



# What makes Rural Solid Waste Management systems work?

Our learnings from building systems  
in Indian villages

October 2026



# Credits

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**Suggested citation:** Anjali V Raj, Archana Tripathi, Aarti Sachdeva 2026, What makes Rural Solid Waste Management systems work? Our learnings from building systems in Indian villages, Saahas, Bengaluru.

## Acknowledgements:

### Field implementation and data support

The report draws on quantitative and qualitative data, field observations and case documentation generated by Saahas field implementation teams across the respective project geographies.

### Government and institutional support

We acknowledge the support and cooperation of State, district, and Gram Panchayat officials across the geographies in which Saahas has worked on rural SWM initiatives, including Karnataka, Assam, Telangana, Tamil Nadu, Madhya Pradesh, Uttar Pradesh, Haryana, Rajasthan and Himachal Pradesh. Their support enabled field implementation, information sharing and engagement with local institutions and communities.

### CSR partners and funders

We acknowledge the CSR partners and funders whose support enabled the projects and initiatives that contributed to the experiences documented in this report.

### Project and community partners

We also acknowledge the local institutions, frontline workers and community members whose participation and experience have contributed to the learning presented in this report.

**Disclaimer:** This report has been developed by Saahas, based on the field experiences across different states. While every effort has been made to ensure accuracy and relevance, the views expressed are those of Saahas and are intended to inform and support stakeholder decision-making.

**About Saahas:** Saahas is a not-for-profit organisation, registered in 2001 under the Karnataka Societies Registration Act, 1960. Working towards a vision of making India a leading Circular Economy, Saahas focuses on sustainable solid waste management across India, including in urban, rural and eco-sensitive regions. Its work spans source segregation, resource recovery from organic and dry waste, and pilots in special waste streams such as e-waste and construction and demolition waste. Saahas also promotes circularity through initiatives on repair and reuse. It works with stakeholders across the waste ecosystem, including governments, entrepreneurs, corporates, communities and waste workers, while supporting dignified and sustainable livelihoods within the waste sector.

*Saahas has been an active member of the Rural WASH Partners Forum (RWPF) since its formation in August 2022 and was recognised as a Swachhata Knowledge Partner by the Ministry of Housing and Urban Affairs in 2023.*



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# Foreword



Saahas has always been a 'solutions' organization, with our feet firmly on the ground as we worked on solving the issues around improper waste management in the country. For the last twenty five years, Saahas has been demonstrating solutions to some of the most stubborn problems around solid waste management.

It started with a 'Less Plastic for Me' campaign in Bangalore, continued with decentralised composting and dry waste sorting systems, and expanded by adding waste streams like e-waste, construction & demolition waste and bulky waste. We experimented in different geographies, places with different levels of urbanization, different socio-economic-cultural-political scenarios and different waste generator profiles. The objective always being to align the solutions within the ambit of the Solid Waste Management Rules and to maximise the recovery of resources from waste. Along with demonstrating the solutions, we also worked on understanding the larger ecosystem and the systemic barriers, and finding ways to overcome some of them. We have been working with the community for awareness and sensitization, with the Government stakeholders for handholding and capacity building support, with entrepreneurs and markets for different business models and with other development sector organizations to build circular systems, together.

As we celebrate 25 years of our work, we have documented the reflections from some of our experiments, which bring out specific learnings from our interventions as well as the implications of these learnings on the larger solid waste management ecosystem. As we move ahead, we hope to continue to run new experiments and document the results in the form of develop toolkits, methodologies, and frameworks which will help embed the solutions in the community, governance and market systems.

This report, along with few others are being released on the occasion of our 25th anniversary, are an outcome of our learnings from our work and we hope these will help practitioners implement solutions which will work reliably and sustainably on the ground.



Regards,

Archana Tripathi  
CEO, Saahas



# List of Abbreviations

|                |                                                        |
|----------------|--------------------------------------------------------|
| <b>B2B</b>     | Business to Business                                   |
| <b>CapEx</b>   | Capital Expenditure                                    |
| <b>CBWTF</b>   | Common Biomedical Waste Treatment Facility             |
| <b>CEO</b>     | Chief Executive Officer                                |
| <b>CMCF</b>    | Central Material Collection Facility                   |
| <b>CSR</b>     | Corporate Social Responsibility                        |
| <b>D2D</b>     | Door-to-door                                           |
| <b>DWCC</b>    | Dry Waste Collection Centre                            |
| <b>EPC</b>     | Empty Pesticide Cans                                   |
| <b>FMCG</b>    | Fast Moving Consumer Goods                             |
| <b>GP</b>      | Gram Panchayat                                         |
| <b>GPLF</b>    | Gram Panchayat Level Federations                       |
| <b>HDPE</b>    | High-Density Polyethylene                              |
| <b>MGNREGA</b> | Mahatma Gandhi National Rural Employment Guarantee Act |
| <b>MLP</b>     | Multi-Layered Plastic                                  |
| <b>MMCF</b>    | Mini Material Collection Facility                      |
| <b>MRF</b>     | Material Recovery Facility                             |
| <b>NBA</b>     | Nirmal Bharat Abhiyan                                  |
| <b>ODF</b>     | Open Defecation Free                                   |
| <b>OpEx</b>    | Operational Expenditure                                |
| <b>O&amp;M</b> | Operations and Maintenance                             |
| <b>PDO</b>     | Panchayat Development Officer                          |
| <b>RRC</b>     | Resource Recovery Centre                               |
| <b>SBM-G</b>   | Swachh Bharat Mission–Grameen                          |
| <b>SLWM</b>    | Solid and Liquid Waste Management                      |
| <b>SWM</b>     | Solid Waste Management                                 |
| <b>SHG</b>     | Self-Help Group                                        |
| <b>TSC</b>     | Total Sanitation Campaign                              |



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# 1

## Rural waste matters



Until recently, rural India was pictured as pristine and green, with the prevailing narrative that it generated minimal waste, predominantly organic and therefore managed at the source. Therefore, even the rules were not specifically focused on rural solid waste management. When 64% of India's population lives in rural areas, and their consumption patterns are inspired by their urban counterparts, rural waste begins to matter.<sup>1</sup> Consumption patterns in rural areas are shifting, along with waste generation and composition.

Recent studies report a 40% increase in rural monthly per-capita expenditure during the period 2011-2023, with food and non-food expenditures nearly equal.<sup>2</sup> The composition of food consumed is changing, with processed food taking up space on the platter.<sup>3</sup> FMCG penetration (46% as of 2025)<sup>4</sup> and the expansion of digital B2B e-commerce into rural areas are inflating dry waste generation. Plastic sachets and single-use plastic packets are also becoming a major concern in rural areas, as they end up littering curbsides and clogging stormwater drains.<sup>5</sup> Disposable single-use tableware has also made its way into rural gatherings and events due to its convenience, low cost, and accessibility.

The Government of India's efforts to raise awareness of menstrual hygiene have led to increased use of sanitary products in rural India. The National Family Health Survey 6 (2023-24) reports that 75% of females aged 15-24 years in rural areas use sanitary products, compared with 33.6% in 2015-16.<sup>6</sup> Recent studies also report increased usage of synthetic diapers in both rural and urban India driven by hygiene awareness, economic changes, and government sanitation initiatives.<sup>7</sup> Rural areas currently lack infrastructure to manage sanitary waste; hence, it is burnt or dumped.

Although hazardous waste is often seen as an urban problem and thus overlooked in rural contexts, the literature suggests that EPCs (Empty Pesticide Cans) are increasing and are a concern in rural areas, where



Defunct composting tanks

they are often dumped recklessly into the environment, burned, or buried near farms.<sup>8</sup> Additionally, other special waste like broken glass, sharps, batteries, bulbs, etc. applies to the rural context as well. Therefore, the perception that Indian villages don't generate much solid waste is misplaced; rural areas also need effective solid waste management systems.

## Policy shift towards rural solid waste management



Historically, rural sanitation policies focused almost exclusively on toilet construction and the eradication of open defecation. Although India's early programs like Total Sanitation Campaign (TSC) & Nirmal Bharat Abhiyan (NBA) technically acknowledged Solid and Liquid Waste Management (SLWM) as a component, it remained largely on paper, with more than 90% of resources and administrative attention directed toward building individual household latrines. Even the Swachh Bharat Mission-Grameen (SBM-G) Phase 1 focused almost entirely on achieving Open Defecation Free (ODF) status across rural India.<sup>9</sup>

India's structured policy focus on rural solid waste management began gaining formal momentum in 2016 with the Solid Waste Management (SWM) Rules. While the 2016 rules expanded the statutory mandate to include rural areas with population greater than 3000, and formally assigned duties to the Ministry of Rural Development and Panchayati Raj departments, rural SWM became a primary, funded implementation priority in 2020 with SBM-G Phase 2. Under Phase 2, SWM ceased to be an afterthought and became a prerequisite for a village to achieve "ODF Plus Model" status.<sup>9</sup> It provided structured capital expenditure for waste collection and processing infrastructure and mandated the convergence of other funding mechanisms, such as 15th Finance Commission Tied Grants for sanitation and Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) funds. With this, Gram Panchayats (GP) got equipped with funding to operationalise solid waste collection and processing. However, infrastructure alone does not guarantee an efficient solid waste management system.

## Status of rural solid waste management systems



Although the SBM-G 2.0 dashboard presents an optimistic picture of rural SWM, showing most states with over 75% of villages at ODF Plus Model status and more than 5.3 lakh villages having solid waste management arrangements in place (as of September, 2026),<sup>10</sup> on-ground observations reveal a different reality. The dashboard primarily tracks administrative self-declarations (with sample-based verification) and initial asset creation (such as the procurement of collection vehicles or the civil construction of sheds) rather than verified, end-to-end functionality. As noted in the Centre for Science and Environment's (CSE) assessments on rural waste, infrastructure reported on digital portals frequently masks non-operational collection systems, abandoned processing units, and persistent open dumping.<sup>5</sup>

Despite having the infrastructure for SWM established through these programs and grants, many villages still have a long way to go before achieving ODF Plus Model status when assessed based on the regular operational status of their SWM systems. Sustainable rural waste management cannot succeed by deploying static hardware alone; it requires operationalising infrastructure as an active, accepted public service built around local realities. Rural SWM operational status is a broad spectrum, with different regions facing diverse operational challenges.



Partially constructed MMCF in Majuli, Assam

Planning and executing daily SWM operations requires technical coordination that existing GP staff are rarely trained to manage. Rural sanitation workers and Panchayat functionaries often transition into SWM roles without formal training in collection route planning, secondary sorting, equipment upkeep, or occupational safety. Without structured knowledge transfer and skill development across local leadership and ground workers, operational systems quickly stall or degrade.

