



Construction and Demolition Waste Management

(The Case of Leh –Ladakh)

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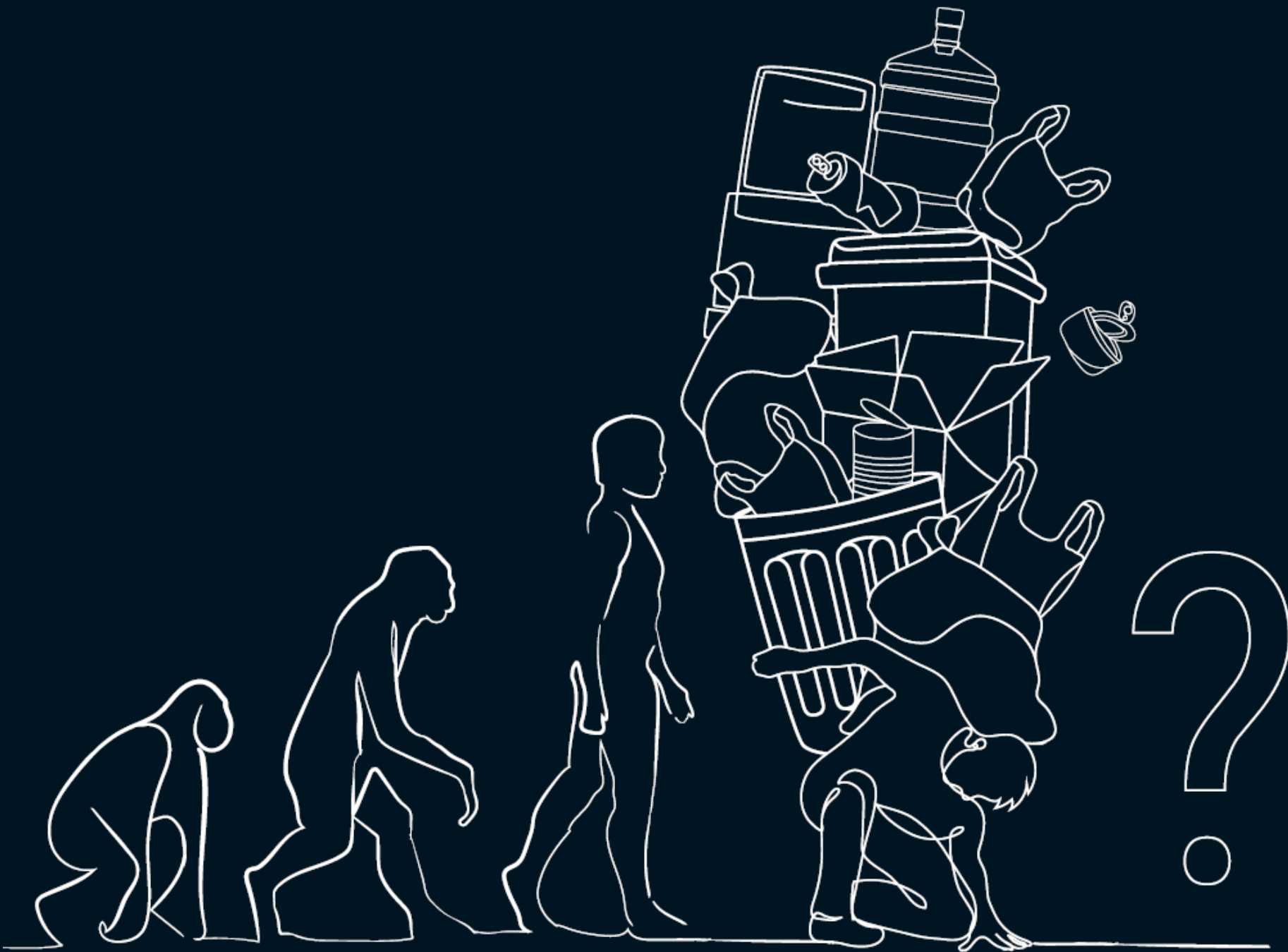
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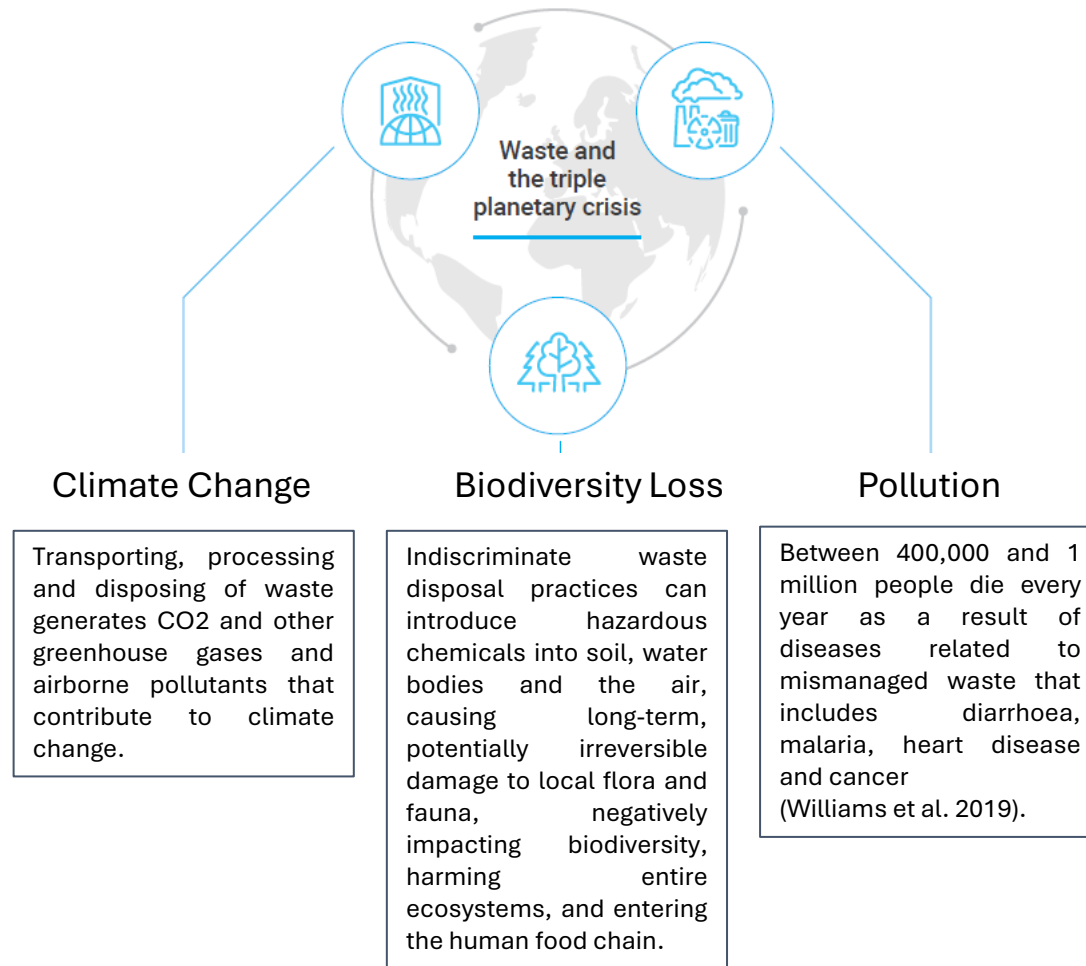
As we reflect on our journey from evolution to accumulation, one question arises,
From evolution to accumulation:

