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A system archetype approach to identify behavioural patterns in flood risk management: Case study of Limbe, Cameroon

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PRESENTATION OVERVIEW

Introduction to flood risk management in Cameroon

Overview of System Archetypes

Case Study: Limbe's Flood Challenges

Identified System Archetypes

Implications/leverage for Policy Development

Takeaway from the study

Introduction to Flood Risk Management in Cameroon

Understanding the challenges and impacts of flooding in coastal cities

Global Risk

Approximately 23% of the global population is at risk to recurrent flooding

Frequent Flooding

Costal cities face recurrent flooding due to climate change effects

Urbanization Impact

Rapid urbanization in Cameroon leads to inadequate infrastructure and increased flood vulnerability

Economic Consequences

Flooding results in significant economic losses beyond immediate property damage

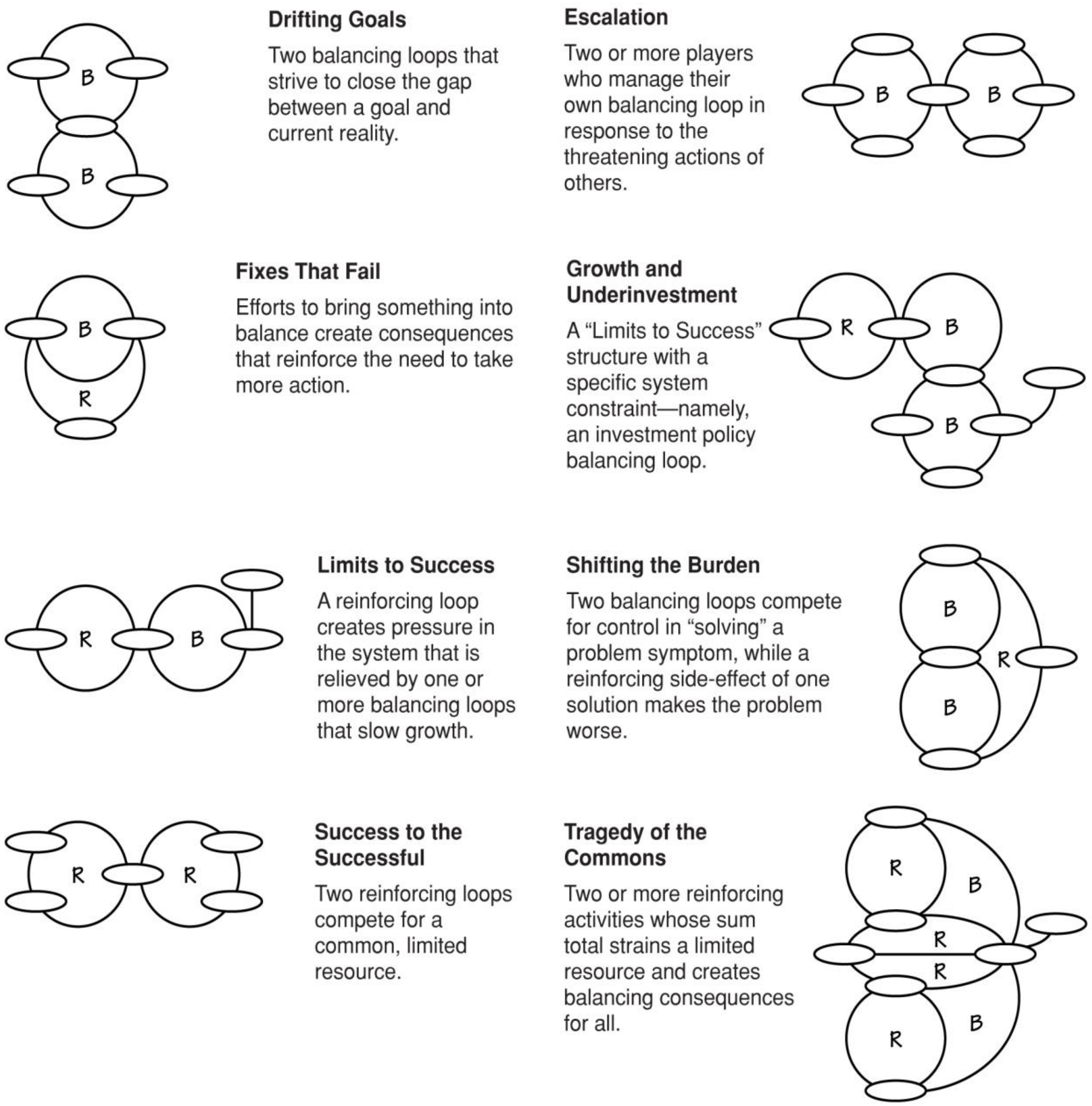
Human Impact

Flood events threaten lives and can lead to loss of life in affected communities

Overview of system Archetypes

- System archetypes are recurring patterns of behavior that can help us understand complex systems. They provide a framework for identifying and addressing systemic issues. In this presentation, we will explore how these archetypes can be applied to flood risk management.