Adding to the systemic burden, GPs equipped with infrastructure for collection and processing are struggling to cover Operation and Maintenance (O&M) expenses (including fuel, vehicle maintenance, worker wages, consumables and disposal of non-recyclable dry waste). While SBM-G grants and tied funds cover SWM CapEx, GPs fall short on OpEx, leaving systems defunct. Many business models assume resource recovery (selling compost and sorted dry recyclables) will subsidise these daily costs. However, in reality, the revenue from resource recovery is contingent on local market availability and reverse supply chains, which often don't exist in many geographically isolated regions.

Compounding these operational and financial constraints is the near-total absence of safe, viable disposal pathways for sanitary and special care waste. Unlike organic waste, which can be treated locally, or dry recyclables, which have scrap value, rural sanitary waste remains an invisible, unmanaged stream. When common rural practices are limited to open burning, shallow burial, or dumping in water bodies, this creates a hazardous blind spot in both national reporting data and local management.

Saahas has witnessed many of these bottlenecks firsthand through our work across varied rural landscapes over the years.



### Observations from Majuli and Natauli

Rural solid waste systems frequently fail when sanitation programs reduce service delivery to a mere checklist of physical assets, assuming that a vehicle, shed, or processing facility automatically guarantees operational functionality. Saahas' field engagements in Majuli (Assam) and Natauli (Uttar Pradesh) highlight the disconnect between infrastructure creation and operational utility.

On the river island of Majuli, where wet waste was traditionally managed through household practices, non-biodegradable dry waste had no proper disposal pathway and was routinely burnt or dumped. Although village storage points and aggregation centres had been constructed, many stood incomplete, unbranded, and abandoned, mistaken for cycle sheds, infiltrated by animals, and disconnected from household collection habits and logistics.

Conversely, Natauli possessed both an intact processing facility and an operational collection vehicle, yet only 7 to 10 of 502 households were giving waste to the system regularly. Here, the barrier was social rather than infrastructural: households resisted keeping waste indoors, segregation was non-existent, and waste handling carried deep-seated social stigma. Together, these disparate field realities demonstrate that a village is not an empty site awaiting the installation of a standardised model; it operates within established cultural habits, spatial realities, and community perceptions.



D2D waste collection, Siddipet district, Telangana

# 2 Lessons learnt from Saahas experiments in rural SWM

Saahas has been working closely with rural local governments for more than a decade, establishing, strengthening and institutionalising SWM systems across the country. From deep rural to modernising peri-urban villages and river islands to protected forests, we have our footprint across diverse geographies, understanding local contexts and requirements. Across these contexts, we have worked with rural local bodies and communities on technical planning, infrastructure development, implementation support, behaviour change and capacity building. **What this experience has shown us is that the design of a rural SWM system must begin with the local context, not with a predetermined infrastructure or technology.**

Over the years, we have also seen that the success of a rural SWM system depends on much more than the availability of processing infrastructure. While waste processing technology has evolved over the years, community behaviour, frontline workers' livelihoods, and local government capacity still need significant improvement. Sustainable rural SWM requires alignment between service delivery, community behaviour, infrastructure, institutions and financial viability. Waste begins to move only when households store it and hand it over to a collection vehicle, workers follow planned routes and ensure regular collection, GPs monitor the service, and recovered material has somewhere to go. The challenge, therefore, is not only to create infrastructure but also to make it function as a public service.

Our experiments in rural SWM began in the GPs of Ballari district, Karnataka, in 2015. Since then, our work has evolved from establishing basic collection and segregation systems to strengthening local institutions, developing resource-recovery pathways, building community ownership and supporting replication at scale. Today, our rural interventions span multiple states and contexts, offering a diverse body of experience on what enables and what constrains the transition from infrastructure creation to functioning and sustainable SWM systems. This report distils these experiences into a set of lessons for practitioners and rural local governments.

The following sections explore a few lessons that we believe are critical to making rural SWM systems work from understanding the local context and designing collection systems to building economies of scale, institutional ownership and long-term financial sustainability.

|                                                                            |                                                        |
|----------------------------------------------------------------------------|--------------------------------------------------------|
| 1 Understand the local context before designing a system                   | 4 Design processing systems around waste               |
| 2 Regular, door-to-door waste collection is the backbone of the SWM system | 5 Financial sustainability must be designed from day 1 |
| 3 Segregation is the key to resource recovery                              | 6 Institutional ownership sustains the system          |



Waste audit, Kaziranga, Assam

## Lesson 1

# Understand the local context before designing a system

**A rural SWM system must be designed around the waste, people, infrastructure and local conditions of the area, rather than around a predetermined model or technology.**



Systems fail when they are designed based on outdated assumptions and generalisations. There is no one-size-fits-all design for all rural SWM; therefore, it is important to understand the lay of the land before designing and planning rural systems. The first step, therefore, is to understand the system that already exists and design around the local context. At Saahas, our interventions begin with a baseline assessment covering waste generation and composition, waste generators, existing infrastructure and human resources, current collection and disposal practices, stakeholders and gaps in the existing system. Our experience across different geographies has reinforced this principle: the approach that works for villages around Panna National Park may not be appropriate for river islands in Majuli or rapidly industrialising villages in Ballari or at the outskirts of metropolitan cities.

## Knowing the waste generators and generation



Understanding who generates waste, how much they generate and what they generate is fundamental to designing an appropriate SWM system. Relying solely on outdated or aggregated datasets can underestimate/overestimate the actual service population and waste quantities, resulting in under-designed or over-designed collection systems, manpower and processing capacity.

A waste-generator mapping exercise can establish the number and types of generators (households, shops, institutions, homestays, hotels and other establishments) and their spatial distribution. This should be complemented by a representative waste audit to understand the quantity and composition of waste generated and how these vary across generator categories and seasons. Together, these assessments provide the basis for decisions on collection coverage and frequency, manpower, vehicle capacity, processing requirements and downstream waste management pathways.



Stakeholder meeting, Lucknow district, UP

## Mapping the stakeholders who can influence the system



The SWM system does not consist of GPs alone. It depends on a network of stakeholders whose roles may extend beyond the conventional SWM function. Mapping these stakeholders and understanding their responsibilities, influence and capacity is therefore an important part of system design.

This includes elected representatives and GP officials, frontline workers, SHGs and community groups, waste generators, informal waste workers, recyclers and other downstream actors. Depending on the context, other institutions may also be critical. In Panna, for example, tourism-related stakeholders and the Panna Tiger Reserve are important because waste management is closely linked to the area's tourism and ecological context. In Majuli, the geography of a river island brings inland water transport and district-level stakeholders into the waste-management system. In industrial areas such as Ballari, local industries can be important stakeholders because of their influence on waste generation, resources and local development.

Recognising these relationships early helps move SWM from being the responsibility of a single department or official to becoming a shared system with defined responsibilities and accountability.

## Understanding existing system, practices and gaps



Before investing in new infrastructure, it is important to understand what is already available and how it is being used. This includes existing collection systems, vehicles, processing facilities, land and other assets, as well as the availability, skills and working conditions of SWM staff. Equally important are the practices that take place outside the formal system: how households currently dispose of waste, whether waste is burnt or dumped, how informal recovery takes place, and what people understand about segregation and collection.

This assessment helps distinguish between a gap in infrastructure and a gap in utilisation, capacity or behaviour. A GP may have an SWM unit but lack the staff or systems to operate it; another may have collection vehicles but inadequate coverage or route planning; a third may have a functioning collection system but no viable downstream pathway for dry waste. The

intervention required in each case will be different. **A baseline is not simply a data-collection exercise before a project begins. It is the process by which the actual problem is defined, thereby determining whether the subsequent system is appropriately designed.**



### Case learning: Lessons from fast-growing peri-urban GPs in Bengaluru

The expansion of urban sprawl also affects the lifestyle of villages on the urban periphery. In Marenahalli, Bagalur, and Bandikodigehalli (BK Halli) GPs in the Bengaluru Urban District of Karnataka, their proximity to the Bengaluru metropolitan area and the Bengaluru International Airport has led to increased population density, increased waste generation, and changes in land use and lifestyle patterns. In these GPs, waste collection systems were either absent or covered only 10-25% of households. Consequently, most residents in these regions either disposed of their waste in public spaces (44-92%) or burned it (~30%).<sup>11</sup>

When Saahas began interventions around three GPs, the official datasets reported around 10,000 waste-generating units (households, commercial establishments, and institutions); however, when an audit and waste-generator mapping exercise was conducted in the area, the actual number rose to over 14,000. Despite having a semi-operational collection system, these GPs faced challenges in collection and waste processing because the existing infrastructure and staff couldn't accommodate the increased number of waste generators.

The baseline therefore did more than establish a set of numbers; it changed the understanding of the problem and informed the system design. During the intervention, the elected representatives and Panchayat Development Officers (PDO) were informed of the importance of an adequate waste management system. Subsequently, the waste collection system was enhanced through the procurement of collection vehicles and the improvement of staff capacity. This improved waste collection coverage from just 10-20% to 95% within a year, enabling door-to-door (D2D) waste collection for everyone.



Community awareness in Marenahalli GP, Karnataka



Primary collection vehicle (electric), Luhari, Haryana

## Lesson 2

# Regular, door-to-door waste collection is the backbone of the SWM system

**A waste management system cannot work if waste cannot reliably reach the right destination. A reliable collection system is not about collecting waste every day; it is about providing collection access, appropriate frequency and practical routes that residents and frontline workers can rely on.**

Dumpsites on roadsides and smoke from open burning are visible symptoms of a system that is not functioning. When waste is not collected regularly, households eventually resort to dumping or burning, regardless of how many clean-up drives or awareness campaigns are conducted. Addressing the accumulation without fixing the collection system only treats the symptom.

A reliable collection system does not necessarily mean collecting waste every day. It means providing a predictable service that households can rely on with defined collection days, timings, routes and waste streams. When residents know when the collection vehicle will arrive, they can store their waste until the next scheduled collection rather than resorting to open dumping or burning. There may be some initial resistance to the reduced frequency of collection. This can be addressed by providing households with larger dry-waste bags or covered bins and explaining that daily collection would incur a significantly higher user fee. The objective is therefore not simply to maximise collection frequency, but to design a system that provides consistent coverage at an appropriate frequency and cost.

## Design collection around the local waste profile



The appropriate collection frequency depends on what waste is generated, where it is generated and how much is generated. Remote villages often have dispersed settlements, longer collection routes and lower quantities of waste per trip. In contrast, rapidly urbanising or peri-urban GPs may have dense settlements and larger quantities of waste, requiring multiple trips or higher collection frequency.

