Operational Expenditure Sustainability in Solid Waste Management

A Monitoring Framework in North Western Himalayas

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Global South Academic Conclave on WASH and Climate 2026

6th – 7th February 2026, Ahmedabad

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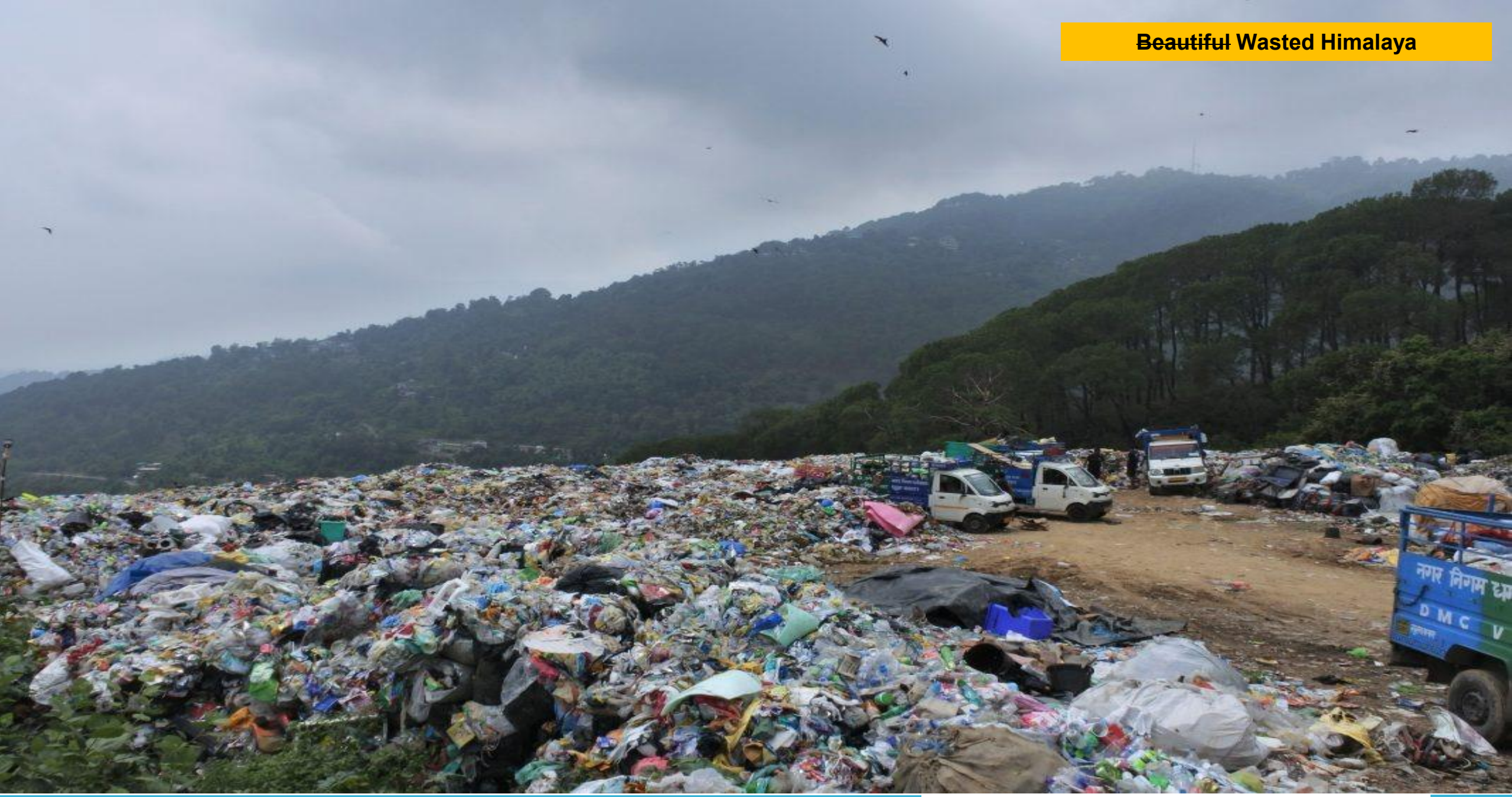
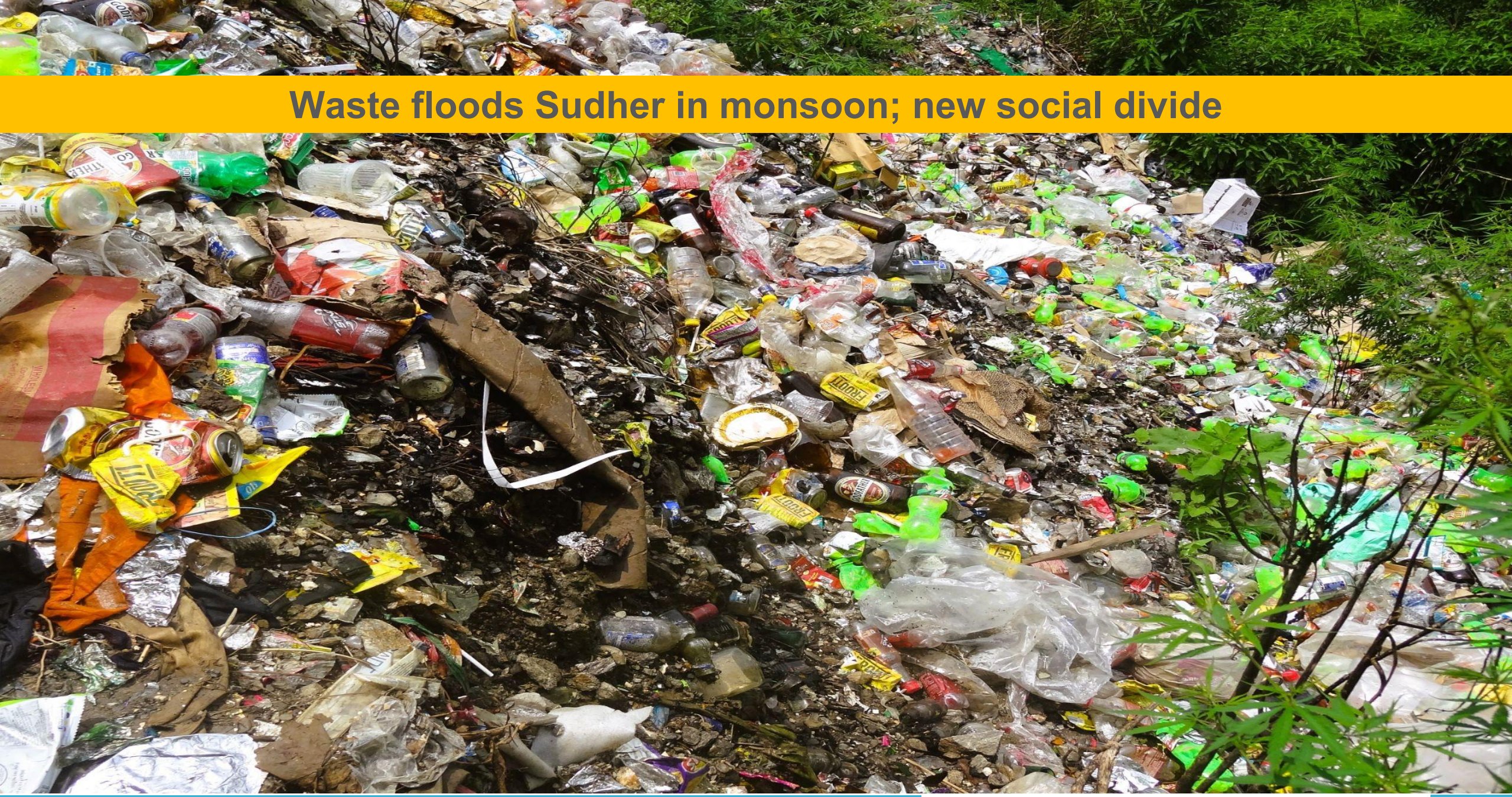

