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Integrated Plastic Waste Management in Rural & Urban areas of Samastipur District , Bihar , India " : For effectively waste management and resource efficiency

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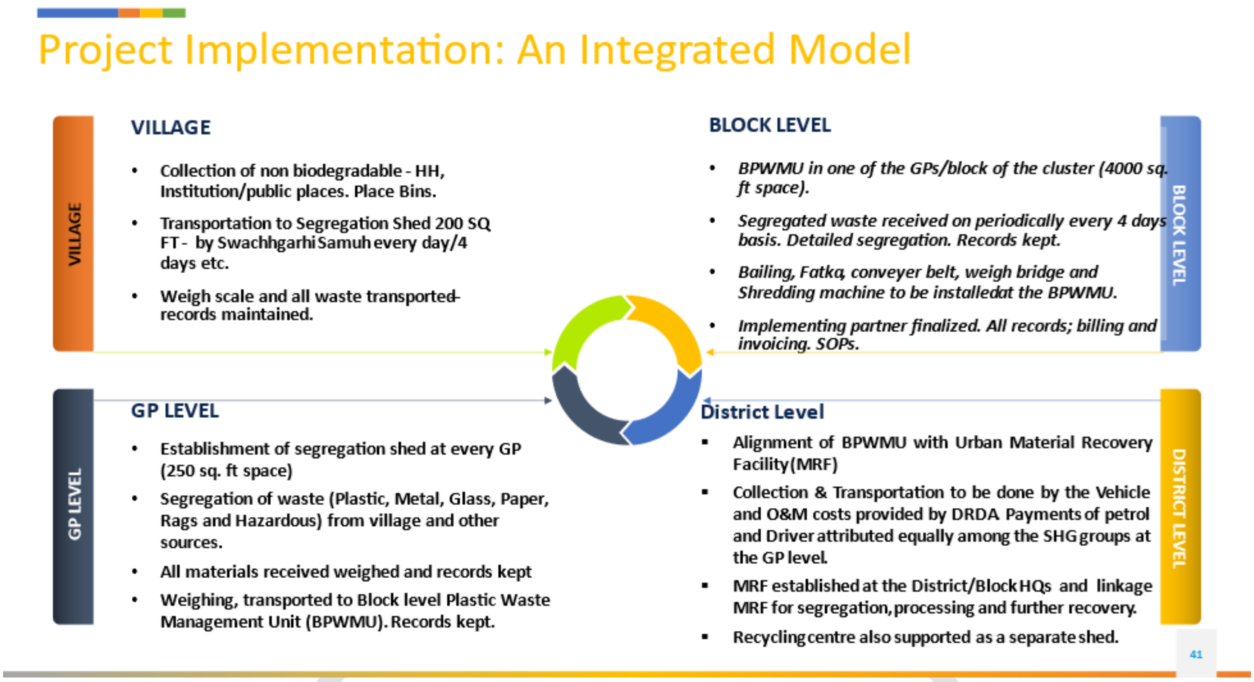
Abstract :

The project aims to promote a more integrated approach for maximizing materials use efficiency across the plastics waste to encourage a sustainable, and a safe environment. In this project the inclusivity of small aggregators ,waste pickers (Safaii Mitras) & Women led group (Self Help Group) will be institutionalized and within the respective governance mechanism made to affect improved social conditions. Project's target at the end of period is have a systemic approach and investments into better management of dry waste in a more circular economy approach in the City of Samastipur.
In this Program we have established 10MT / day Plastic (Dry Waste) Processing plant at Dharampur processes 10 MT / day dry waste coming from 20 block plastic waste management unit , 149 Panchayat & 20 wards & involved 6500 Womens for collection , segregation , Processing & operation & maintenance of Waste processing unit at Panchayat , block & district level .

1.Introduction :

Samastipur is one of the thirty-eight districts of Bihar in India. The district occupies an area of 2904 km² and has a population of 4,261,566. There are 29 Wards in Municipal corporation (Urban Areas) & 20 block , 149 panchayat in rural areas . Every day 110 Metric tonne Solid waste (65 Metric tonne Organic , 45 Metric inorganic (9 Metric Tonne Plastic Waste) generated in Samastipur in Urban areas & 9 Metric tonne in Rural Areas . But it management was big challenges due to lack of any infrastructure of collection , Processing & Community engagement for Segregation at sources .



