



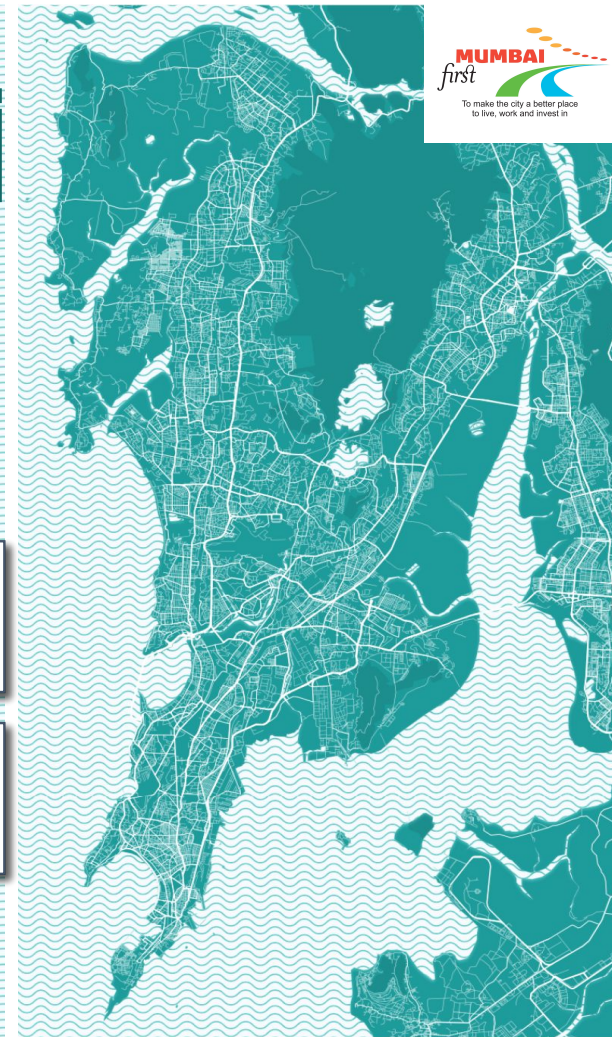
**Climate
Change is
&
Biggest
Opportunity to
transforming
Mumbai into
equitable,
Sustainable
liveable city**

MyMumbai & MyBMC

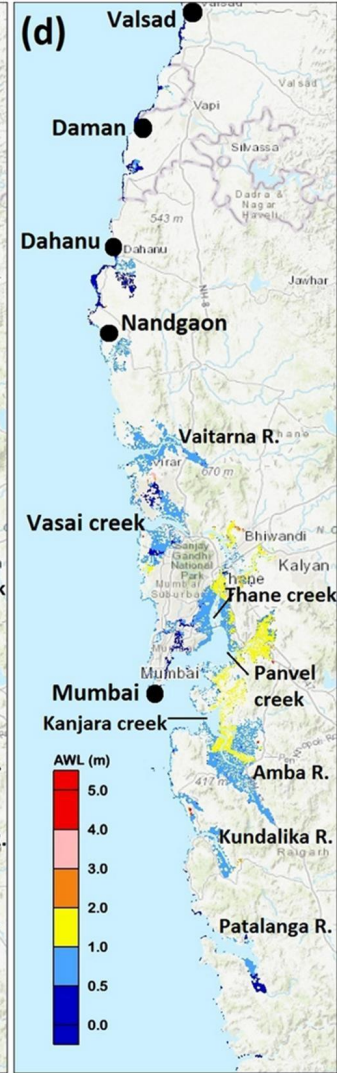
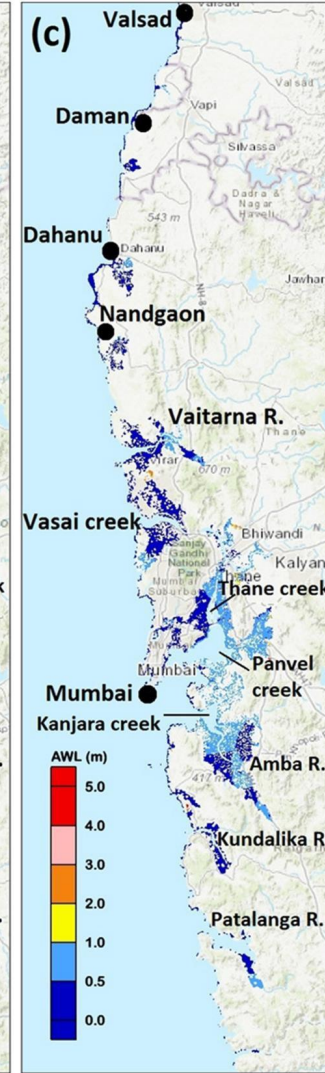
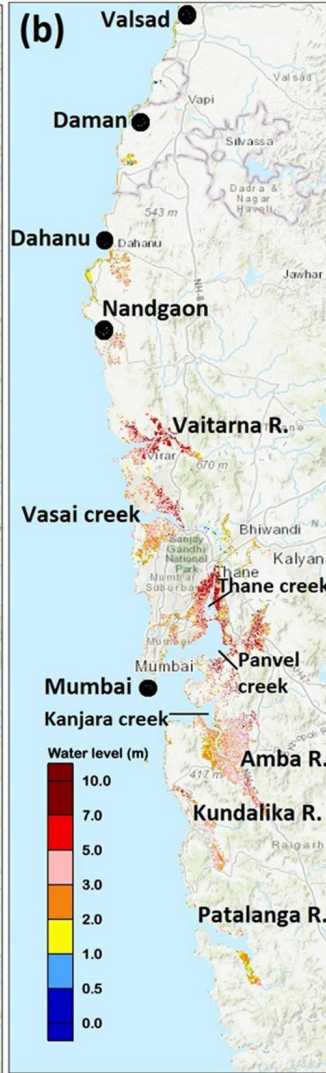
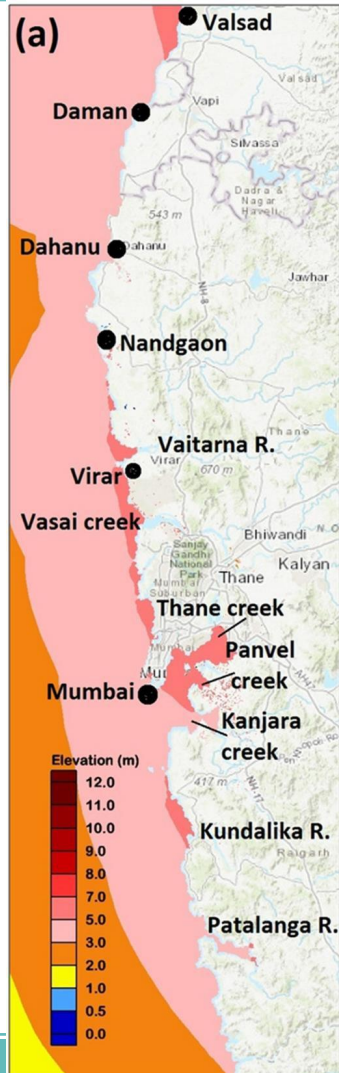
Area
475.47 Sq Km

Population
1.4 Cr
(2017 mid year
estimate)

Slum Population
70 Lakh
(out of 130 Lakh people)