On-site management of wet waste can also influence collection requirements. In villages where households compost wet waste, feed it to livestock or poultry, or otherwise manage it locally, dry, sanitary and special care are the streams requiring collection. Except sanitary waste the other two can often be stored for longer periods. In villages in hilly regions, the dry waste collection of once in 15 days or once a month has also proven to be successful. In peri-urban settlements, where such practices may be less feasible, more frequent collection may be necessary, particularly for wet waste.

Collection schedules should therefore be designed around the waste profile, settlement pattern and local practices, rather than applying a uniform frequency across all villages. The schedule should clearly specify collection days, timings and the waste streams to be collected. Separate collection days for different waste streams can also improve segregation and reduce the logistical complexity of transporting materials to different destinations.



## Optimise routes before adding resources



Once the collection frequency is established, the next question is how the service can be delivered efficiently. Route optimisation should consider the number and location of waste generators, waste quantities, road conditions, collection points, vehicle capacity, collection time and available manpower.

### A well-designed route should answer practical questions:

- Which roads can be accessed by which type of vehicle?
- Where are point-based or alternative collection arrangements required?
- Where should a route begin and end?
- Where should waste be transferred or unloaded?
- How many households can a vehicle and collection team realistically service on one route?
- What collection timings work for different groups of residents?
- Can the route be completed within the vehicle's operating capacity and working hours?

These decisions have a direct bearing on both service quality and cost. Efficient routing can increase coverage, reduce unnecessary travel and fuel consumption, and help GPs manage their operation and maintenance costs. It also makes the collection schedule more predictable for residents.

Where household availability is important for direct handover, collection timings should be aligned with residents' routines. For example, household collection may be scheduled in the morning, while commercial establishments in densely commercialised areas may be better served later in the day. The exact timing, however, should be determined by the local context rather than treated as a universal standard.

Collection schedules also need to account for the routines of the people being served. In communities with migrant or temporary populations, conventional morning D2D collection may not work if residents are away at work during collection hours. Simply increasing collection frequency does not solve this mismatch; the system needs to adapt to when and how people can hand over their waste.

In Doddajala GP in Bengaluru Urban District, Saahas encountered such a challenge in a temporary migrant settlement. The existing collection schedule did not align with residents' availability, resulting in waste being dumped in the surrounding area. At the same time, while residents were willing to store dry waste, storing wet waste for several days at the household level was difficult and on-site wet-waste management was not feasible.

Saahas team therefore introduced a temporary storage bin (perforated drums) within the settlement in their common space. Wet waste was cleared from the bin twice a week, while dry waste was collected on Sundays, when more residents were available to hand over their waste. This arrangement was introduced alongside awareness-building on segregation and responsible waste disposal to reduce instances of mixed waste dumping. The collection staff also monitored and reported to the GP in case there was mixed waste.

The collection system must be designed around the realities of the community it serves. Where residents cannot participate in a conventional collection schedule, the solution may be to change the timing, provide an alternative handover point, or create a combination of household and community-level arrangements. One thing to note is that just placing unmanned bins for different waste streams at public places or at ends of streets doesn't help as most people drop mixed waste in these bins. So if a public bin is to be installed, it needs to be manned to ensure segregated waste is collected, or the awareness levels of citizens and monitoring should be good enough to prevent mixed waste disposal.

## Choose the collection method and vehicle for the terrain



D2D waste collection using pushcarts, Ballari



Rural settlements often present a combination of narrow roads, undulating terrain, dispersed households and long travel distances. A vehicle that is appropriate for one GP may be inefficient or not feasible for another. Vehicle selection should therefore consider road accessibility, collection distance, waste quantity and composition, carrying capacity, availability of fuel or charging infrastructure, maintenance requirements and the skills available to operate the vehicle.

Where roads are too narrow for motorised vehicles, pushcarts or tricycles can provide the last-mile connection to households. Waste can then be transferred at a suitable point to a larger vehicle for onward transportation. In areas with significant tourist, pilgrim or migrant populations, or where conventional collection timings do not work for residents, drop-off facilities or waste kiosks can provide an additional access point to the system.

These alternatives should not be viewed as substitutes for a well-designed collection system, but as context-specific components of one. The objective is to ensure that every waste generator has a practical way to hand over waste without compromising the efficiency of the overall system.



Waste Kiosk, Keylong, Himachal Pradesh



## Case learning: Lessons from Luhari, Haryana and Keylong, Himachal Pradesh on designing collection around local conditions

The importance of context-specific collection design is evident in two very different geographies where Saahas has worked: Luhari in Haryana and Keylong in Himachal Pradesh.

When Saahas began working in Luhari, a remote village of 1,138 households, there was no organised waste collection system. Residents commonly dumped or burned waste, contributing to waste accumulation and clogged stormwater drains. A baseline assessment was undertaken to understand waste generation, composition and existing disposal practices before designing the collection and processing system. Remoteness also influenced the choice of collection vehicle. Conventional petroleum-fuelled vehicles were difficult to sustain because the petrol pumps were far away and could interrupt operations. Electric vehicles were therefore considered for D2D collection. It also had a lower CapEx. The decision was not simply about adopting a new technology; it was a response to a specific operational constraint.

The constraints in Keylong are very different. Villages around Keylong in the cold desert of Lahaul and Spiti experience prolonged winters, with many areas becoming inaccessible for almost five months. The seasonal workforce adds another layer of complexity, the temporary sanitation workers who migrate from Nepal during the dry season leave the region as winter approaches ('The October Shift'), while the terrain itself restricts access for both motorised and manual collection vehicles. Rather than replicating a standard vehicle-based D2D model, the collection system was adapted to the terrain and season.

During the accessible months, collection staff carry sacks and collect dry waste D2D on alternate days, transferring it to a motorised vehicle stationed at the nearest accessible road. Wet waste is managed locally through existing practices, while other waste streams are collected separately. Before winter, households are provided with sacks to store dry waste, with local staff undertaking monthly collection where possible. A drop-off arrangement for sanitary waste provides an additional service during the period when regular collection is constrained.

The Khimsa Waste Kiosk in Keylong further illustrates how alternative collection infrastructure can respond to local conditions. Within two months of installation, it helped divert more than 200 kg of dry waste that could otherwise have entered the Chandra River, while also creating a visible disposal point for tourists.

**Collection frequency, routes, vehicles, transfer arrangements, storage and even the feasibility of D2D collection need to be determined by the geography, waste profile, workforce and operating conditions of each location.**

### Appropriate vehicle design to optimise maintenance cost



The choice of collection vehicle must consider the collection system, vehicle configuration, and methods for storing different waste streams. Compartmentalised vehicles can help maintain segregation when wet and dry waste are collected on the same day, but their built-in partitions also reduce effective carrying capacity and can lead to uneven loading. Wet waste is heavy and

occupies relatively little space, whereas dry waste is light but bulky. Consequently, one compartment can become heavy while the other fills up by volume, affecting how efficiently the vehicle can be loaded and potentially its balance. Saahas conducted a study on vehicle design and compartmentalisation across the Marenahalli, Kudluru, Chikkajaala, and Doddajaala GPs in the Bengaluru Urban and Rural districts of Karnataka.<sup>12</sup>

The study found that compartments created using separate bins or bags in a non-partitioned vehicle can sometimes provide greater flexibility than a permanently partitioned body. Dry waste, in particular, packs more efficiently when stored in bags, while wet waste can occupy less space when placed directly in the vehicle body. The choice therefore needs to be based on the quantity and composition of waste, collection frequency, available vehicle capacity, and the local operating context, rather than on a standardised vehicle specification.

In addition, how waste is stored in the vehicle has significant implications for operation and long-term ownership costs. Wet waste contains moisture and generates acidic leachate, which can corrode the vehicle body, floor and other components. Significant corrosion was observed in vehicles in Kudluru and Chikkajaala where wet waste was placed directly on the body; Chikkajaala also required an additional ₹1.5 lakh for major repairs to the vehicle body. Across the vehicles studied, maintenance expenditure was generally higher where waste was stored directly on the vehicle body. In contrast, keeping wet waste in HDPE plastic bins and dry waste in bags can reduce cleaning and corrosion-related maintenance, potentially extend vehicle life and delay replacement costs. Although this arrangement increases material-handling effort, workers have to lift and empty the wet-waste bins, the additional effort is considered worthwhile because it reduces direct contact between wet waste and the vehicle body. This is particularly important for GPs because the initial vehicle may be financed through government grants, while recurring maintenance and eventual replacement must be borne by the GP.

Therefore vehicle procurement should consider the total cost and effort over the vehicle's operating life, not only the purchase price, stated carrying capacity or initial ease of collection.

## Collection staff are as important as vehicles



Even a well-designed collection route will fail if there are not enough staff to operate it. Rural SWM systems frequently face challenges in recruiting and retaining collection workers, including the social stigma associated with sanitation work, limited availability of local workers and competition for other forms of employment.

GPs therefore use different approaches to staffing. In some locations, existing sanitation workers (sweepers) are assigned to D2D collection, with drivers are engaged additionally. Where GPs have greater financial capacity, higher remuneration can help attract and retain workers. Some systems also provide collection staff with an opportunity to earn from the recovery and sale of dry waste, creating an additional incentive linked to resource recovery.

In Haryana, for example, staff shortages in Luhari and Nuh led to district-level decisions for engaging a third-party agency for D2D collection. The agency recruited workers from neighbouring regions who were willing to undertake sanitation work. However, such arrangements depend on the financial capacity of the GP and are not equally feasible everywhere.

In Karnataka, a different model has emerged through partnerships between GPs and Gram Panchayat Level Federations (GPLFs) of Self-Help Groups (SHGs). Through the Karnataka State Rural Livelihood Mission (Sanjeevini), SHG members can be trained in waste collection, driving, personal safety, bookkeeping, sorting and processing. This creates an opportunity to link rural SWM with local livelihood institutions while building a locally anchored workforce. However, Saahas's experience also shows that identifying SHGs willing to take up SWM work is not always straightforward. In Shivamogga, for instance, sustained awareness-building and sensitisation were required before SHG groups came forward to participate, after which Saahas supported their training and facilitated agreements with GPs.

**The lesson is that human resources need to be designed into the collection system from the beginning including recruitment, regular and adequate remuneration, training, safety, workload and mechanisms for accountability and retention.** People are not only the operators of an SWM system; they are central to whether it can be sustained. Building a stronger rural SWM workforce requires investment in continuous training and capacity building, fair remuneration, manageable workloads, appropriate personal protective equipment, insurance and other measures that provide safety and security at work. Equally important is recognising the dignity and value of sanitation work. Improving working conditions and the social recognition of frontline workers can help address the stigma associated with sanitation work and make the sector more attractive for recruitment and retention.