Are we progressing, or is our waste weighing us down?

Every year across the globe more than two billion tonnes of municipal solid waste is generated.

1. Why Waste Matters ?

Addressing the waste is not just about managing garbage it's central to tackling the triple planetary crisis of pollution, climate change, and biodiversity loss. Effective waste management is critical to achieving all 17 Sustainable Development Goals.



Waste and the triple planetary crisis

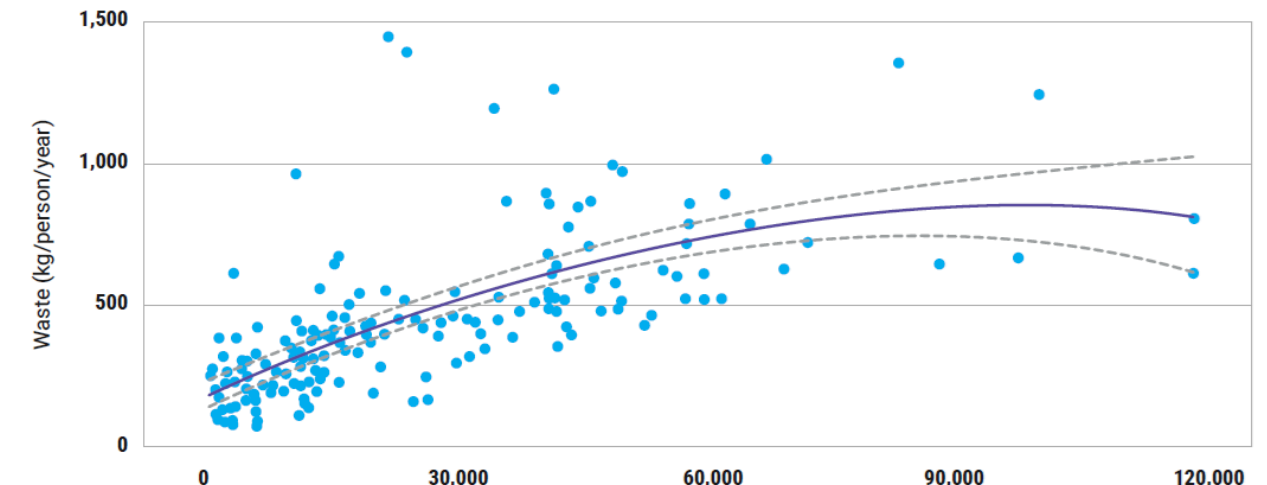
SUSTAINABLE DEVELOPMENT GOALS



Effective waste management supports all 17 Sustainable Development Goals, from improving public health (SDG 3) and clean water (SDG 6), to sustainable cities (SDG 11), and climate action (SDG 13). Managing waste wisely is not a choice it's a global necessity.

2. Global Trends In Solid Waste Management

As nations grow wealthier, shifting lifestyles and consumption patterns lead to a marked rise in per capita municipal solid waste generation.

