



Transforming Rural Waste, One Cluster at a Time

Design, Implementation and Lessons from One
of India's Earliest Documented Cluster-Level
Rural MRF Models

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Credits

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Disclaimer: This report has been developed by Saahas, based on the field experiences in Karnataka during the implementation of project 'Paripurna', funded by HCL Foundation. 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





Capacity building session at Ramanagara MRF

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First pilot MRF in the region at Nitte GP, Udupi district



Second MRF in rural Karnataka -
at Yedapadavu GP, Dakshina Kannada district

Executive Summary



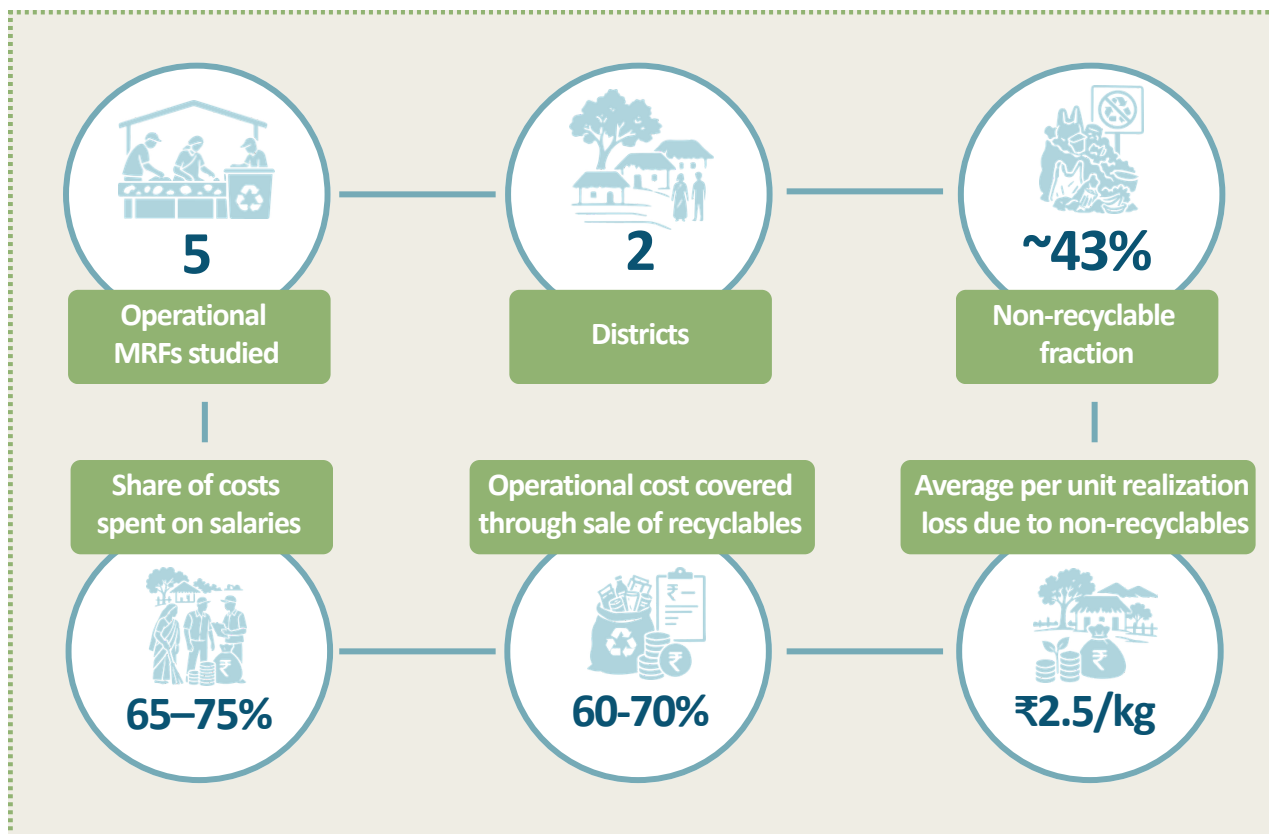
India's rural waste landscape is changing rapidly, while rural local bodies continue to face gaps in collection, segregation, processing and disposal systems. Cluster-level Material Recovery Facilities (MRFs) offer a practical solution by aggregating and sorting dry waste from multiple Gram Panchayats (GPs). This report examines five operational rural MRFs across Udupi and Dakshina Kannada districts established through Project Paripurna, with Saahas supporting the development of waste supply chains, source segregation and institutional capacity.



Key Findings

- **Cluster-level MRFs can improve rural dry waste management** by creating economies of scale through aggregation of dry waste from multiple Gram Panchayats.
- **Feedstock:** Their success depends on a steady flow of clean dry waste, segregated at source, which in turn relies on village level solid waste management systems.
- **Institutional ownership is essential for continuity.** MRFs owned by Zilla Panchayaths and operated through private operators, cooperatives or Self-Help Groups have continued beyond the initial project period, indicating growing local institutionalisation.
- **Non-recyclable waste is the biggest operational challenge.** Approximately 43% of incoming dry waste is non-recyclable. This material generates little or no revenue but adds to sorting, transportation and disposal costs.
- **Recyclable sales alone are insufficient for financial sustainability.** Sale of waste covers only about 60-70% of MRF operational costs, of which staff salaries is a major component.
- **Predictable service revenue is critical.** Fixed service fees and other forms of external support can help cover core operating costs, particularly staff salaries. Rural MRFs should therefore not be designed on the assumption that recyclable sales alone can finance operations.
- **Human resource capacity requires sustained attention.** Local hiring creates employment but experienced workers can be difficult to attract. Training, peer learning and operational support are important for maintaining efficiency and viability.
- **New sustenance models are currently being explored.** These include increased administrative control, fixed-fee models and value addition to non-recyclable waste.

Rural MRFs in Karnataka — At A Glance



Key Message

Rural MRFs should not be expected to operate as standalone, commercially viable enterprises. They are an essential component of **public service infrastructure** and should be planned, financed and supported as part of the overall solid waste management system. Their long-term viability depends on three factors:

1. Reliable supply of dry waste, segregated at source
2. Efficient operations and skilled workers
3. Predictable revenue to cover the costs, especially for scientific management of non-recyclable waste

1 Introduction

From Rural Waste Challenge to Cluster-Level Solutions



Inauguration of Ramanagara MRF



Solid waste management (SWM) rules 2026, mark a significant milestone for rural India, explicitly bringing rural local bodies within their scope. Rural local bodies (RLBs) are now mandated to undertake SWM activities similar to their urban counterparts. For far too long, waste generation in rural India has remained largely unaccounted for, let alone adequately managed— even though 64% of the Indian population resides in rural areas (World Bank, 2022).



Generation of waste in rural areas is relatively lesser in comparison to cities. In 2008, the Department of Drinking Water & Sanitation (DDWS) reported that rural areas in India generate 0.3-0.4 million metric tons of solid waste per day (UNICEF, 2008) , and most of it is organic in nature. Owing to the economic growth induced lifestyle changes, the quantity and composition of solid waste in rural India is changing, leading to an increasing proportion of non-biodegradable waste. Organic waste content is still significant due to agricultural and livestock rearing practices, but it gets managed locally particularly through household-level or community-level practices linked to agriculture and livestock rearing.



Composition of waste varies significantly based on socio-economic factors; plastic waste for instance has strong linkages with economic growth (FICCI and Accenture, 2020). Enhanced access and purchasing power in the villages is leading to an increase in consumption of packaged commodities (Times of India, 2023). Sachet packaging by FMCG companies to tap into the low-income and rural market segments has added to the challenge of rural waste management (CII and IPP, 2022).



Waste management is more challenging for the rural local bodies as most villages lack the formal infrastructure required for collection, aggregation and processing waste locally, as reported by Pratham Education Foundation (Pratham, 2022). The report also stated owing to lack of systems, locals resort to unscientific methods of waste disposal such as open dumping and burning which has detrimental health and environmental implications.



