WATER DISTRESS IN GROWING CITIES
Issues & Challenges
**DIRTY PICTURE**

Despite rapid urbanisation, cities fail to meet growing water demand, treat sewage, finds CSE study

**NEW DELHI**: Major metros like Delhi and Mumbai face huge water and environmental crises as infrastructure tries to keep pace with the increasing population, says a new study of 71 Indian cities.

The report, Excreta Matter, prepared by the Centre for Science and Environment (CSE), comes at a time when India is urbanising at the highest rate in the world and half of all Indians are expected to be living in cities by 2050. "If we do not get the arithmetic of water waste right, it will drown us in its own excreta," said Sunita Narain, CSE’s director general.

The study presents the dirty picture of Indian cities’ capacity to treat less than half the sewage they generate. Moreover, the dirty sewage generated flows into rivers like Yamuna in Delhi, Mithi in Mumbai and wetlands in east Kolkata. Even a modern city like Bangalore is able to treat just 30% of its sewage.

What is worse, the treated sewage is not even utilised for non-food or non-bathing purposes. “Most cities don’t have water management plans,” the report says.

The study also points out another major flaw — water loss during distribution. Over 35% of water in Delhi and about 50% in Mumbai is lost because of leaks, the report says.

Delhi extracts around 12% of its supply of 1,824 million litres per day (MLD) from the ground but fails to replenish the same amount by way of water harvesting. The availability of water in certain regions is around 63 metres below the ground. Even though the capital’s population has increased by 50% since 1991, the increase in water connections is just 3%, the report says, indicating that the Delhi Jal Board has failed to augment water supply in the city.

Mumbai faces no better. Residents of high-rises receive about 220 litres per capita per day whereas those in slums get less than 40 litres. With its population estimated to be 15 million in 2011, it needs about 1,200 MLD to meet the demand.

**KOLKATA**:

- **Existing demand (2011):** 1,049 MLD
- **Existing supply:** 790 MLD
- **Extra supply possible if leakages plugged:** Nil
- **Required increase in water supply:** Nil
- **Total sewage generated:** 1,121 MLD
- **Treatment capacity:** 173 MLD
- **Treated:** 173 MLD
- **Disposal:** East Kolkata wetlands and Hooghly river

Mumbai is slightly better than the two in meeting its water requirement but may fall in the same trap if its sewage treatment capacity is not increased. From a water-surplus city, Kolkata is turning into a water-deficient city.

Source: CSE

**Hindustan Times, 21/02/12**
One of the first big accounts of urban floods is from July, 2004, when the Brahmaputra River at the peak was flowing at 1.75 meters above the danger mark.

Source: Volume 3 Impacts of Floods and Landslides on the Iconic Cultural Heritage of Guwahati, For ASDMA, Government of Assam
Comparing the Two scenarios...

Case of Guwahati...

Deepor Bil, reduced from 40sq.m. to 4sq.km

Case of Chennai...

Pallikaranai marshlands, reduced from 250sq.m. to 50sq.km
The part of city that floods the most...
One of the first big accounts of urban floods is from July, 2004, when the Brahmaputra River at the peak was flowing at 1.75 meters above the danger mark.

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Cause For Flooding
BRAHMAPUTRA RIVER – Level of Brahmaputra Bed higher than the CITY level
- RAINWATER FROM MEGALAYA – as it is on higher topography
- UNBALANCE IN WATERSHED
Back flow from brahmaputra

SLUICE GATE TO DIVERT WATER & BLOCK BACK FLOW FROM RIVER

Water from Guwahati backflows into the storm water drain when it reaches HFL...
One of the causes for FLOODING

**PERMEABLE SURFACES**

- **10% RUNOFF**
- **40% EVAPORATION**
- **50% DEEP INFILTRATION**
- **75%-100% PERMEABLE SURFACE**
  - Rainwater - Infiltrates in porous soil as ground water
  - Stored as ground water
  - Seeps in stream
  - Prevents flood by not entering directly in streams.

**IMPERMEABLE SURFACES**

- **30% EVAPORATION**
- **55% RUNOFF**
- **15% DEEP INFILTRATION**
- **75%-100% IMPERMEABLE SURFACE**

**RAPID URBANIZATION**

- Roads
- Parking lots
- Building Pavements

**INCREASED QUANTUM & INCREASED SPEED**

**Source:** Federal Interagency Stream Restoration Working Group (FISRWG) US.
Stormwater challenges

CURRENT

**STORMWATER** one of the major cause for **FLOODING** in the city.

- **LAND SLIDE**
- INCREASE in **RISK** of Landslide
- **SILTATION OF DRAIN**
  
  Reducing carrying capacity

**DECREASED CARRYING CAPACITY**
**LEADING TO FLASH FLOODS**

Current Techniques to De-silting Nallahs in Guwahati
One of the causes for FLOODING