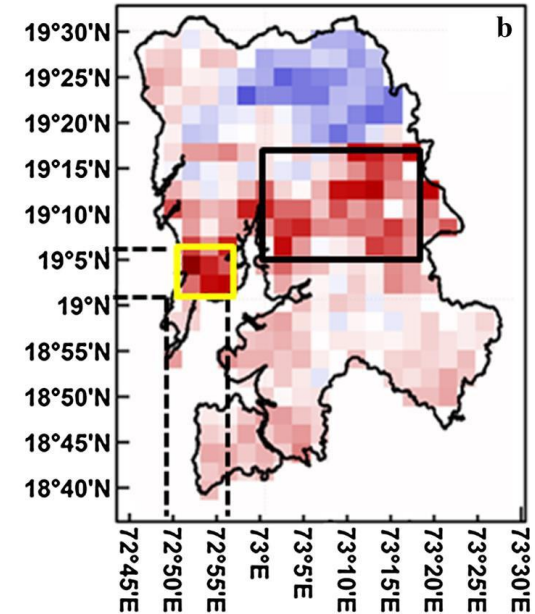
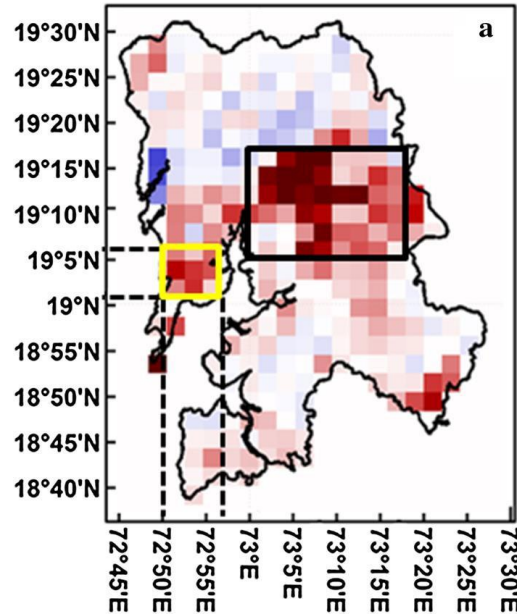
a Probable Extreme Maximum water elevation of Zone4 and Zone5 for present scenario, **b** associated probable maximum coastal inundation extent and water levels, **c** AWL for moderate scenario and **d** AWL for extreme scenario



Climate Change Impact

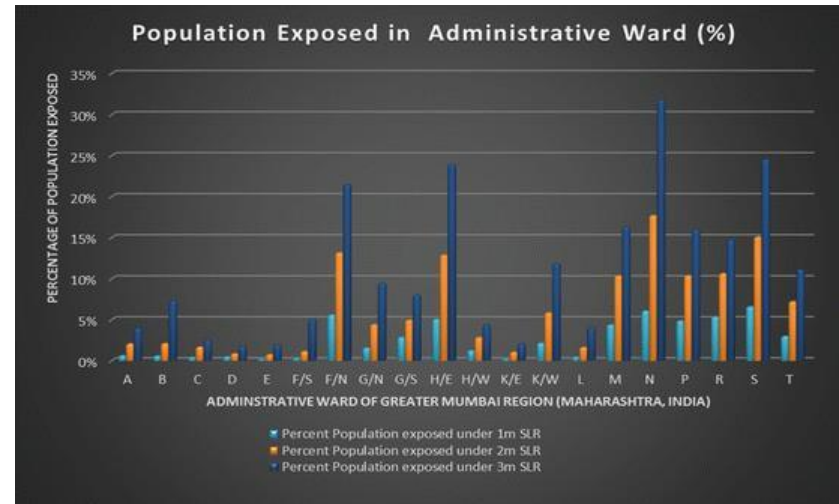
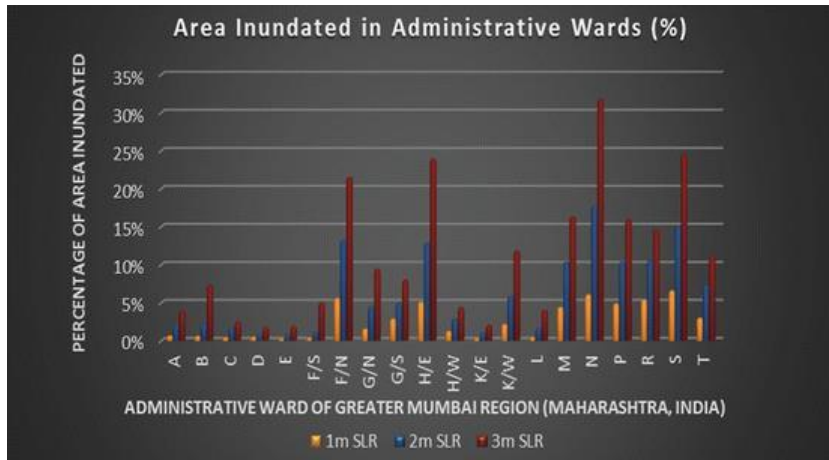
- estimates the effect of urban expansion of Mumbai over last 30 years and further up to 2050 on rainfall extremes. This is integrated with the downscaled climate change projections at urban scale.
- integrated projections for the future considering two different emission scenarios. We find an increase in the projected extreme rainfall with the increase urbanized areas.
- Signature of urbanization is prominent over the city of Mumbai for extreme precipitation. **Extreme events are getting intensified over few pockets of the city which are at the boundary region between the build up and forest area.**

Identification of the hot-spot region. The mean rainfall over a box of 16 km², where increased magnitude of extreme rainfall amount are simulated by WRF-UCM as impacts of urban growth. This is prominent for both future projected (2050) (a) and present urbanization (2001) (b) with respect to pre-urbanization (1973)



Shastri, H., Ghosh, S., Paul, S., Shafizadeh-Moghadam, H., Helbich, M. and Karmakar, S., 2019. Future urban rainfall projections considering the impacts of climate change and urbanization with statistical-dynamical integrated approach. *Climate Dynamics*, 52, pp.6033-6051.

Ward-wise area inundated in year 2101 under 1 m, 2 m, and 3 m SLR scenario

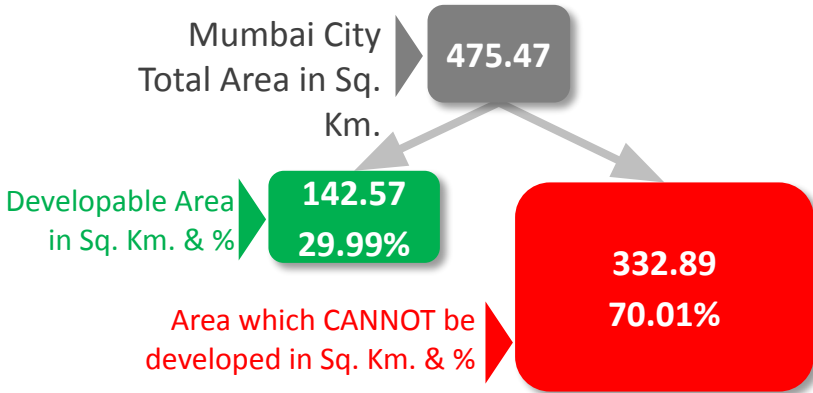


Singh, P.D. and Kambekar, A.R., 2017. Assessing impact of sea level rise along the coastline of Mumbai City using geographic information system. In *Understanding Built Environment: Proceedings of the National Conference on Sustainable Built Environment 2015* (pp. 87-96). Springer Singapore.

