Center for Science and Environment, New Delhi
Webinar on
Protecting Flood Plains
Webinar on 25 April 2024
Existing Policies, Plan and Practices for flood plains
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Content

- National and State Policies for flood plains
- International practices
- Climate Adaptive Planning
- Conclusion
Flood scenario in India

- 21 States/UT Out of total 36 are affected by flooding.
- Madhya Pradesh, Assam and Maharashtra are the top states affected by Flooding. (In terms of Human loss, Housing damage, Crop damage etc.)

### Flood affected states

<table>
<thead>
<tr>
<th>States</th>
<th>No of Districts</th>
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</thead>
<tbody>
<tr>
<td>Dadra &amp; Nagar Haveli and Daman &amp; Diu</td>
<td>20</td>
</tr>
<tr>
<td>Uttarakhand</td>
<td>19</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>18</td>
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<tr>
<td>Telangana</td>
<td>17</td>
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<tr>
<td>Tripura</td>
<td>16</td>
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<tr>
<td>Sikkim</td>
<td>15</td>
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<tr>
<td>Odisha</td>
<td>14</td>
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<tr>
<td>Nagaland</td>
<td>13</td>
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<tr>
<td>Meghalaya</td>
<td>12</td>
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<tr>
<td>Meghalaya</td>
<td>11</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>10</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>9</td>
</tr>
<tr>
<td>Kerala</td>
<td>8</td>
</tr>
<tr>
<td>Karnataka</td>
<td>7</td>
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<tr>
<td>Himachal Pradesh</td>
<td>6</td>
</tr>
<tr>
<td>Gujarat</td>
<td>5</td>
</tr>
<tr>
<td>Goa</td>
<td>4</td>
</tr>
<tr>
<td>Chhattisgarh</td>
<td>3</td>
</tr>
<tr>
<td>Bihar</td>
<td>2</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>1</td>
</tr>
<tr>
<td>Assam</td>
<td>1</td>
</tr>
<tr>
<td>Arunachal Pradesh</td>
<td>1</td>
</tr>
</tbody>
</table>

*Source: Report publish by Ministry of Home Affairs Disaster Management Division Dt. 6th August, 2022,*
Policy framework for floodplains

The Ministry of Water Resources in 1975 had issued a draft Model Bill on floodplains and asked the states to frame legislation. Land and flood management is a state subject. However very few state enacted a law. Manipur was among the first to frame the Manipur Flood Zoning Act in 1978, while Uttarakhand came up with the Uttarakhand Flood Plain Zoning Act 2012. The National Disaster Management Authority (NDMA) in 2008 also issued guidelines for states for floodplain zoning as an important “non-structural measure” to mitigate floods. These guidelines only suggestive and non-binding to the states. The Maharashtra government also created norms to regulate and talked about prohibitory zones in floodplains of its rivers.
National and state Policies

Policy framework for floodplains

The 2021 report of a NITI Aayog Committee, for the formulation of strategy for flood management works in the country, also recommended floodplain zoning as an important non-structural measure to counter flood damages.

After 2019 floods in western Maharashtra, Govt. set up committee and submitted report in 2020. A cursory analysis of these floods revealed that it was not just fury of nature that wrecked havoc but large problem attributed to the human interventions in the riverine and stream ecosystem.

To set up flood zoning authorities for Sangli and Kolhapur districts with necessary powers, function and duties for regulating land uses in the flood plains and restrictions/prohibiting/removing obstructions to the natural drainage. It also suggested amendment of the Maharashtra Irrigation Act, 1976 clause 16 for demarcation of flood plains.
National and state Policies

Policy framework for floodplains
There is institutional fragmentation, and this is more pronounced in the case of water. There are different institutions to deal with different aspects of water and there is very little coordination amongst them.

For example, the institutions that deal with surface water is different from the ones that deal with groundwater. This is mainly because surface water and groundwater are seen in silos.

Large scale urban agglomeration where large amount of land use changes occurs does not come under jurisdiction of water management co-ordinations.
International Practices- Netherlands

The Netherlands- Room for the River approach
Spatial planning and flood risk management issues in the Netherlands are guided by the National Adaptation Strategy, the Delta Plan on Spatial Adaptation under the national Delta program (based on the Water Act) and the Spatial Planning Act. Following devastating floods in 1953, the Dutch adopted flood management solutions, which prevented water from reaching the city.