~~Beautiful~~ Wasted Himalaya

Waste floods Sudher in monsoon; new social divide



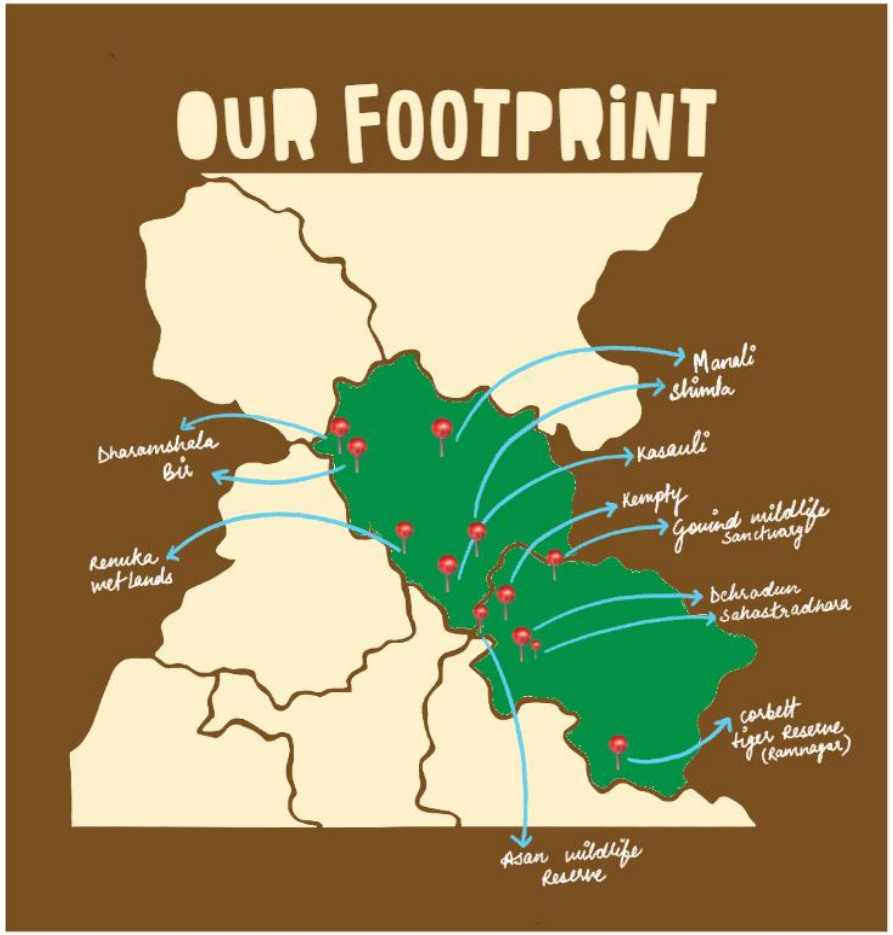
Why Operational Sustainability Matters in WASH Outcomes?

- Solid waste management (SWM) systems are being established across India; however, **operational expenditure (OPEX) is rarely monitored beyond infrastructure (CAPEX) and coverage metrics**

- **Coverage indicators mask operational fragility; OPEX monitoring exposes the risks that determine service failure**
  - Rising emissions from day-to-day operations
  - Service interruptions and operational inefficiencies
  - Persistent financial deficits and system stress

- **Unmanaged solid waste** directly compromises **WASH** outcomes:
  - **Water safety** through runoff and leachate
  - **Sanitation functionality** via blockage and overflow
  - **Hygiene conditions** through persistent exposure and vectors