50% of Mumbaikars live in slums – Opportunity to house all in dens, infrastructure provided metro corridors

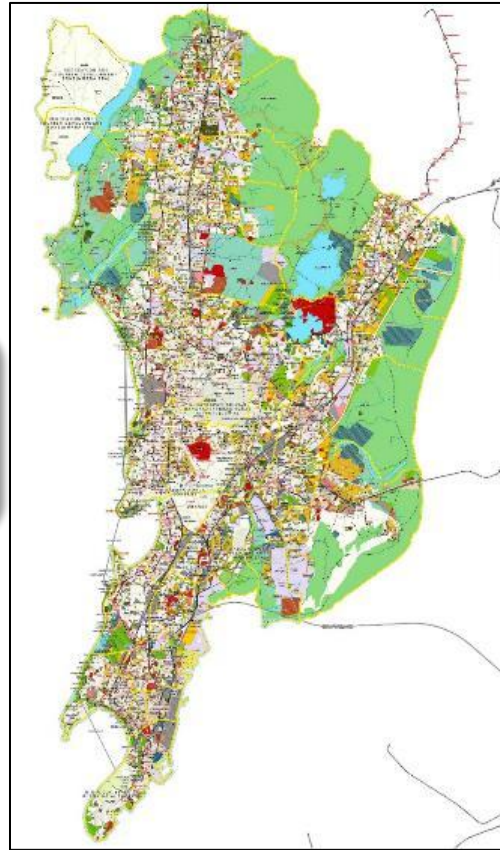


opportunity # 1: Mumbai space constraint; hence Dense Transport Corridors along metro lines for Housing for all



Area which CANNOT be developed	Area
Area under Special Planning Authority	43+
Natural Area & CRZ I*	126+
Existing & Proposed Road Area	57+
Designation (Excl. Housing & Offices)	65+
Reservation (Excl. Housing & Offices)	33+
Remaining area of Aarey	8+

* (SGNP + CRZ I + NDZ, TDA, Salt Pan + Natural Water course)

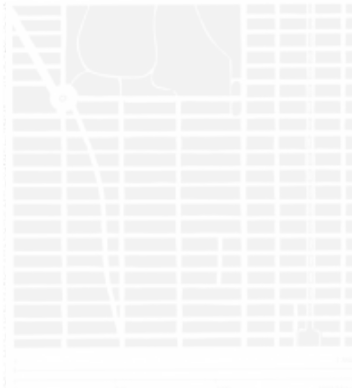


Challenge # 2: Less Public Spaces BUT more wasted Private Open Spaces

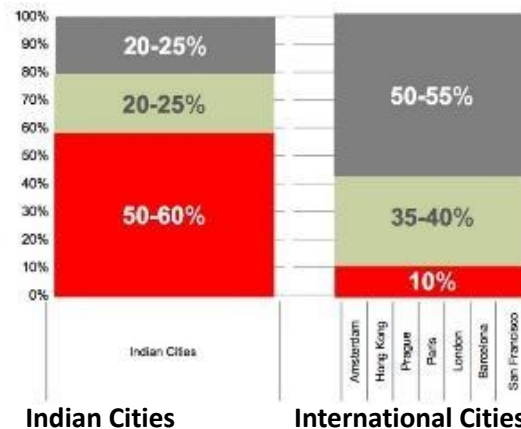
Credits: Dr Bimal Patel (President CEPT University)



Mumbai
Total Area: 259 ha
Streets: 29 ha (11%)



New York
Total area: 259 ha
Streets: 86 ha (33%)



- Building footprints
- Public Spaces
- Private Open Spaces

Public space under streets provides city infrastructure

Create new roads without halting Mumbai



Metro Projects in Maharashtra

Total metro network: 345 km

Mumbai and Navi-Mumbai: 253 km

Pune and Nagpur: 92km

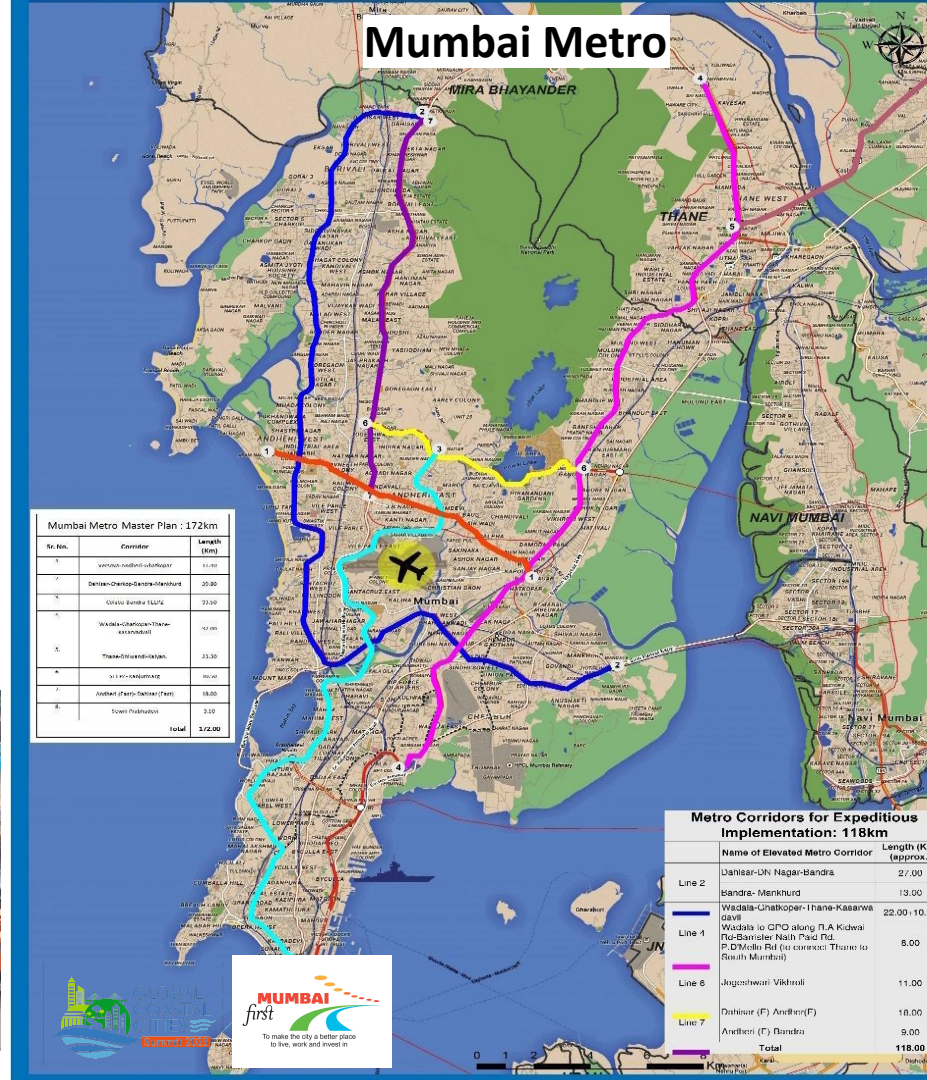


Daily commuters
11.1 Million

Total cost: \$21.8Bn



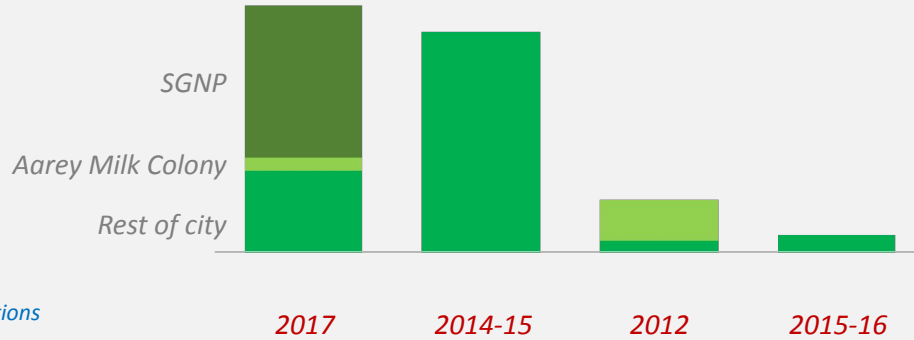
10% under operation
More than 40% under construction