Source segregation of waste

## Lesson 3

# Segregation is the key to resource recovery

**Waste can become a resource only when the materials within it remain recoverable. Source segregation is the first link in the resource-recovery chain, and it can be sustained only when convenient collection, appropriate infrastructure, community engagement and consistent reinforcement work together.**

When different waste streams are mixed, contamination reduces the quality and value of recyclable materials and makes subsequent sorting and processing more difficult and costly. Source segregation is therefore not simply a household-level behaviour; it is the foundation on which the rest of the resource-recovery system depends. But segregation happens when the system makes the desired behaviour possible, convenient and socially reinforced.

A processing facility can function only when it receives an adequate and consistent supply of the appropriate waste stream. This means that investments in composting facilities, Dry Waste Collection Centres (DWCCs) or other resource-recovery infrastructure need to be accompanied by investment in the system that feeds them. Collection planning and community mobilisation therefore cannot be treated as separate activities: as the collection system is established, GPs need to simultaneously build awareness, create convenient opportunities for waste handover and reinforce source segregation.

Our experience in two GPs in Anekal taluk, Bengaluru Urban district, showed us the consequences of having infrastructure without a functioning collection and segregation system. Although the GPs had collection and processing infrastructure, the absence of regular D2D collection meant that residents commonly resorted to dumping and burning.

In these GPs, Saahas began by establishing a regular collection system alongside D2D awareness and community engagement on source segregation. Within a year, 99% collection coverage was achieved. Approximately half of the households were handing over waste to the collection vehicle, while around 47% were segregating waste at source. As the collection and segregation system strengthened, the decentralised composting facility and DWCCs began receiving segregated waste, creating the conditions for resource recovery. A processing facility cannot create a resource-recovery system on its own. The system begins at the point where a household separates and hands over its waste.

## Mobilisation needs to be designed around the community



Community mobilisation is often treated as a standard project activity, delivered through a common IEC package. In practice, however, the choice of who engages with the community, how they engage and which communication channels they use can determine whether households participate.

Saahas's interventions have used a combination of D2D engagement, community meetings and IEC materials such as flyers, posters, wall paintings, jingles and public announcements. More



Sanitation staff conducting segregation awareness, Shivamogga, Karnataka

importantly, efforts have focused on identifying people who already have a relationship of trust within the community. ASHA workers, Anganwadi workers, ANMs and sanitation staff can be trained to reinforce messages on segregation and responsible waste management because residents may be more receptive to familiar and trusted local faces. Where additional outreach is required, GPs can also engage Swachhata Sakshis or community mobilisers to support sustained sensitisation.

The approach needs to respond to local social and cultural contexts. Understanding gender norms, social relationships, community structures and acceptable forms of interaction should therefore be part of the initial assessment rather than something considered only when an awareness campaign fails to gain traction.

## Different communities may need different messengers



Saahas's experience across its rural programmes shows that there is no standard script for community engagement.

In Udupi and Dakshina Kannada, elected representatives and local religious leaders were engaged in community awareness events, helping reach residents through locally influential voices. In Lucknow, Uttar Pradesh, PRI members were involved in awareness campaigns, using the existing local governance structure to reinforce the message on source segregation.

In Ballari, Karnataka, some changes to the way households were equipped to participate also made a difference. Providing storage bags and installing nails on compound or external walls gave households a practical place to store waste before collection and was associated with improved participation in collection and source segregation.

These examples highlight that community mobilisation is not only about communicating the right message. It is also about making the desired behaviour socially acceptable, practically convenient and locally supported.



### Case learning: Luhari and Nuh — when gender shapes engagement

The experience of Luhari and Nuh in Haryana provides a more explicit example of why community engagement strategies need to reflect local social norms.

While in Kota, Rajasthan, Saahas teams found it comparatively easier to engage directly with women on topics including source segregation, responsible waste disposal and sustainable menstruation, including through male field staff, in the neighbouring State the situation was not the same. In Luhari and Nuh districts of Haryana, however, cultural norms made direct interaction between male field staff and women more difficult. Saahas therefore engaged women staff for D2D awareness and community mobilisation, enabling conversations on sanitation and menstrual health in a manner more appropriate to the local context.

The difference between these contexts demonstrates that the question is not simply how to reach the community, but who is best placed to reach which section of the community. Local context



Spot segregation training for residents, Shivamogga, Karnataka

assessment therefore needs to extend beyond waste quantities, infrastructure and geography to include social relationships, gender dynamics, trusted community actors and channels of communication.

## Awareness is necessary but it is not enough



Awareness does not automatically translate into practice. A household may understand the importance of source segregation and know the consequences of dumping or burning, yet still choose not to segregate or hand over waste appropriately, even when a D2D collection service is available.

Behaviour therefore needs to be reinforced through the design and operation of the collection system. Collection staff are often the most frequent point of contact between the SWM system and households and can play an important role in identifying non-compliance, reminding residents about segregation and reinforcing expected practices. Regular monitoring can help GPs identify households or areas where segregation is weak and target further engagement. Where appropriate and supported by local regulations, enforcement mechanisms and penalties can complement awareness and service improvements.

The objective is not to run an awareness campaign and expect behaviour to change permanently. It is to create a system in which segregation becomes the normal and expected way of participating in waste management. **Source segregation is not an isolated behaviour-change intervention. It is the first link in the resource-recovery chain, and sustaining it requires the simultaneous alignment of convenient collection, appropriate infrastructure, trusted community engagement, frontline-worker involvement and consistent monitoring and reinforcement.**



Waste data monitoring, Telangana



Sorting of dry waste in a DWCC, Marenahalli, Karnataka

## Lesson 4

# Design processing systems around waste

**The right processing system is not necessarily the most sophisticated one; it is the one that matches the quantity and quality of waste, local operating conditions, available resources and a viable end use or market, and can remain functional over time.**

There is a common assumption that once processing infrastructure is built, the SWM system will begin to function. Rural SWM experience suggests otherwise. Infrastructure is only one component of a functioning system, and infrastructure that is poorly matched to the waste generated, local operating conditions or available markets can quickly become underutilised or defunct.

A significant share of public investment in rural sanitation has gone towards creating SWM infrastructure. Yet Saahas's experience shows that the question is not simply "What infrastructure can we build?", but "What processing system can the GP operate and sustain with the waste it actually generates?"

Processing pathways should therefore be designed based on waste quantity and composition, segregation quality, technical and operational feasibility, land and resource availability, local climate, manpower, operating costs, and the market or end use for the recovered material. The availability of a particular technology or a sanctioned infrastructure project should not, by itself, determine the processing model.

## Managing wet waste: process it as locally as possible



Wet waste can often be managed closer to the point of generation in rural areas. Where households have access to land, livestock or agricultural activity, on-site management through home composting, animal feed or other locally appropriate practices can reduce the need for collection and decentralised processing. In more densely populated or peri-urban GPs, however, household-level management may be less feasible and collected wet waste may need to be processed through community or decentralised facilities.



**Home composting bins distributed to residents**

The appropriate processing pathway depends on the quantity and characteristics of the feedstock, segregation quality, available land, local climate, availability of operators, operating costs and demand for the end product. Rather than selecting a technology first and then trying to fit the waste into it, GPs should assess which pathway can be operated consistently with locally available resources.



Wet waste composting tanks in Natauli, UP

| Processing pathway           | When it may be appropriate                                                                                                              | Key considerations                                                                                              |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Community composting         | Clusters of households using common compost bins. In many villages, wet waste is often mixed with cow dung in open piles (Thippe/Ghur). | Land; segregation; maintenance; local use of compost                                                            |
| NADEP/tank composting        | Rural settings with suitable land and local use for compost. Permanent structures                                                       | Feedstock (Best for agricultural waste); land; O&M; compost use                                                 |
| Pit composting               | Rural settings with suitable land and local use for compost. Pits are dug into the ground.                                              | Soil and groundwater conditions; land; turning/aeration technique; compost use                                  |
| Windrow composting           | Larger quantities of segregated biodegradable waste requiring centralised or decentralised processing                                   | Feedstock quantity; land; compost pad; turning; moisture and leachate management; operators; compost use/market |
| Vermicomposting              | Segregated organic waste where suitable temperature and moisture conditions exist and there is a use or market for vermicompost         | Feedstock quality; temperature/moisture; bed management; operators; end-use/market                              |
| Biogas / anaerobic digestion | Consistent organic feedstock with a viable use for biogas and/or digestate                                                              | Feedstock consistency; contamination; scale; technology; skilled operation; end-use/demand                      |

The objective is not to identify the "best" technology in isolation, but to identify the technology that is appropriate for the waste and capable of being operated consistently in that particular location. One constant observation across locations has been that expensive technologies like 24 hour composters, wet waste shredders sold to villages don't sustain and largely remain non-functional due to service constraints and high electricity requirements.



### Case learning: Natuali, Uttar Pradesh

In Natuali GP of Lucknow district, UP, the GP collects less than 20 kg of wet waste per day from households, while some farmers periodically give dry cow dung to the GP vehicle; most farmers, however, continue to use their cow dung directly in their fields. The GP uses four NADEP tanks (~121 cubic feet each) for composting the collected wet waste. Cow dung received from farmers is processed separately through eight vermicomposting tanks and is also used as an inoculum for the NADEP composting process. An arrangement has been established between the Gram Pradhan (elected head of the GP) and participating farmers: half of the vermicompost produced from the cow dung is returned to the farmer, while the remaining half is retained by the GP and sold at approximately ₹7–10 per kg.

The initiative is led by the Gram Pradhan, who has a particular interest in vermicomposting. Both NADEP and vermicomposting are located within the Resource Recovery Centre compound, allowing the GP to have the same two staff members who sort and aggregate dry waste also undertake routine maintenance of the composting systems. The NADEP system is functioning, although the compost has not yet been harvested.