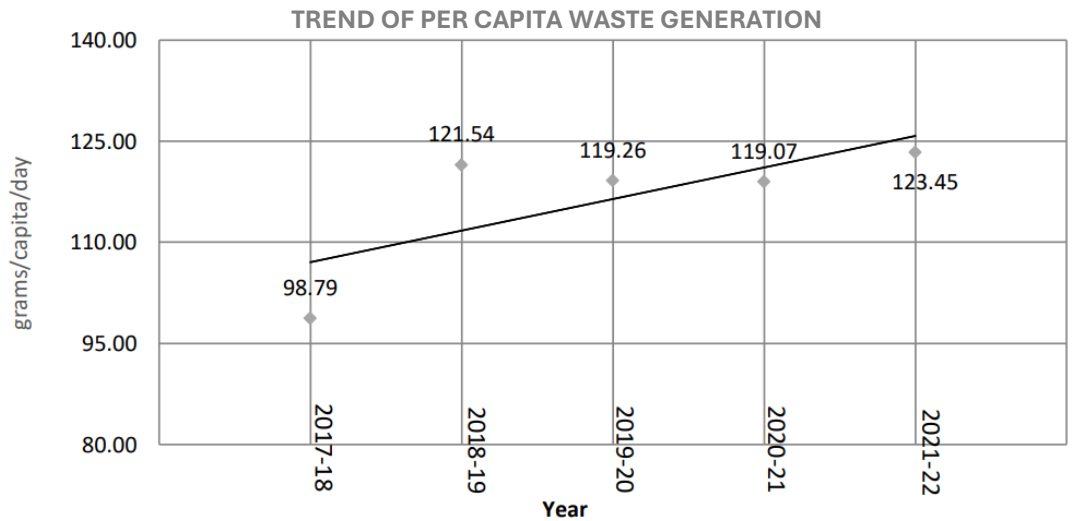
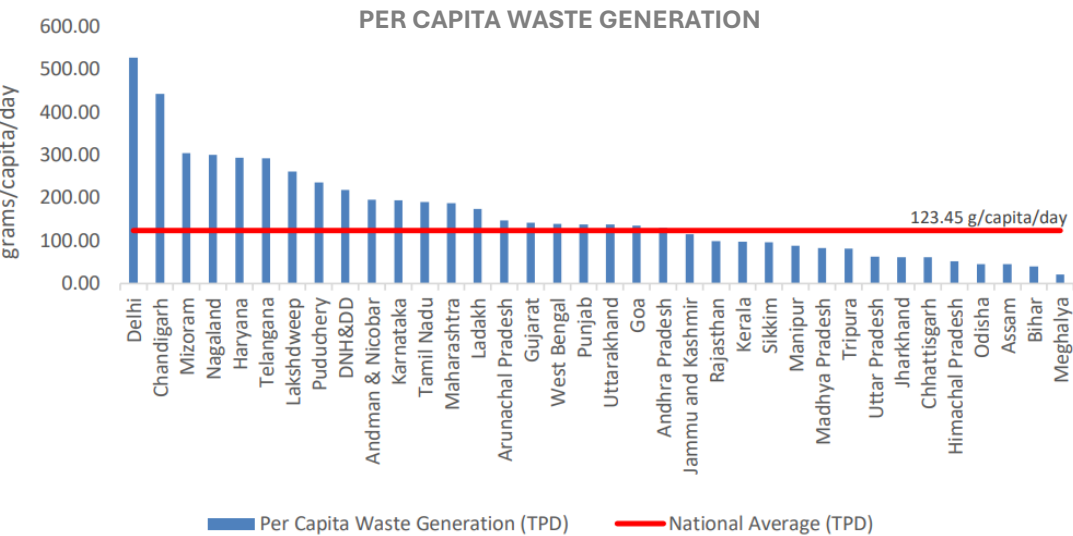


GDP per capita (purchasing power parity – constant 2017 international US\$)

Relationship between gross domestic product (GDP) and waste generation in most recent year available between 2010 and 2020

3. National Trends In Solid Waste Management

Per capita waste generation shows an increasing trend with an increment from 98.79 grams/capita/day to 123.45 grams/capita/day in the last five years.



4. Aim, Objectives and Scope

AIM

Exploring challenges and identifying opportunities to develop a context-specific C&D waste management plan for **Trans Himalayan** regions.

OBJECTIVES

1. Evaluate existing policies, regulations, practices and associated challenges for management of solid waste with specific reference to C&D waste in hilly and cold climatic regions.
2. Analyze urbanization patterns and their influence on construction materials and Practices, to explore linkages with generation and management of Construction and Demolition (C&D) waste in hilly regions.
3. Assess existing C&D waste management system in Leh, with focus on:
 - Current Status of Waste Management.
 - Stakeholder Mapping
 - Institutional Frameworks
 - Construction Project Approval Process
 - Heritage Conservation Practices
4. Developing a C&D Waste Management Plan tailored for Trans Himalayan regions, focusing on:
 - Quantification and Composition
 - Sustainable solutions
 - Heritage conservation
 - Sustainable tourism
 - Integration of effective city governance strategies.