Costs incurred by rural local bodies to improve SWM can be offset, in part, by reduced expenditure on waste-related challenges. Improvement in rural waste infrastructure has also been associated with reduction in drain cleaning costs for GPs (SBM Gramin, 2023). The study was conducted by Saahas in 23 GPs in 10 districts of Karnataka, and reported an average saving of 32% on drain cleaning costs.



Material Recovery Facilities (MRFs) are recognized as a cornerstone for sustainable waste management, as they process dry waste in bulk, maximize resource recovery from recyclable waste and offer cost-effective sorting of non-recyclable waste, enabling scientific disposal. The Ministry of Housing & Urban Affairs stated that MRFs can play a significant role to bring circularity in the waste sector by improving the recovery of materials (MoHUA, 2021). The Niti Ayog and UNDP handbook on plastic waste management also presents MRF as a model for improved PWM implementation (Niti Aayog and UNDP, 2021). It also generates employment and provides dignified livelihood to waste workers; while creating business opportunities for private sector and cooperatives.



Economic viability of MRFs is better in cities because of the high quantum of dry waste generation due to demographic and socio economic factors, as well as due to proximity to the recycling ecosystem. However, establishing and sustaining MRFs in rural areas, where waste management processes are less developed, requires overcoming challenges in securing a steady, high-volume waste supply as well as establishing linkages for the forward supply chain. This necessitates iterative assessments to determine the appropriate capacity and service area for rural MRFs to achieve sustainability, as well as identification of the most suitable operating models.



Cluster-level rural Material Recovery Facilities (MRFs) can significantly improve dry waste recovery in rural areas when supported by appropriate institutional, operational and financial systems.

This report captures the establishment and institutionalisation of one of India's earliest reported cluster-level rural MRF initiative, drawing on Saahas' on-ground experience to identify pathways for replication across rural India, by:

- Documenting the initiative from conception to implementation and institutionalisation.
- Mapping rural dry waste flows from generation to recovery and disposal.
- Highlighting the role of key partners in this initiative.
- Assessing operational and financial viability, including key challenges.
- Identifying enabling factors for replication and scale-up of rural MRFs

2

Context Setting

Cluster-level MRFs in Karnataka

Background of the intervention

In Karnataka, Department of Drinking Water and Sanitation (DDWS) and Rural Development and Panchayati Raj Department (RDPR) pioneered rural SWM in India by planning 100 cluster level MRFs in the state in 2021 with a budgetary allocation of Rs. 2.5 crores each. Four pilot MRFs were announced under the scheme, with one each at Udupi, Dakshina Kannada, Ramanagara and Ballari districts. The subsequent sections of this report present a detailed account of the pilot intervention's development, and extract valuable learnings to replicate such models across the country.

The first rural MRF of 10 TPD capacity was inaugurated in August 2021 at Nitte GP in Udupi district (Karnataka). It was commissioned with the capital funding from SBM Grameen, Central funds from 15th Finance Commission, and Nitte GP's own funding (PIB, 2022), to cater to dry waste of 41 GPs. On the same lines, the second 10 TPD MRF catering to 51 GPs was inaugurated in January 2023, located in Yedapadavu GP in Dakshina Kannada district. The third facility, established in Ramanagara district was unfortunately destroyed by fire soon after installation. And the MRF in Ballari district was constructed, but did not get operational due to a land dispute which created accessibility issues.

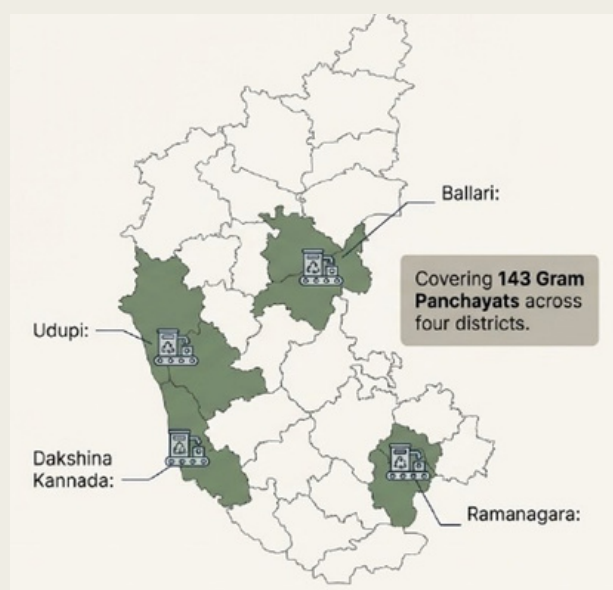
In Udupi and Dakshina Kannada districts, owing to the success of the pilot MRFs in Nitte GP and Yedapadavu GP, more MRFs were planned and operationalized. As of September 2026, there are eight operational rural MRFs in these two districts (five in Udupi and three in Dakshina Kannada), of varying capacities.

Initial Plan

4 MRFs

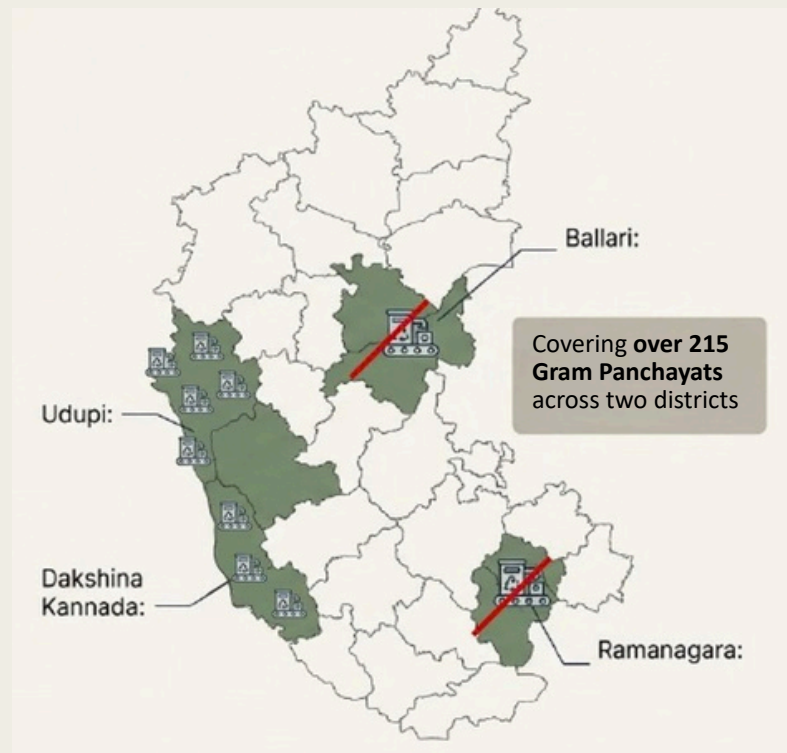
One each in:

- Udupi
- Ramanagara
- Ballari
- Dakshina Kannada



Actual Scenario in the pilot districts as on September, 2026

8 MRFs:
5 in Udupi
3 in Dakshina Kannada



Additionally, the districts are also creating smaller 1.5 TPD MRFs, and upgrading their existing waste management infrastructures “Swachh Sankeernas” or Dry Waste Collection Centres into Plastic Waste Management Units to cater to the waste generated by the remaining talukas not channelized to MRFs.

Role of Saahas

As the pilot MRFs were being established, the critical dependence on a consistent supply of segregated dry waste became evident, which required efficient collection and storage of waste segregated at source. At that time, the village level SWM systems were not in place, with negligible source segregation, challenges in primary collection, occasional sale of high value recyclables and majority of waste unmanaged, leading to open dumping and burning.