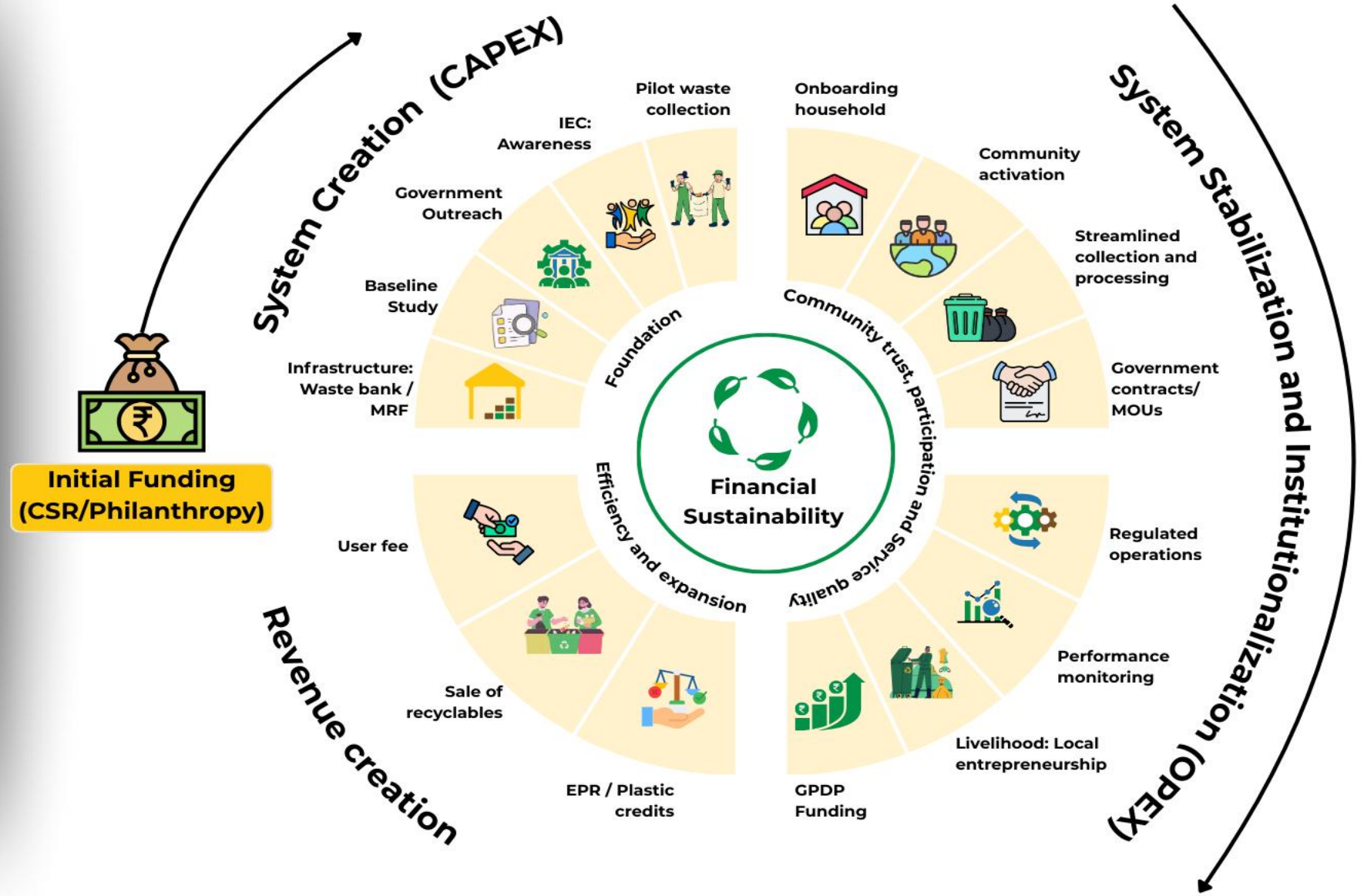
- In the IHR, **ecological fragility + difficult terrain + climate volatility** combine to raise costs, weaken operations, and threaten WASH service continuity
- **SWM Operational Expenditure** (OPEX) determines *sustainability* i.e., the ability to keep the system running day after day, ensuring service continuity and WASH resilience



- No Funds
- Lack of System

Unmanaged waste

CAPEX Builds the system, OPEX Sustains it



How OPEX Monitoring Was Done

Study Objectives

Primary Objective

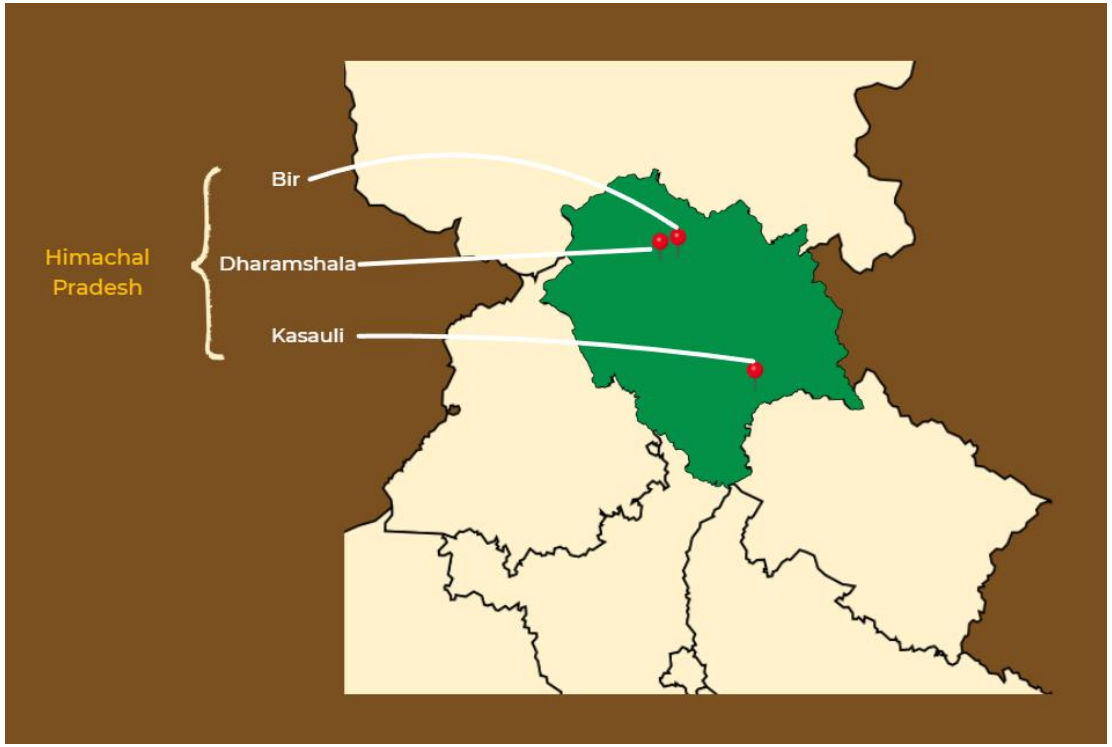
- To assess OPEX sustainability of SWM models using monitoring data