Meerlaagseveiligheid flood risk management approach, which adopted a multilayer security approach where in addition to prevention measures, flood risk is reduced by adapting spatial planning and urban design of the city to include water management, and by introducing disaster management.
In Rotterdam, different aspects of water management are managed by various organisations and are financed on different levels. Primary flood protection from major rivers and against storm surges from the North Sea is handled by the national government and financed by the state’s general funds (Delta tax).

1. **National/state water services under the Ministry of Infrastructure and Water Management**
2. **Province of South Holland**
3. **Water boards**: Hollandse Delta Water Board and Water Board of Delfland
4. **Water company**: Evides (semi-public)
5. **Rotterdam Municipality**
Center of Excellence for Sustainable Urban Transformation

Long-term strategic initiative (Source-Pathways-Receptor)

– To transform our utilitarian drains, canals and reservoirs into vibrant, aesthetically pleasing and clean flowing streams, rivers and lakes

– To bring people closer to the water so that they will cherish and take ownership

– To create a seamless blue-green network well integrated with the adjacent developments
Singapore’s problem is not lack of rainfall but lack of space to capture and adequately store water.

Under the 1972 Water Master Plan, a water catchment policy was developed, which oversaw the development of catchment areas and reservoirs to collect rainwater to boost local water supply.

The first drainage master plan was thus developed in close consultation with development agencies like the Urban Redevelopment Authority (URA), Housing and Development Board (HDB) and Jurong Town Corporation (JTC).

Singapore is now preparing for more intense and frequent extreme storms. To cope with the intense rainfall, PUB, Singapore’s national water agency has adopted a “source-pathway-receptor” approach.
This approach uses catchment-wide solutions to achieve higher levels of flood protection. This holistic approach allows the system to be flexible and adaptable, addressing not just the drains and canals through which stormwater travels (pathway), but also in areas where stormwater runoff is generated (source) and areas where floods may occur (receptor).

In Singapore, the idea of multifunctional urban spaces for flood management is advocated. The Framework, which serves to guide the enhancement of existing natural assets and the development of residential landscapes to enhance liveability.

Framework’s guidelines on flood hazard mitigation suggests designing multifunctional green and open spaces (e.g. sports fields, outdoor ways to incorporate multifunctional basketball courts, paved plazas) to function as emergency flood detention basins during extreme storm events.
Planning in Mula Mutha sub basin

Urbanization along the river - Heavy urbanization in PMC and PCMC areas over the past few decades has led to haphazard urban development along the river. At some locations, the development extends right up to the edge of the river.

Pune lies on the western margin of the Deccan plateau, on the leeward side of the Sahyadri mountain range. The city is blessed with Mula and Mutha Rivers that originate in the Sahyadri ranges and traverse across Pune. The two rivers further meet and upon their confluence Mula-Mutha river is formed which further drains itself into the Bhima River. The total length of these three rivers traversing through Pune Municipal Corporation is 44km approximately. Out of this, 22.2km is Mula River, 10.4km is Mutha River and 11.8km is Mula Mutha River.
Pune city falls within flood plain area of rivers, the very basis of establishment of Pune city. In the floodplain region the rivers deposit fertile silt and sediments along its banks. These fertile banks are ideal for agriculture and thus attract a settlement.
Pune City

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Land Cover

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>(1991) % Area</th>
<th>(2015) % Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water bodies</td>
<td>1.70</td>
<td>0.92</td>
</tr>
<tr>
<td>Agricultural Land</td>
<td>4.65</td>
<td>1.08</td>
</tr>
<tr>
<td>Vegetation Cover</td>
<td>25.76</td>
<td>14.22</td>
</tr>
<tr>
<td>Settlement area</td>
<td>29.07</td>
<td>49.30</td>
</tr>
<tr>
<td>Open / Barren Land</td>
<td>38.82</td>
<td>34.48</td>
</tr>
</tbody>
</table>

Map: Dr. Shrikant Gabale
Pune city - Urbanised areas

Urbanization along the river - Heavy urbanization along rivers from last many decades has led to haphazard urban development along the river. At some locations, the development extends right up to the edge of the river.