Uninformed Controversies and : First the good news Mumbai has higher green cover than any other mega city



Trees (in lacs)

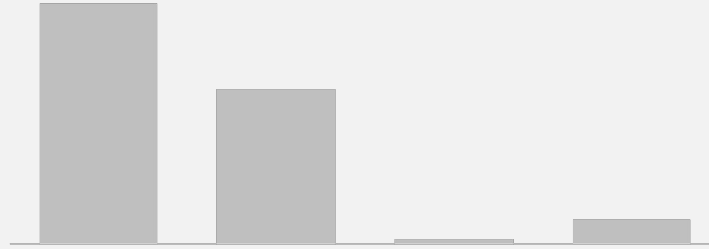


SGNP has ~55 lac mature trees and additional 3.5X saplings & regenerations

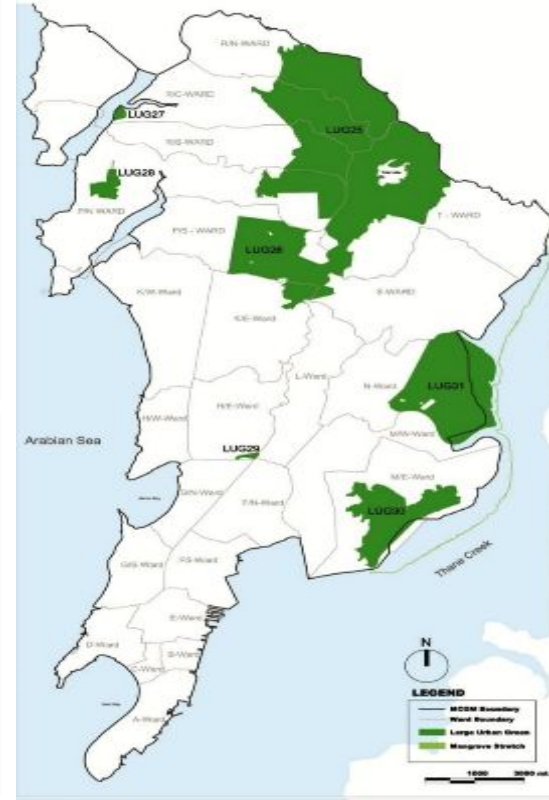
Trees per Sq. Km.

Source:

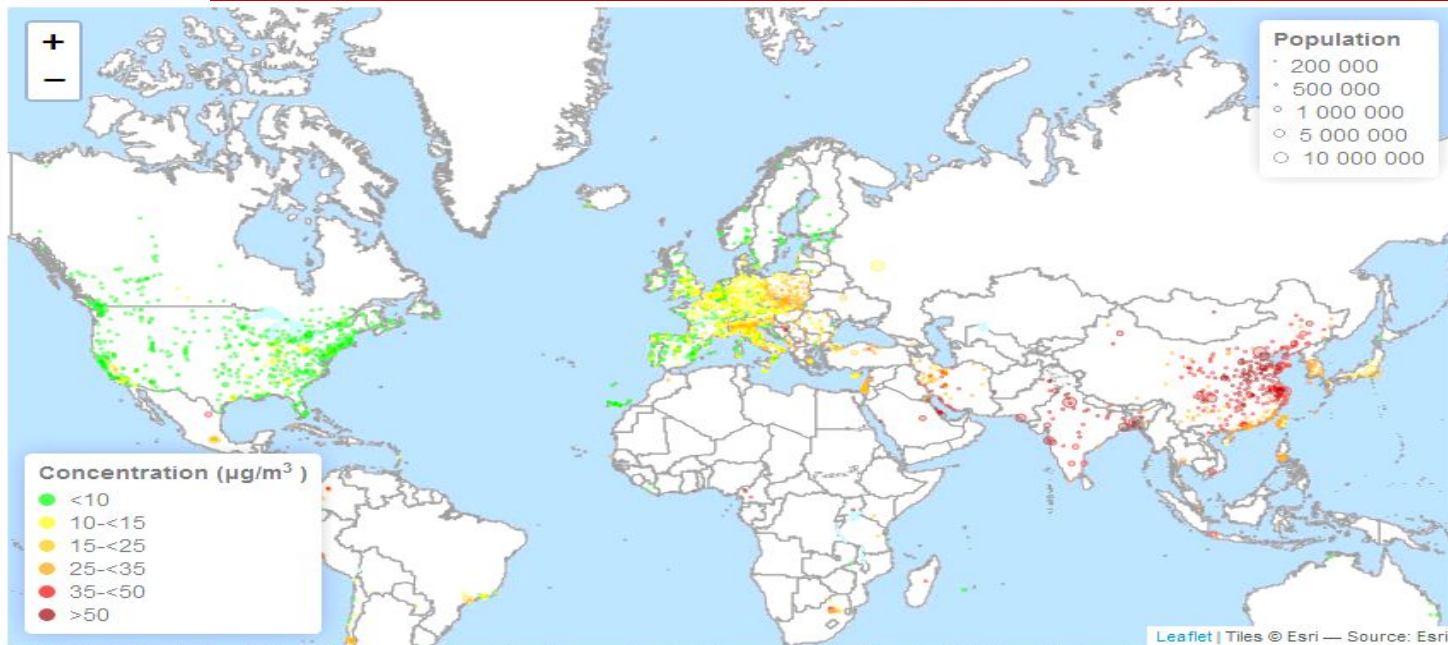
- Mumbai: Tree census 2017 by MCGM. Article published on Dec, 21, 2017 in Asian Age by Sonali Telang quoting tree census data of Mumbai.
- Article published in The Asian Age dtd 8th Sept, 2019.
- Tokyo: The Urban Forest of Tokyo(Article published online on 27.3.2012 by Sheauchi Cheng, Keizo Fukunari and Joe R. McBride)
- London: Data taken from London Datastore
- New York: Tree count 2015-16 street tree census inf on official web of new york city department of parks and recreation. Nycgovparks.org/trees/treescount.