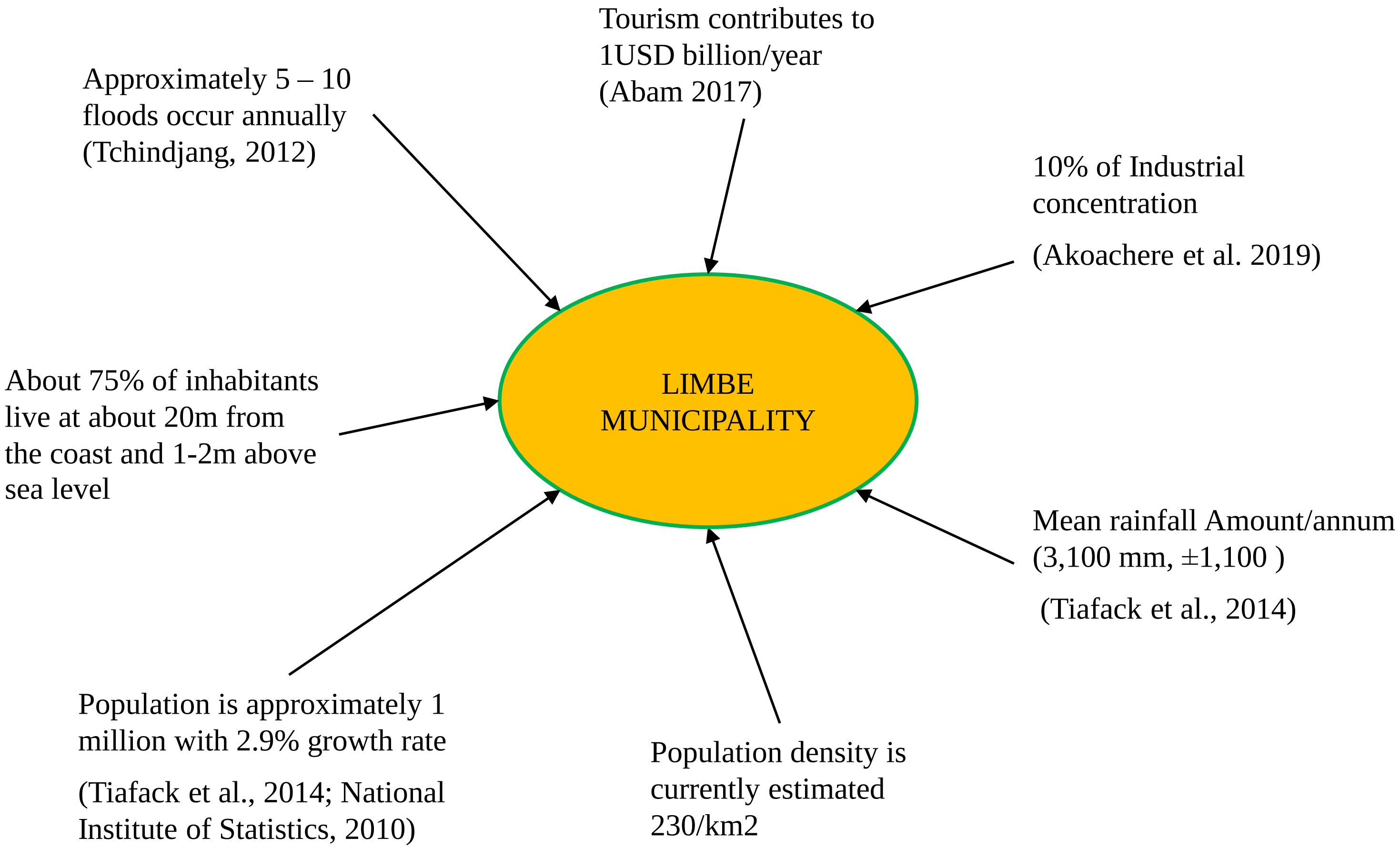
- Flood risk management involves the assessment, mitigation, and response to flood risks. It includes strategies such as infrastructure development, early warning systems, and community engagement. Understanding the behavioral patterns in flood risk management can lead to more effective strategies.



