Flood Risk Assessment

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Contents:

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Background:

FLOOD → An overflow of water from the channel/ stream that submerges land typically due to heavy rainfall. Can have significant impact on ecosystem, agriculture and urban areas.

FLOOD RISK → Refers to potential adverse impacts both in damage and losses, that can arise due to flooding.

Probability – Frequency of an event to occur

Vulnerability – Susceptibility of people, property and environment

Exposure – Extent to which assets and populations are flood-prone

Resilience – Ability to withstand

FLOOD RISK ASSESSMENT → Refers to evaluating the potential of flooding in an area and understanding associated risks

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Background: …. 3

Singh et al. (2006), Sharma et al (2009), Singh et al (2012)

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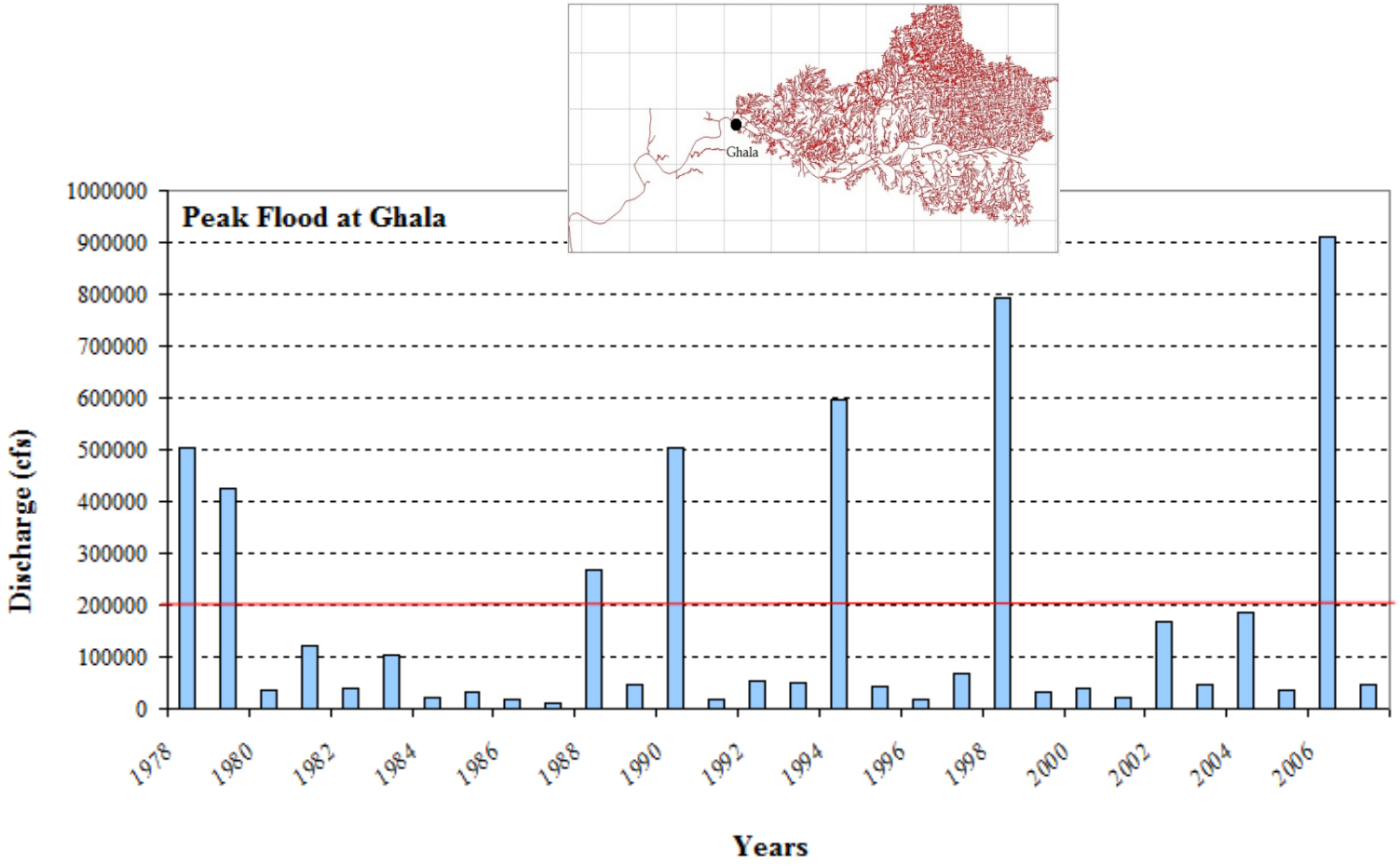
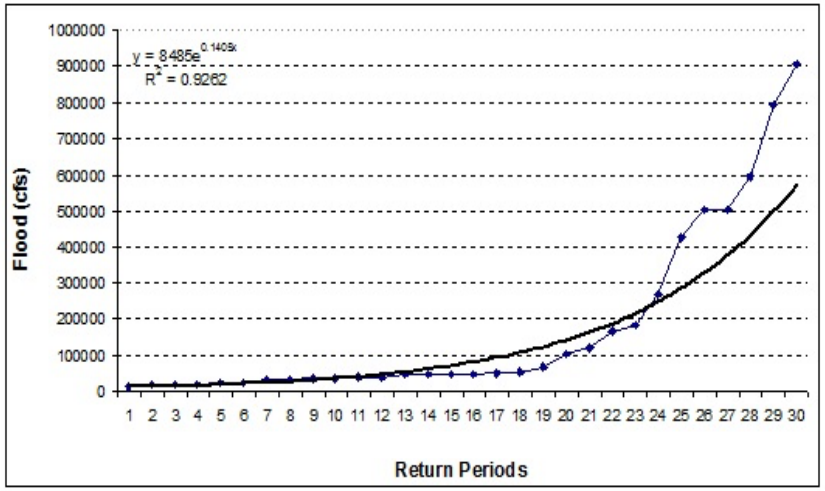
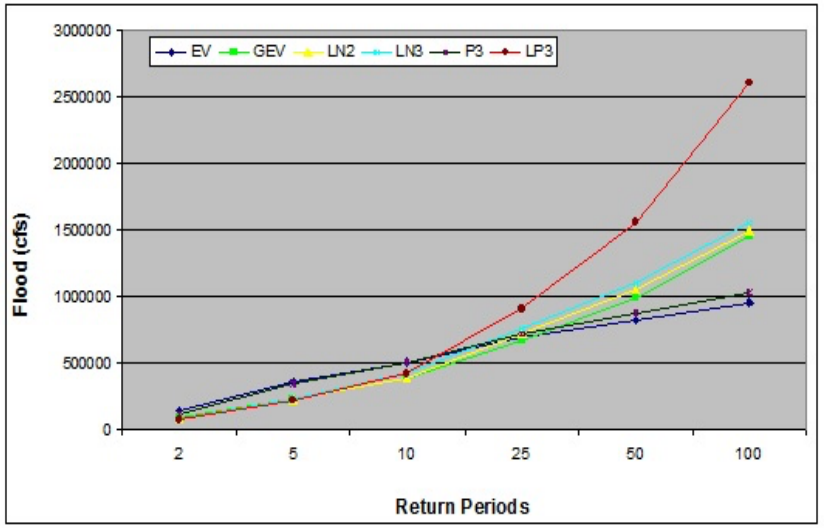