The expansion of Pune city with every development plans (DP) from 1956 covered more land surface. The rising construction activities have altered the topography, drainage, and geomorphic environment of the region. This had negative impacts on the physical environment such as loss of agricultural land, surface and groundwater depletion, changes in geomorphic features, flooding, and others, have increased as the city expanded.
Climate adapted planning for Urban Flooding

A map preparation can combine information about land elevation and permeability (some of this information can be found in land-use plans), in order to develop a hydrodynamic assessment.

To complete the flood vulnerability analysis, cities can overlay a map of flood-prone areas with one of socio-economic indicators (such as the number of low-income households) or the city’s critical infrastructure.

Looking beyond spatial planning's role in regulating the development and use of land.
### Climate adaptive planning

#### Three main steps for flood management

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Developing future projections at a local scale</td>
</tr>
<tr>
<td>2</td>
<td>Mapping out vulnerable population, assets and infrastructure</td>
</tr>
<tr>
<td>3</td>
<td>Determining the city’s flood adaptation capacity</td>
</tr>
</tbody>
</table>
Climate adaptive planning

1. Developing future climate projections at a local scale

- There are needs of a wide range information about urban weather and environment, including the following aspects:
  1. *Weather and environmental service for better city operations*
  2. *Urban air quality forecast and environmental emergency response*
  3. *Weather and environment Service for public health*
  4. *Mitigation and adaptation to climate change and sustainable development*
2. Mapping out vulnerable population, assets and infrastructure

Multi-Scale Disaster Vulnerability Analysis, disaster prevention Planning

Exposure

Sensitivity

Urban Potential Vulnerability

Adaptive Capacity

Urban Climate change disaster vulnerability
High Risk – Area with flood index of 0.7 to 1. The high risk areas are the areas which have chances getting inundated immediately after the flood occurs. - 89.5 sq.km
Moderate risk – Area with flood index of 0.5 to 0.6. These areas have less chances of getting inundated as compared to high risk areas, -82.17 sq.km
Low Risk – Area with flood index of 0.1 to 0.4. The areas which have negligible chances of getting flooded. 75.56 sq.km
No risk – 42.77 sq.km
Extreme weather events such as surface water flooding caused by incidents of heavy rainfall and climate change impacts have a spatial footprint, although the location and extent of this footprint is subject to considerable uncertainty from event to event.

Spatial planning provides a key policy lever that can be applied to the task of urban adaptation. Looking beyond spatial planning's role in regulating the development and use of land, reasons for this include the forum it provides for stakeholder engagement and that it offers a nexus for planning much of the key infrastructure supporting cities.
Climate adaptive Planning

Integrated ground water recharge approach

Through overlay analysis of TWI, Soil, Water level, water drainage density, landcover and slope map potential zones for interventions are identified as shown in map.
Integrated groundwater recharge

Water infiltration Map

Aquifer disposition map of Pune city (Map: ACWADAM)
Flooding: How to increase your city’s permeability

Incentivise or require increased permeability on public and private property
Charging property owners for impervious surfaces on their land.

Offering grants for the installation of permeable surfaces and rebates or other credits to properties with greater permeability.

Incorporating permeability requirements into codes and ordinances for new developments and existing property.
To further expand permeable surfacing in new developments, cities can provide permitting credits and discounts, require permeability assessments or incorporate minimum standards into building codes for new developments and major retrofits.
Conclusions

India has poor regulation of its river floodplains. Flood Plains Protection Act must be enacted by all states. Flood Plain protection is better be done through a river basin approach in implementing flood plain zoning and integrated flood management. Both Singapore and Netherlands cases shown the importance of spatial planning for addressing floods in cities. In Indian context along with spatial planning underground water resource must be integrated. Better results for flood plain protection only be obtained through public participation. Master Plans/Development plans must be prepared based on watersheds and aquifers locations.
References


Living with Water E-book By Centre for Liveable Cities, 45 Maxwell Road #07-01, The URA Centre Singapore 069118


Evolution as opposed to revolution seems to us to be the most likely development scenario in which elements of both the “high-tech” and the “low tech” approach will play complementary roles in solving the flood Plains problems.