Despite excluding 55+ Lacs SGNP trees



PM2.5 Concentrations in cities across the World in 2018 (Source: WHO)



Beijing		73
Mumbai		64
Johannesburg		41
Tehran		28
Mexico City		22
Tokyo		17
Paris		16
London		12
New York		7

In micrograms per cubic meter

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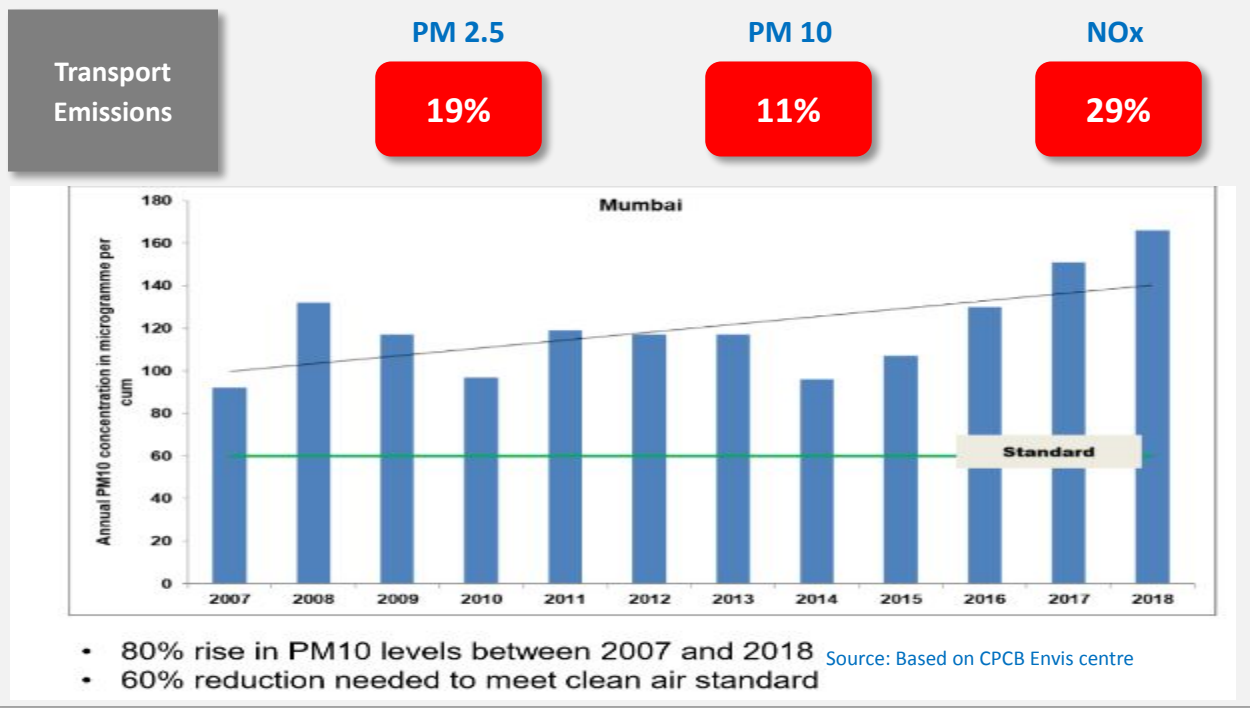
Air pollution & # vehicles in Mumbai have grown rapidly



More vehicles on road > More time to travel due to congestion and long distances > Poor public transport

Year	# Vehicles (lacs)
2016	28.2
2015	25.7
2014	23.3
2013	21.9
2012	20.3
2011	18.7
2010	17.7
2009	16.7
2008	16.1
2007	15.0
2006	13.9
2005	13.0
2004	12.0
2003	11.2
2002	10.7
2001	10.3

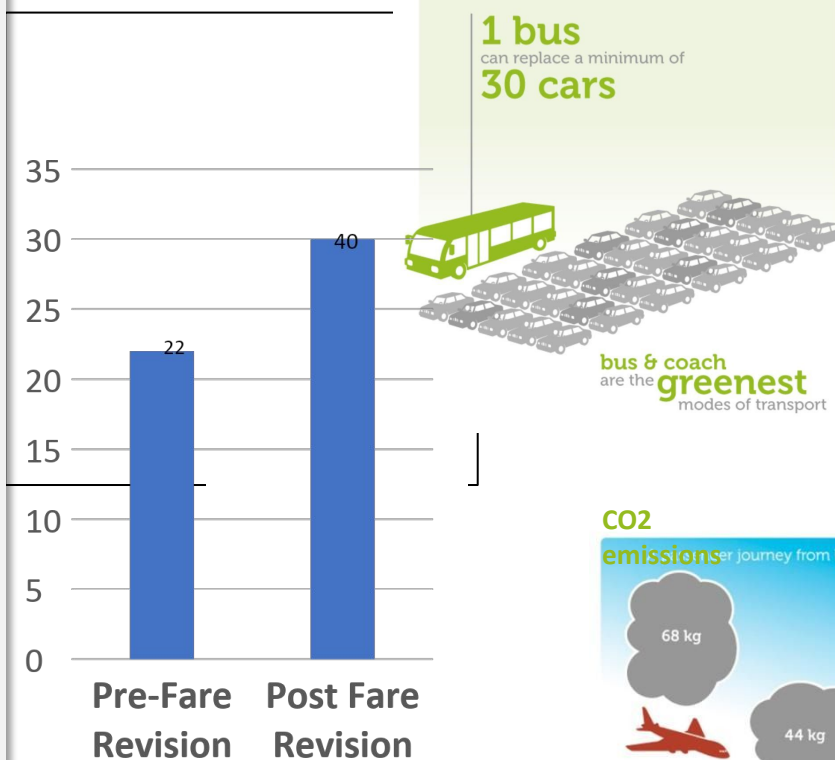
Before Ola, Uber Era



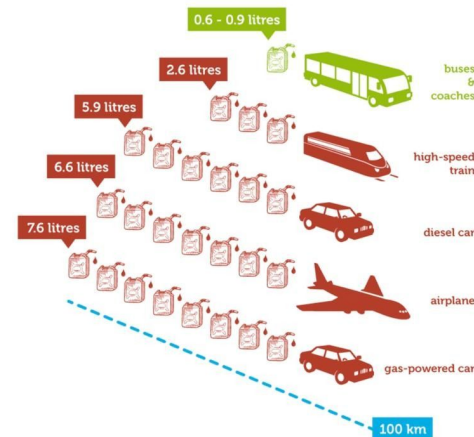
Source: MoRTH Statistics

Public Transport – BEST – Growth in Passenger Numbers

- The bus fare slabs rationalized from 16 slabs to only 4 slabs
- Minimum fare is only
 - Rs.5/- for Non-AC
 - Rs.6/- for AC
- Wet leasing of new fleet operating at 15%-20% less price compared to BEST owned
- Added 2000 buses



What does it take to carry one passenger over 100 kilometres?



CO2

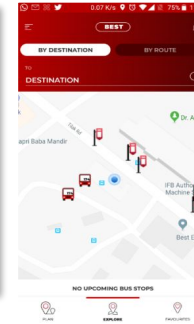
emissions per journey from London to Blackpool in the UK will emit:



Source: Union of Concerned Scientists

Public Transport – BEST – PRAWAAS

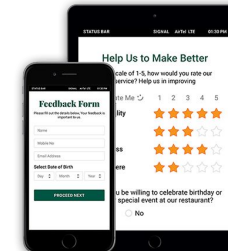
- ▶ Real Time Tracking of buses
- ▶ Availability of ETA on mobile app and on bus stop LED displays
- ▶ Announcement of next stop in a bus.
- ▶ Auto availability of arrival & departure timings of buses at Chowky



Map Position							
Bus No :	3222	Depot Name :	POISAR	Origin Stop :	CHABURP	Destination Stop :	KANDIVLE STN (W)
Tip Seq. :	36	Route No. :	DOWN	Route No./Serial No. :	2760/04/WEK/3	Driver Check :	ACHREKAR DHONDU LAKHMAN/11508
Conductor :	MADHANE HANDESH HANDESRANG/11866		Conductor Contact No. :	889237029			
Driver :	ACHREKAR DHONDU LAKHMAN/11508		Driver Contact No. :	702049185			

- ▶ Monitor Driver's Behaviour
 - Over Speeding
 - Route Diverted
 - Skip / Miss stops
 - Unauthorised stoppage

- ▶ Improve quality of service
- ▶ Real time passenger feedback from mobile application
- ▶ Centralise access of data & applications.