Secondary Objectives

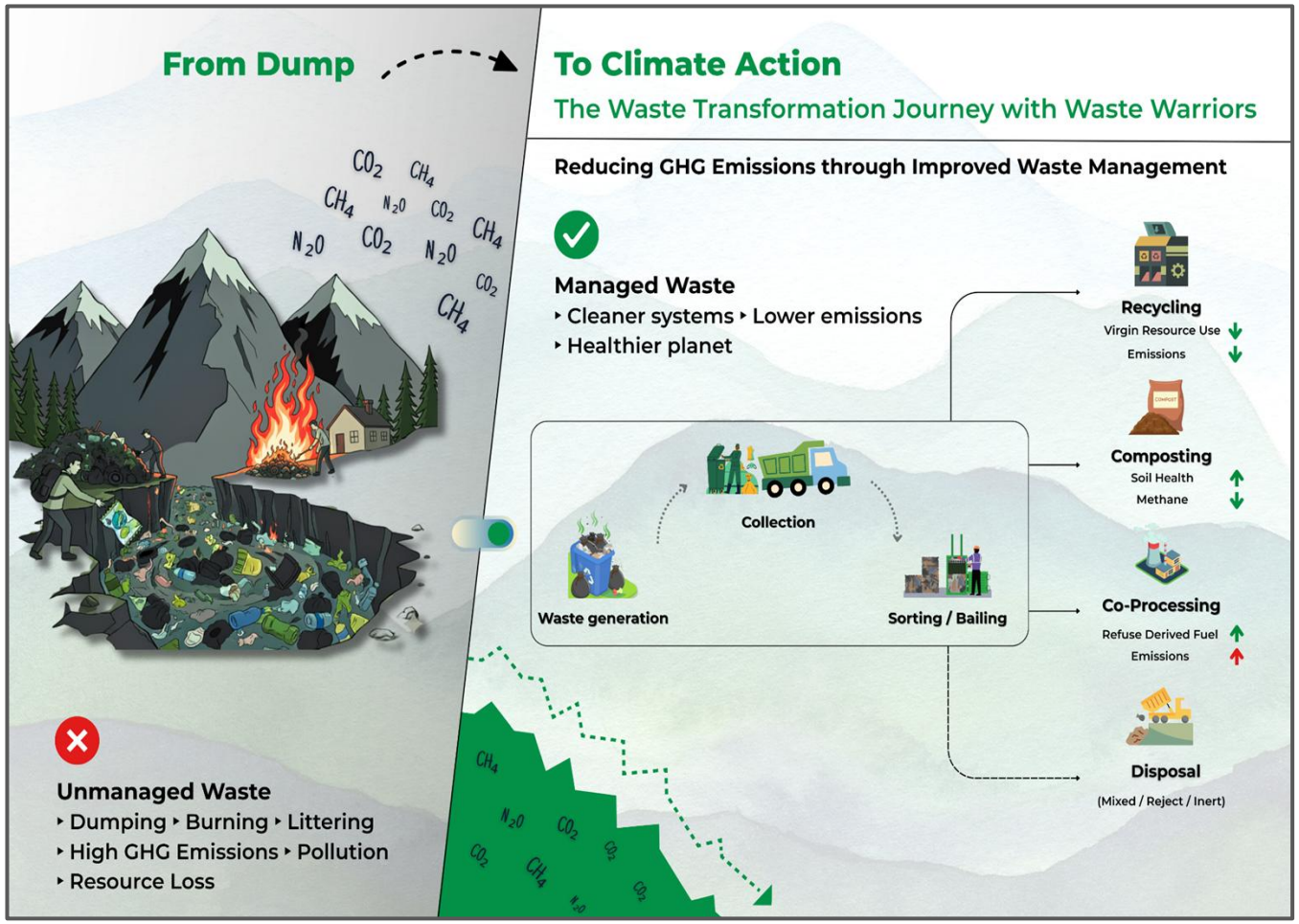
- Analyse income vs expenditure across the waste value chain
- Identify operational and financial gaps
- Inform resilient, climate aligned SWM models

Study Area & Scale

- 13 panchayats
- Kasauli, Bir & Dharamshala in Himachal Pradesh
- Study period: 1 April 2024- 30 November 2025 (20 Months)



Our Interventions



Gram Panchayat	Total Units	Total Wards	Total Population	Collection Frequency (Current Year)	Collection Frequency (Before)
DHMR Total - 6 GPs	3,536	44	16,316	5 GPs: Weekly; Barwala: Twice/week	Weekly
Bir Total - 4 GPs	2176	26	12,000	Once/10 days	Weekly
Kasauli Total - 3 GPs	1085	21	6,500	Garkhal Sanawar & Gulhari: Twice/week; Garkhal Kasauli: Weekly	–
13 GPs	6,797	91	34,816		

- **Door to Door waste collection service**
- **Type of Waste: DRY only**

Impact Metrics:

Waste Managed: DHMR- 339.02, Bir- 193.08, Kasauli- 56.35 MT
Days of livelihood: DHMR-4661, Bir-2577, Kasauli-41886
People engaged: DHMR-5299, Bir-3367, Kasauli-1684

Visuals from Study Area

Location: Dharamshala(Rural),HP

Location: Bir,HP

Location: Kasauli,HP

What Monitoring Revealed

Total Waste Collected: 540 Metric Tons (540,000 Kg)

Total Expenses: ₹ 97.5 lakh

Total Income: ₹48.1 lakh

Gap: ₹49.3 lakh (income falls short of expenses)

Critical Per-Kg Financial Insights

Total Expenses: ₹18.23

Total Income: ₹9.00

Total Gap: ₹-9.22

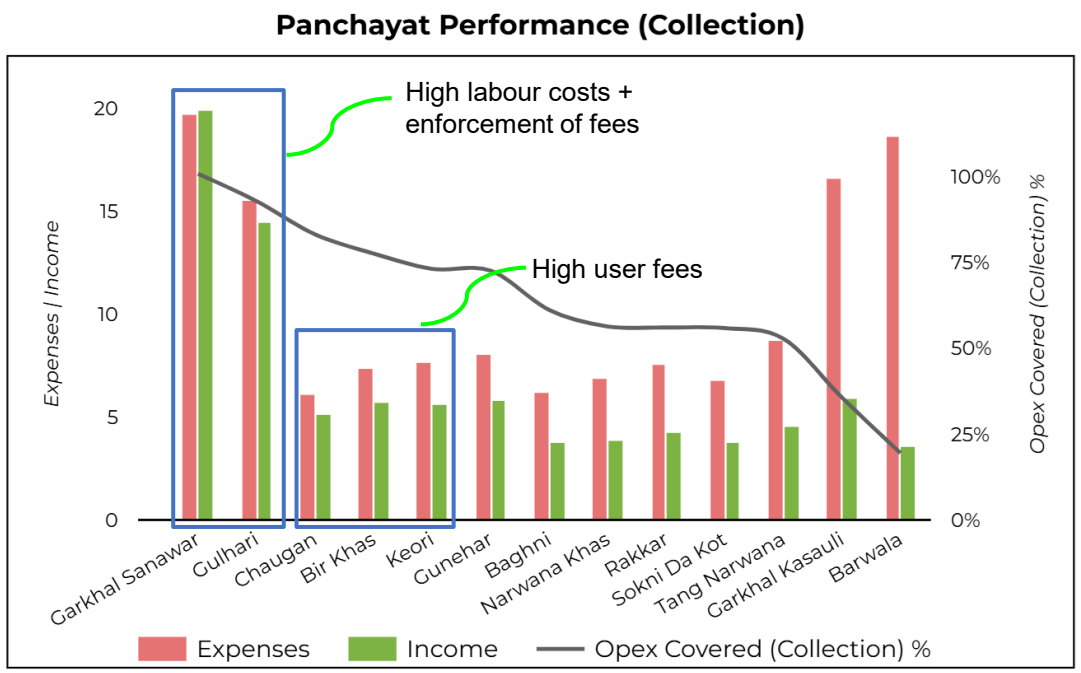
OPEX Covered: 49.4% of operational expenses (collection & processing)