Archetypes as structural patterns (Kim & Lannon, 1997)

Application of System Archetype to FRM: Case Study of Limbe, Cameroon

The Study area: Limbe-Cameroon



This case study examines the application of system archetypes to identify behavioral patterns in flood risk management in Limbe.

Study Objective/Questions

Research Objective: To analyze flood dynamics and assess the impact of different policies on flood risk in Limbe, Cameroon through System Archetypes lens.

Research Questions

- Why do floods persist despite multiple interventions?
- Can current operational policies provide sustainable solutions to recurrent flooding?
- How do these policies directly or indirectly influence flood events?

Conceptual Methodology

Stage 1: Problem Analysis

- Literature review, pilot survey, and stakeholder interviews.
- Stakeholder Identification through purposive and snowball sampling.
- Key Drivers: Identify and map drivers of flood risks using system archetypes.
- Workshops: Engage stakeholders to understand current flood patterns and challenges.

Stage 2: **Design**

- **Behavior Over Time (BOT):** Develop a problem tree and BOT graphs to explore flood dynamics.
- **Variables Identification:** Examine increase/decrease patterns of identified drivers.

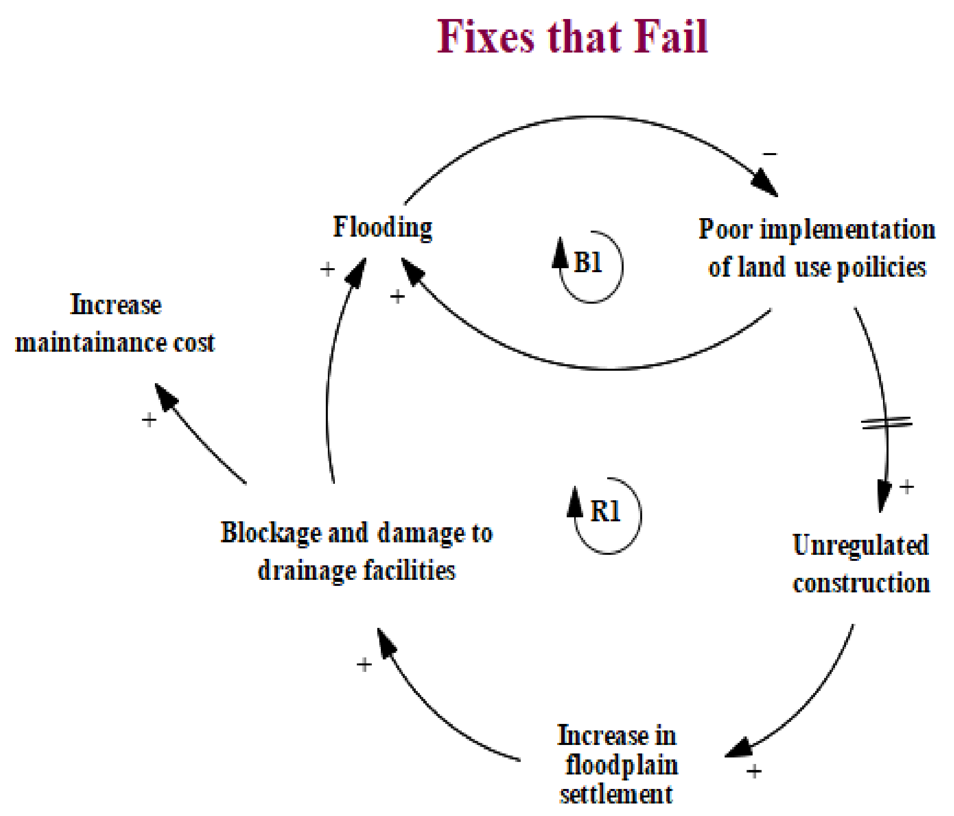
Stage 3: **Archetype Development**

- **Causal Loop Diagrams (CLDs):** Construct CLDs to show interconnectedness in flood dynamics.
- **Balancing (B) and Reinforcing (R) Loops:** Capture behavior patterns and feedback loops.

Stage 4: **Model Interpretation & Validation**

- **Stakeholder Validation:** Review model with stakeholders for accuracy.
- **BOT Graph Validation:** Integrate stakeholder input with empirical data.
- **Recommendations:** Discuss leverage points and actions to address flood risks.