Siltation because of slope erosion

Siltation along natural storm water drains in Guwahati, Assam
Slope stabilization techniques

PROPOSED

Geo-grid
Image Source: www.grasscrete.com
Natural slope stabilization

EXISTING

PROPOSED
Cross sectional correction & restoration of riverine ecology

- Existing cross-section
- Proposed gared section with slope correction
- Extra safety buffer (35-50% of existing area)

Non-monsoon flow (all year)
Every rain (29 days/year)
Heavy rain (10-15 days/year)
Once in every 5 years

- WALKWAY & CYCLE TRACK
- BIOSWALE
- WATER QUALITY TERRACE
- BIO FILTRATION TERRACES
- RESTORED WETLAND
- UPPER LEVEL WALKWAY
- BIOSWALE
- GREEN SLOPE
Case of Delhi - Ridge & the River

Delhi’s stormwater drains from the western ridge areas to the river situated in the east. There are 19 major drain outfalls into the River Yamuna.

- Rain water falls on green area
  - some quantity soak in.
  - rest goes to near by drain.

- Other areas
  - Some let the rain water go into the near by drain on road
  - Plots above 100 sq. mt. should do rain water harvesting as per building bye laws.

- Roads
  - All water goes to nalla and then to river.
  - No ground water recharge.

Source: GOOGLE MAPS

60% OTHERS

45% GREEN

25% ROAD
One pipe leading to Another

All the stormwater falls on road and it is diverted towards the closest nala or drain.
Eco system services

All the green areas in the city should be connected and programmed to help in storm water management.

As per Delhi’s MPD 2020
“ZERO RUN OFF
SHOULD BE ACHIEVED”

The Present drainage system targeting
“100% RUN OFF”
Design Strategies for sustainable SWM

MANAGE STORM WATER IN A CITY BY ADOPTING FOLLOWING MEASURES

- FILTRATION
- CONVEYANCE
- DETENTION
- RETENTION
- INFILTRATION

SLOW ➔ SPREAD ➔ SOAK
Storm water management techniques

- **Filtration**
  - Gravel filter chamber
  - Gravel filter strip
  - Vegetated filter
  - Riparian buffer

- **Conveyance**
  - Bio swale
  - Planters

- **Detention**
  - Detention pond
  - Dry swale

- **Retention**
  - Retention pond
  - Constructed wetland
  - Underground storage tank
  - Rain water harvesting

- **Infiltration**
  - Infiltration trench
  - Infiltration basin
  - Permeable paving
  - Rain garden
New strategy for disconnecting from the conventional pipe system and using all possible alternate areas for recharge.
Storm water facilities that can be put on Road
1. A riparian buffer is a vegetated strip along the banks of flowing water body.

2. Riparian buffers are a simple, inexpensive way to protect and improve water quality through local plant materials.

3. Buffer strips structurally stabilize banks and shorelines to prevent erosion. Trees and shrubs provide shade to maintain consistent water temperature necessary for the survival of some aquatic life.
SEWAGE WATER IN A CITY
River Yamuna in Delhi

22 KM STRETCH IN DELHI
2% OF TOTAL RIVER LENGTH

BUT

70 % OF TOTAL POLLUTION LOADED IN YAMUNA IN DELHI

(BOD:>40; COLIFORM: 24MILLIONS)
Stop the pollution at the source

Better to catch and treat the pollution at source rather than treating the entire polluted water body

DECENTRALISED WASTE WATER TREATMENT
Case study of biological waste water treatment

OSHO PARK, PUNE
An overview of sewage treatment strategy

Raw Wastewater Influent

\[\downarrow\]

Screens

\[\downarrow\]

Grit Chamber

Primary Residuals (e.g. grit, rags, etc.)

Primary Sludge

Primary Settling Tank

Biological Treatment System (attached growth system e.g. trickling filter)

Wetland (constructed wetland)

Disinfection (selective)

Treated Wastewater Effluent

Discharge to receiving rivers

Typical section showing the concept of pool & riffle

Source: AquaBio Environmental Technologies, Inc.

www.aquabiocleanup.com
Wetlands, case study: Hongkong Wetland Park

Natural trails and decks to enjoy the scenic beauty of the place

Role of plants in purification of water
South Delhi Greenway

Key elements

1. ECO MOBILITY CORRIDOR
2. MULTI MODAL INTEGRATION
3. ACCESSIBILITY & VISIBILITY
4. OPEN SPACE MANAGEMENT
5. WASTE WATER TREATMENT
6. STORMWATER TREATMENT
7. ECOLOGY-BIO DIVERSITY
8. WORKING LANDSCAPE
9. HERITAGE
EXISTING
RIVER FRONTS AS DESTINATION SPACE
STRATEGY FOR MORA BHARALU
SOLAR RIBBON
CONGRATULATIONS TO THE WINNERS OF INDIA’S FIRST SMART CITIES CHALLENGE!

CONGRATULATIONS, GUWAHATI!

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