Flood Risk Analysis:

$$\text{RISK} = \text{Probabilities} * \text{Consequences} = \sum p(x) * x \qquad \ldots\ldots (1)$$

Flood Risk Measurement:

1 **Planning**

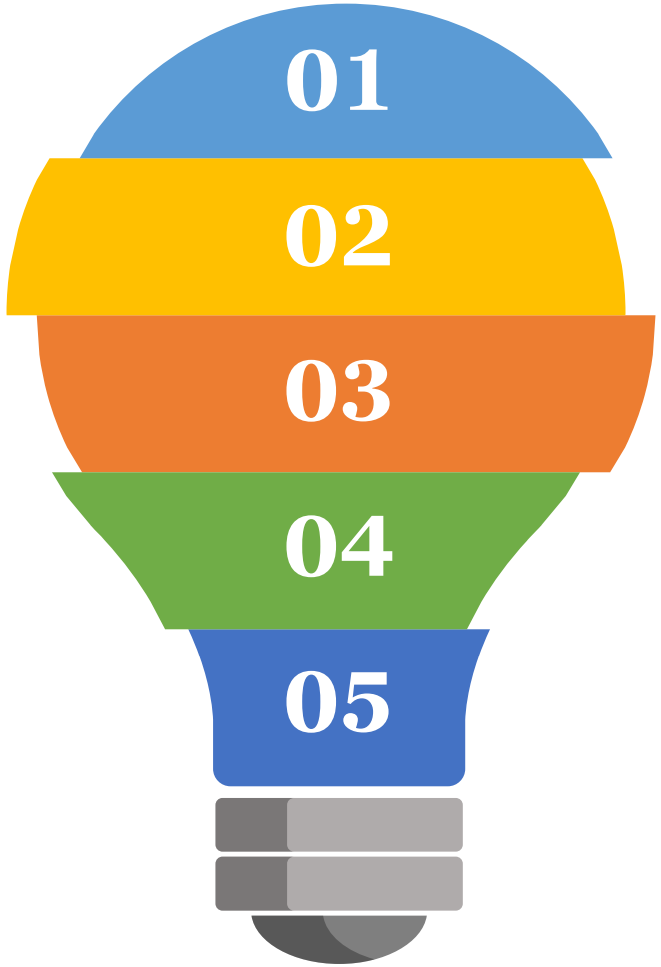
City master plan, Responsibility of municipal or federal government