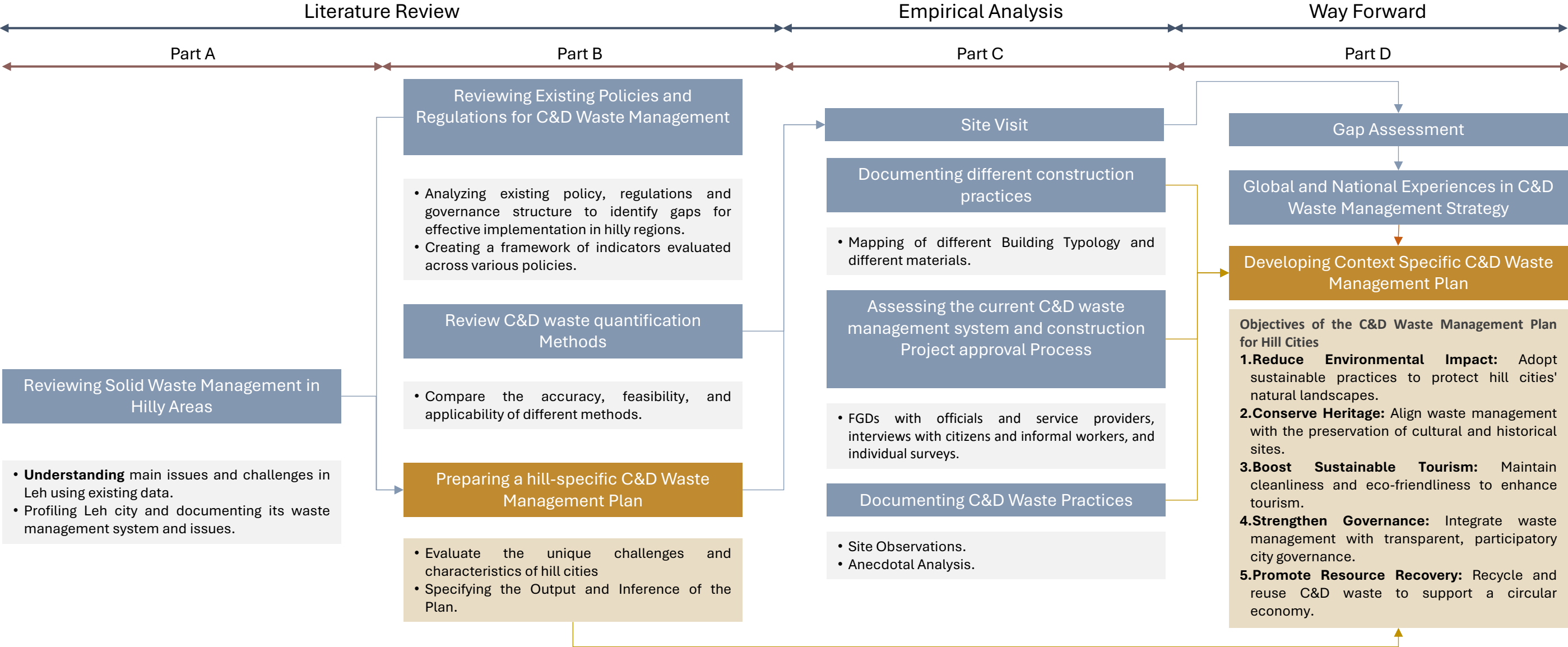
SCOPE

1. The study focuses on Leh Municipal Council within the Leh district. Findings are specific to Trans Himalayan region, limiting their applicability to other geographies and climatic contexts.
2. The study provide local-level policy recommendations focused on C&D service planning and management, along with building-level suggestions on construction materials, rather than a broader or nationwide analysis.

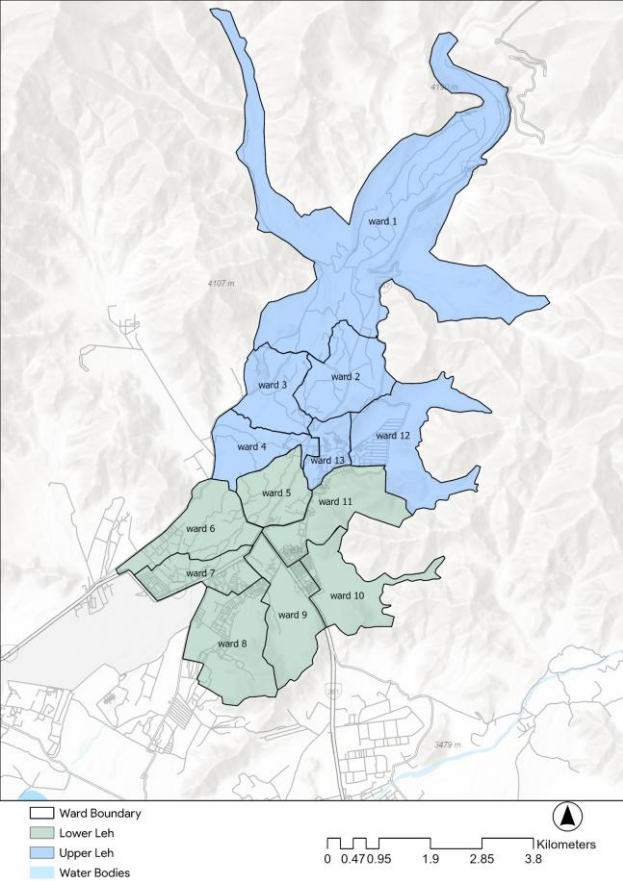
Why Trans Himalayan Region?

The Trans Himalayas highest range of Himalayan Regions stand out from other mountain ranges due to their unparalleled height, vast geographical extent, and significant influence on climate, water resources, and biodiversity.

5. Research Methodology



6. An Introduction to Leh



Location and Topography

- It is an altitude of 3,310m above mean sea level at its southern end and 3,915m above MSL at its north edge.

Climate

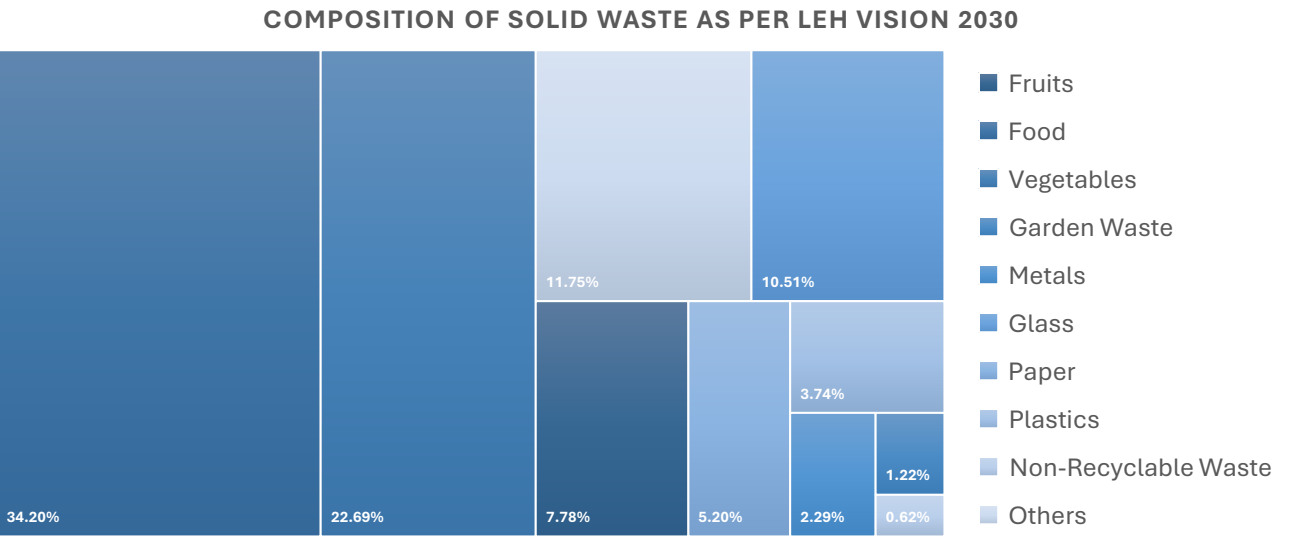
- Cold desert climate
- Winter (Nov-Apr): Avg. min. temp. -15°C, record low -28.3°C
- Average annual rainfall: 102mm
- 2010: Flash floods and mudslides causing significant loss and destruction.