Samastipur Administration has initiated to establish the infrastructure for collection , transportation & Processing of Waste on the every step : Waste Processing unit at Panchayat level, Block Plastic Waste Management Unit at Block or cluster level & Material recovery facility at district level under the Swachh Bharat Mission 2.0 Urban (Government of India Flag ship programme) & Lohiya Swachh Bharat Abhiyaan (Government of Bihar Swachhta Abhiyaan) . Simultaneously initiated Social behaviour & Communication activities & IEC (Information , education & Communication) activities to Engage community& Citizens to promote segregation at Sources.

B. <u>The project's main aim is to establish –</u>

a) **Set up of sustainable dry waste management and recycling center (SWACHH CENTRE/ Material recovery Facility) -** to **promote ULBs for** better segregation of different dry waste, including plastics, further recycling of various rigid plastics, thin and multilayered and getting the granules also processed into products. Creating job creation and impact livelihoods for the informal sector stakeholders. Ensuring efficient processing systems through both collection and purchase of the materials in the supply chain to strengthen collection of all types of plastics.

b) **Create Decentralized Waste Collection Centers (DWCCs) and mainstreaming small aggregators -** in the City Wards with a focus on small aggregators by resourcing them with investments in machinery to create entrepreneurial habits. Supporting them with more formal systems approach.

c) **Mainstreaming Waste Pickers individually and SHGs –** Safai Mitras (SM) individually or through self-help groups (SHGs) by norming and forming their enterprises in the waste sector. This will open new opportunities and lead to more sustainable ways of collection, segregation, and processing of plastics. Deliver better social security measures, job creation and impact livelihoods for the informal sector stakeholders.

d) **Creates technology applications -** to integrate the material flow efficiencies through digital app-based models for better traceability and transparency of materials.

e) **Capacity Building and Experiential Learning** – focus on larger trainings and exposure visits for all the stakeholders in the plastics supply chain. Focus on safety at the <u>Swachh Centers</u> shop floor, and remain safe systems approaches to combat COVID and its resurgence, emerging use of compostable plastic packaging, which is not a blanket solution, but rather one for specific, targeted applications.

B. Process : A detailed assessment of the Integrated Dry Waste Management and Waste Processing Units (WPUs) implemented in Samastipur, Bihar. This initiative aims to address plastic waste management challenges through sustainable practices, community engagement, and technological innovations. The report evaluates the effectiveness, impact, and areas for improvement based on comprehensive data collection, analysis, and stakeholder consultations.

1. <u>Methodology</u>
The evaluation employed a mixed-method approach, combining quantitative data analysis and qualitative assessments. Key methodologies included:

- **Data Collection**: Gathering data on waste generation rates, recycling volumes, operational efficiencies of WPUs, and community participation levels.
- **Stakeholder Interviews**: Conducting interviews with key stakeholders including local officials, waste management personnel, community leaders, and residents to gather perspectives on the initiative's impact and challenges.
- **Site Visits**: On-site inspections of WPUs to assess infrastructure, technology utilization, compliance with environmental standards, and operational practices.
- **Document Review**: Reviewing project documents, policies, and regulatory frameworks related to waste management in Samastipur.

Assessment

The assessment done team through site visits to the material recovery facility; villages & panchayats; reports; workshops; virtual discussions; and follow-up of standard operating procedures .

2. Findings

Environmental Impact The Project identified significant achievements in reducing plastic pollution and improving environmental quality in Samastipur. Key findings include:

- **Reduction in Landfill Waste**: Decreased volumes of waste sent to landfills due to increased recycling and waste diversion through WPUs.
- **Water and Soil Quality**: Improved water and soil quality as a result of reduced leaching of harmful chemicals from improperly disposed plastics.
- **Biodiversity Preservation**: Enhanced biodiversity in local ecosystems due to reduced environmental contamination from plastic waste.
- **Carbon Emission saved**: Dry and Plastic waste diverted from landfill and sent for recycling reduces the use of virgin materials, thus reducing the GHG emissions emitted in environment.