## Managing dry waste: build the value chain, not just the MRF

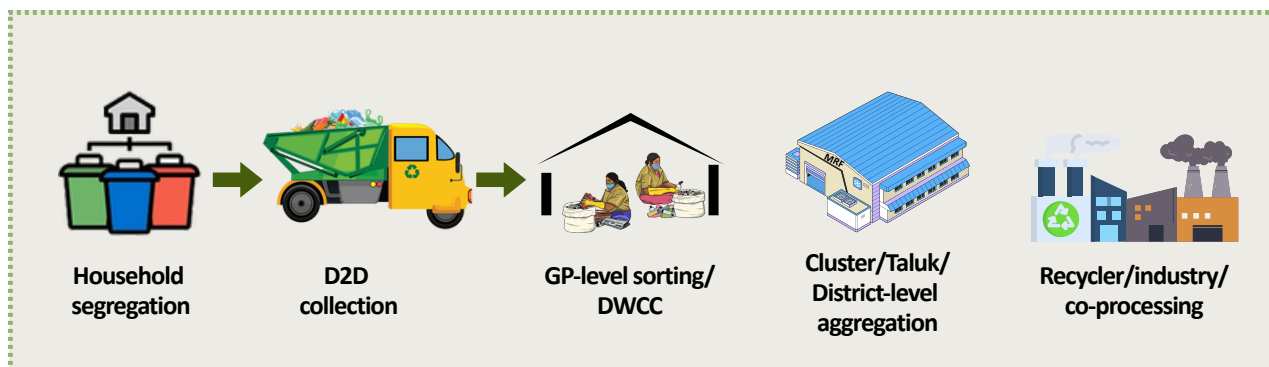


Unlike wet waste, which can often be managed close to the point of generation, dry waste typically requires sorting, aggregation and access to recycling or end-use markets. A rural GP



Nitte MRF, Udupi district

may not generate enough material of each category to make local sorting or direct sale viable. The system therefore needs to connect household-level segregation and collection to GP-level sorting, cluster or district-level aggregation, and downstream recyclers or end users.



The scale and configuration of each stage should depend on the quantities generated, geographic spread, transportation costs, available infrastructure and access to markets. This is particularly important for low-value materials, where the cost of transporting small quantities can exceed their market value.



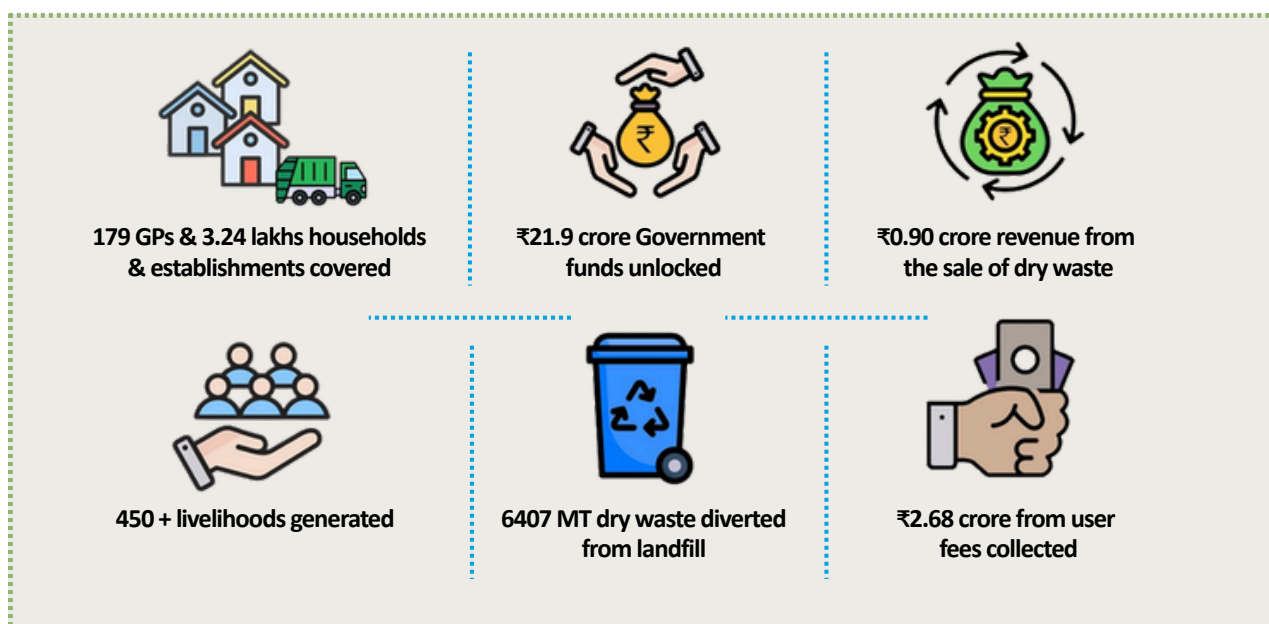
### Case learning: Designing MRF catchments around actual waste

A good example of why processing infrastructure needs to be planned around actual waste quantities comes from Saahas's work supporting district-level rural MRFs in Karnataka. In 2020–21, the Department of Rural Development and Panchayati Raj, Government of Karnataka, allocated Performance-Based Incentive funding under SBM-G for the construction of district-level rural MRFs in Udupi, Dakshina Kannada, Ramanagara and Ballari. Initially, 145 GPs across the four districts were mapped to these MRFs for dry-waste aggregation and onward movement.

However, constructing an MRF is only one part of establishing a functional resource-recovery system. As the MRFs were being built, a critical dependency became clear: the facility needed a reliable flow of segregated dry waste from GPs to remain operational and financially viable. The upstream value chain at the GP level was broken. There were no robust systems for source segregation, reliable collection or sustained community participation. This is when Saahas, through an HCL grant, intervened to provide the critical operational and institutional systems needed at the GP level. Saahas supported improvements in waste collection and source segregation and built the capacity of GP officials and SWM workers. Downstream linkages were also established for non-recyclable combustible dry waste, including formal arrangements with cement factories.

Baseline assessments and waste audits found that actual dry-waste generation per household was lower than the initial estimates. To ensure that the MRFs received sufficient material to operate at their intended capacity, the number of GPs mapped to the MRFs was increased from 145 to 179.

The experience demonstrates that processing capacity cannot be determined independently of the waste supply chain feeding it. A technically sound facility can remain underutilised if there is insufficient segregated feedstock, while a smaller facility can become a bottleneck if the catchment generates more waste than it can process. Over four years, this initiative demonstrated what becomes possible when infrastructure is connected to functioning upstream and downstream systems.



## When the planned infrastructure is not available, find an operational solution



Infrastructure constraints are common in rural areas. Land may not be available for a new processing facility, sanctioned infrastructure may take time to become operational, or an existing facility may be unsuitable for the waste generated. Waste generation, however, does not stop while infrastructure is being planned.

Saahas's experience shows the value of using existing assets and finding temporary solutions while working towards a longer-term system. In Ramanagara and Shivamogga in Karnataka, as well as in Kota in Rajasthan, Nuh in Haryana, and Thiruvallur in Tamil Nadu, old and underutilised buildings have been repurposed for sorting and temporary storage of dry waste. In one GP in Ramanagara, farmers were approached to provide land for wet-waste composting pits in exchange for the compost generated.



Dry waste sorting in a temporary facility in Melnalathur GP, Tamil Nadu

In Majuli's river-island GPs, the challenge was different. The dispersed geography made it difficult to move dry waste directly to central facilities. Mini Material Collection Facilities (MMCFs) were therefore used as intermediate storage points, with waste subsequently transferred to Central Material Collection Facilities (CMCFs) once a month. However, partially constructed MMCFs lacked walls and could not adequately serve as storage facilities. Rather than wait for additional infrastructure funding, the local Saahas team used locally available bamboo to enclose the structures. At a cost of less than ₹5,000 per facility, the MMCFs were made functional for dry-waste storage and aggregation.

Similar village level storage facilities have been successful in optimising the logistics of secondary waste collection and aggregation in GPs surrounding Panna Tiger Reserve where the villages are spread out. These examples demonstrate that infrastructure planning needs to distinguish between what is technically desirable and what is operationally possible. A low-cost adaptation that enables waste to move through the system may sometimes be more valuable than waiting for an ideal facility.



## Every waste stream needs a destination: the challenge of sanitary waste



Sanitary waste remains one of the more difficult waste streams to manage in rural areas. In the absence of accessible and affordable authorised disposal or treatment facilities, sanitary waste end up being burned or openly dumped.

Where Common Biomedical Waste Treatment Facilities (CBWTF) are not accessible, rural guidelines (SBM-G and Menstrual Hygiene Management guidelines)<sup>13</sup> approve of deep burial under specified conditions. However, Saahas's experience indicates that implementation can be inconsistent, making it important for GPs to identify safe and feasible disposal pathways rather than treating sanitary waste as an afterthought.

Some GPs have established formal arrangements with authorised CBWTFs. In Vaddu GP in Ballari, for example, an agreement was established with a CBWTF at a flat rate of ₹5,000 per month, including transportation. In Dakshina Kannada, the Zilla Panchayat facilitated an arrangement covering 50 GPs, with an authorised biomedical waste handler collecting sanitary waste at a rate of ₹19/kg. The company also supplies dedicated yellow bags at a nominal additional cost and provided storage instructions.

Saahas has also supported sustainable menstruation initiatives in several project locations in Karnataka, Rajasthan and Haryana. Reducing the quantity of disposable sanitary products entering the waste stream can complement improvements in downstream management.

**The broader lesson is that every waste stream needs an identified pathway. A system that successfully recovers recyclables but has no safe solution for sanitary waste or rejects remains incomplete.**



Sustainable menstruation session, Nuh, Haryana

## Look beyond the GP: convergence can expand processing options



Rural GPs do not always have the scale, land or financial resources to process every waste stream independently. Where appropriate facilities exist nearby, urban-rural convergence and inter-GP aggregation can provide an alternative to building duplicate infrastructure in every GP.

In Bhadravathi taluk in Shivamogga district, some GPs had no land available to construct their sanctioned Swachha Sankeernas. Instead, these GPs partnered with the Bhadravathi City Municipal Council to process their waste. Dry waste is sorted for resource recovery, while wet waste from households without on-site management is processed at the CMC's windrow composting facility. The GPs pay a processing fee of ₹100 per tonne of dry waste. Depending on the distance, waste is either transported directly to the CMC or transferred at an intermediate point into the CMC's secondary collection vehicle.<sup>14</sup>

Such arrangements can be particularly useful where constructing and operating a GP-level facility would be financially or operationally difficult. However, convergence works only when both sides have a clear benefit and the roles, costs and service expectations are defined.

Downstream markets are equally important. Recyclable dry waste can generate revenue, but the non-recyclable fraction still requires a destination. In several GPs in Karnataka, including Ballari, non-recyclable combustible dry waste is sent to cement factories after recyclable materials are recovered. Similar arrangements operate through MRFs in Udupi and Dakshina Kannada. These linkages can divert material from open burning or landfilling, although transportation costs can become significant when end-use facilities are located far from the collection area.