Mumbai - Climate Resilient & Circular Economy

Circular
Economy

Climate
Resilience

Governance



Opportunity : we will run out of water : can we use market to support Circular flow

- 3750 MLD water supplied to Mumbaikars. Daily!
- 6800 Kms long pipelines
- Most modern facility centres, acknowledged by international bodies
- Amongst the cheapest & purest water in any mega city in the world!



Average cost of water incurred by BMC:
INR 15/m³

Average Residential cost:
INR 5.25/m³
(90 % of total)

Average Commercial cost:
INR 35-40/m³
(10% of total)



Tansa Dam
Source of Mumbai's water



Water :



Average cost of water incurred by MCGM: INR 15/m³

Average Residential cost: INR 5.25/m³ (90 % of total)

Average commercial cost: INR 35-40/m³ (10% of total)

- Mumbai pure water, filtered by forest, cheapest source via gravity
- Instead of building new Dams, Reuse?
- Rainwater harvesting for toilets flushing
- Volumetric metering of individual flats to incentivize water conservation
- **BULK NON HUMAN CONSUMPTION WATER TO COME FROM TREATED WASTE WATER AND RAIN WATER RECYCLED**

WwTF– Vital information

Zone	Zone Name	Status	Plant design (MLD)	Recycle Reuse (MLD)
I	Colaba	Expected completion Oct 19	37	37
II	Worli		500	100
III	Bandra		360	72
III	Dharavi		250	50
IV	Versova		180	36
V	Malad		454	90
VI	Bhandup		215	43
VII	Ghatkopar		337	67

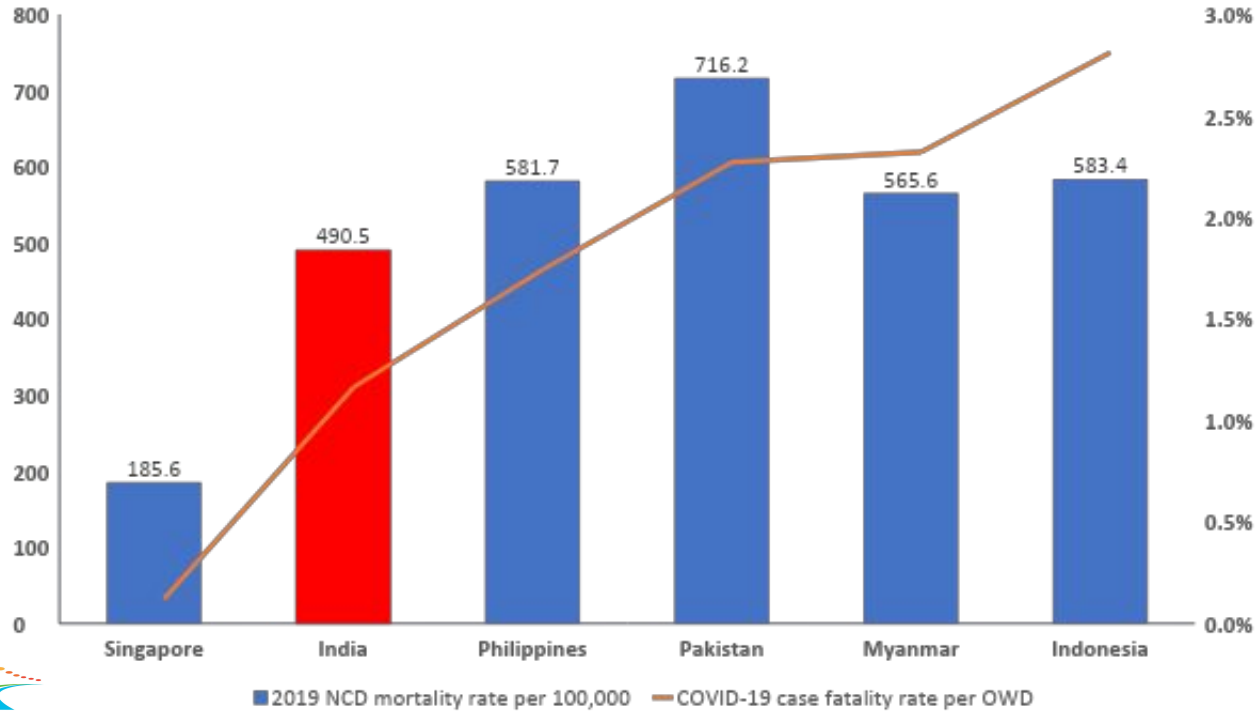
- MCGM can mandate such bulk generators to compulsorily use the treated water.
- STP operators to also produce electricity from the sludge (to ensure its proper treatment and indirectly avoid its dumping in the upstream)

Climate Change will bring more Viral Epidemics



NCD and Covid Case fatalities are co-related :small NCD burden leads to low case fatality rate

Correlation between NCD mortality rate and COVID-19 case fatality rate in South and Southeast Asia