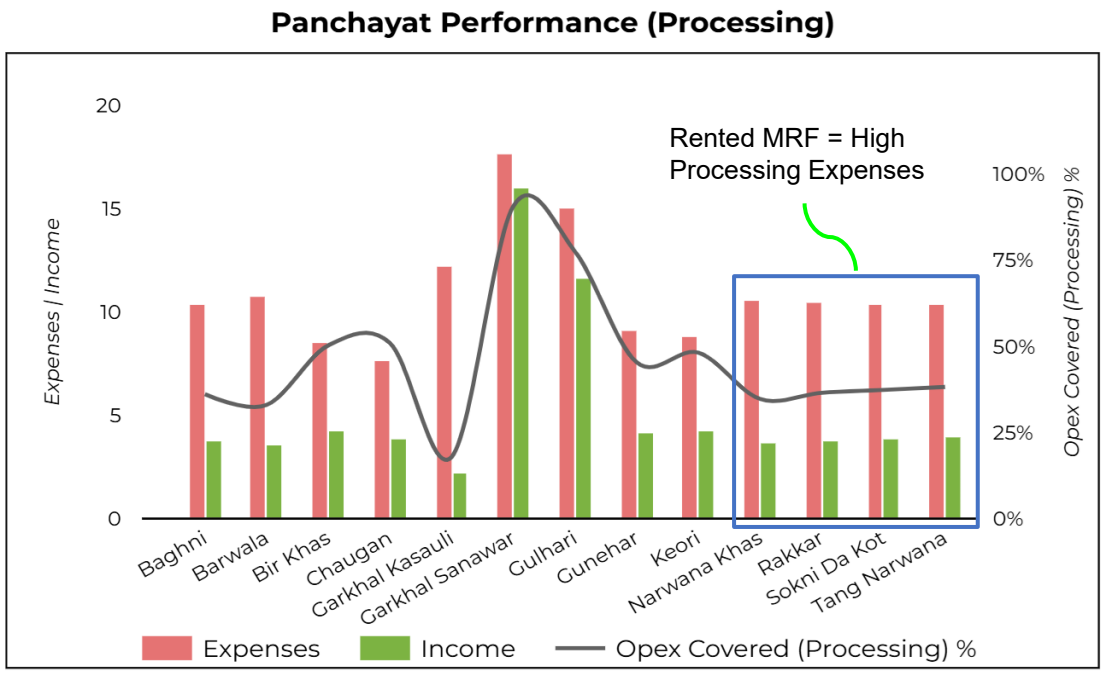
50% operational deficit

Category	Indicator	Dharamshala (Rural)	Bir	Kasauli
Monthly Waste Managed	**Metric Tons**	**16.50**	**9.65**	**3.24**
Overall	Total Expenses (₹/kg)	₹17.96	₹15.38	₹30.21
	Total Income (₹/kg)	₹7.81	₹9.59	₹14.17
	Financial Gap (₹/kg)	**₹-10.14**	**₹-5.79**	**₹-16.04**
	OPEX Coverage (%)	**43.5%**	**62.5%**	**46.9%**
Waste Collection	**OPEX Coverage (%)**	**53.5%**	**76.1%**	**52.7%**
Waste Processing	**OPEX Coverage (%)**	**36.4%**	**51.1%**	**39.6%**

Detailed flow of operational expenses and income between different stakeholders involved in the SWM model is outlined in Annexure.

Panchayat-Level Variations





Dharamshala: Moderate collection recovery + relatively high processing expenses

- **Rented MRF facilities** increase **processing OPEX(~10%)** in Dharamshala Panchayats like Narwana Khas, Rakkar, Sokni Da Kot, & Tang Narwana

Bir: Consistently higher and stable collection OPEX coverage

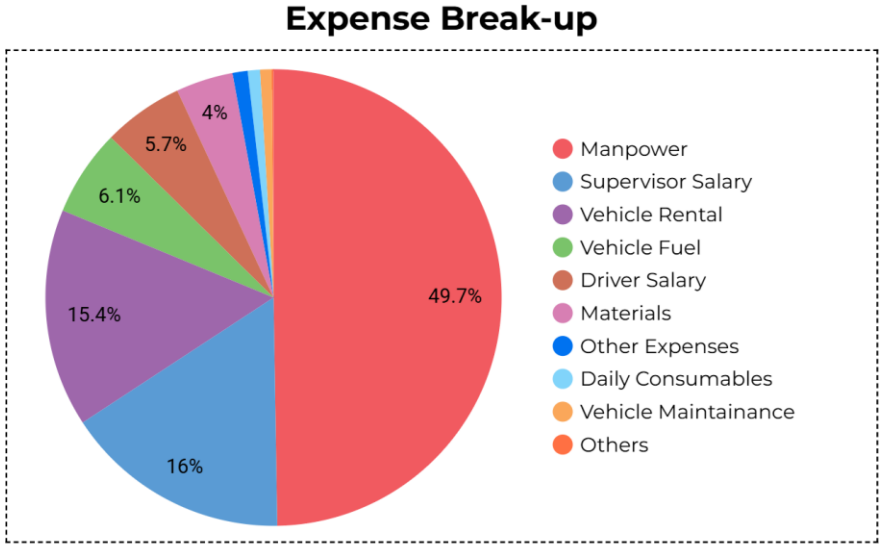
- **High user fee collections+ Enforcement (challans) + active panchayat leadership** in Bir Khas, Chaugan, & Keori **cover large % of collection costs**
- **Commercial / tourism activity (Keori, Chaugan)** → stronger willingness to pay and dependence on services