3 **Hydraulic**

Physical properties of water, Movement of water, Dams & levees

5 **Geotechnical & Operations**

Probability of levee failure | Operation of dam or river under given probability



Hydrology 2

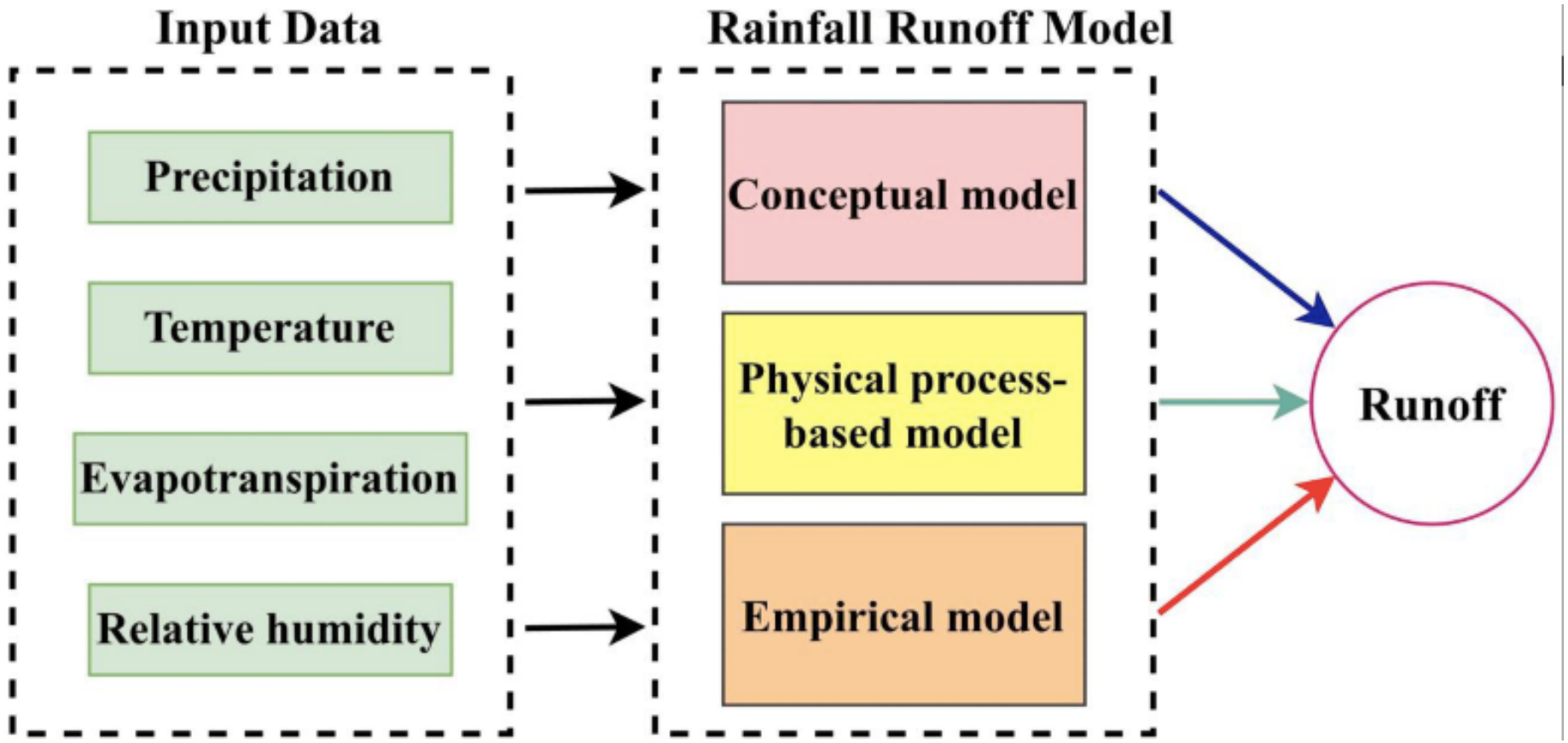
Spatial and temporal distribution of water, flood probability, storm hydrograph

Economics 4

Consequence or damage associated with given hydrological or hydraulic conditions

FRA using hydrological approach:

Flood risk assessment using hydrological approach involves input data, put into a model to obtain runoff/ discharge.



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FRA Using Hydrological Approach: … 2