This prompted collaboration among state and non-state actors to fix the system and operationalise the MRFs. Drawing on its experience in rural Karnataka since 2016, Saahas, with support from HCL Foundation started project Paripurna in 2021, to help establish supply chains for segregated dry waste from nearby villages. With dedicated district-level teams, Saahas acted as a catalyst within the state-led ecosystem. The core mandate was to build capacity, drive behaviour change and provide targeted support to ensure the MRFs became functional, scalable and sustainable. This led to targeted IEC interventions, capacity building at multiple administrative levels, as well as infrastructure and initial opex support for MRFs. Project Paripurna successfully ended in March 2025.

3 Methodology

Data Collection:

A multi-faceted data collection strategy, integrating both qualitative and quantitative methods, was employed to gain a comprehensive understanding of the intervention.



1. Qualitative Data Collection:

- **Memoranda of Understanding (MOUs):** The MOUs signed between the Zilla Panchayath (district-level administration) and the MRF operators was analysed to underline the responsibilities of each stakeholder, including operational mandates, infrastructure provision, and financial obligations.



- **Project Reports and Guidelines:** Relevant project reports, guidelines issued by DDWS and Saahas, and other pertinent documentation related to the planning, implementation, and monitoring of the MRF intervention was reviewed to understand the intended objectives, operational procedures, and anticipated challenges.



2. Quantitative Data Collection:

- Available Profit and Loss (P&L) statements for five MRFs supported by Saahas under Project Paripurna, funded by HCL Foundation, were analysed to assess waste inflow and outflow volumes, financial performance, revenue streams and operational costs. Other MRFs established in the region, including those established after completion of the project, are excluded from the analysis.

MRF location (GP)	District	Operator	No. of GPs	Capacity (tonnes per day)	Year of Establishment
Nitte	Udupi	Mangala Resource Management Pvt Ltd	41	10 TPD	2021
Yedapadavu	Dakshina Kannada	Mangala Resource Management Pvt Ltd	51	10 TPD	2023
Bantwala	Dakshina Kannada	Mangala Resource Management Pvt Ltd	57	7 TPD	2025
Hosadu	Udupi	Ghana Mattu Drava Sampanmoola Nirvahana Sangha	17	4 TPD	2023
Ujire	Dakshina Kannada	Vaishnavi Industries	48	7 TPD	2025

Limitations: The analysis is based on the operational and financial data available from the five MRFs and therefore may not capture all costs, revenues or operational variations across the entire period. Financial performance is also influenced by differences in capacity, number of GPs served, operating model and external financial support. The findings should therefore be interpreted as case-study evidence rather than as representative of all rural MRFs in India.



Ramanagara MRF (Dakshina Kannada)



Construction phase of Ballari MRF

4

Initialization Planning and set-up

4.1 | Land allocation



MRF land must fulfil certain criteria like being levelled and approachable, and such government owned plots are restricted to industrial areas. Due to influential corporate and public pressure, such land parcels are usually not allocated for waste. The Zilla Panchayaths (ZP) are forced to give remote locations or in hilly or low-lying terrains, that require huge investment for levelling and to create suitable approach roads.

In Udupi and Dakshina Kannada, backlash from the public over the choice of MRF land, caused delay and eventually a change of location under pressure. Saahas conducted awareness sessions with the local community and also supported the administration in selection of appropriate land parcels. However, despite best efforts, the initial projects of Nitte (Udupi) and Yedapadavu (Dakshina Kannada) were delayed by four months and one year respectively. In Ballari, MRF land has access issues due to which it hasn't been operational yet.

4.2 | Land & Infrastructure



The gazette for Solid and Liquid Waste Management in Panchayat Raj Model Bye Laws recommends that dry waste collection centres should be set up in all GPs, and the waste so collected should be aggregated at taluka level for further processing (RDW&SD, GoK, 2020). In Karnataka, the State Rural Drinking Water and Sanitation Department planned to set-up 100 rural MRFs for managing waste generated in the respective talukas. The ownership is shared between ZP and GP.

The existing MRFs are owned by the ZPs of the respective districts in which the MRFs have been established. The ownership of land used for MRF construction is with the local GP.

4.3 | Capital



Under SBM(G) Phase II, rural SWM infrastructure can be supported through programme funds and convergence with 15th Finance Commission grants, MGNREGS, CSR and other Central and State schemes.

In Karnataka, DDWS and RDPR have set aside a budget of Rs. 2.5 crores for 100 rural MRFs in the state. Nitte MRF in Udupi district was commissioned with the capital funding from SBM Grameen, Central funds from 15th Finance Commission, and Nitte GP's own funding (PIB, 2022).

4.4 | Operations



The Roadmap for Circular Economy for Plastics in India, published by TERI states that MRFs should be set-up in Public Private Partnership mode at first to support the land, equipment and overhead operational costs; and later, through sale of recyclables, become self-sustainable models (Kapur-Bakshi et al, 2021).

Out of the five MRFs analyzed, three are operated by one company – Mangala Resource Management Pvt. Ltd, one by an SHG group and one by another company – Vaishnavi Industries.

4.5 | Terms of agreement between stakeholders

The effective functioning of a rural MRF depends on clear roles and coordination among multiple stakeholders. ZPs provide overall oversight, facilitate inter-GP coordination and support the MRF's long-term operations. GPs are responsible for ensuring source segregation, collection and timely delivery of segregated dry waste to the MRF. MRF operators manage day-to-day operations, including sorting, storage and chanelisation of recovered materials to appropriate end destinations. Waste generators—households, institutions and other establishments—are responsible for segregating waste at source and handing it over through the designated collection system. Collectively, these stakeholders form an interconnected system, where gaps at any stage can affect the performance and viability of the MRF.

This section outlines the standard agreement terms between MRF operator and rural administration, i.e. ZP and GP, in Karnataka, including penalty clauses for non compliance at each level.



Responsibilities of the MRF operators: MRF operator is responsible for secondary transportation, secondary sorting, baling and channelizing the non-biodegradable waste generated in their respective GPs, for which they are obligated to:

- ensure compliance under all applicable laws such as taxes, employees, occupation, safety etc.
- ensure that all waste is processed in accordance with SWM Rules 2016, and no waste is illegally dumped or burnt
- weigh and maintain records of the dry waste received from different GPs
- furnish periodic progress reports for waste collected, sold, processed and disposed, based on the format provided by the ZP
- bear all operational costs in running the MRF including maintenance of the vehicles, insurance of all assets etc.
- ensure that at least 80% staff employed at MRF is from the local GP



Responsibilities of the GP: Primary collection and storage of non- biodegradable waste, for which they are required to:



Ujire MRF, Dakshin Kannada



Inside view at Ujire MRF, Dakshina Kannada

- educate the rural masses regarding source segregation, processing and disposal of waste, by engaging with NGOs or other community organization to run IEC programs
- ensure segregation of waste at source
- ensure collection of only segregated dry waste at their own cost, including maintenance of collection vehicles etc. If wet waste needs to be collected, then enable its separate collection and processing.
- ensure that waste is clean, e.g.: milk packets etc are cleaned by the waste generators, GP collection vehicles should be covered to ensure that waste doesn't get wet.
- aggregate the segregated dry waste, not mixed with any other waste streams, in HDPE bags at the local waste management unit from where MRF operator collects the waste time to time, as per schedule
- ensure that high value dry waste is not removed at the time of aggregation
- specify and collect user fee from waste generators
- give information of any bulky waste such as mattress etc to the MRF operator 2 days in advance and pay additional cost for its transportation to MRF
- prepare monthly reports to include number of waste generators, quantity of waste collected and user fee collection.



Penalties: There is a provision of punitive action on

- waste generators who do not handle their waste as per bye-laws
- GPs if they allow waste burning or disposing in open areas
- MRF operators, if they do not collect dry waste as per schedule, or burn waste etc

4.6 | Human Resources for MRF operations



Effective operation of a rural MRF requires adequate and appropriately skilled human resources. While SBM(G) emphasises leveraging local capacities and community participation in implementing rural SWM, with flexibility for GPs to engage local agencies, groups or individuals for implementation. For rural MRFs, this provides an opportunity to mobilise local human resources, including SHGs, waste workers and other community-based enterprises, while ensuring that personnel have the skills and training required for effective operations.