GENERAL INFORMATION	
Class	Leh Municipal Committee
District	Ladakh
Area (sq.km)	9.15
Total city population	30870
Total household	7360 lakhs
Density (person per sq.km)	3372
Total No of Wards	13



7. Waste Management in Leh

Leh generates a highly variable amount of solid waste, with daily generation ranging from approximately 9.2 metric tonnes during winter to about 38.8 metric tonnes during peak summer (April to October) as in table 11 and 12. This significant seasonal variation is largely driven by the influx of tourists and migrant workers. The summer population of Leh includes approx. 35,190 residents, 50,000 migrant laborers, and 9,140 tourists, together contributing to the daily waste load. The average per capita waste generation stands at 0.47 kg/day.



7a. Construction and Demolition Waste Management in Leh

Acknowledgment: C&D waste is identified as a significant component of Leh’s overall waste stream.

Key Issues:

- **Lack of documented data on the quantification of construction and demolition (C&D) waste**, along with the absence of information on its material composition.
- **Illegal Dumping of C&D Waste** along Canal, Streams Near Army Cantonment Along Roadways, Bombgarh Remediated Landfill Site and at New Skampari Scientific Landfill Site.
- Despite having defined permissions and compliance processes, on-ground implementation remains weak **due to the absence of designated dumping sites and processing facilities for C&D waste**.
- While the Draft Unified Ladakh Building Bye-Laws 2024 mandate heritage preservation and responsible development, in practice, but Currently only **LAMO an NGO operates actively in Old Leh, with no broader measures implemented on ground**.

8. C&D Waste Management Rules 2016 & Draft 2025

Policy Shifts in Construction & Demolition Waste Management: 2016 – 2025												
Thematic Area	Objective	Applicability	Segregation at Source	Waste Generators	Local Authorities	Processing Facility Operators	Use of Recycled Materials	Enforcement & Penalties	State Govt Role	Data & Reporting	Integration with Planning	Time-bound Targets
C&D Rules, 2016	Focused on safe disposal and promotion of recycling	Construction and demolition activities	Mandated for large waste generators	Must segregate, store, and hand over waste	To establish collection and transportation systems	Required to obtain authorization from SPCBs	Encouraged	Not clearly defined	Policy support, land for processing	Minimal data provision	General mention	Implied but not enforced
Draft Rules, 2025	Emphasizes circular economy and lifecycle approach	All construction, renovation, repair & demolition works with few exceptions	Retained; mandatory for all waste generators	Must also maintain records and pay charges to local bodies	Must develop C&D Waste Management Plan, ensure compliance and reporting	Must also maintain detailed record-keeping and reporting	Mandatory use in govt projects (10–20%)	Introduces Environmental Compensation for violations	Also to monitor implementation and allocate resources	Compulsory digital reporting, performance tracking, and database	Mandatory integration with urban development & building permissions.	Calls for 100% recycling by 2035 and phased action plans

- The Draft C&D Waste Policy, 2025 does not specifically address the unique challenges of hilly regions, and the urgent need for context-specific waste management strategies.
- Swachh Survekshan, which plays a key role in supporting policy. Also fails to recognizing the unique challenges faced by hilly and high-altitude areas when assessing city services.

9. Key Issues Identified and Corresponding Recommendations

S.No	Key Issues	Recommendation
a.	Swachh Survekshan fails to recognize the unique challenges of hilly areas	Adaptive SBM Assessment Framework for Hilly Regions
b.	Lack of Documentation of Quantification and Composition of C&D Waste	Process Flow for Quantification and Characterization of C&D Waste Generation
c.	Lack of Treatment and Waste Processing Infrastructure in Leh	Feasible and Context-Sensitive Management Approaches
d.	There is no integrated source-to-sink C&D waste management plan	Strategic Recommendation for Enhancing C&D Waste Management for Source to Sink
e.	Lack of Enabling environment for Enhancing C&D Waste Management	Strategic Recommendation for Institutional Strengthening, Data Systems, and Awareness in C&D Waste Management