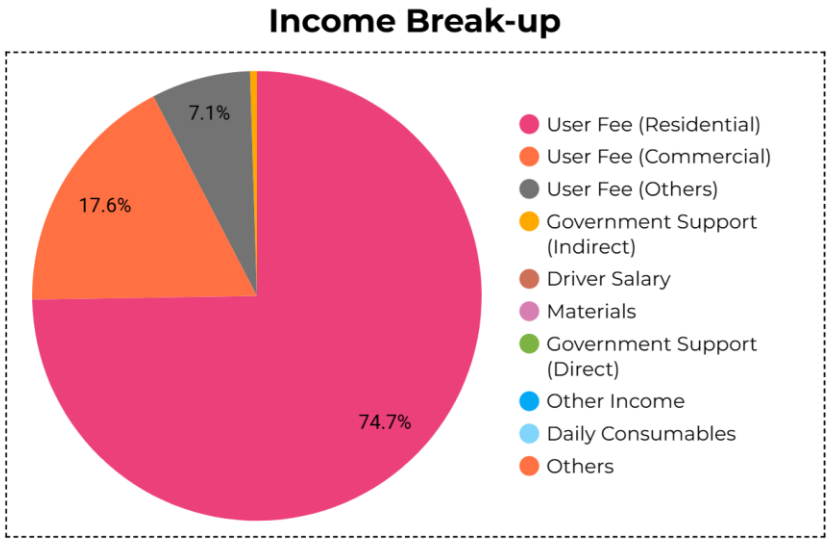
Kasauli: High collection costs, mixed collection recovery, weak processing sustainability

- **High labour costs** in urban wards of Garkhal Sanawar & Gulhari in Kasauli **increased collection expenses**. However, **strong support from Panchayat** enabled **enforcement of fee collections** and good Opex coverage.

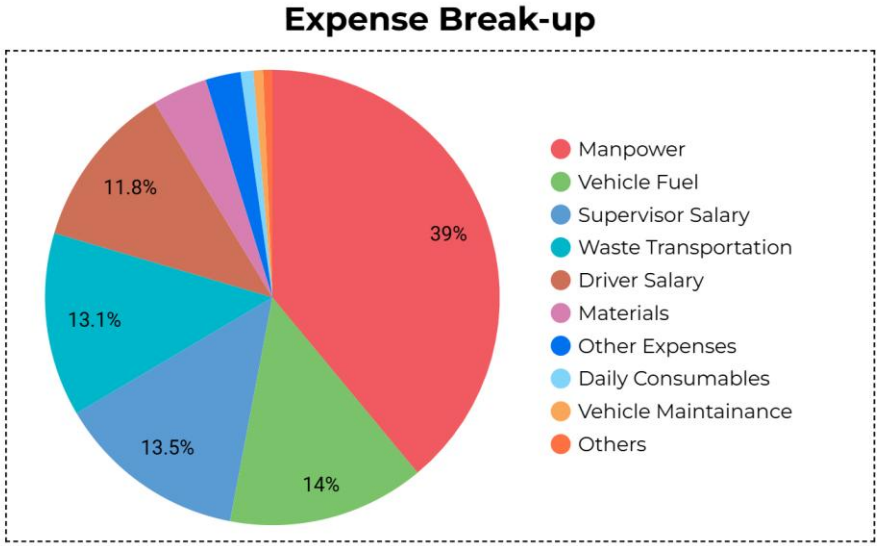
Expenditure vs Income

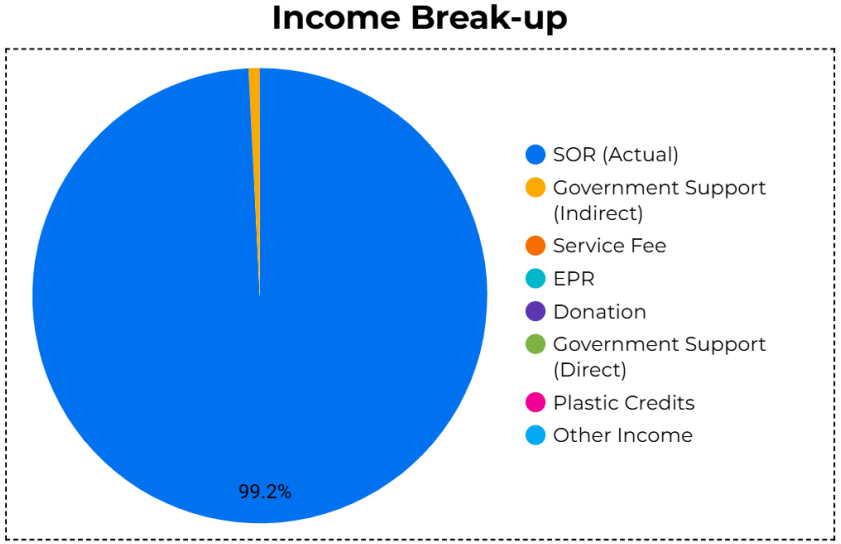
Collection Summary





Processing Summary





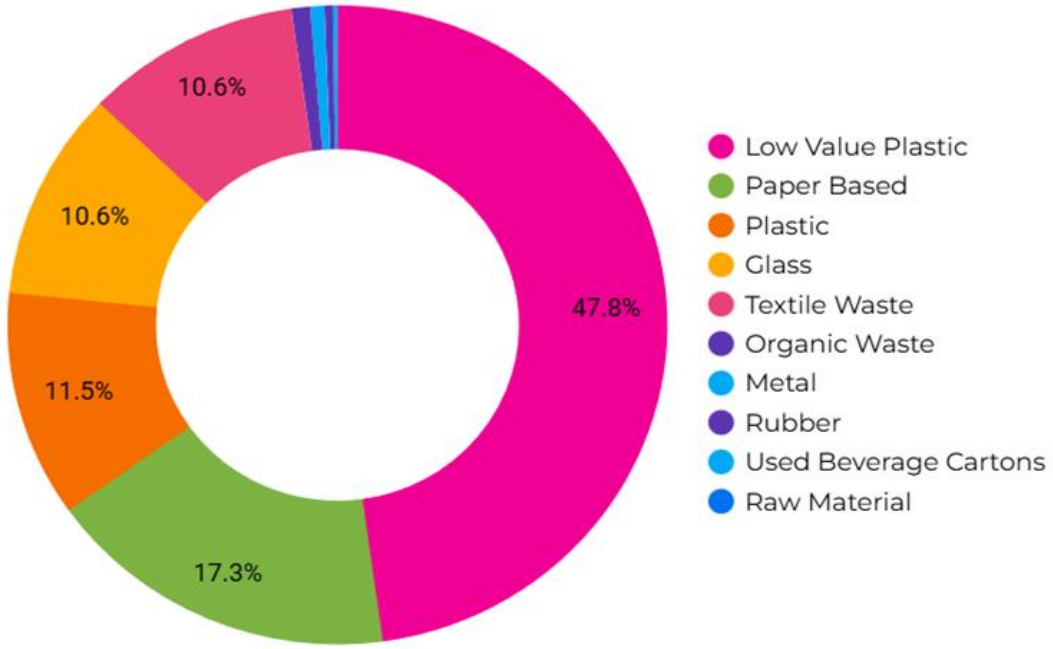
- Manpower and salaries are major expenses.
- High dependence on user fees and sale of recyclables since government support is low
- Granular cost & revenue tracking under this framework highlights these gaps (shared with govt)