In Karnataka, rural MRFs prioritised hiring workers from the same or neighbouring villages, thereby creating local employment opportunities and reducing the need to bring in workers from outside the area. However, a key challenge was the availability of trained and skilled human resources who could efficiently manage MRF operations. At Nitte MRF in Udupi district, the first and largest facility in the state, employs 51 people, which includes sorting staff, finance, operations, security and general management.

Operators explored hiring experienced scrap dealers and other workers familiar with the recycling trade. However, this proved difficult as scrap dealers could earn higher incomes through their existing businesses than the remuneration offered at MRFs, which was largely benchmarked to minimum wages. Although MRF employment provided statutory benefits

such as EPF and ESI, these benefits did not carry the same immediate value or relevance for workers who prioritised higher take-home earnings.

As a result, the workers who were hired often had limited prior experience in MRF operations and required on-the-job training. The newly recruited workers were initially trained at nearby MRFs, which provided the technical support and practical exposure needed to build their skills. This peer-based approach helped bridge the initial skill gap and enabled the new workforce to gradually take on MRF operations.

4.7 | Ensuring steady flow of feedstock



MRFs require regular inflow of clean dry waste, segregated at source, to be able to function effectively. Both quantity and quality of waste determine the efficiency of MRF operations. This requires a convergence of systemic and behaviour change to ensure that waste is segregated at the waste generator level, collected regularly and aggregated at the GP level for MRF operators to organize secondary collection periodically.

For supporting the cluster level rural MRF initiative, Saahas implemented project “Paripurna” with funding support from HCL Foundation, with the following objectives:

- *Implement SWM systems in 179 Gram Panchayats in 4 districts of Karnataka*
- *Ensuring consistent supply of clean segregated waste to the 4 pilot MRFs by driving behavioral change on source segregation at household and community level*
- *Dignified livelihood generation by creating new job opportunities where people work with dignity and self-respect in clean and hygienic environment.*

This involved mass awareness activities such as door to door campaigns, capacity building of GP members, training for sanitation workers etc. Through such interventions, the MRFs started receiving a regular supply of segregated dry waste which then gets sorted into various categories for recycling and disposal as appropriate. This process ensures maximum resource recovery from recyclable waste in line with the principles of Circular Economy. The non-recyclable waste, majorly comprising MLPs, is disposed of through co-processing in cement plants, in accordance with the guidelines issued under Plastic Waste Management Rules, 2016. The project ended in 2025 and has resulted in providing solutions to rural waste challenges, which continue to sustain post Saahas exit.



5 Operations

Inflow and outflow

MRFs receive segregated dry waste from GPs and sort it into different material categories, including paper, glass, metals and various types of plastics. Each recyclable stream is then baled to improve transportation efficiency and channelled to recyclers or aggregators. Non-recyclable waste is similarly baled and sent to appropriate end destinations, such as energy recovery facilities or landfills.

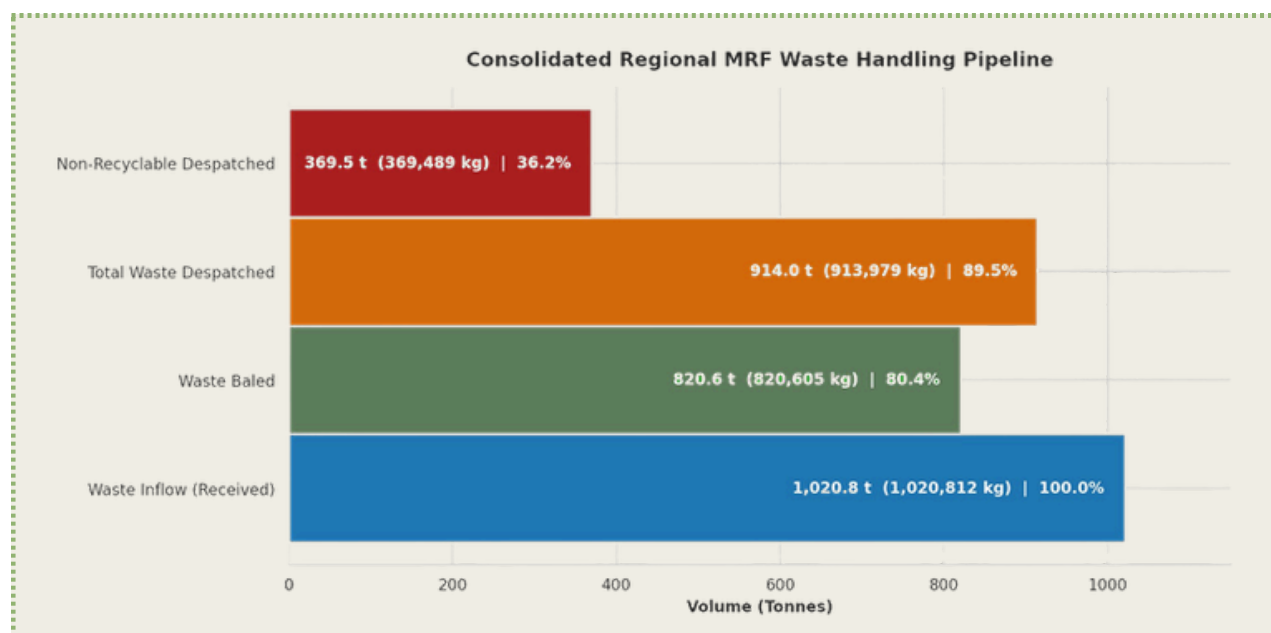
A key function of rural MRFs is the systematic handling and channelisation of non-recyclable waste, which is often difficult for individual GPs to manage due to cost and capacity constraints. The proportion of non-recyclable waste varies across geographies, influenced partly by the availability of nearby recycling markets. Similarly, the cost of managing residual waste depends on the availability and distance of suitable end-of-life processing facilities, such as cement plants that can utilise suitable material for co-processing

5.1 | Feedstock and processing

Available P&L statements for the rural MRFs were analysed from inception through March 2025.

Consolidated analysis (Graph 1) indicates that, on average, approximately 80% of the waste received was baled, while around 90% was despatched. The additional 10% despatched could come from bales or material that was already in stock, or from material that was sorted and directly despatched without being recorded as baled. Although despatch rates varied across MRFs, as discussed in the subsequent section, approximately 36% of the total waste despatched comprised non-recyclable waste.