Results (Identified Archetypes in Limbe)



A: Fixes that Fail: Urban Land Tenure Regulation and Flooding in Limbe

Challenges identified

- **Ineffective Regulations**: Land ownership and town planning laws prohibit building in flood-prone areas, but poor enforcement leads to settlements in hazardous zones.
- **Short-term Solutions**: Measures like riverbed dredging and demolishing buildings near rivers provide temporary relief but fail to address underlying causes (e.g., uncontrolled urban expansion).
- **Recurring Floods**: July 2023 floods resulted in 5 deaths, 2000 affected, and severe damage to homes and schools.

"Fixes that Fail":

- Short-term measures (e.g., dredging) create **temporary relief** but lead to worsened floods over time.
- Financial and human resource constraints hinder sustainable solutions.

B: Shifting the Burden (Addressing Flood Symptoms)

Problem:

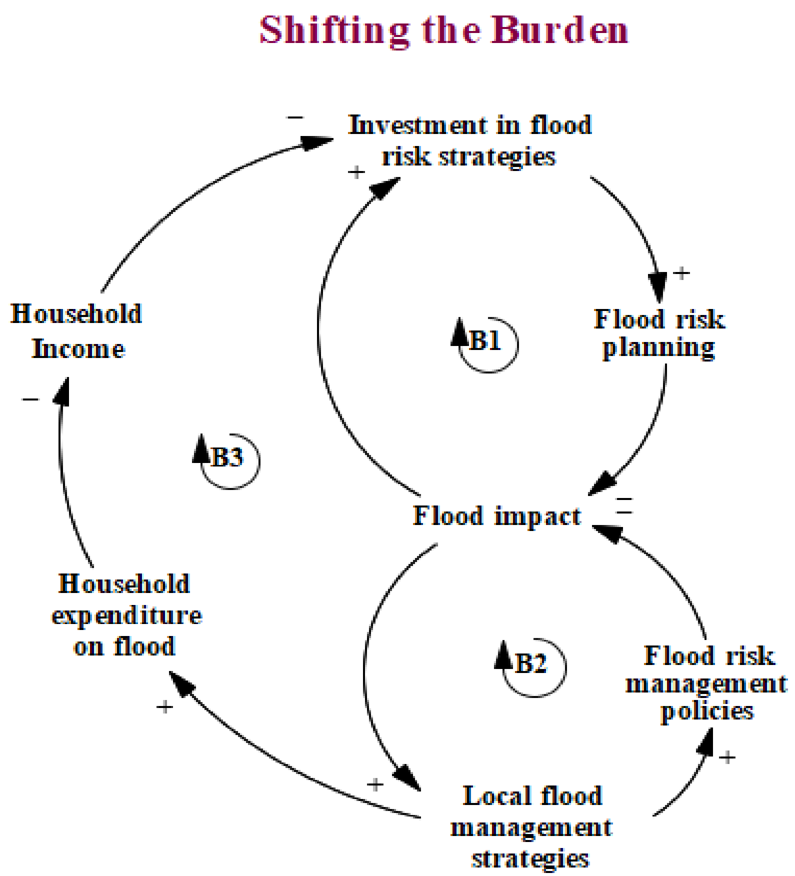
- Lack of formal government preparedness and effective flood adaptation strategies.
- Communities adopt **local and informal** strategies (e.g., sandbags, raffia palm, libations) to cope with recurring floods.

Temporary Solutions:

- The community bears the financial and emotional burden, with local knowledge filling gaps left by ineffective government policies.
- These indigenous solutions provide **short-term relief** but fail to address the **root causes** of flooding (urban expansion, poor planning, etc.).