Collection efficiency is driven by local socio-economic and geographic realities, while processing performance depends more on operational scale and quality of segregation

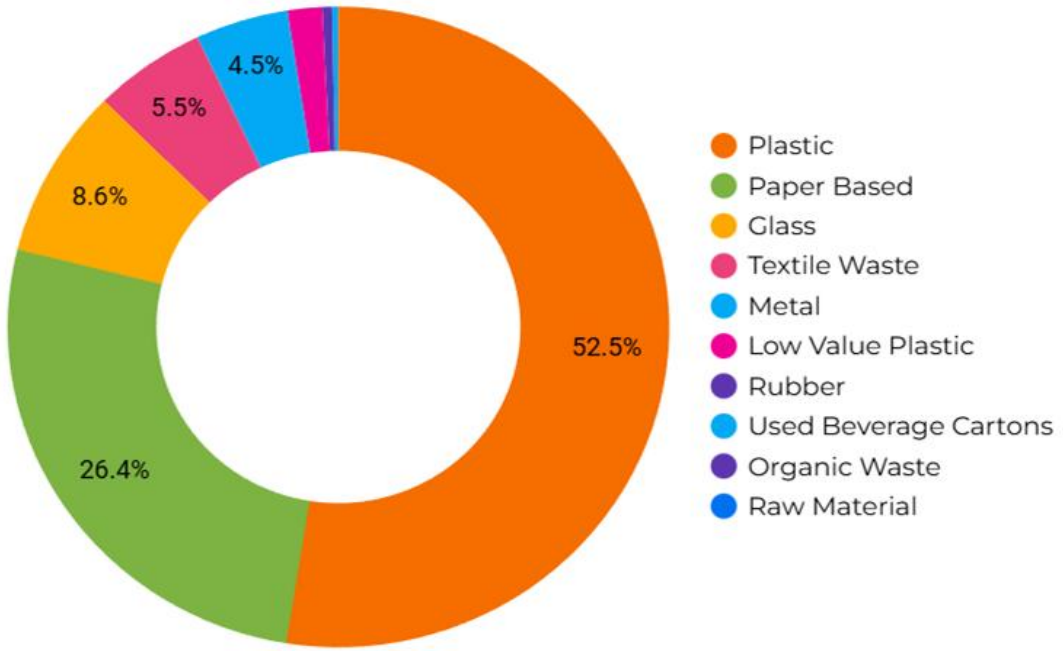
Location: Bir,HP

Waste is ~~Wealth~~

Waste Outward Mix by Quantum (MT)



Waste Outward Mix by Revenue (%)



- Low Value Plastics (Single/Multi-layer) accounts for **48% of total waste** but only contribute to **~2% of revenue**
- No Value/Low Value category typically contains Discarded **Clothes**, TetraPak, **Multi Layered Packaging (MLP), Single Use Plastic items** such as Used Cutleries, Carry Bags, Broken Glass, etc.
- The composite materials such as MLP generally have good properties but **very difficult to recycle by design and their % waste contribution is increasing** with changing consumption patterns

Rate Bucket (Sale Price per Kg)	% Waste Quantum	% Revenue Contribution
No Value	47.7%	0%
Low Value (Below Rs. 5)	31.3%	20.9%
Medium Value (Rs. 5 to Rs. 15)	13.5%	34.9%
High Value (Above Rs. 15)	7.5%	44.3%

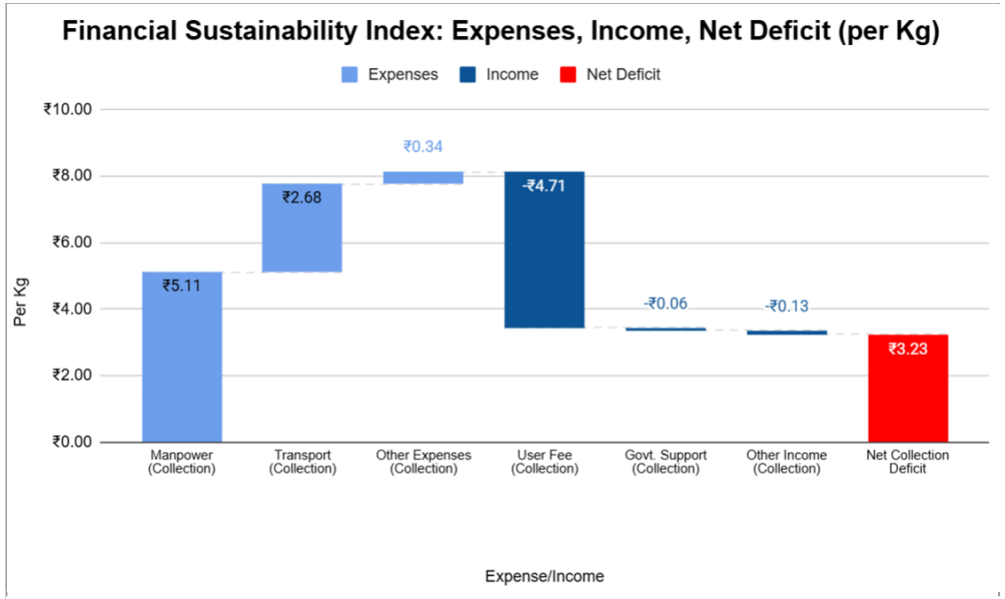
Monitoring Findings: Challenges & Actions