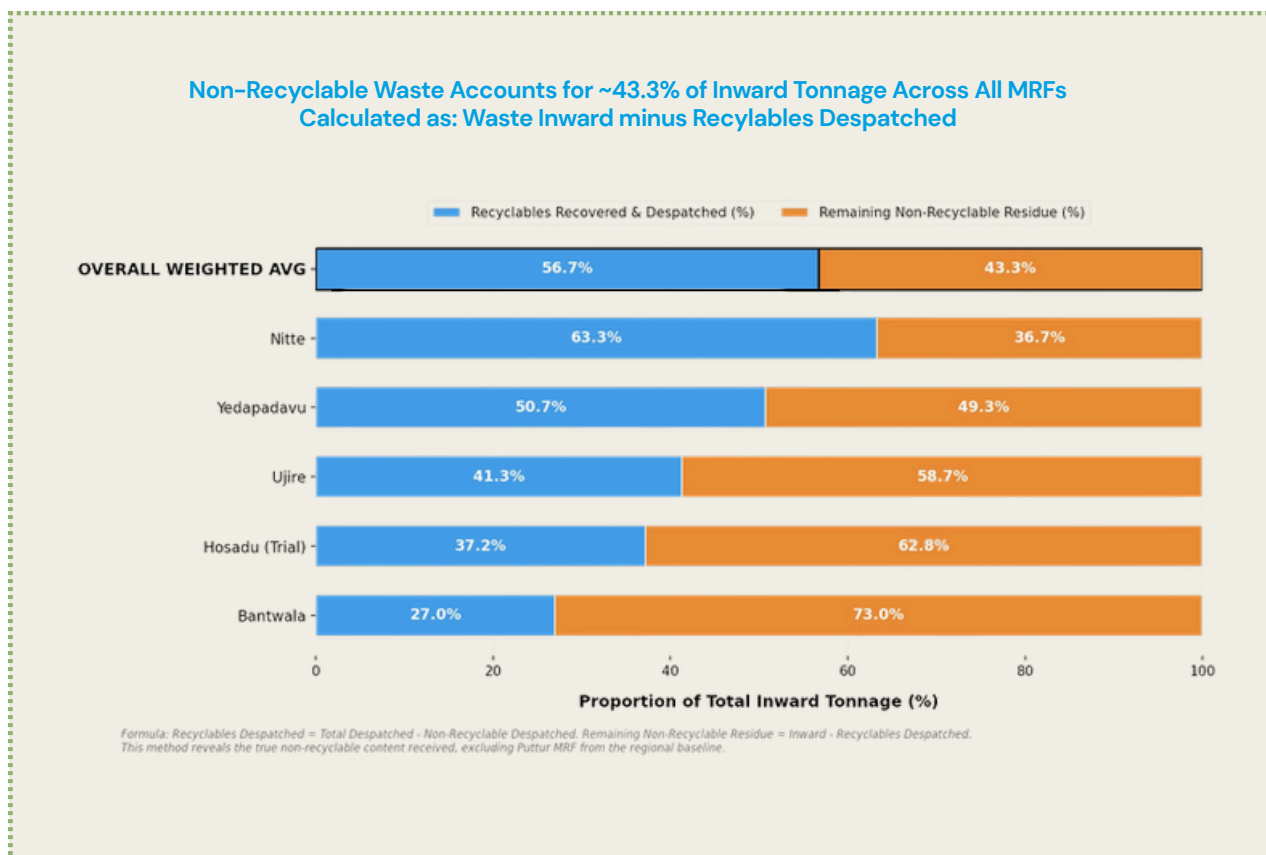
Graph 1: Cumulative material flows



5.2 | Recyclable vs non-recyclable waste

MRF-wise data on total waste received, baled and despatched were analysed on a monthly basis. Graph 2 presents the waste inflow and the quantity despatched for recycling or recovery across the MRFs. At times, batches of waste received are contaminated or mixed and therefore not sorted or baled. The difference between waste inflow and recyclables despatched consequently indicates that, on average, approximately 43% of the dry waste received at rural MRFs comprises non-recyclable material.

Graph 2: Recyclable vs non-recyclable dry waste at pilot MRFs

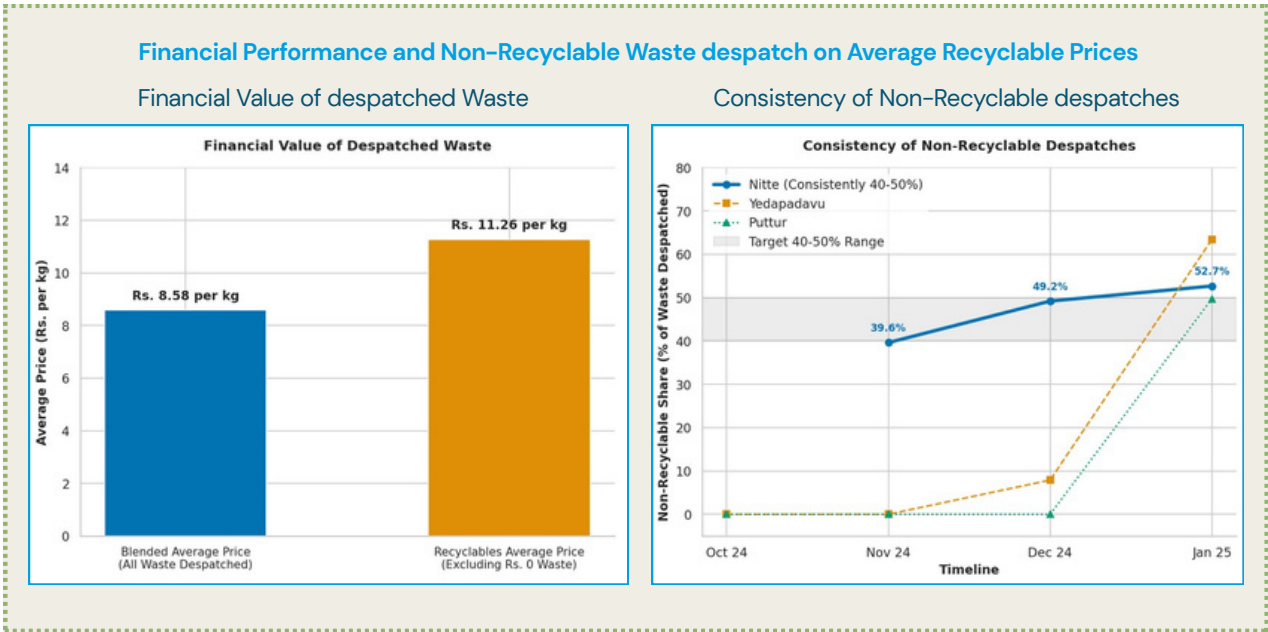


5.3 | Revenue from Waste

Based on the quantity of each material despatched and its corresponding sale price (Graph 3), the average selling price of all material despatched was calculated at ₹8.58/kg. Excluding the non-recyclable fraction, the average selling price of recyclable material increases to ₹11.26/kg. The quantity of non-recyclable material was estimated by aggregating the material despatched at zero sale price (i.e., ₹0/kg).

It can also be observed that the Nitte MRF (Udupi) consistently despatched 40–50% of its non-recyclable material each month, unlike the other MRFs, where despatch of non-recyclable material was less frequent. This was enabled by financial support from Repurpose Global, a US-based plastic action enterprise, towards the disposal of non-recyclable material (The Hindu Bureau, 2022).

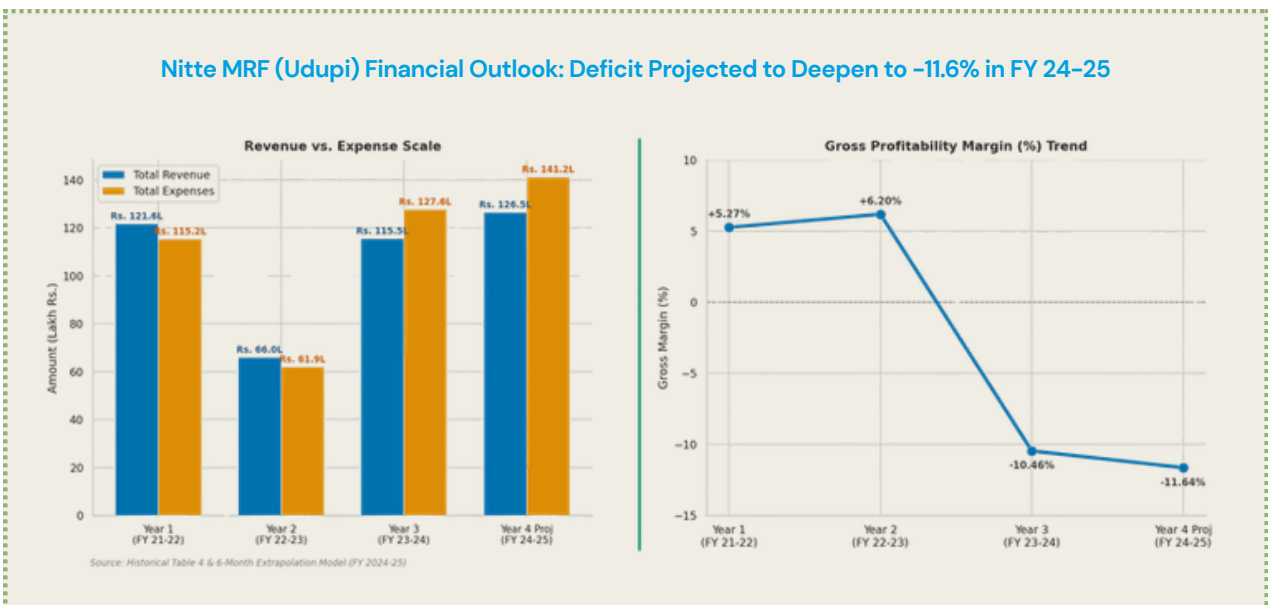
Graph 3: Impact of Non-Recyclable Waste Despatch on Average Recyclable Prices