9a. Adaptive SBM Assessment Framework for Hilly Regions

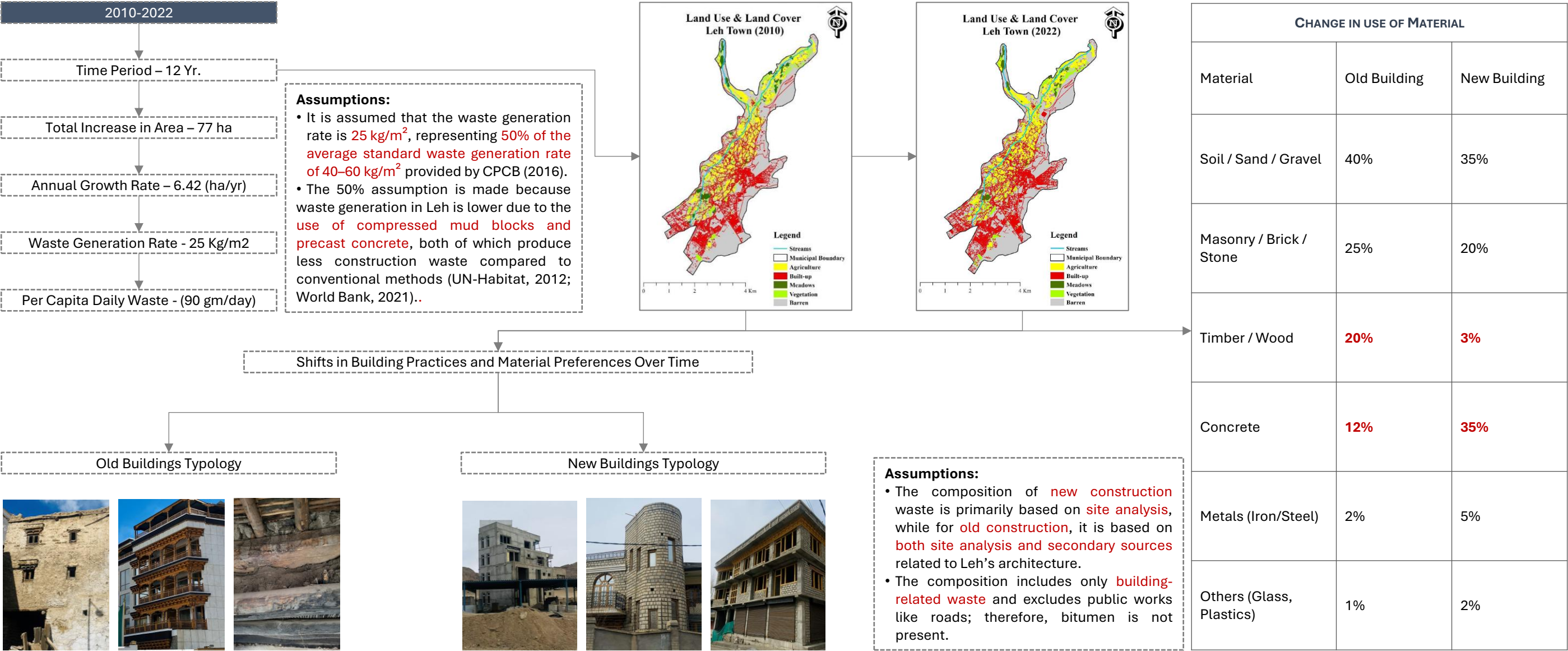
Swachh Survekshan Indicators Adaptation

Indicators

Sub-indicators

	Retained	Modified	Excluded
Indicators	33	19	N/A
Sub-indicators	106	53	7
	Has the ULB notified a publicly accessible schedule of charges for the collection, transportation, processing, and disposal of C&D waste, including any charges incorporated into construction permits?	Existing Does the ULB provide designated, geo-tagged C&D waste collection points within a reasonable distance for generators? Why to Modify? Limited utility in small hill ULBs; consider flexible zoning or citizen-reported locations.	Existing Does the city have an adequate number of Machine Hole Dredger Why to Exclude ? Less relevant due to fewer manholes and terrain not suited for deep sewer networks.

9b. Quantification and Characterization of C&D Waste Generation in Leh



9c. Feasible and Context-Sensitive Management Options

Option 1: “Regional Hub Model”



Distance Between Leh and Kargil : 215 Km

Single Centralized Plant in Leh with On-Call Collection
35 TPD capacity plant located in Leh, covering both Leh and Kargil waste.
Risk - Transport disruptions in winter and High dependency on vehicle availability

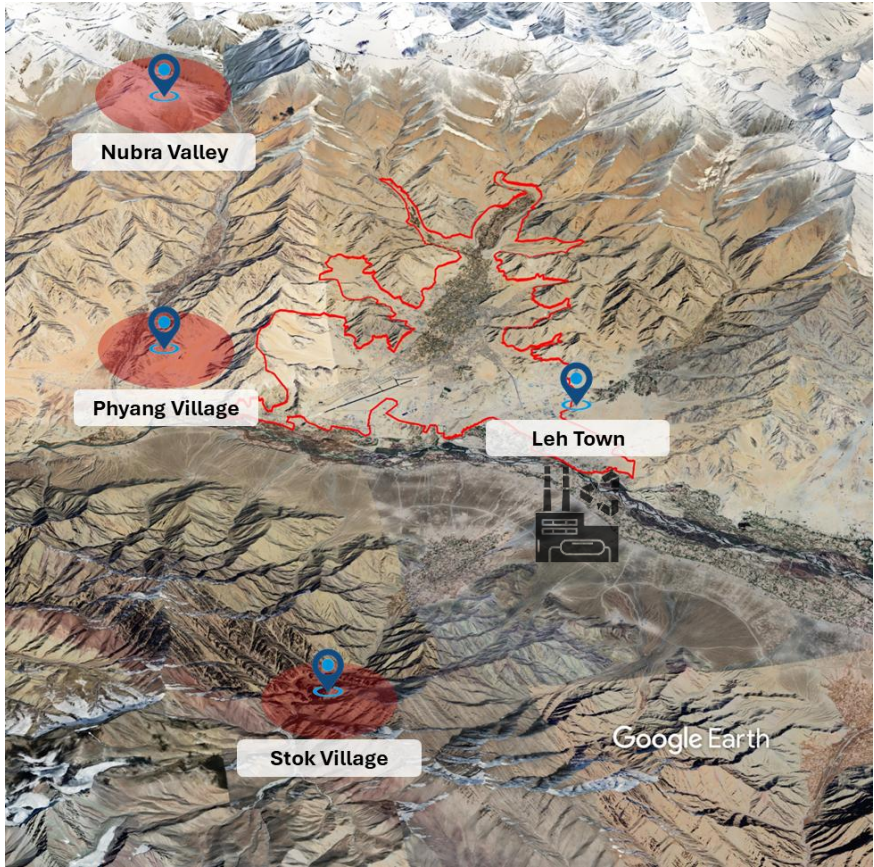
Option 2: “District Hub Plant Model”