Annual NCD Mortality Ratio

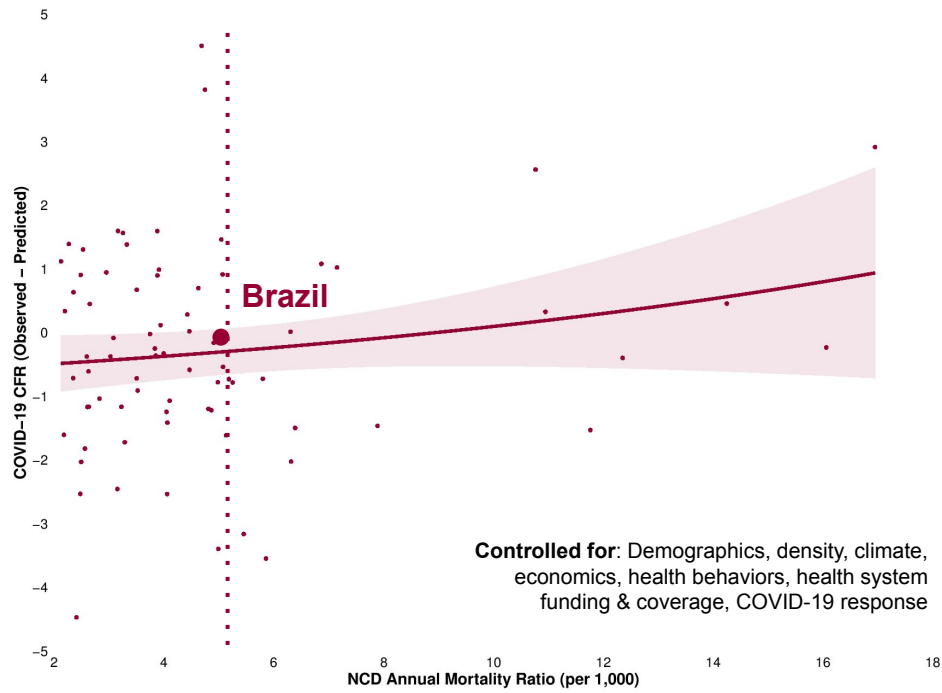
↓ 10 %

COVID-19 Case Fatality Ratio

↓ 20 %

5.00 per 1,000 population

24 per 1,000 cases



Example: Country with 60 million people

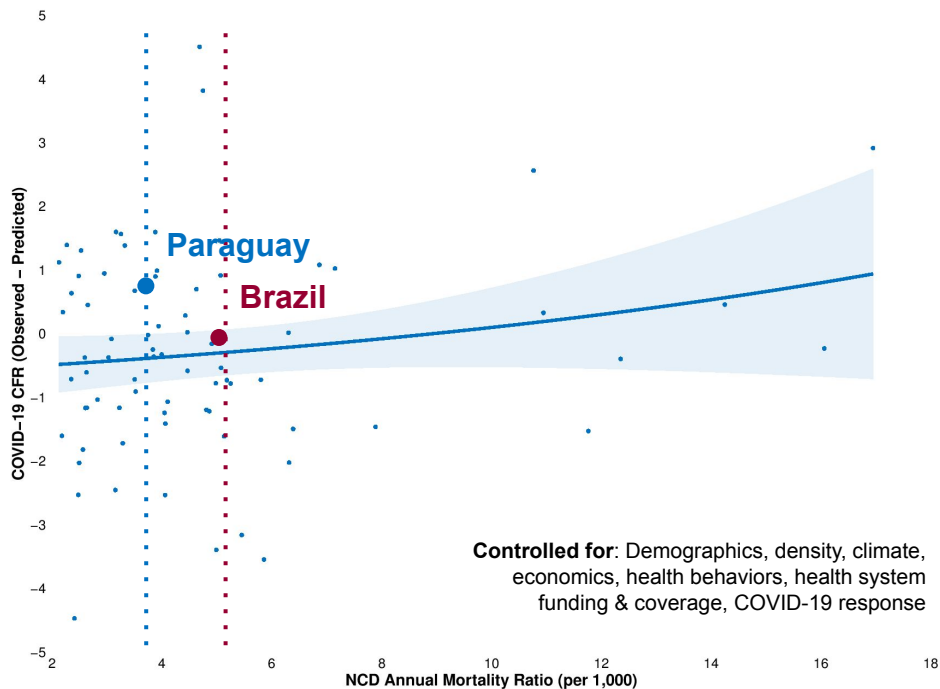
6 million infected people

144 thousand deaths





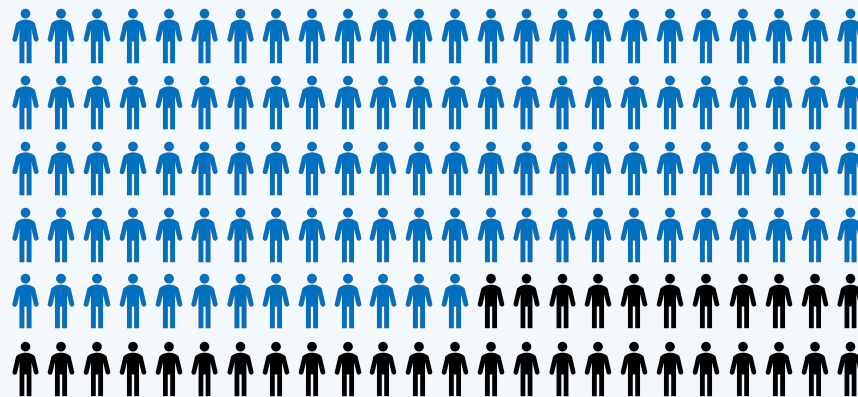
5.00 per 1,000 population \rightarrow 24 per 1,000 cases
 3.75 per 1,000 population \rightarrow 18 per 1,000 cases



Example: Country with 60 million people

6 million infected people

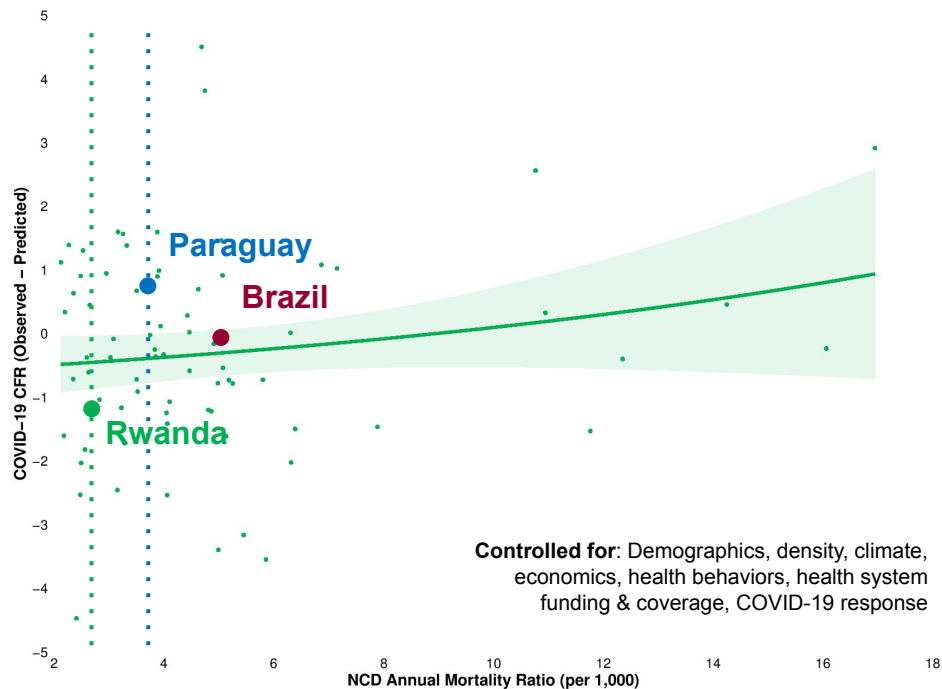
108 thousand deaths



36 thousand deaths averted



- 5.00 per 1,000 population \rightarrow 24 per 1,000 cases
- 3.75 per 1,000 population \rightarrow 18 per 1,000 cases
- 2.50 per 1,000 population \rightarrow 14 per 1,000 cases



Example: Country with 60 million people

6 million infected people

84 thousand deaths



60 thousand deaths averted

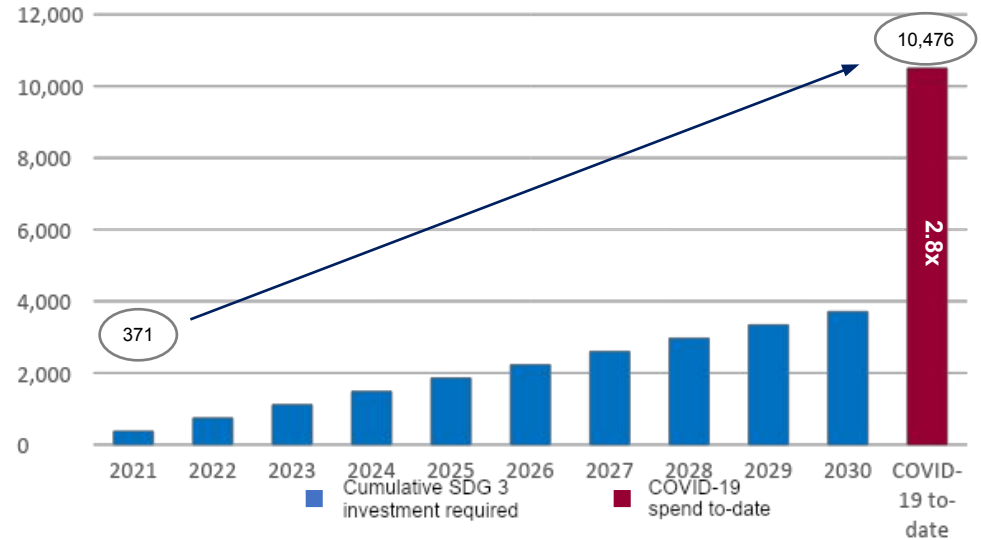
The amount spent globally on COVID-19 response in one year is 2.8x what is required to achieve all SDG 3 goals