5.4 | Profitability of rural MRFs

Nitte MRF (Udupi), the first operational pilot MRF, started on a strong footing, with service fee of Rs. 3/kg waste from Udupi ZP and gap funding from Saahas in year one, which collectively constituted up to 30% of its revenue. The MRF reported profits in its first two years of operation. In May 2022, the operator - Mangala Resource Management Pvt. Ltd. secured the strategic partnership with Repurpose Global that provided financial aid for disposing of non-recyclables. That year, they reported net profit of 6.2%. Subsequently, more GPs were added in its purview, to increase the operational capacity. While cost increased because of the additional waste, and the service fee progressively declined to zero by Year 4, due to which, the facility began reporting losses in subsequent years (Graph 4).

Graph 4: Nitte MRF (Udupi) Financial performance



Yedapadavu MRF (Dakshina Kannada), which became operational in 2023, two years after Nitte MRF (Udupi), did not get service fee from Dakshina Kannada ZP. Even though the operator was the same, the facility reported heavy losses in Yr 1 and Yr 2 (Graph 5).

Graph 5: Yedapadavu MRF (Dakshina Kannada) Financial performance



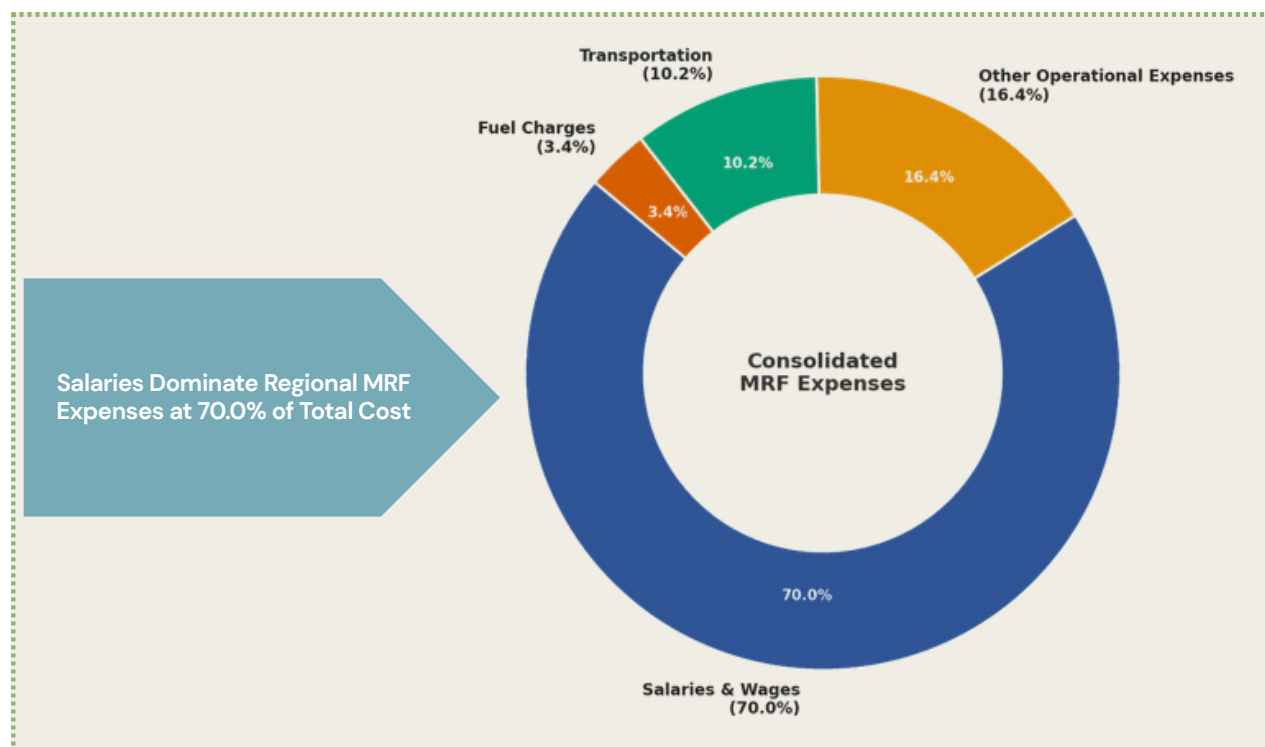
The other three MRFs were excluded from the financial performance analysis as they are smaller facilities and were not part of the initial pilot strategy.

5.5 | Operating costs of rural MRFs

Operating costs for rural MRFs were primarily driven by salaries, which accounted for 65–75% of total costs, followed by **transportation and fuel**. As sorting is labour-intensive and requires trained personnel, human resource costs are closely linked to sorting efficiency. Typically, one person can sort approximately 200–250 kg of waste per day. Therefore, lower sorting efficiency increases the number of workers required to process the same volume of waste, resulting in higher human resource costs. Other costs incurred by MRFs were maintenance of equipment, power etc.

For the newly established MRFs, **transportation of non-recyclable waste to cement factories** emerged as the next major expense after salaries, accounting for **10% of costs in Ujire and 17% in Hosadu**. The cost of disposing non recyclables depends on the distance and transportation cost of co-processing units from the MRF, cement factories do not pay for the waste or its transportation, in most cases, even though they are eligible to trade EPR certificates for End of life treatment of non recyclable plastic waste.

Graph 5: Major cost and revenue heads of rural MRFs



5.6 | Operating revenue of rural MRFs

Revenue generation for rural MRFs is typically limited to the sale of recyclable material, which, on average, covers approximately 70% of the MRFs' operating costs. With the exception of the Nitte MRF (Udupi), which had three distinct revenue sources, four of the five MRFs relied on a single revenue stream—the sale of recyclable material. Nitte MRF (Udupi) had the following three revenue sources:

- Sale of recyclable material
- Service fee from GPs
- Financial support from Repurpose Global towards the disposal of non-recyclable material.

Dry Waste to Pellets Process Flow Chart



RDF pelletizing unit in Dakshina Kannada

6 Sustenance Institutionalizing MRFs

Sustenance in this context refers to the ability of an MRF to operate financially and operationally as an integral part of the rural SWM system. It implies that the MRF has a predictable and sustainable mechanism to meet its recurring operational costs, including manpower, transportation, maintenance and management of residual waste, through appropriate public funding, service fees and revenue from recovered materials. Sustenance therefore goes beyond the continued operation of the facility; it means that the MRF is institutionally embedded within the SWM system and does not remain dependent on time-bound support from civil society organisations, CSR funding or other external grants.

Current situation of the pilot MRFs: Despite reporting losses year on year, three of the five facilities continue to operate as is. The Ujire MRF operator, Vaishnavi industries was forced to discontinue operations due to persistent losses owing to dependency on sale of waste alone to meet its operational costs. There was no user fee support or any other external gap funding, hence the facility was subsequently operated by Mangala Resources, who now operates 5 out of 6 MRFs. They are able to continue operations, likely due to the financial support agreement with Repurpose. The Hosadu MRF, previously operated by a cooperative society, which also had no service fee or other support, underwent a change in operational control, with a different SHG taking over its operations under revised terms.