Distance Between Leh and Nubra Valley : 160 Km

Two Decentralized Plants: One in Leh, One in Kargil
Two plants (17 TPD Leh, 18 TPD Kargil) with localized collection and processing.
Risk - Risk of underutilization during low construction activity

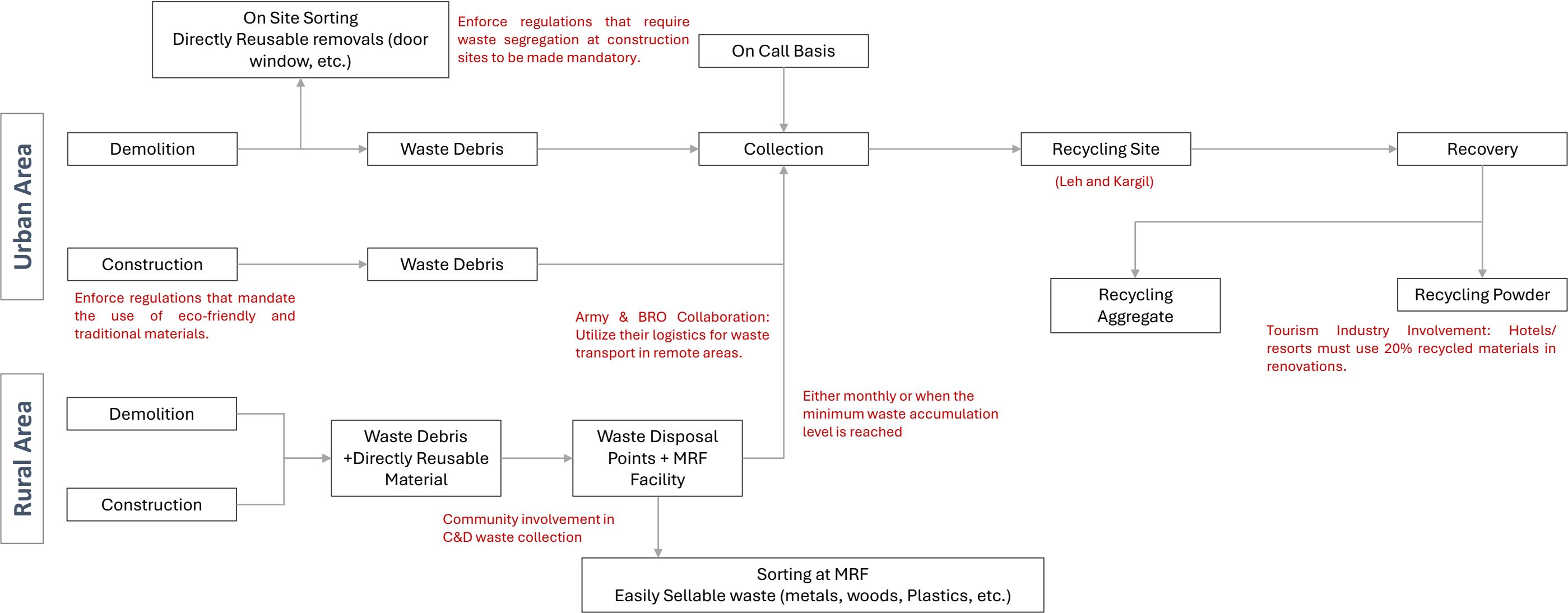
Option 3: "Integrated District Hub and Satellite Model"



