



URBAN FLOOD RISK ASSESSMENTS

AND

PROGRAM OF MEASURES

FEBRUARY 2024



AGENDA OF THE MEETING

1. Urban Flood Risk
2. India challenges
3. What is all about?
4. Approach required
5. Data for Urban Flood Risk assessments
6. Flood Hazard and Risk Maps
7. Program of Measures
8. Conclusions

URBAN FLOOD RISK IN INDIA

- High loss of life and damages:
 - Over 17,000 dead between 2012-2021 (The Hindu)
 - Over US\$ 4.2 billion in losses 2022 (World Meteorological Organisation 2022)
- Unprecedented urban expansion
 - India has the second-largest urban population globally. By 2050, an additional 416 million people, resulting in 50% urban population (Niti Aayog, 2022)
- Every city is different, and it is likely that several flood sources coincide in one location

Major Flooding Events

2000	Hyderabad
2001	Ahmedabad
2002-03	Delhi
2004	Chennai
2005	Mumbai
2006	Surat
2007	Kolkata
2008	Jamshedpur
2009-10	Delhi
2010	Guwahati
2014	Srinagar
2015	Chennai
2023	Delhi, Chennai



Inadequate integration of urban and infrastructure development



Unsynchronized spatial and economic planning



Inadequate governance structure



Sub-optimal land use management



Policy and regulatory constraints



THE WORLD BANK

INDIA'S URBAN FLOOD CHALLENGES

- **Inadequate and outdated infrastructure with deficient maintenance**
- **Accessibility and unavailability of current flood hazard & risk modeling** – cities lack financial and/or technical capacity for hydrodynamic modelling
- **High-population density and associated vulnerabilities** - rampant encroachments on watercourses , high densities limit options for flood mitigation
- **Institutional inadequacy, capacity, and enforcement** - fragmentation of stormwater management across multiple government agencies, lack of capacity, and poor enforcement of flood control measures
- **Need for updated regulatory guidance for climate-resilient design** - statutory frameworks should incorporate more climate-conscious considerations into key instruments like master plans, zoning laws, road design, and building codes
- **Non-responsive urban planning & lack of integration of flood risk analysis** – long horizon master plans limit their efficacy and relevance

WHAT IS ALL ABOUT?

- **EU Floods directive**

- After the floods in 2005, there was a need to change approach
- 2007 EU Floods directive to be implemented in cycles
- Proactive, flexible and Adaptable to different realities
- To reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity.
- Unified approaches
- Catchment approach
- Stakeholder engagement

- **Resulting in three stages**

- Preliminary Flood Risk Assessment
- Flood Hazard and Risk Maps
- Flood Risk Management Plans with Program of Measures



APPROACH REQUIRED

- **Awareness**

- Risk awareness for current flood risks and future risks exacerbated by climate change is **IMPERATIVE** to plan
- No such thing as zero risk
- Implement flood risk assessments and communicate, disseminate results.

- **Proactive and systematic planning**

- Traditionally reactive approaches post massive events have taken place
- Absence of systematic, integrated and catchment approaches

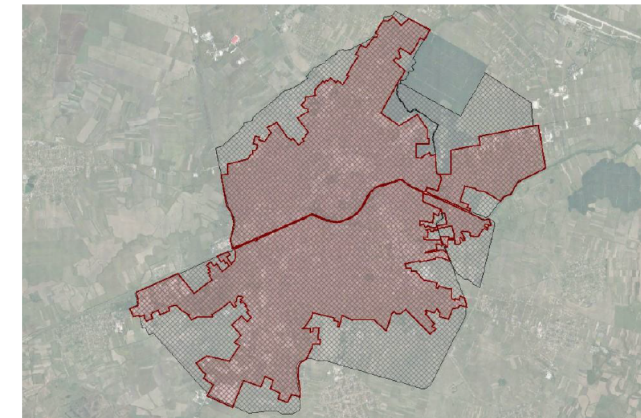
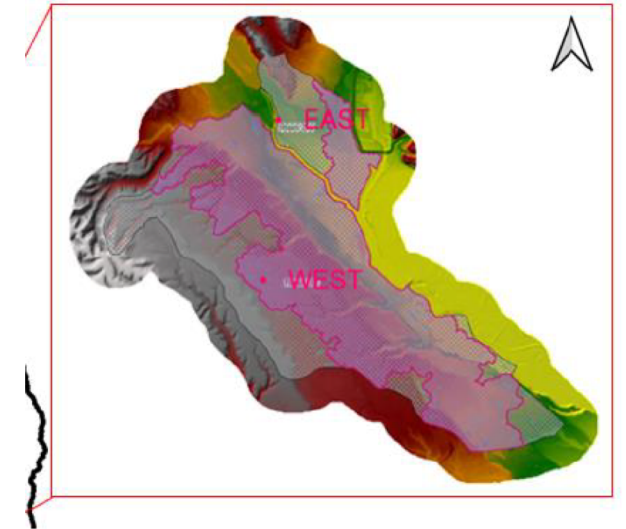
- **Implementation**