New MRFs: Reportedly, three new MRFs have been established in Udupi district post 2025, following the completion of Project Paripurna. This demonstrates the sustainability of a solution that is owned by the local administration and adopted by the community. Updated list of eight rural MRFs in Karnataka, as on September, 2026:

MRF location	District	Installed Capacity (tonnes per day)	Year of Establishment
Nitte	Udupi	10 TPD	2021
Yedapadavu	Dakshina Kannada	10 TPD	2023
Bantwala	Dakshina Kannada	7 TPD	2025
Hosadu	Udupi	4 TPD	2023
Ujire	Dakshina Kannada	7 TPD	2025
Yellur	Udupi	5 TPD	2025
Kadur	Udupi	3 TPD	2026
Kedur	Udupi	3 TPD	2026

Some new approaches are also being explored to support continued functioning of MRFs:



1. **Higher control by ZP:** The operations of the new MRFs in Udupi have been entrusted to local Self-Help Groups (SHGs). Under this model, the ZP retains overall control of finances, while the SHGs are provided fixed salaries. This model has lower operational rigour than privately operated facilities, partly because SHGs have limited experience in business and operational management. They were trained by the ZP appointed technical partner which led to considerable improvement in the processes. However, the ZP is keen to go ahead with this model as it provides better control over data, for both waste and financials. Authentic data is essential for sustained roll out as well as for policy recommendations.



2. **Fixed Service fee model:** In Udupi, as ZP recognised that the sale of recyclables alone cannot make MRFs financially viable, they have introduced a fixed monthly service fee for the GPs linked to each MRF, replacing the volume-based fee model previously adopted at Nitte MRF (Udupi). Smaller GPs contribute Rs. 15,000 per month, while larger GPs contribute Rs. 20,000 per month. With typically 15–20 GPs linked to each MRF, this model provides a predictable revenue stream that largely covers salaries—the major cost component of MRF operations.



3. **Value-addition to non recyclable waste:** In Dakshina Kannada, a new solution is being piloted to add value to non-recyclable waste by converting the Segregated Combustible Fraction (SCF) into Refuse Derived Fuel (RDF) pellets. The pellets will then be sold as an alternative fuel to boiler-based industries in the region. If commercially viable, this approach could reduce the cost of managing non-recyclable waste and create an additional revenue stream for MRFs.

7

Learnings and Key success factors for replicating the rural MRF model in other parts of the country

7.1 | Key considerations for setting up MRFs

Owing to the mandates under SBM(G) Phase II, which advocates Sampurn Swachhta through the establishment of solid and liquid waste management systems, rural waste management infrastructure is gradually improving. In 2024–25, approximately **4.8 lakh villages were covered under SWM initiatives** (DDWS, 2024–25). However, public perceptions of waste-handling facilities are often shaped by their association with odour, litter and unhygienic conditions, creating apprehension towards the establishment of MRFs (Aarti Sachdeva, 2023).

Changing this perception requires a systemic approach across the waste management chain. Source segregation, regular collection, clean village-level aggregation and hygienic MRF operations can demonstrate that waste can be managed as a resource rather than as a source of nuisance. When villages within a cluster of GPs collectively channel their dry waste to an MRF, it also enables scientific management of recyclable and non-recyclable material while **reducing the burden of managing residual waste at the village level**.

These considerations highlight the need to plan MRFs as part of an integrated rural SWM system, rather than as standalone facilities. Planning therefore requires a **holistic view of the entire waste management chain**

Components of cluster-level MRF planning



- **Capacity planning:** Effective MRF planning requires an assessment of waste quantities and composition, based on waste audits, GP size, number of households, per-household generation and projected growth. This knowledge directly informs capacity planning for MRFs and the optimal number of GPs, one facility can cover.

The 10 TPD Nitte (Udupi) and Yedapadavu (Dakshina Kannada) MRFs serve 41 and 51 GPs, respectively, while the 4 TPD Hosadu MRF supports 17 GPs.



- **Land allocation:** Allocation of suitable land for construction of rural MRFs, preferably in industrial plots, which are levelled and accessible is important.

At Ballari, the MRF is located on a site without a public access road, restricting access for waste collection vehicles and preventing the facility from becoming operational despite its installation.



- **Equipment planning:** Depending on capacity of the MRF, various types of machinery and equipment is required for secondary sorting such as conveyor belts, magnetic separator, trommel, etc and for aggregating such as Baling machine, Palat Trucks etc.

The 10 TPD MRF at Nitte (Udupi) and Yedapadavu (Dakshina Kannada) MRFs have a much bigger floor area with a 10,000 sq ft shed, bigger mezzanine length, two balers (single and twin box), and two floor conveyors, whereas for smaller MRFs such as in Hosadu, shed is 3600 sq ft, and has smaller mezzanine length and floor conveyors, and one baler.



- **Financial planning:** This includes identifying and unlocking government schemes for funding capex based on the infrastructure.

For all pilot MRFs in Karnataka, funds for infrastructure were mobilized through programs like the 15th Finance Commission, SBM, and MGNREGS (DDWS, 2021)



- **Value chain Mapping:** This involves identifying end destinations of all waste streams to ascertain the proportion of non-recyclables, as it is inversely proportional to the profitability of MRFs.

Only 57% waste received in Karnataka rural MRFs is recyclable.



- **Operator selection:** This requires careful consideration, as government-owned MRFs need efficient management to maximise resource recovery, minimise the environmental impacts of mismanaged waste, support dignified livelihoods and generate reliable data for planning and decision-making. The operator's technical capacity, operational experience and ability to sustain the facility should therefore be key considerations.

Mangala Resource Management Pvt. Ltd., an eco-startup incubated by Ramakrishna Mission, operates 5 of the 10 current MRFs, while the remaining MRFs are operated by SHG units under close monitoring by the Zilla Panchayat.



- **Responsibility mapping of all stakeholders:** Contractual arrangements between administrative bodies and MRF operators should clearly define the responsibilities of all stakeholders, along with provisions for penalties or corrective action in case of non-compliance. Clear roles and accountability are essential for ensuring coordinated functioning of the MRF.