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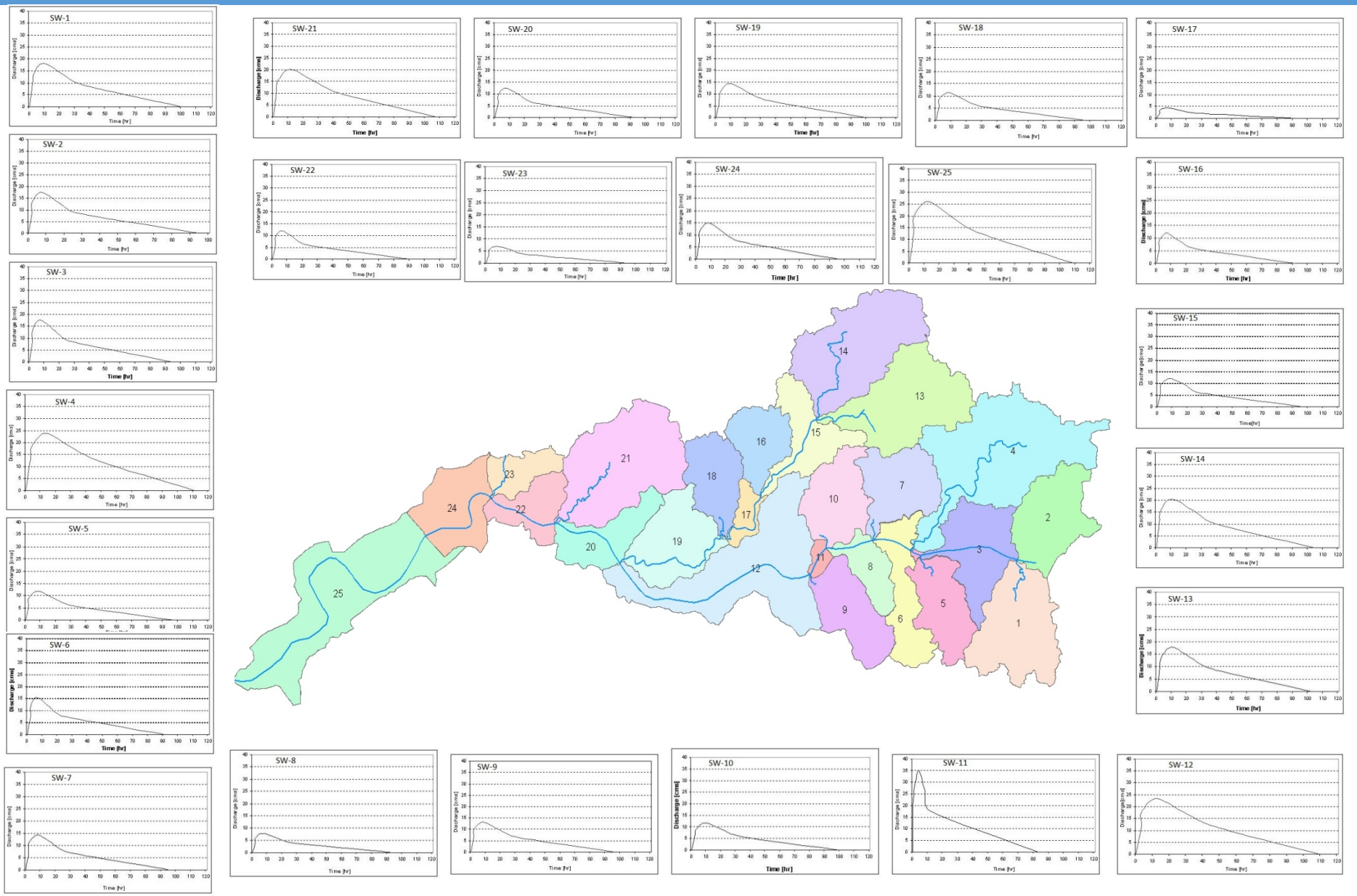
Research project
OGP-54
ISRO, Govt of India

Flood forecasting in lower Tapi basin



FRA Using Hydrological Approach: … 3

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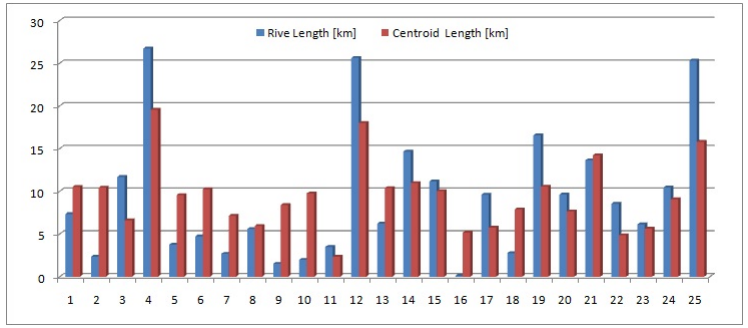
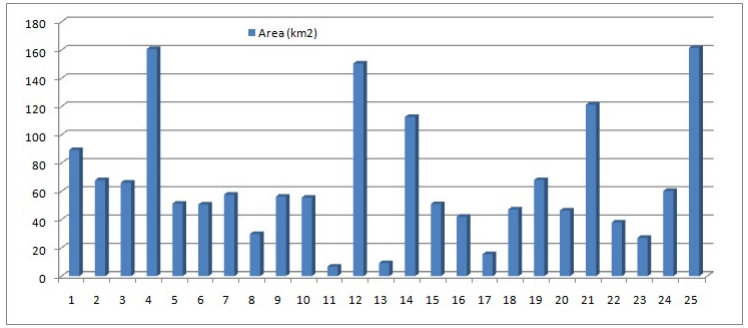
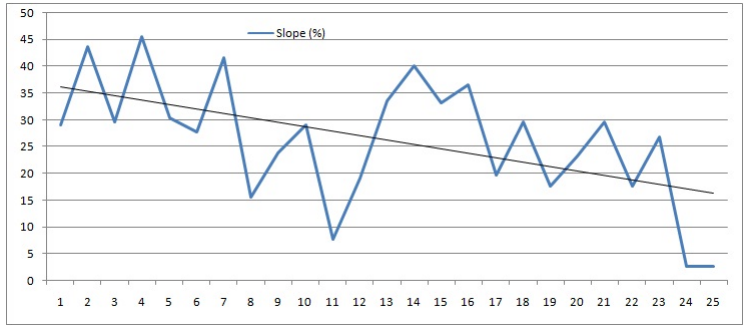
Flood forecasting in lower Tapi basin