SDG 3 annual investment required: USD 371 billion

COVID-19 health-related spend in one year: USD 10.5 trillion

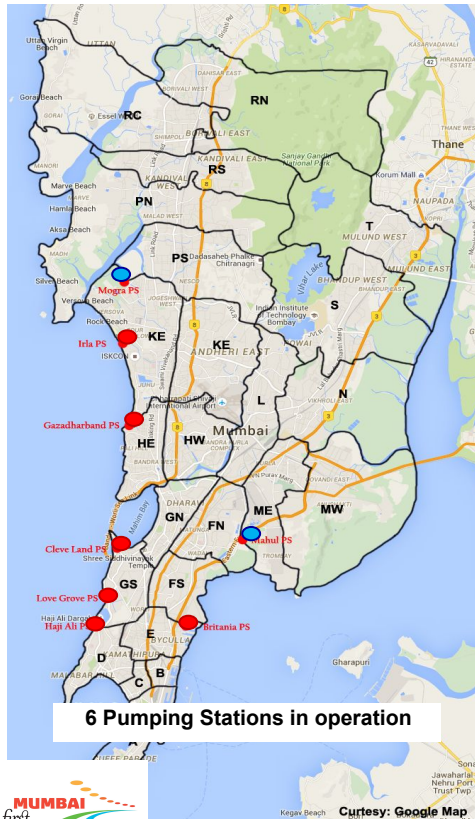
Cumulative funding required to reach all SDG 3 goals vs COVID-19 spend to-date (in USD billions)



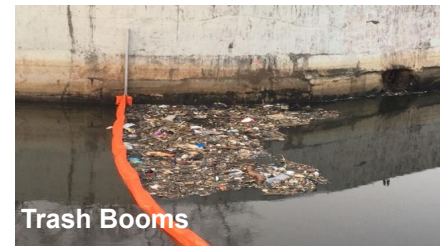
Source: World Economic Forum, Devex



Flooding – Today’s technologies barely capable to solve today’s problems : Tomorrow’s problems need tomorrow’s technologies

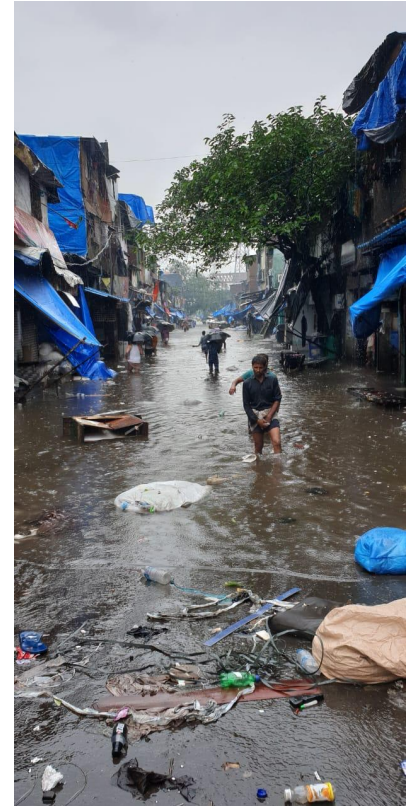


Measures taken post 2005: Prevention & Mitigation

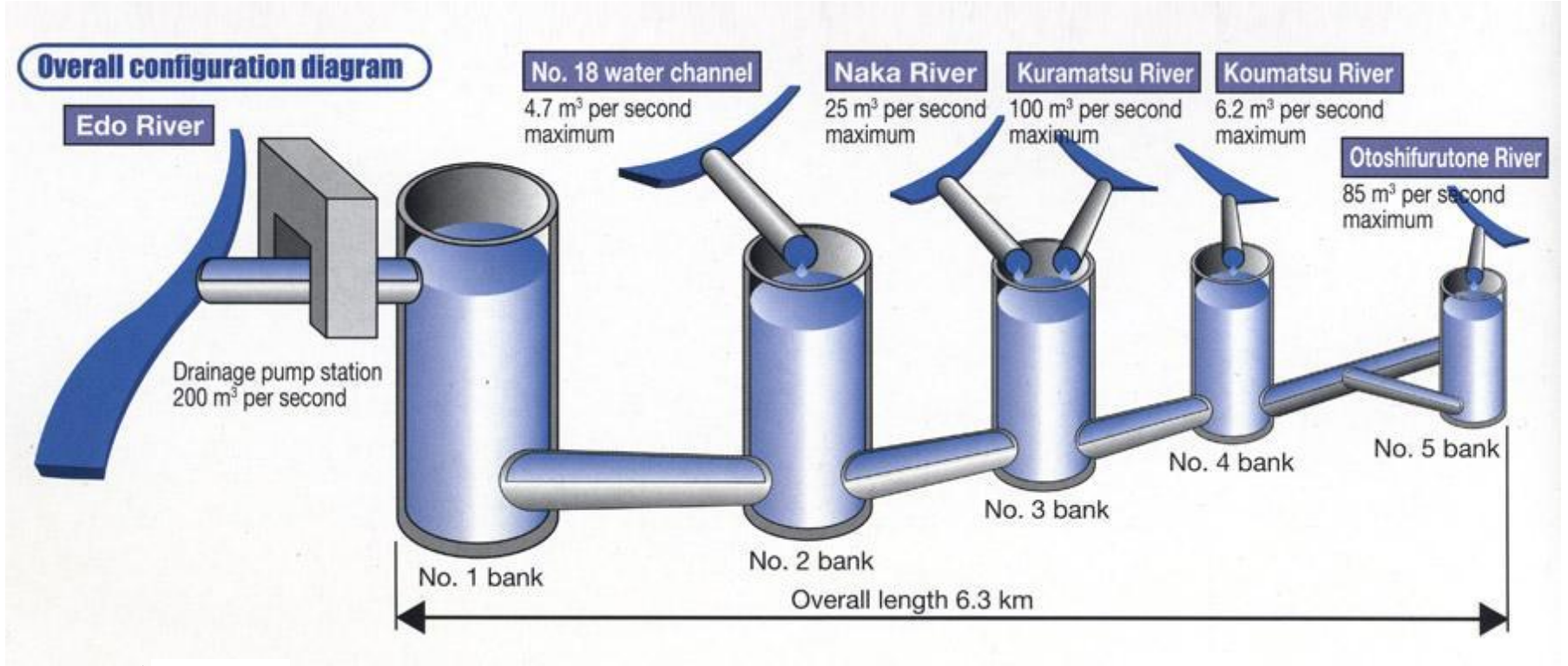


Despite these interventions, flooding in Mumbai happened in 2019

40% of rainfall in 2019 in Mumbai was received in just 3 rainfall events
CLMATE CHANGE is leading to greater intensity of rainfall in very few rainfall events



Flooding – Solutions built in Tokyo



Some Principles

- Have 'dream' vision , work with your team and larger external stakeholders to align your vision with their ownership
- Work with elected representatives to share common developmental vision and coordinate and share actions being taken to give them ownership
- Partnership with all opposing forces before they become opponents : NGO, civil society groups, press
- Knowledge driven, counter intuitive approach to policy making rather than routine incremental approach
- Problem solving approach with juniors rather than instruction and order giving approach
- Can work with Judiciary for common developmental goals