- Essential to transform the planning into actions and projects to be implemented
- Typical constraints exist - available funding and capacities
- WB is available to assist and fill in the gaps

REQUIRED

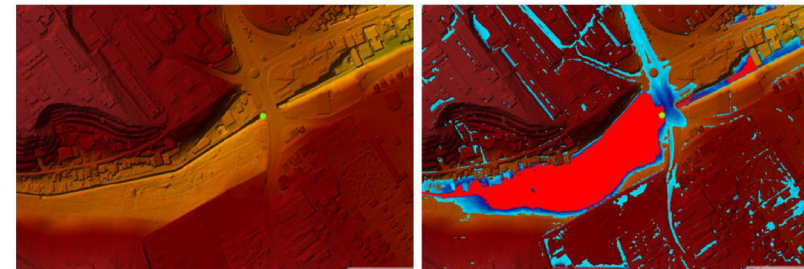
DATA FOR URBAN FLOOD RISK

- **Digital Terrain Models and topographic data**
 - These are required to be very accurate with a minimum of 15 cm vertical accuracy as this is what will most affect the quality of the modeling outputs
 - Additional topographical surveys are needed to refine critical areas
 - Detailed topographical information of the drainage network to be modelled
- **Exposure data**
 - Detailed information about exposed elements by sector should be mapped in GIS and especially critical infrastructure e.g. economic activities, protected areas, hospitals, schools, fire stations, roads, water supply, bridges, etc.
 - This needs be updated regularly
- **Flood sources and historical data**
 - The flood sources causing the flooding in the city should be identified and studied
 - Historical information such as flood maps, water marks, emergency interventions records should be collected.

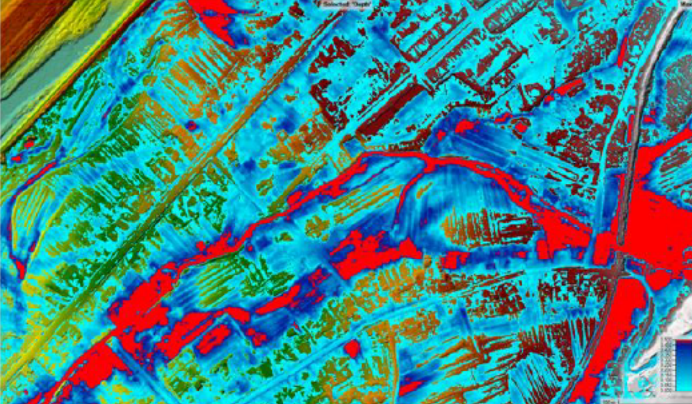
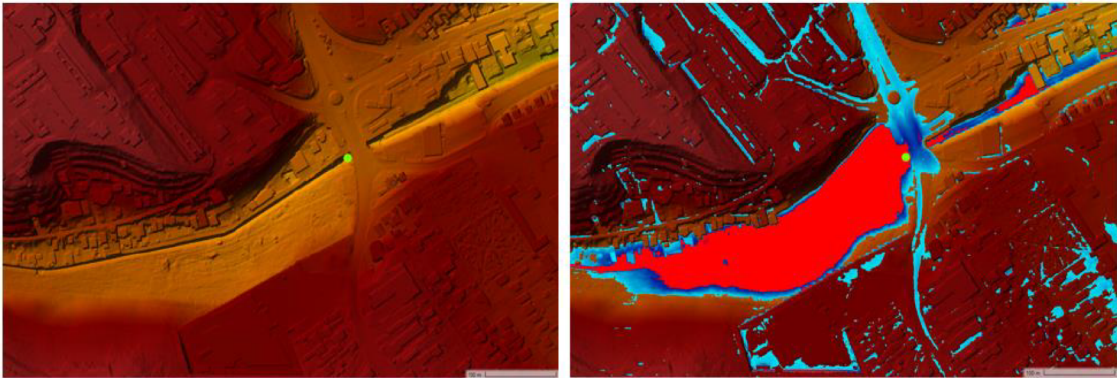
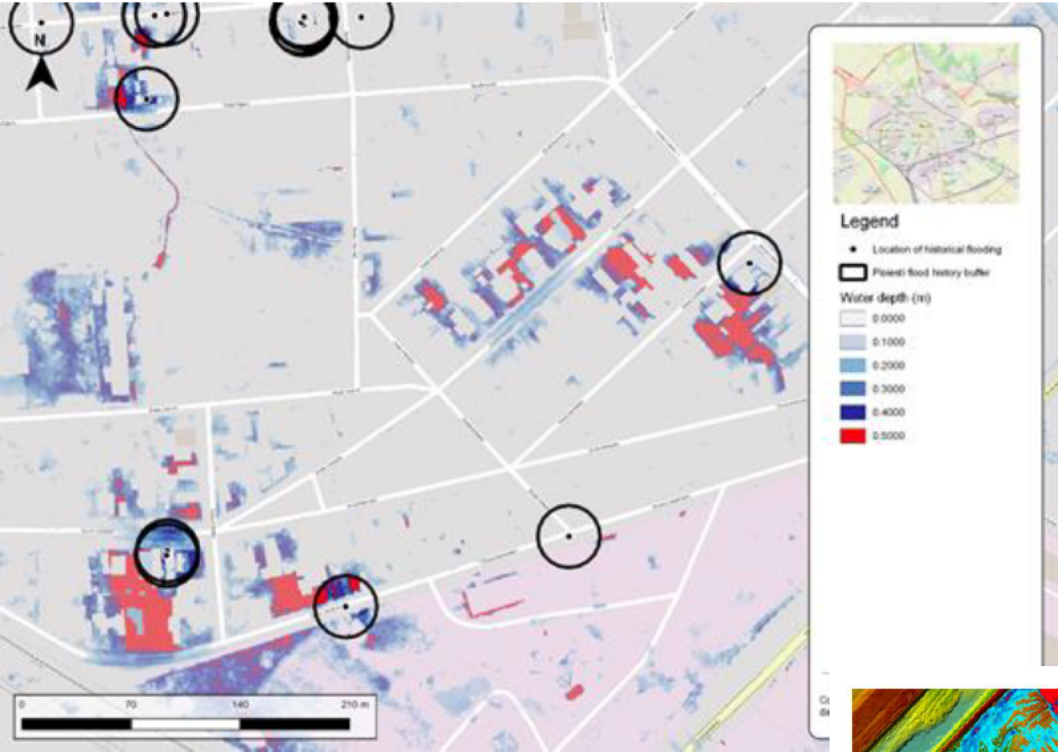