Watershed ID	Length [km]	Centroid Length [km]	Area [km²]	Avg Slope [%]
1	7.33	10.52	89.27	29.11
2	2.35	10.44	67.88	43.70
3	11.68	6.61	66.16	29.71
4	26.72	19.56	160.78	45.57
5	3.75	9.56	51.35	30.39
6	4.73	10.25	50.66	27.73
7	2.68	7.14	57.67	41.58
8	5.59	5.94	29.82	15.66
9	1.51	8.39	56.29	23.88
10	1.98	9.75	55.59	29.13
11	3.49	2.34	6.77	7.80
12	25.62	18.00	150.52	19.09
13	6.22	10.38	9.27	33.65
14	14.65	10.97	112.64	40.13
15	11.15	10.03	50.99	33.18
16	0.11	5.17	41.96	36.61
17	9.60	5.75	15.54	19.75
18	2.76	7.88	47.26	29.75
19	16.57	10.55	68.04	17.77
20	9.62	7.65	46.45	23.34
21	13.64	14.21	121.36	29.62
22	8.55	4.86	37.98	17.74
23	6.13	5.63	27.11	26.78
24	10.45	9.07	60.27	2.70
25	25.32	15.80	161.54	2.77

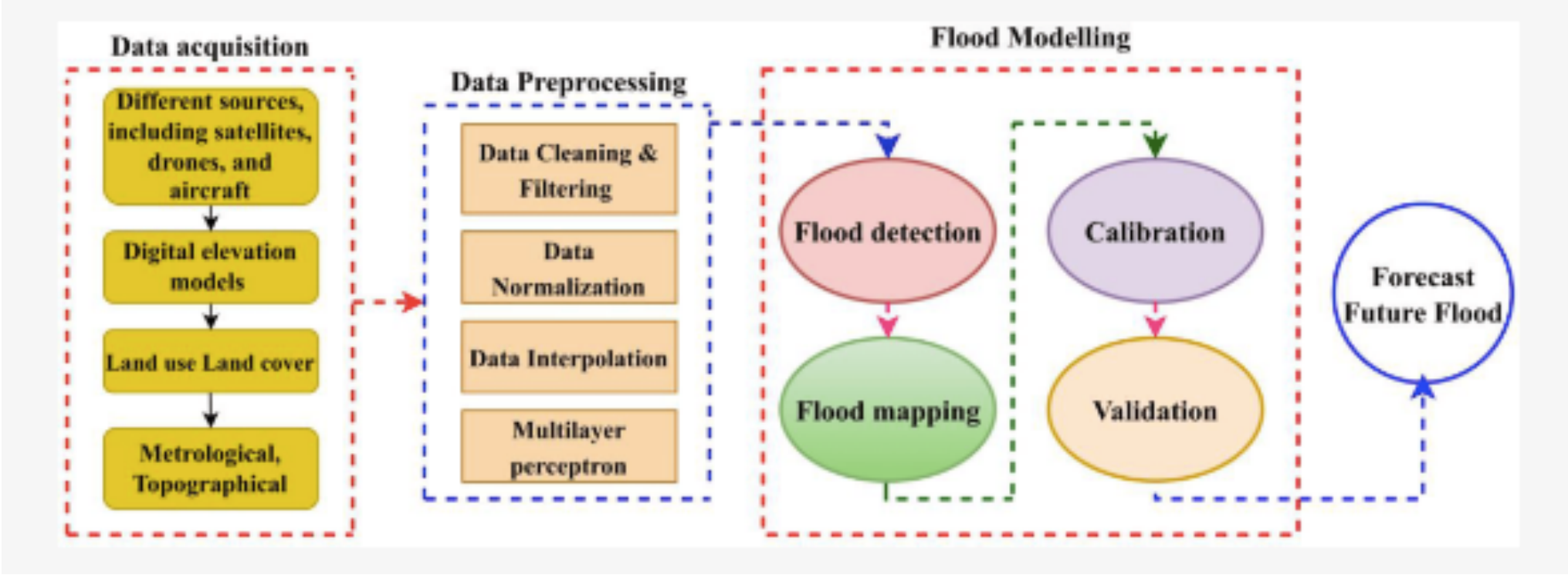






FRA Using RS & GIS Approach:

Flood risk assessment using remote sensing & GIS approach involves input satellite data, data processing, data validation and input to a hydrological/ hydraulic model to obtain runoff/ discharge.



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Flood Risk Assessment:

Flood risk assessment involves

Hydrological modelling → Analyzing rainfall patterns, river flow, catchment characteristics to predict potential flooding

Hydraulic modelling → Simulating water flow, depth, and velocity to understand how flooding might occur in specific areas

GIS mapping → Using GIS tools to map flood-prone areas, considering factors like topography and land-use

Historical data analysis → Examining past flood events to identify recurrence intervals, severity, and impacted regions

Flood plain mapping → Determining areas susceptible to flooding based on the surrounding landscape and watercourses

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Flood Risk Assessment: …. 2

Climate change impact assessment → Considering future changes in climate patterns and their potential influence on flood risks

Community inputs → Engaging with local communities to gather insights into historical floods, vulnerable areas, and adaptive measures

Infrastructure evaluation → Assessing the resilience of existing structures like dams, levees, and drainage systems to determine their impact of flood risks

Combining these methods provides a comprehensive understanding on flood risk & mitigation strategies.