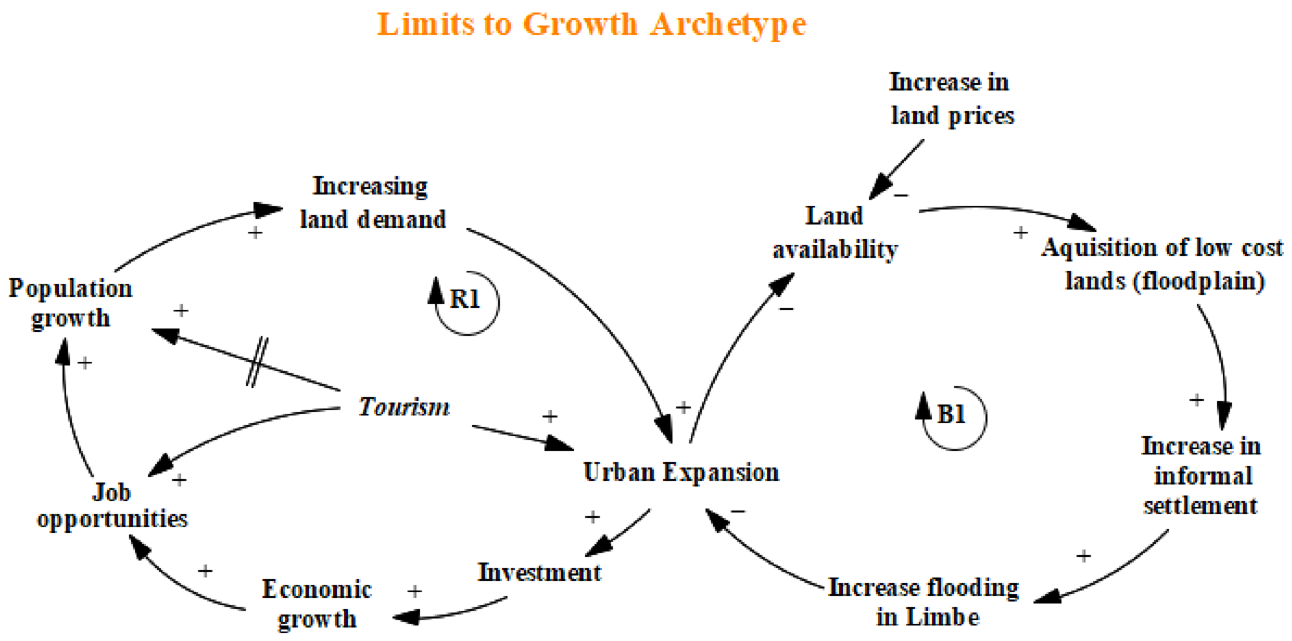
Shifting the Burden:

- Government's **inaction** pushes the burden of managing floods onto the community.
- **Cycle**: Temporary local solutions reduce impacts short-term, but as flood events intensify, the community faces increasing costs, with no sustainable resolution (Loop B2).
- Result: Communities are trapped in a **cycle of short-term fixes**, leading to escalating impacts and costs (Loop B1, B3).