In areas near recycling facilities, even low-value materials can sometimes find a market. In Lucknow district, for example, approximately 20 GPs have sold MLP and other low-value plastics to industries at around ₹4/kg. Such examples demonstrate that the viability of resource recovery depends not only on how much waste a GP generates but also on its location relative to aggregation and recycling markets.

Processing infrastructure should be treated as one component of a larger resource-recovery system. The appropriate system is determined by the waste generated, local operating conditions, the required scale, the capacity to operate the facility, and the availability of a viable downstream pathway. **Sometimes the right answer is a GP-level facility; sometimes it is a cluster- or district-level system; and sometimes it is a temporary or shared arrangement that uses existing infrastructure.**



GP waste transferred to Bhadravati CMC compactors



Userfee collection, Shivamogga district, Karnataka

## Lesson 5

# Financial sustainability must be designed from day 1

**Financial sustainability begins with understanding the full recurring cost of delivering SWM services and planning a realistic mix of user fees, resource-recovery revenues, GP revenues, grants and convergence to meet those costs.**

There is a persistent narrative that associates waste with wealth and that waste management can generate enough revenue from recovered materials to sustain the system. While there are opportunities to recover resources and generate revenue from waste, this does not come at no cost. Unlike infrastructure creation, sustaining a waste management system requires recurring expenditure, including sanitation worker salaries, collection and transportation costs, vehicle maintenance, electricity, consumables and processing operations.

SWM should therefore not be viewed as a source of revenue, but as an essential public service that incurs a recurring cost. While government programmes may support the creation of rural SWM infrastructure, the recurring costs of collection, transportation and processing need to be met through a combination of GP revenues, user fees, grants, convergence and, where possible, revenue from resource recovery. In practice, however, many GPs struggle to meet these recurring costs. Delayed staff salaries can affect collection services, while inadequate funds for vehicle maintenance, fuel or processing can result in systems becoming non-functional despite infrastructure being available. Financial viability and the long-term O&M gap therefore need to be understood and planned for before infrastructure is established, rather than addressed after the system begins operating.

## Understand the cost of providing the service



The first step towards financial sustainability is to understand what it actually costs to operate the SWM system. This includes not only vehicle fuel and maintenance, but also staff salaries, consumables, electricity and the costs of processing and safely disposing of different waste streams.

Our experience from the mining-affected regions of Ballari district, particularly Ballari and Sanduru taluks, illustrates this gap. GPs in these areas spend, on average, around ₹40,000 per month on primary collection and transportation. Where DWCCs or Swachha Sankeernas are operational, there is additional cost. The revenue generated from the sale of recyclables is generally minimal—less than ₹5,000 per month in most GPs. In several GPs, non-recyclable waste is stored for dispatch to cement factories or, in the absence of a viable disposal pathway, ends up being dumped. Consequently, the cost of managing this fraction is often not reflected in the reported operating expenditure. In GPs where processing units were not operational, financial constraints were also affecting the basic collection system, including delays in staff salary payments. The experience demonstrates that the viability of the entire SWM chain, not only the infrastructure, needs to be considered when planning the system.



Loading non recyclables for cement factory dispatch, Ballari

### Average monthly OpEx for Toranagallu GP, Sanduru taluk

| OpEx type*                             | Rs/month     | Revenue sources      | Rs/month      |
|----------------------------------------|--------------|----------------------|---------------|
| Vehicle Fuel                           | 18400        | User-fee             | Not collected |
| Vehicle O&M                            | 2500         | Sale of compost      | NA            |
| Electricity                            | NA           | Sale of biogas       | NA            |
| Staff salary                           | 28000        | Sale of recyclables  | NA            |
| Consumables (Gloves, Mask, Bags, etc.) | 1000         | Penalty              | Not collected |
| <b>Total OpEx</b>                      | <b>49900</b> | <b>Total revenue</b> | <b>0</b>      |

\*non-recyclables are being picked up by a cement plant run by the CSR funder of the project in this GP. In the absence of this mechanism, the cost of sending the non-recyclables to the nearest cement plant or industrial unit needs to be included.

\*cost of disposal of sanitary waste and special care waste is not included here.

### Average monthly OpEx and revenue for Yashvanthanagara GP, Sanduru taluk

| OpEx type*                             | Rs/month     | Revenue sources      | Rs/month      |
|----------------------------------------|--------------|----------------------|---------------|
| Vehicle Fuel                           | 6000         | User-fee             | Not collected |
| Vehicle O&M                            | 2000         | Sale of compost      | NA            |
| Electricity                            | NA           | Sale of biogas       | NA            |
| Staff salary                           | 25000        | Sale of recyclables  | 1000          |
| Consumables (Gloves, Mask, Bags, etc.) | 2000         | Penalty              | Not collected |
| <b>Total OpEx</b>                      | <b>35000</b> | <b>Total revenue</b> | <b>1000</b>   |

\*cost of disposal of non-recyclables, sanitary waste and special care waste is not included here

The financial data from these GPs further demonstrate that revenue from the sale of recovered materials alone is insufficient to cover recurring SWM expenditure.

## Waste can generate revenue, but not enough to run the system



The value of waste is realised only when materials are adequately segregated, recovered and linked to a viable market. Even then, not all waste streams generate revenue.

Recyclables have a market value, and some GPs may generate income from the sale of compost or other recovered materials. However, the system also has to manage materials that have little or no market value. Non-recyclable combustible waste needs to be transported to cement factories or other authorised end users, sometimes over considerable distances. Similarly, sanitary waste requires safe treatment and disposal, which can involve processing and transportation costs. These costs can be significant. Where cement factories or other downstream facilities are more than 100 km away, the cost of transporting non-recyclable waste can become a major burden on the GP. Safe disposal of sanitary waste through an authorised CBWTF can also involve processing charges of around ₹35–40 per kg.

The recurring cost of rural SWM should be assessed across the entire service chain, rather than limited to D2D collection. GPs should account for the costs of primary collection and transportation, operation and maintenance of wet- and dry-waste processing facilities, and the safe disposal or onward management of waste streams that cannot be recovered, including sanitary and non-recyclable waste.

The OpEx should also include the cost of maintaining the system's performance. Regular awareness and behaviour-change activities may be required to improve waste handover and source segregation, while periodic monitoring and evaluation are necessary to identify gaps and ensure that the system continues to function effectively. These activities should therefore be treated as part of the recurring cost of SWM, rather than as one-time expenses.

Some GPs may be able to absorb these costs through higher own-source revenues, but this is not the case everywhere. Without a planned source of funds for these recurring costs, waste streams with no immediate economic value are more likely to be stored indefinitely, dumped or openly burned.

## Build a revenue mix for SWM



Revenue from resource recovery can contribute to SWM finances, but it needs to be considered alongside other sources of funding. Depending on the context and applicable government provisions, GPs may draw on:

- 1. User fees from households, commercial establishments and institutions**
- 2. Sale of recyclables, compost and other recovered materials or energy**
- 3. GP own-source revenue**
- 4. Fifteenth Finance Commission grants and other applicable government grants**
- 5. Convergence with other government programmes or institutions**
- 6. Penalties for littering, dumping or non-compliance, where applicable.**

Grant-based funding and GP own-source revenue may not always provide a predictable stream dedicated to day-to-day SWM operations. Not every GP will have the same capacity to generate revenue. In Anneshwara GP in Bengaluru Rural district, the presence of the Bengaluru International Airport and associated development generates relatively high revenue from land taxes. However, despite this revenue base, the GP's SWM system was not adequately streamlined. Saahas worked with the GP's officials and elected representatives to build understanding around the need for an efficient SWM system and to secure a commitment to allocate a portion of the GP's own revenue towards SWM OpEx. This helped establish and sustain the system.

The GP own-source revenue can be an important source of SWM funding where the local revenue base permits it. However, this model cannot be assumed to be replicable across all rural GPs. Own-source revenues vary considerably between GPs and must also support other local priorities. For GPs with limited revenue capacity, user fees can therefore play an important role as a recurring, locally generated source of revenue linked directly to the waste collection service. This requires an important shift in how SWM is viewed: waste collection should be treated as a continuing public service with defined service levels, costs, responsibilities and mechanisms for revenue collection, not as an activity that continues only while project or scheme funding is available. The user fee should be based on the full cost of delivering the SWM service, not just the cost of collecting waste. That being said, user fees are more likely to be accepted when there is a functioning service for which users can see value. Hence GPs first need to establish a reliable service, communicate the service and its cost to waste generators, and put in place a mechanism for collection and follow-up.

A realistic estimate of the full recurring cost provides the basis for determining the financial requirement of the system and, where user fees are applicable, setting the fee at a level that contributes meaningfully towards service delivery costs.

|| Shri Ganesh Prasanna ||

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Policy No. \_\_\_\_\_ Amount \_\_\_\_\_ Risk \_\_\_\_\_

**NOTICE**  
The consignment covered by this set of Special Lorry Receipt From shall be stored at the destination under the control of the Transport Operator and shall be delivered to or to the order of the Consignee Bank whose name is mentioned in the Lorry Receipt it will under no circumstances be delivered to and on without the written authority from the Consignee Bank or its order endorsed on the Consignee copy of or on a separate Letter of Authority.

Demurrage Chargeable after ..... Days from today @ Rs. 3-00 per day per Qty. on Weight charged.

**GST PAYABLE BY: CONSIGNEE**

**CONSIGNEE**

Vehicle No. : KA05A90954

From : Katbelthun

To : Dalmia Cement - Yadwad.

Signee Name & Address : Dalmia Cement, Yadwad - Belgum

GST IN: \_\_\_\_\_

| Packages    | DESCRIPTION (Said to Contain)                                                                                             | Weight Actual    | Weight Charged    | RATE         | Amount to Pay/Paid/ TBB |     |
|-------------|---------------------------------------------------------------------------------------------------------------------------|------------------|-------------------|--------------|-------------------------|-----|
|             |                                                                                                                           |                  |                   |              | Rs.                     | Ps. |
| As Per Bill | Dispatches of Non-Recyclables to Dalmia Cement Kilns.<br>→ 12 mt Capacity vehicle.<br>Cost of logistic cost with loading) | 12 mt            | Capacity vehicle. | Freight      | 12,500.00               |     |
|             |                                                                                                                           |                  |                   | Hamali       | 5,000.00                |     |
|             |                                                                                                                           |                  |                   | Coll/Dly Ch. |                         |     |
|             |                                                                                                                           |                  |                   | Sur. Ch.     | 100                     | 00  |
|             |                                                                                                                           |                  |                   | Risk Ch.     |                         |     |
|             |                                                                                                                           |                  |                   | GST          |                         |     |
|             | <b>Total</b>                                                                                                              | <b>17,500.00</b> |                   |              |                         |     |

Consignor's Signature \_\_\_\_\_ Signature of the Transporter \_\_\_\_\_



## Case learning: Aneundi GP, Koppal district, Karnataka

Aneundi GP demonstrates how user fees can be introduced after a basic collection and processing system has been established. The GP has 1,740 waste generators, including commercial establishments and institutions. Over two years of consistent efforts by the GP and the local Saahas team, the D2D collection system was streamlined, with 93% of waste generators giving waste to the collection vehicle. Collected dry waste is sorted at the DWCC within the GP and sold to a local scrap dealer, as there is no MRF in the district.