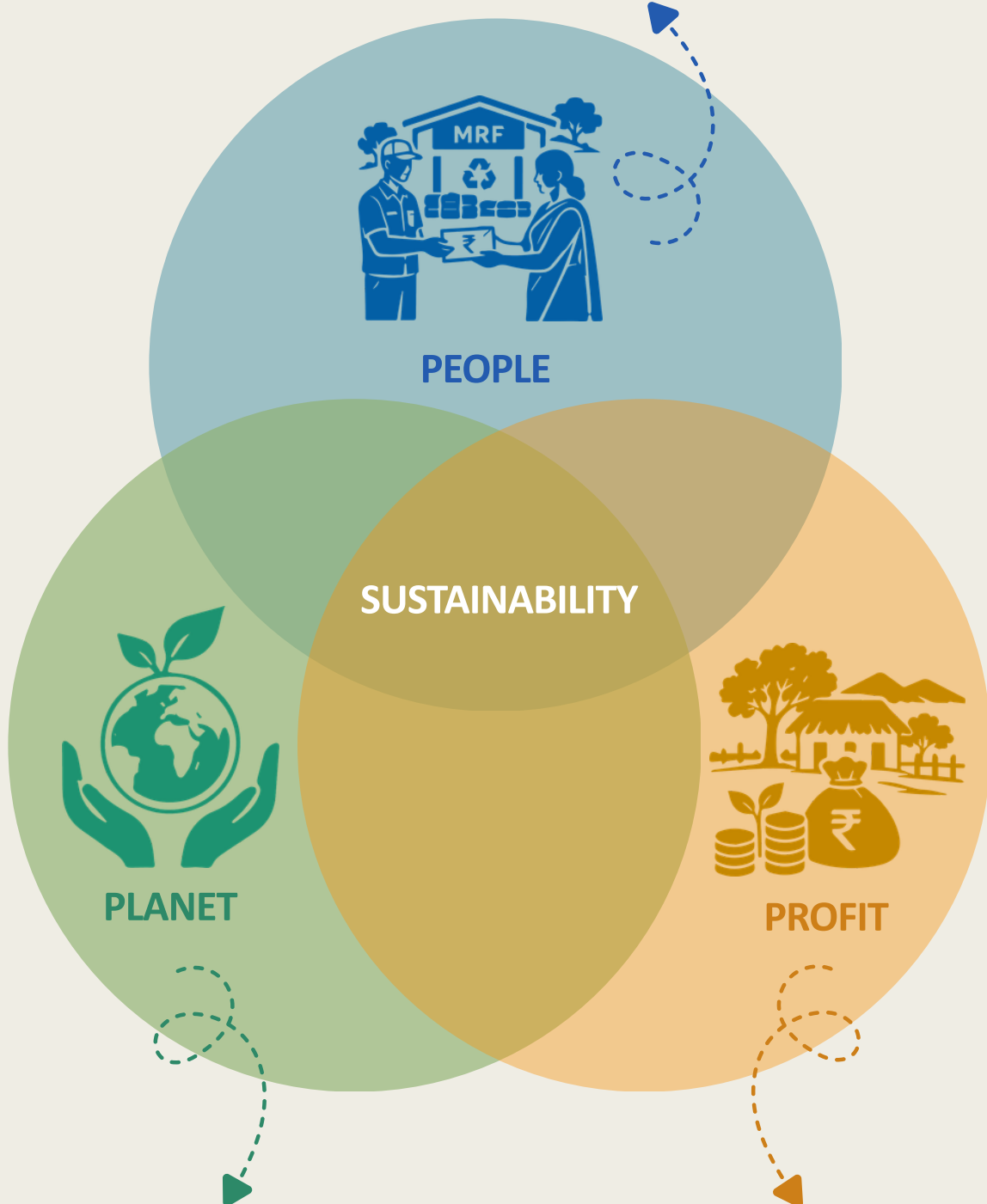
The MoU between the ZP and MRF operators in rural Karnataka clearly defines the responsibilities of key stakeholders, including waste generators, GPs, the ZP and the MRF operator.

7.2 | Operationalizing and sustaining MRFs

Based on the analysis of rural MRFs in Karnataka, it is evident that MRF operations face multiple challenges, and sustained efforts are required to ensure their continued functioning. Without such support, the risk of operational failure and underutilisation of infrastructure remains high. This may partly explain why SWM infrastructure in several parts of the country remains underutilised or defunct. Beyond ensuring an adequate and consistent supply of segregated waste, the table below summarises the key operational challenges identified and provides recommendations to strengthen the operational viability and long-term functioning of MRFs.

Challenge	Explanation	Recommendation
~ 43% waste that reaches MRF in non-recyclable	The reasons for the high proportion of non-recyclables can be attributed to cherry picking and sale of high value recyclables by the waste generators, and waste collectors. An informal recycling system exists in all parts of India, where households segregate and sell high-value recyclables (newspapers, plastic bottles, glass, metals) directly to Kabariwalas (CPHEEO, 2018). However, recyclables perceived as having lower value (torn paper, small plastic/glass/metal pieces) are typically added to the regular dry waste, which reaches the MRFs.	- Integrating waste workers into collection and transportation contracts can create a clear contractual obligation to channel collected segregated waste to the designated MRF, rather than diverting recyclable material elsewhere. Contracts can specify the designated MRF, minimum quantities or routes to be serviced, documentation of waste delivered, and payment linked to verified delivery. Ground-level audits and periodic reconciliation of collection and MRF receipt data can provide the checks and balances needed to ensure compliance. - In parallel, stronger oversight of informal recycling networks, including adherence to environmental regulations and fair wage practices, can help create a more level playing field between formal and informal recycling systems.
Scientific disposal of non-recyclable waste reduces the average revenue per unit of waste despatched by ~30%.	Sending non-recyclable material to cement plants for co-processing can be cost-intensive for MRFs, particularly where plants are located at considerable distances. As cement plants generally do not bear the costs of transportation or pay for the material, these costs are borne by the MRF, creating a financial disincentive for the scientific disposal of non-recyclable material.	Shifting the cost burden from MRF operator to producers, through a stricter implementation of Extended Producer Responsibility (EPR) for plastic waste and introduction of EPR for textile, footwear and other non-recyclable waste is required. - Until such provisions are put in place, supporting rural MRFs through service fee can support disposal costs. - Alternatively, ZPs can either provide for transport of non-recyclable waste to industries or cement factories at no cost, or pass the cost burden to cement factories - Other practical ways to reduce costs is to send baled waste, so maximize the load per vehicle.
Salaries are the largest operating expense for MRFs	MRF operations are anyways labour-intensive, and finding trained local labour in rural areas can be a challenge. Limited availability of skilled labour may require additional manpower or training, increasing operating costs.	Training the human resources for maximizing efficiency is paramount to cost optimization. Performance-based contracts can be explored after the initial training period, linking payments to productivity to optimise manpower requirements and costs.
Sale of recyclable material is the primary-and, for most MRFs, the only-source of revenue.	Dependence on only sale of recyclables is not sufficient to ensure long term financial sustainability.	- A predictable service fee is critical for ensuring financial viability of MRFs. - Increasing the cost of waste by improving the economics of recycle and creating greater demand of recycled material, through stricter implementation of EPR policy

Local employment generation.
Typically, 1 sorting staff is required
for every 250 kg of waste.



Waste diverted from Landfill; MRFs
triple the Resource recovery from
waste (MoHUA, 2021).

Cost savings for GPs, new business
opportunities for private operators
and cooperatives.

8

Conclusion

The experience in Udupi and Dakshina Kannada shows that cluster-level MRF can provide an effective solution for managing dry waste across multiple Gram Panchayats. By **aggregating waste at scale**, MRFs can improve sorting, increase resource recovery and create a more organised pathway for recyclable and non-recyclable waste, while creating local livelihood opportunities. However, the study also makes it clear that setting up an MRF is only one part of the solution.

The performance of an MRF depends first on what happens at the village level. Regular collection, segregation at source and proper aggregation of dry waste are essential to ensure a steady supply of feedstock to the facility. This requires sustained community engagement, collection infrastructure and clear responsibility at the Gram Panchayat level. Capacity planning, suitable land, appropriate equipment and trained workers are equally important for efficient operations.

The larger challenge is financial sustainability. The experience from these facilities shows that the sale of recyclables alone cannot cover the full cost of operations. A significant share of the incoming dry waste is non-recyclable which is a 'cost' to dispose. Apart from this, salaries and transportation remain other major costs. Rural MRFs therefore need to be treated as essential public service infrastructure, with predictable funding for the service they provide. Fixed service fees, stronger implementation of Extended Producer Responsibility, and support for transporting of non-recyclable waste to cement plants, can help bridge this gap.

The Karnataka experience also shows the **importance of institutional ownership**. Continued operations after the initial project period, the involvement of Zilla Panchayath and Gram Panchayats, SHG-led operations and fixed service fees indicate that local systems can take ownership when roles and financing are clearly defined.

For other districts and states looking to replicate this model, the key lesson is simple: an **MRF cannot succeed as a stand-alone facility**. It must be supported by a functioning village-level collection system, capable operators, clear institutional accountability and a realistic financial model. When these elements are planned together, cluster-level MRFs can become a practical and scalable part of rural solid waste management.

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Yedapadu MRF (Dakshina Kannada) in operation



Administrative visit at Nitte MRF, Udupi district



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