FLOOD HAZARD AND RISK MAPS

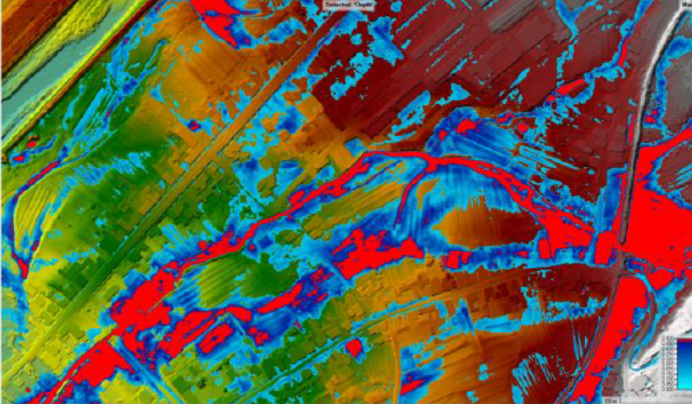
- **Definition of methodologies for each flood sources**
 - The should be based in best international best practices and considering the local specificities. This documents should be flexible and updated regularly.
- **Collection, curation and QC of the data**
 - This part is key as this will affect the final results and all the needed data needs to be collected and curated and quality controlled considering the purpose to which will be used.
- **Setup of the models, calibration and obtaining outputs**
 - The flood sources causing the flooding in the city should be identified and studied
- **Developing the hazard and risk maps and make it available to the public**
 - With output of the models GIS maps such as water depth rasters, velocity rasters, AED rasters are produced and publish normally in web viewer accessible for the public.



FLOOD HAZARD AND RISK MAPS



• Raw output



• Post processed

PROGRAM OF MEASURES

- **Definition of methodology**

- This needs to include a multi-criteria analysis that will help prioritize the right balance of grey and green infrastructure and at the same time prioritize non-structural measures.
- Cost-benefit analysis is also required to prioritize measures
- Approaches for most vulnerable are possible

- **Collection, curation and QC of the data**

- Here the Flood Hazard and Risk Maps play an important role
- Other data like property rights, critical infrastructure, etc.

- **Balanced program of measures**

- This will provide a set of prioritized measures
- Project concepts that provide preliminary designs and an evaluation of the reduction of the flood risk and new CBA

PROGRAM OF MEASURES

MCA CRITERIA				
Social	Economic	Cultural	Environmental	Implementability
INDICATORS PER CATEGORY				
<ul style="list-style-type: none"> • Domestic properties • Human health • Water abstraction for human consumption • Social infrastructure • Recreational infrastructure • Marginalised and vulnerable communities • Resilience 	<ul style="list-style-type: none"> • Transport infrastructure • Utility Infrastructure • Non-domestic properties • Economic output • Agriculture 	<ul style="list-style-type: none"> • Cultural Assets • Landscape and townscape 	<ul style="list-style-type: none"> • Pollution • Biodiversity • Fisheries • Naturalised rivers (related to hydro-morphology) • Water quality • Land quality • Climate change vulnerability • Greenhouse gas sequestration 	<ul style="list-style-type: none"> • Implementability

CONCLUSIONS

- The problem is starting to be too big to be manage and requires immediate action
- Need for an Urban Flood Risk Assessment and Management framework that will guide cities in how to assess risk and develop program of measures to inform City Storm water management plans
- At the same time, there is need to introduce Flood Risk Management into Urban and Spatial Planning
- There is a need to create a National program that will provide funding and capacity building support to implement the framework at state and municipal level.

THANK YOU