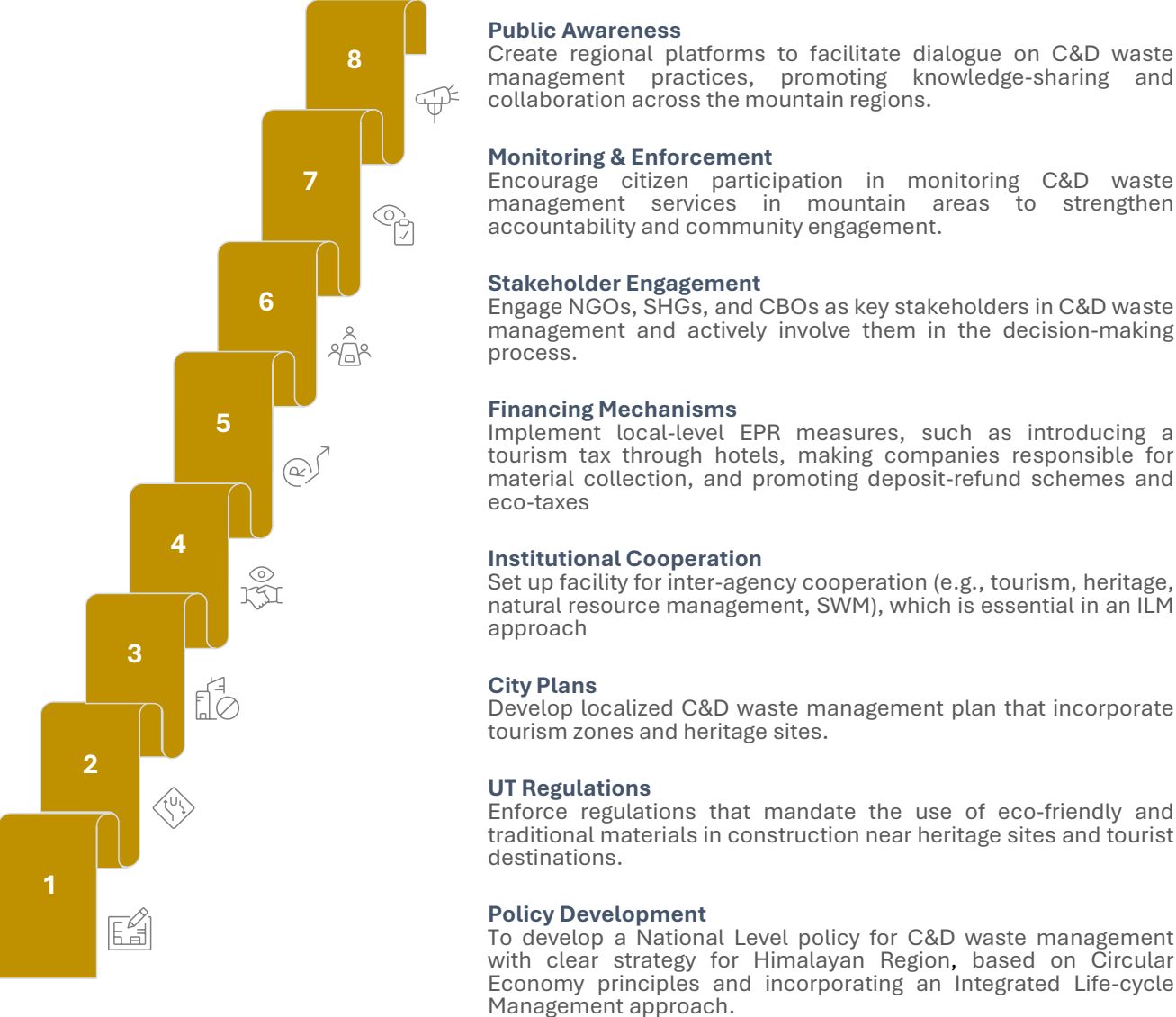
Distance Between Leh and Phyang : 20 Km

Two Plants of 10 TPD + Cluster Level MRFs for Rural Areas
Two main plants of 10 TPD (Leh and Kargil) plus 5–6 rural MRFs.
Risk - Management challenges at rural MRFs and Harsh weather can impact remote access

9d. Recommendations for Enhancing C&D Waste Management from Source to Sink

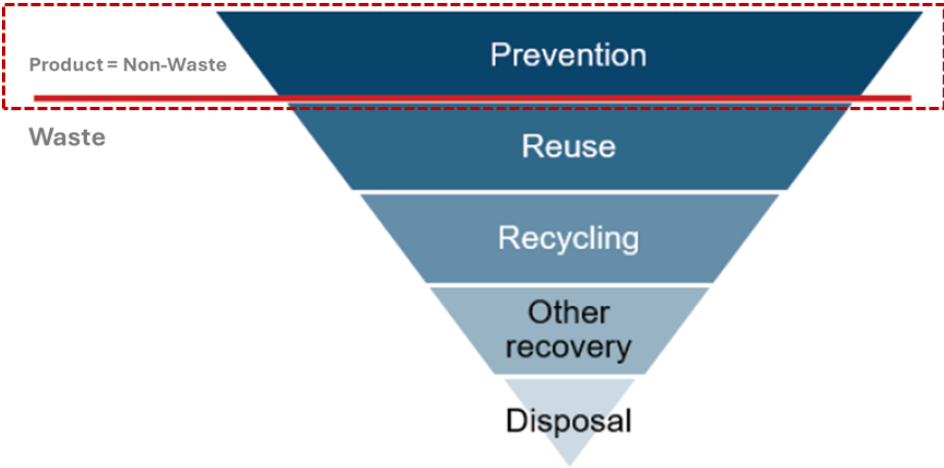


9e. Recommendations for Policy Environment, Capacity Building, Data Systems, and Awareness in C&D Waste Management



10. Conclusion

If we want to reach the prevention level in Construction and Demolition (C&D) waste management where every product is designed to be non-waste, and materials remain within the loop then mountain cities like Leh must undergo a strategic transformation.



The challenge of managing C&D waste in ecologically fragile, culturally significant, and rapidly urbanizing regions of the Indian Trans-Himalayas cannot be addressed through reactive measures alone. It demands a circular, integrated, and adaptive governance system rooted in local realities. This thesis has developed a five-pronged strategic framework that not only identifies the critical gaps across Leh’s C&D waste value chain, but also offers pathways that are regionally sensitive, operationally feasible, and environmentally sustainable:

- Adaptive Swachh Bharat Mission (SBM) Assessment Framework for Hilly Regions
- Process Flow for Quantification and Characterization of C&D Waste Generation
- Feasible and Context-Sensitive Management Approaches
- Strategic Recommendations for Enhancing the C&D Waste Value Chain (Source to Sink)
- Strategic Recommendations for Institutional Strengthening, Data Systems, and Awareness

Together, these recommendations reframe C&D waste not as a burden, but as a resource flow to be managed, designed for reuse, and embedded in the broader vision of sustainable and carbon-neutral urban development in the Himalayas.