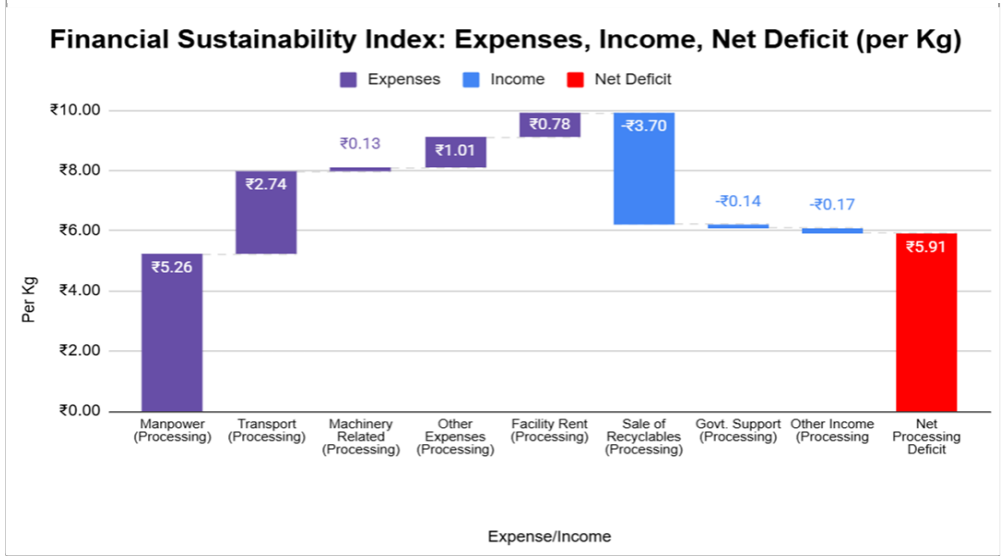
Financial Sustainability Constraints

- **High LVP transport cost: ₹4–5/kg** (in-state), **₹6–7/kg** (out-of-state)- significant bottleneck to the financial sustainability
- **High manpower cost: ₹10–11/kg** (collection + processing), **~60%** of OPEX
- **Low user fee recovery: ₹4.7/kg** - insufficient for collection costs
- **Low SOR income: ~₹3.7/kg** - inadequate to offset operations

Community Participation Challenges

- **Household onboarding: 40–50%**, varies by region
- **Post-handover drop-off:** Poor operational continuity & communication by Local Entrepreneurs (LEs) lead to service gaps and declining user trust.
- **Limited Panchayat follow-up:** Non availability of strict enforcement and regular engagement from local governance
- **User fee reluctance:** Waste services perceived as a public good
- **MRF resistance (Barwala):** Odour, noise, aesthetics, and proximity concerns





Monitoring Findings: Challenges & Actions

Operational & Recovery Constraints

- **Resource recovery limited** by waste composition, not operations
- **Removing High MRF rent burden** could improve sustainability by **8–12%** depending on scale and context
- **Need permanent infrastructure** in hilly regions with limited land availability and large geographical blocks; Plastic Waste Management Units (PWMUs) underutilized
- **LVP processing & disposal expensive** due to costs of baling/bagging/shredding, transport costs across long distances to cement plants

Operational Strategies:

Cluster-Based Planning

➢ **What we did**
Grouped multiple Gram Panchayats to jointly hire a single Local Entrepreneur (LE)

➢ **How it worked**
Shared manpower, transport, and administrative resources

➢ **Impact**
35% reduction in operational expenditure (OPEX)

Improved Material Recovery

➢ **What we did**
Implemented community awareness programs to promote household-level waste segregation

➢ **How it worked**
Cleaner waste streams at processing facilities

➢ **Impact**
Reduced rejection rates & Increased recovery of recyclable material

Potential Solutions & Next Steps

01	**Financial sustainability & OPEX security** *(Making daily operations viable and predictable)*	• Dedicated OPEX funds for day-to-day waste operations • Blended financing models for sustainable operations (industry contributions/partial subsidy from government programs like **16th Finance Commission & SBM 3.0**) • User fee policy and enforcement • Financial monitoring as part of a **climate-smart WASH strategy**
02	**System efficiency & regional collaboration** *(Reducing costs and logistics pressure)*	• Cross-Panchayat collaboration by shared vehicles, segregation units, and collection points via formal agreements Engagement with cement factories for waste transportation / co-processing • Organized RDF system for low-value plastics • Support mechanisms for low-value plastic streams at Panchayat level
03	**Circular economy & climate outcomes** *(Linking operations to emissions reduction)*	• Higher material recovery → reduced emissions & improved circularity • Strengthening Extended Producer Responsibility (EPR) in rural areas
04	**Social inclusion & behaviour change** *(People as system enablers)*	• Formal recognition and integration of informal workers • Community awareness campaigns to improve segregation • Incentivizing citizen participation

Next Steps: Evolving further; We'll:

- Extend to different waste stream setups: dry, wet, integrated, with/without LVP
- Add scenario analysis to test costs and operations
- Gradually incorporate sustainability indicators (emissions, resource efficiency, social impact)

"We offer the ecosystem a monitoring framework and invite collaboration to drive collective impact"

Thank You

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Annexure

Different components across waste collection and processing phases used for developing financial sustainability Index

Operations Phase	Income/Expense	Income/Expense Head	Data Type	Additional Details
Collection	Expense	Manpower	Variable	Total Salary paid amount for Waste Workers involved in collection only
		Supervisor Cost	Fixed	Collection Supervisor (if any) Salary paid amount
		Transport	Variable	Includes all vehicle related costs (fuel, maintenance, rentals) and driver salary
		Other Expenses	Variable	Includes material (such as bags, PPE kits) costs, daily consumables, office expenses, sundry costs, etc.
Collection	Income	User Fee	Variable	User Fee received from all residential, commercial or other establishments
		Government Support	Variable	Monetary equivalent of any Govt. support related to collection only
		Donation	Variable	Any donation amount received from community members for collection only
		Other Income	Variable	Misc. Income, if any
Processing	Expense	Manpower	Variable	Total Salary paid amount for Waste Workers involved in processing (Segregation & Baling) only
		Supervisor Cost	Fixed	MRF Supervisor, Operations Manager, Office Admin, etc. Salary paid amount
		Transport	Variable	For waste outward to recycling partners, also includes loading/unloading, fuel, rental, maintenance charges
		Electricity & Equipment Related	Variable	Electricity bills, equipment maintenance costs, etc.
		Facility Rent	Variable	If applicable
		Waste Disposal	Variable	Landfill Charges/Tipping Fee/Sanitary Waste disposal charges
		Other Expenses	Variable	Includes material (such as bags, PPE kits) costs, daily consumables, office expenses, sundry costs, etc.
Processing	Income	Sale of Recyclables	Variable	Sale of Recyclables amount received excluding GST
		Government Support	Variable	Monetary equivalent of any Govt. support related to processing only
		Donation	Variable	Any donation amount received from community members for processing only
		EPR/Plastic Credit Income	Variable	If applicable
		Other Income	Variable	Waste processing fee paid by Govt. bodies or other misc. Income