Once the collection and processing system was established, the GP passed a resolution to collect user fees from waste generators to support the financial sustainability of SWM operations. Households were charged ₹30 per month, while commercial establishments and institutions were charged ₹100 per month. Spot fines were also levied on defaulters who littered, dumped or burned waste in public spaces.

The GP's location close to an industrial belt also provides a relatively viable downstream pathway for non-recyclable waste. The cost of dispatching this fraction to a cement factory is approximately ₹15,000 per month and is currently borne by the cement factory on a mutual agreement.

### SWM financial statements for Aneundi GP

| OpEx type*                             | Rs/month     | Revenue sources     | Rs/month              |
|----------------------------------------|--------------|---------------------|-----------------------|
| Vehicle Fuel                           | 14000        | User-fee            | 18950                 |
| Vehicle O&M                            | 1000         | Sale of compost     | NA                    |
| Electricity                            | NA           | Sale of biogas      | NA                    |
| Staff salary                           | 18000        | Sale of recyclables | 9760 (~ 500 Kg/month) |
| Consumables (Gloves, Mask, Bags, etc.) | 2000         | Penalty             | 500                   |
| <b>Total</b>                           | <b>35000</b> | <b>Total</b>        | <b>29210</b>          |

Within one year of the user-fee resolution, **around 20–25% of waste generators** had begun paying the fee regularly. User fees contributed approximately **54% of the GP's monthly SWM OpEx**, supplemented by revenue from recyclable materials and penalties.



## Case learning: Uppunda GP, Udupi district, Karnataka

Uppunda GP presents a case of how a user-fee system can evolve alongside improvements in collection coverage and eventually cover the recurring cost of SWM operations.

Udupi district has a long-standing decentralised rural SWM model, with SHG-led Solid Liquid Resource Management systems linking waste collection with local livelihoods and resource recovery. In Uppunda GP, however, collection coverage and awareness were initially limited, despite administrative and political willingness to improve the system.

When Saahas began supporting the GP, the system gaps were assessed and additional collection vehicles and resources were allocated to improve coverage. Through system strengthening, capacity building and community awareness, D2D collection coverage increased from 11% to 98% over three years, while the proportion of waste generators giving segregated waste to the collection vehicle increased to 75%.

The GP had a system where onsite wet-waste management was encouraged, while wet waste from generators without onsite provisions was composted in the GP President's areca farm. Since an operational MRF was available in the taluk, collected dry waste was stored at the DWCC and sent to the MRF for processing at zero processing cost but also no revenue from dry waste to the GP. This meant that the GP's main recurring expenditure was primary collection and transportation.

The GP already had a user-fee mechanism, but initially only the 11% of waste generators covered by the collection system were paying. As collection coverage expanded, the user fee was extended to all waste generators and increased from ₹30 to ₹50 per month for households. The fee was collected along with the water bill, and mechanisms were put in place to improve compliance. By the end of the third year, 72% of waste generators were paying the user fee regularly, generating ₹1.2 lakh per month. This covered 100% of the GP's monthly SWM OpEx.

| Uppuda GP SWM details                                                  | Year 1       | Year 3        |
|------------------------------------------------------------------------|--------------|---------------|
| Total waste generators (households, commercial estb & intitutions) (#) | 2911         | 2911          |
| Primary collection vehicles (#)                                        | 1            | 2             |
| SWM operation staff (#)                                                | 6            | 9             |
| D2D collection coverage (%)                                            | 11           | 98            |
| % waste generators giving waste to the collection vehicle              | 11           | 75            |
| Total dry waste collected (MT/month)                                   | 2.37         | 16.3          |
| <b>SWM OpEx (total- Rs/month)</b>                                      | <b>58200</b> | <b>110200</b> |
| Vehicle Fuel cost                                                      | 3000         | 8000          |
| Vehicle O&M                                                            | 1000         | 1000          |
| Electricity                                                            | 200          | 200           |
| Staff salary                                                           | 52000        | 98000         |
| Consumables (Gloves, Mask, Bags, etc.)                                 | 2000         | 3000          |
| Revenue from user fee (Rs/month)                                       | 25,000       | 1,20,000      |
| Waste generators paying user fee (#)                                   | 320 (10 %)   | 2110 (72 %)   |
| <b>% OpEx met through user fee</b>                                     | <b>42 %</b>  | <b>100 %</b>  |

Financial sustainability requires a reliable source of recurring revenue, and user fees can provide this when linked to a functioning waste collection service. The experience of Anegundi and Uppunda shows that financial sustainability followed the institutionalisation of the service, rather than preceded it. **At the same time, user fees can strengthen accountability: when waste generators contribute towards a service, they have a clearer basis to expect regular service, while the GP has a clearer responsibility to maintain service quality.**



### Karnataka - Challenges

| Rank | Challenge                         | Impact                                  |
|------|-----------------------------------|-----------------------------------------|
| 1    | Sluggish & poor fund disbursement | Project execution affected              |
| 2    | Water availability & sourcing     | Risk of water shortage, high cost       |
| 3    | Logistics & infrastructure        | Difficult transport, higher cost        |
| 4    | Governmental & social awareness   | Community resistance, low participation |
| 5    | Skilled workforce availability    | Contract local talent, higher cost      |
| 6    | Regulatory approvals              | Multiple authorities, time delay        |
| 7    | Political & ethnic                | Local community issues, resistance      |
| 8    | Market & demand fluctuations      | Price volatility, demand uncertainty    |

Review of SWM performance in Karnataka (State level)

## Lesson 6 | Institutional ownership sustains the system

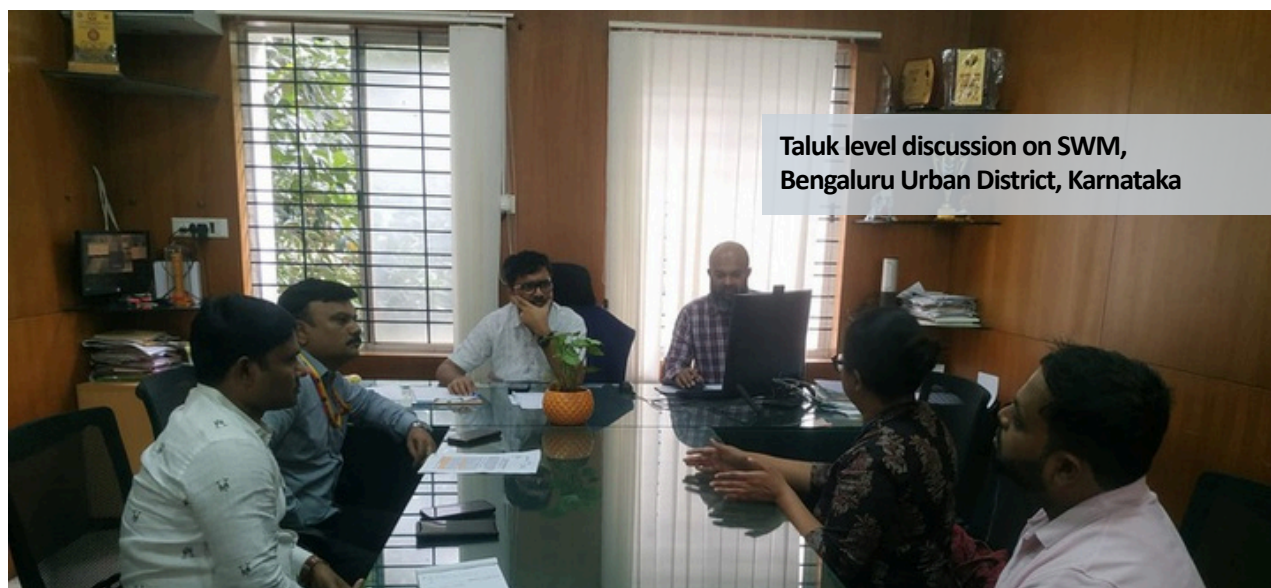
**An SWM system becomes sustainable when responsibility for monitoring its performance, responding to problems and maintaining the system is embedded within the institutions and communities.**

Infrastructure, collection systems and community awareness can establish an SWM system, but they do not guarantee that it will continue to function. Long-term sustainability depends on whether responsibility for the system is embedded within the institutions and communities that will operate and oversee it after an external intervention or driver ends. This requires two things: measuring whether the system is actually delivering the intended service, and ensuring that someone is responsible for acting on what the data show.

SWM performance should therefore not be judged by the amount of infrastructure created, visual cleanliness or the quantity of waste collected alone. More meaningful indicators include collection coverage, the proportion of waste generators handing over waste to the collection system, source segregation, waste diversion and resource recovery, financial performance, and indicators of community compliance and ownership. Data on these parameters can identify where a system is weakening, but monitoring has value only when the information reaches the people responsible for taking corrective action.

Institutional ownership needs to exist at multiple levels. State, district and taluk/block administrations provide oversight and can enable corrective action, while GPs and their elected representatives are responsible for ensuring that day-to-day systems function. Frontline workers and communities also play an important role in identifying gaps, reinforcing desired practices and providing feedback.

One of the clearest tests of an SWM intervention is what happens after external support reduces or ends. Saahas' experience in Luhari and Nuh illustrates how similar interventions can produce different outcomes depending on the degree of institutional and local ownership.





## Case learning: Luhari and Nuh: The difference between establishing a system and sustaining one

In Luhari, Haryana, local collection staff were trained not only in vehicle operation, waste collection and handling, their role expanded beyond collection: they educated households on segregation and waste handover and maintained records of collection, segregation and processing. This local ownership was supported by institutional commitment. The GP, district officials and the SBM consultant actively supported the system, creating an enabling environment for collection and processing to continue. The result was a system that could continue operating beyond the initial intervention.