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Flood Risk Assessment: Model 1

Carl Folke (2006) suggested a simplified system for FRA.

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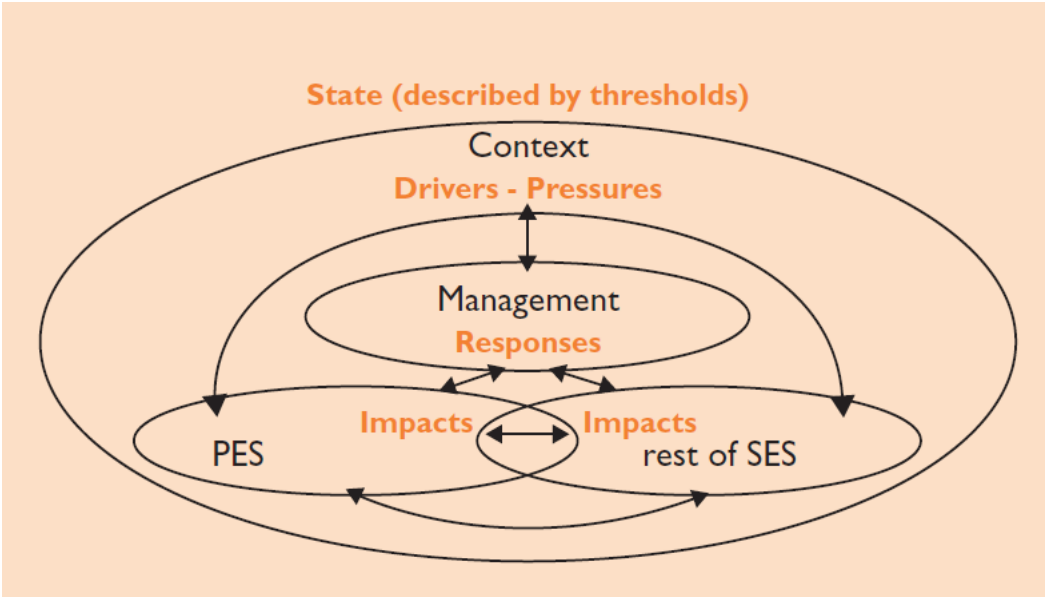

