for the level of flooding that followed.

Whereas in the south of Chennai, flooding was caused by overflowing waters from the Adyar river, to the north of the city, rainwater accumulation in low-lying areas was a greater issue. Floodwaters persisted in central Chennai for over 10 days and had to be pumped out.

### What's next?

Given the very rare nature of the December 2015 flood event, it could be argued that the city's social and physical infrastructure cannot be expected to withstand such an event. However, flooding is a common occurrence in Chennai, and there are many human causal factors that increase the vulnerability and exposure to flooding of residents in the city.

- 5 TNM staff (2016) 'Union govt report on Chennai floods puts Chennai Corporation, sewerage board in the dock', *The News Minute* (TNM), 18 August ([www.thenewsminute.com/article/union-govt-report-chennai-floods-puts-chennai-corporation-sewerage-board-dock-48416](http://www.thenewsminute.com/article/union-govt-report-chennai-floods-puts-chennai-corporation-sewerage-board-dock-48416)).
- 6 Lakshmi, K. (2015) 'Understanding Chembarambakkam', *The Hindu*, 7 December. ([www.thehindu.com/news/cities/chennai/understanding-chembarambakkam/article7956383.ece](http://www.thehindu.com/news/cities/chennai/understanding-chembarambakkam/article7956383.ece)).
- 7 Rajendran, D. & Ramanathan, S. (2015) 'Chennai floods: What happened at Chembarambakkam, negligence or nature's fury?' *The News Minute*, 9 December ([www.thenewsminute.com/article/chennai-floods-what-happened-chembarambakkam-negligence-or-nature-s-fury-36675](http://www.thenewsminute.com/article/chennai-floods-what-happened-chembarambakkam-negligence-or-nature-s-fury-36675)).
- 8 Chanson, H. (2009) 'Chapter 4: Embankment overflow protection systems and earth dam spillways' in Hayes, W.P. and Barnes, M.C. (eds) *Dams: Impacts, stability and design*. New York: Nova Science Publishers, Inc.
- 9 TNN (2015) 'Surplus water released from Chembarambakkam reservoir', *The Times of India*, 16 November (<http://timesofindia.indiatimes.com/city/chennai/Surplus-water-released-from-Chembarambakkam-reservoir/articleshow/49798711.cms>).

## Recommended further reading

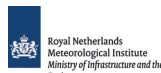
- [CDKN Chennai extreme rainfall science summary](#)
- [Indian Parliamentary Standing Committee report](#)
- [Hyderabad remote sensing centre assessment study](#)

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This publication is an output from the Raising Risk Awareness project. The project is funded by the UK Department for International Development (DFID) through the Climate and Development Knowledge Network (CDKN), and by Eric and Wendy Schmidt through Climate Central, Inc. CDKN is a programme funded by DFID and the Netherlands Directorate-General for International Cooperation (DGIS) for the benefit of developing countries.

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