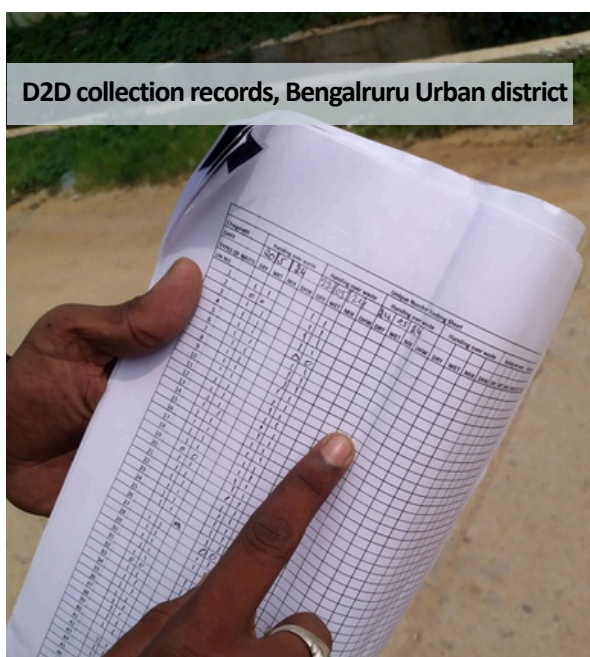
The experience in Nuh district provides a contrasting lesson. Although a similar system-building approach was attempted, the system did not sustain itself after Saahas exited. The intervention operated in a context where government institutions and communities had considerable exposure to NGO-led sanitation programmes, and there was an expectation that the external organisation would continue to drive activities. More importantly, there was limited ownership and monitoring by the GP and district administration. Without an institution taking responsibility for overseeing the system and ensuring that day-to-day operations continued, the infrastructure and processes established through the Saahas project were insufficient to sustain SWM services.

**While external support might be necessary to establish a system, it must progressively transfer responsibility to the institutions that will ultimately own and operate the system.**

### Monitoring matters when it leads to action



Regular monitoring can identify where collection is falling, segregation is declining, infrastructure is not being used or financial performance is weakening. But monitoring becomes meaningful only when this information is converted into action.



D2D collection records, Bengaluru Urban district



District level review of SWM data, Udipi



## Case learning: Luhari and Nuh: The difference between establishing a system and sustaining one

Saahas' experience in Yadgir district showed that establishing infrastructure, collection systems and community awareness was not sufficient to ensure sustained performance. A rural grading tool was used to assess GP performance across parameters including SWM infrastructure, collection efficiency, community engagement and livelihood development. The findings were consolidated into monthly reports and shared with the district administration, creating visibility on the performance of individual GPs and enabling gaps to be followed up at the appropriate administrative level.

The monitoring mechanism subsequently triggered administrative action. Based on the grading and monthly reports, the CEO issued notices to PDOs of underperforming GPs in February 2026. When most PDOs did not respond, the matter escalated in April 2026. PDOs from 12 GPs received notices, and an SBM inquiry committee conducted field verification that documented gaps in SWM system functioning. Subsequent administrative action brought consequences for non-performance.

The process was followed by visible changes in several aspects of system management, including accelerated MRF construction, more regular SWM review meetings and surprise site visits by GP officials. Across the 63 GPs where Saahas was involved, collection increased from 22% in April 2026 to 30% in July 2026, while segregation increased from 15% to 17%.

The Yadgir experience demonstrates that data becomes a management tool when it is linked to responsibility, review and follow-through. A grading system or dashboard by itself does not improve performance; the institutional response to the information does.

## Accountability needs to reach the GP and the community



District-level monitoring is important, but much of the accountability for SWM ultimately needs to operate closer to where the service is delivered. GP officials can regularly track collection coverage, waste handover, segregation, processing, user-fee collection and complaints. Field visits and community feedback can help verify whether reported performance reflects what is actually happening on the ground. Accountability also needs to extend to waste generators. Awareness is essential for changing behaviour, but where non-compliance persists, monitoring and enforcement mechanisms can reinforce the system.

In Konaje GP in Dakshina Kannada, an institutional bulk waste generator was found dumping waste on the roadside. The matter was brought to the attention of the GP, following which the PDO filed an FIR and the bulk waste generator took action to manage its waste.

Similarly, in Samethanahalli GP in Bengaluru Rural district, high-resolution CCTV with audio was installed at five major garbage-vulnerable points, supported by home guards assigned to monitor illegal dumping. Spot fines of around ₹2,000 were levied on identified defaulters. The GP reported an increase in the number of waste generators handing over waste to the collection vehicle and a reduction in garbage-vulnerable points.

These examples illustrate that enforcement works best as part of a functioning service system. **Fines alone cannot create source segregation or regular collection. They are more effective when residents have a convenient collection service, understand their responsibilities and know that non-compliance will be monitored.**

## Create a local platform for monitoring, feedback and grievance redressal



For an SWM system to remain responsive, there also needs to be a mechanism through which the people operating and using the system can raise concerns, provide feedback and seek resolution. This includes not only residents and other waste generators, but also frontline sanitation and collection workers, who are often the first to identify operational problems.

Such a platform can take different forms depending on the local context—a functional Village Water and Sanitation Committee (VWSC), a voluntary GP-level committee, a Gram Sabha or another locally appropriate mechanism. The purpose is more important than the institutional label: there should be a recognised forum where SWM performance can be reviewed, concerns can be raised, responsibilities can be assigned and follow-up can be tracked.

Under rural sanitation programmes, GPs may constitute VWSCs to support community-level monitoring and oversight. However, the existence of a committee does not necessarily translate into active oversight of SWM. In Saahas' experience, many GPs have constituted VWSCs, but these committees are often inactive or their discussions remain focused primarily on water supply. The gap therefore is not always the absence of a committee; it can be the absence of an active mechanism that brings together the GP, elected representatives, frontline workers and the community to review the functioning of the SWM system.



Review meetings for SWM, Haryana



## Case learning: Husnabad, Telangana — Sustaining change through local leadership

Husnabad Mandal in Siddipet district had basic SWM infrastructure, including a DWCC, collection vehicles and sanitation workers. However, these resources were poorly utilised, with irregular collection, overburdened sanitation workers and poor visual cleanliness. Over three years of Saahas' intervention, source segregation increased to 49%, and the three-way segregation system became established.

The real test came when the four-way segregation system under the SWM Rules 2026 had to be introduced just as the project ended. Newly elected representatives in Husnabad took ownership of the transition and rolled out the new system rather than waiting for continued external support. District officials supported Panchayat Secretaries, GPs added a fourth compartment to collection vehicles, and residents were encouraged to hand over all four waste streams separately. GP officials and elected representatives continued to monitor collection and segregation, oriented sanitation workers and residents to the new system, and used monthly Gram Sabhas to keep SWM on the community agenda.



VWSC meeting, Husnabad, Telangana



D2D collection, Dakshina Kannada district, Karnataka

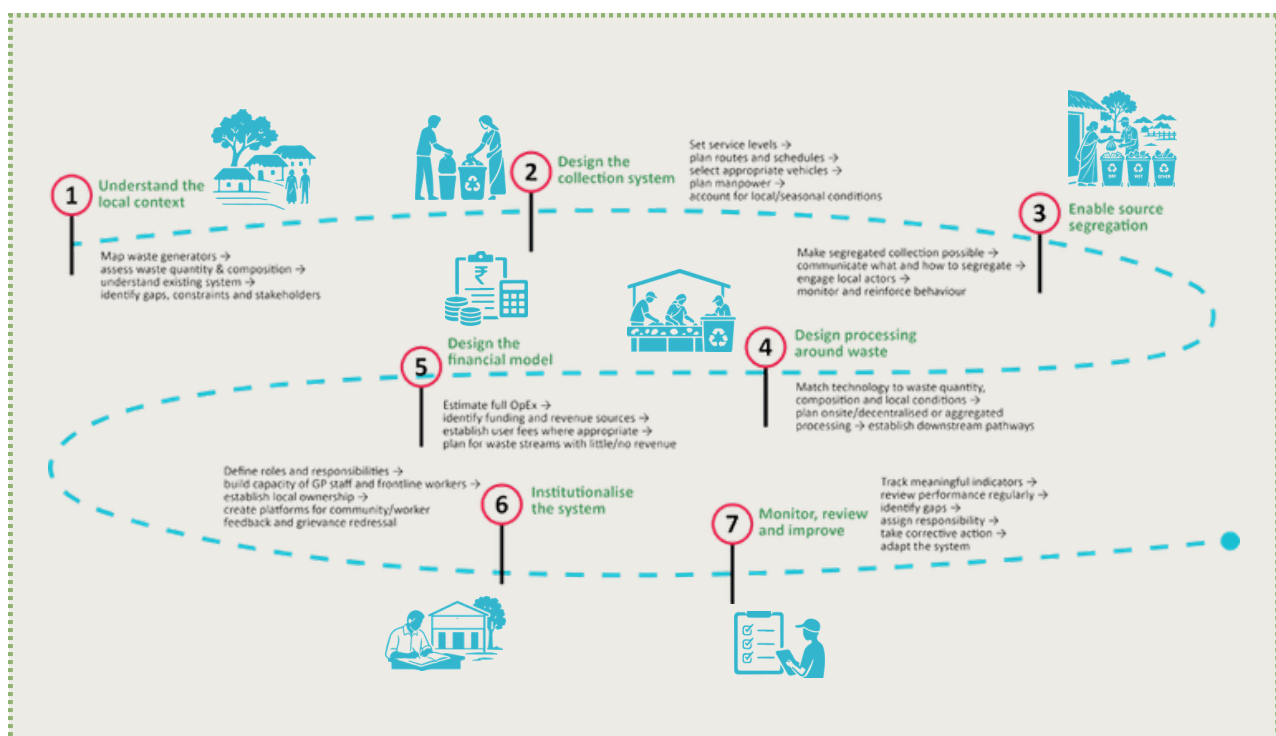
# 3 Summary

The ultimate goal of rural SWM interventions should not be to create infrastructure, achieve a short-term collection target or establish a processing facility. It should be to help create a local service delivery system that can continue to function in the long run, keeping the villages clean and recovering resources from waste.

A sustainable rural SWM system is one where waste generators know how and where to hand over their waste; frontline workers have the resources and capacity to provide the service; processing systems match the waste and local conditions; the GP has a realistic mechanism to meet recurring costs; and local institutions have the information, responsibility and authority to identify and address problems. The role of external programmes and organisations is therefore not simply to establish these components, but to help build the capacity, systems and ownership required for them to endure.

There is no single model for rural solid waste management. A system that works in one GP may not be appropriate for another because waste quantities, settlement patterns, terrain, livelihoods, infrastructure, institutional capacity and markets vary considerably. However, Saahas' experience across rural geographies points to a set of principles presented in the report that can guide the design and strengthening of rural SWM systems.

## Key Principles for Building Sustainable Rural SWM Systems



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