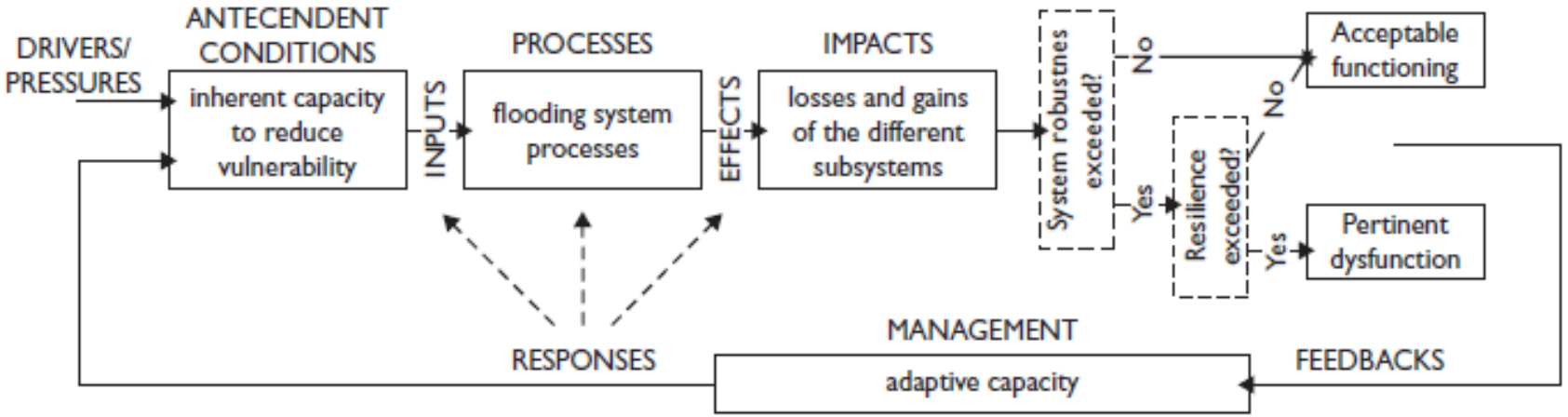

Flood Risk Assessment: Model 2

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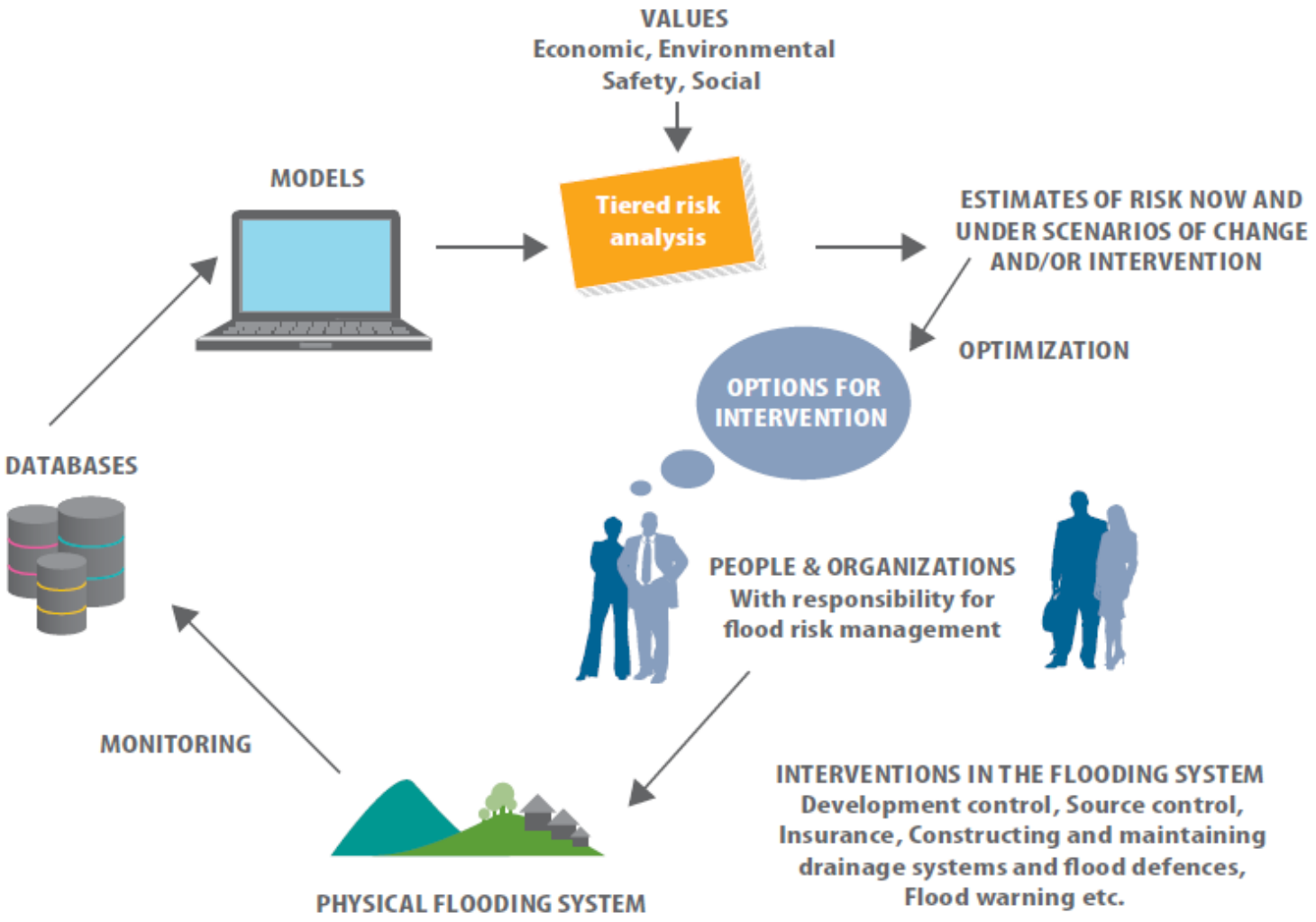
IFRA model based on physical, economic, environment, safety, social, population parameters

a. Database
b. Model
c. Risk estimates
d. Operations
e. Flood system
f. Revised database