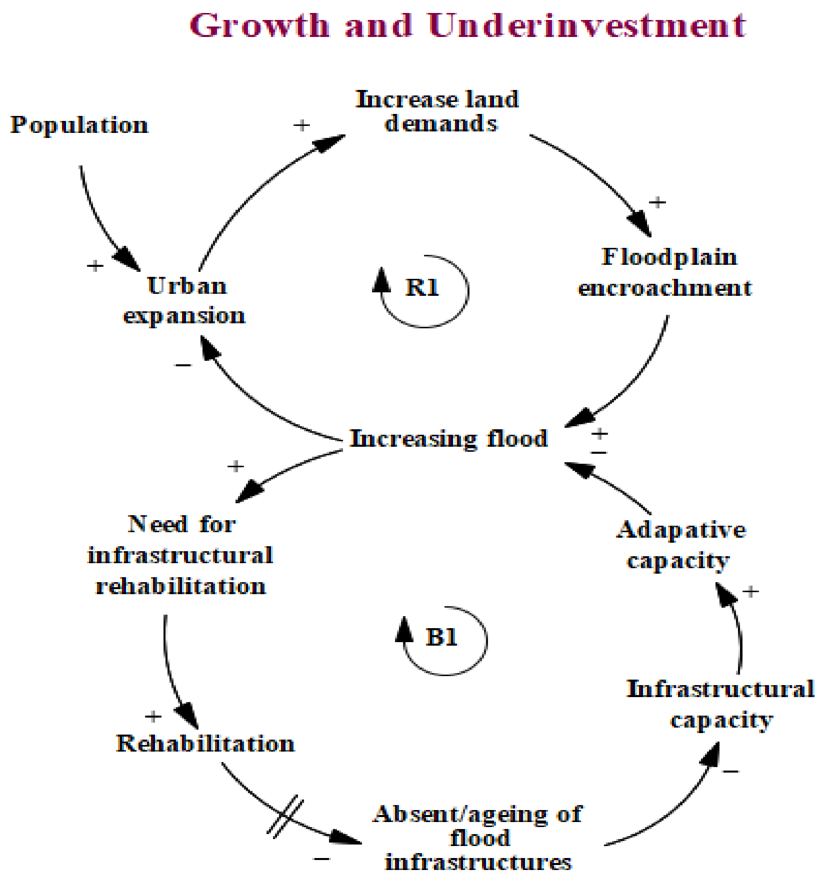


C: Limits to Growth: Unregulated Urban Expansion in Limbe

- **Problem**:
  - **Unregulated urban expansion** driven by rapid population growth and economic opportunities (tourism, agriculture, oil).
  - Expansion into **flood-prone areas** increases long-term flood risk, undermining economic and environmental sustainability.
- **Temporary Solutions**:
  - Economic growth is booming, but unregulated land use for residential and commercial purposes contributes to increased **flood risk**.
  - As urbanization expands, the **capacity to manage floodwaters decreases**, exacerbating the flood problem (Loop R1).
- **Limits to Growth**:
  - The city's rapid growth hits a limit due to **flooding** risks (Loop B1).
  - **Flood events** lead to economic losses, halting further growth, and restricting long-term sustainability.
  - **Cycle**: Uncontrolled expansion creates temporary economic growth, but in the long run, flooding constrains further progress, illustrating the **limits to growth archetype**.



D: Growth and Underinvestment: Flood Infrastructural Investments in Limbe



Problem:

Lack of critical **flood management infrastructure** due to ineffective urban planning and failure to invest in flood-prone areas.

Ageing or unavailable infrastructure worsens the impact of floods and increases community vulnerability.

Temporary Solutions:

Communities rely on **short-term local measures** (e.g., drainage maintenance, sandbags) that do not address root causes of flooding.

Limited financial resources lead to delayed investments in critical infrastructure, perpetuating a reactive approach to flood management (Loop B1).

Growth and Underinvestment:

Urban expansion without matching **flood infrastructural investments** amplifies flood risk, impacting both resilience and sustainability.

Reactive measures to address flooding increase costs and risks over time, while timely investments could promote resilience and reduce the impact

The **mismatch** between urban growth and infrastructure development highlights a cycle of underinvestment that limits long-term sustainability and flood mitigation capacity.

Leverage points within the system (Summary)

Archetype	Archetype Highlight	Strategic Policy Intervention Point
Fixes that Fail	Dredging rivers, channelisation, and unclogging blocked drainage systems does not solve the issue of flooding in Limbe, as these are short-term measures.	The government should prioritise long-term flood prevention measures over quick fixes for flooding in Limbe, focusing on addressing the leading/root cause(s) rather than just treating symptoms or relying on temporary solutions. This can be facilitated by active stakeholder engagement, revisiting and redefining existing policies, and enforcing policy implementation to address these root causes.
Shifting the Burden	Flooding in Limbe is only a sign of underlying issues within the system. It is a red flag highlighting the failures and weaknesses of the existing operational DRM policies.	Incorporation of local indigenous knowledge into formal flood Disaster Risk Reduction (DRR) strategies
Limits to Growth	Unregulated and unplanned urban expansion is exacerbating flooding in Limbe. The "Limits to Growth" archetype highlights the ineffective implementation of policies related to land use, urban planning, and building regulations	Effectively manage population expansion through land-use policies (building regulations and patterns). Urban planning should be done with consideration for long-term population growth to enhance sustainable urban expansion. Incentives should be given to individuals and business owners willing to settle in designated areas away from the city centre.
Growth and Underinvestment	Urban growth is a common phenomenon in most coastal cities. However, urban development should be checked, and provisions should be made beforehand to accommodate growth.	The national DRM framework should make provisions for financial and infrastructural investments. Budget allocation for DRM should be integrated effectively for proactive flood infrastructural investment. Capacity building focused on enhancing the skills of current Disaster Risk Management authorities is crucial for effectively handling and mitigating potential risks more efficiently.

Takeaway from the study

- The study identified four archetypes (Limit to Growth, Growth and Underinvestment, Fixes that Fail, and Shifting the Burden) to explain and understand flood dynamics in Limbe, highlighting how complex systems function.

- The main issue contributing to flooding in Limbe was not the absence of policies but rather lack of enforcement of the existing policies.

- There are existing policies in Limbe, but poor implementation has led to complex human-flood interactions and unintended consequences, emphasizing the need for ‘proactive’ over ‘reactive’ strategies in Disaster.

- System archetypes provide a holistic view, exposing unseen dynamics that shape flood risk management. They show the need for policies that resolve root causes, rather than merely managing flood symptoms.

- The study's findings highlight the importance of using system archetypes to understand the deeper dynamics of flood risk management.

Thank You