Flood Risk Assessment: Model 3

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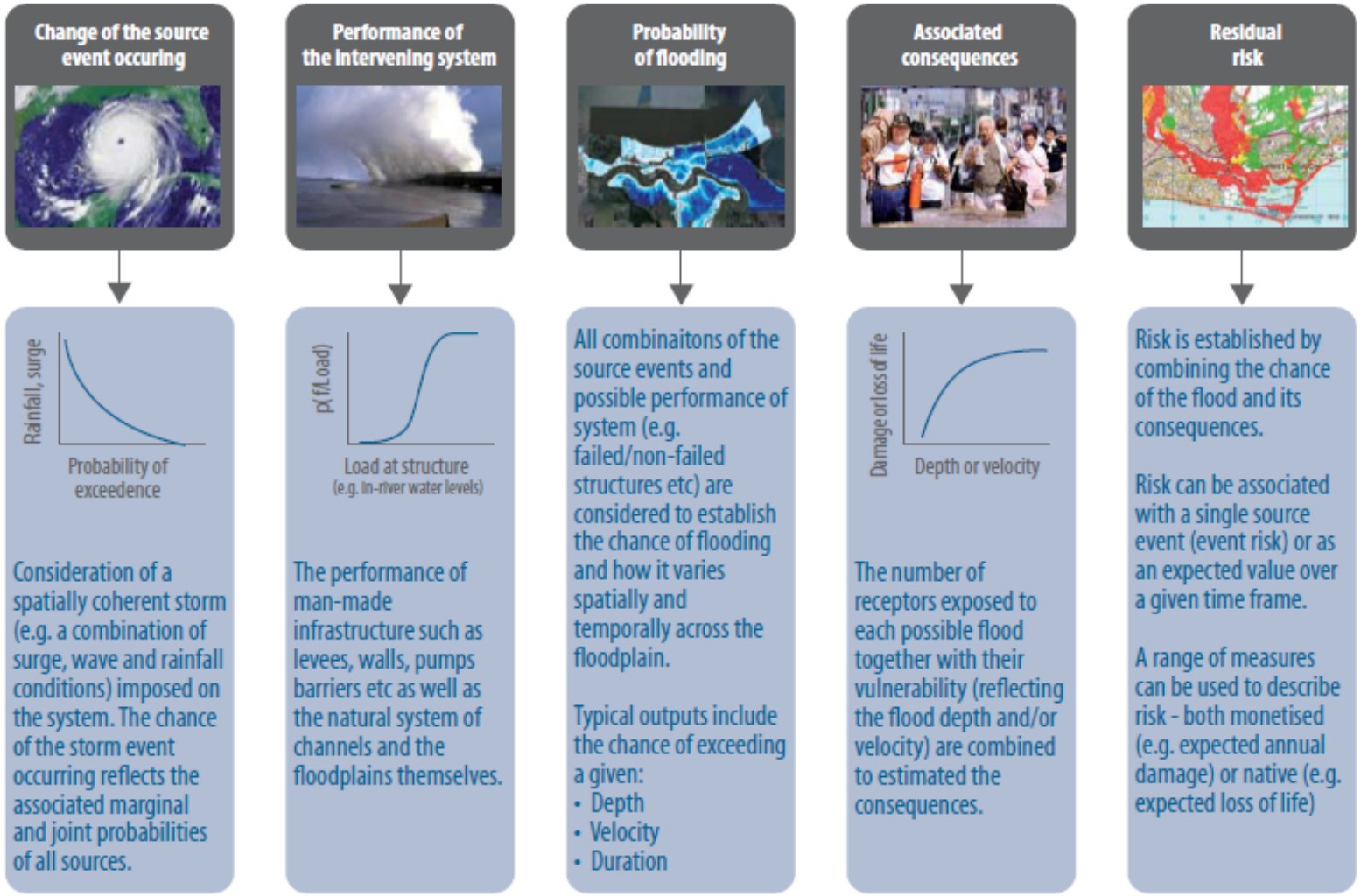
Sayers et al. (2002), Link and Galloway (2009) suggested as FRA model

a. Change of event
b. Performance of system
c. Probability of flooding
d. Consequences
e. Residual risk



Flood Risk Mitigation Strategies:

Several flood risk mitigation strategies include:

Floodplain zoning → Regulating land use in flood-prone areas to minimize exposure to potential inundation
Levees and flood walls → Constructing barriers along watercourses to prevent floodwater from reaching vulnerable areas
Retention and detention basins → Building reservoirs or basins to temporarily store excess water during heavy rainfall, and releasing it gradually
Channelization → Modifying natural watercourses to improve their flow capacity and reduce the risk of flooding
Elevating structures → Raising buildings above potential flood levels to protect them from inundation
Early warning systems → Implementing systems to provide timely alerts and warnings to residents in flood-prone areas
Green infrastructure → Using natural features like wetlands and green spaces to absorb and manage excess water

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Flood Risk Mitigation Strategies: ….. 2

Stormwater management → Developing systems to control and redirect stormwater, reducing its impact on vulnerable areas

Improved urban planning → Implementing sustainable urban development practices that consider flood risk and incorporate resilient design

Community education → Increasing public awareness about flood risk, preparedness, and evacuation procedures

Climate change adaptation → Consider long-term climate change impacts and integrating adaptive measures into flood risk mitigation strategies

Combining these strategies in an integrated and adaptive manner helps communities better prepare for mitigate the effects of floods.

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Flood Risk Assessment Report:

A flood risk assessment report is a document that reviews a development/ project in its proposal form to assess it against the risk of flooding.

Determine whether the proposed project site is safe for its lifetime?
Determine whether the proposed project site provides sustainable benefits to the area?

Report should include that

(a) project unintentionally is not creating a greater risk of flooding in the neighborhood by abstracting flood routes,
(b) In case of flooding, how people are going to interact with floodwater?

A water sensitive development and most urban development is the key to flood risk assessment report.

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Conclusions/ Recommendations:

Urban local bodies/ municipal corporations must include flood risk assessment (**fra**) a part of building development plan permission. In absence of **fra** plan, application can't be validated.

Mandate **fra** under national planning policy framework and city master plan process for building projects ≥ 1.0 hectares in size.
Need **fra** if the project is situated within 100-m range of a river, stream or waterbody.

Using flood modelling and mapping tools for flood risk assessment such as Flood Re, JBA Risk Management, Flowroute-i, RMS, Fahom, AIR Worldwide, KatRisk, Swiss Re Flood Risk Framework, Delft FEWS, Aquaveo WMS, HEC-GeoRAS etc

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Questions, if any please

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