During the ongoing monthly monitoring and program and financial audits have highlighted significant environmental gains, along the waste value chain - including reduced plastic pollution because of collection, segregation and recycling and increased waste diverted from landfills. **Below at Figure I.**

Sr. No.	Particulars	Cumulative data *(Till May 2024)*
1	Inward - dry & plastics materials	**2,230.70 MTs** *(From October 2022)*
2	Purchase - dry & plastics materials	**₹ 3,95,24,463**
3	Outward - dry & plastics materials	2,204.13 MTs *(From July 2023)*
4	Sales - dry & plastics materials	**₹ 5,01,35,948**

Figure 1: Waste Collection Status at Samastipur, Bihar

The project has collected **2,230.70 MTs** of Dry and Plastic Waste from Urban areas and surrounding Villages till May 2024. **98.8%** of the total collected waste linked to **11** Recyclers/ Aggregators of different categories of *dry waste* like tin, leather, rubber, textiles, paper, cardboard, all types of plastics, glass etc. Out of 2230.70 Mts nearly 1600 Mts is all plastics waste. Plastic waste has helped nationally in reduction of the production of **1,600+ MTs of virgin plastics.** This waste has been collected and diverted from landfills and has contributed in reducing **4,300+ MTs of CO_2 Emissions from October 2022 to May 2024.** This has resulted in saving costs in transportation, and production costs in the life-cycle approach of plastics.

Therefore, the MRFs are acting not only as materials sorting efficiencies but also are helping to reduce the virgin materials production, contributing to mitigate the climate change targets of the country and impacting the Net Zero targets of the country. Promote a low carbon (economy) lifestyle/consumption system. Recyclables are segregated through semi-automatic processes at MRFs known as Swachh Centres; which offer livelihoods to marginalized informal waste pickers, small aggregators, and reduce landfills/dumping sites. Builds on Government of India's initiatives on Green Credits, Reduce-Reuse-Recycle (RRR) Centres and Lifestyles for Environment (LIFE) program.

District strategy encourages constant engagement, dialogue with proactive practitioners, companies {plastic waste processors} and policymakers. Find ways to promote reuse, better collection mechanisms for the problematic or mismanaged plastic packaging; better management of Single-Use Plastics (SUPs). The partnership model did erection of MRF infrastructure in cooperation with Samastipur Municipal Corporations (MC) in urban and with District Rural Development Agencies (DRDAs) in rural areas. In this project in **20 blocks, 347 villages and panchyats in SBM-G of the district** have been linked to the MRF and the collections of dry waste and plastics is also happening periodically from the small storage centres created under the Swachh Bharat Mission Grameen at block levels by the district administration. Navjagriti has been given all the contracts for the convergence model of rural-urban convergence.

The Waste Processing Units (WPUs) played a pivotal role in processing and recycling plastic waste, contributing to improved water and soil quality and preserving local biodiversity. Special emphasis is given to Consent to Establish (CTE) and Consent to Operate (CTO) documents from the State Pollution Control Board. The **Consent to Establish (CTE) certificate** was successfully issued to the MRF Centre on **10th December 2022**. Following the Consent to Establish certificate, MRF Centre has successfully obtained the **Consent to Operate (CTO) certificate** on **28th July 2023**. This certificate will be valid up to 30th June 2028. Compliance with such norms enables the project to keep our emissions and residues/ discharges from the MRF facility under check.

3. Community Engagement and Social Impact The report highlighted positive outcomes in community involvement and social benefits:

- **Awareness and Education**: Increased awareness among residents about waste segregation, recycling practices, and environmental stewardship through educational campaigns and workshops.
- **Community Participation**: Active participation of local communities in waste management activities, contributing to higher recycling rates and cleaner neighbourhoods.
- **Economic Opportunities**: Creation of employment opportunities in waste collection, sorting, and recycling sectors, supporting local livelihoods and economic development.

Assessment on Community Engagement:

The project has greatly focussed in making community engagement as foundations in the project. With its interdisciplinary (different stakeholders), integrated (different processes). multifaceted (business approach), and holistic model (segregation, collection, optimizing transportation, processing, sustainable recovery, recycling, and safe disposal) has a strong emphasis on the different elements of maintaining circular economy approaches - refuse, reduce, reuse, recover, repair, refurbish, recycle and respect for the last mile.

This success is driven by a more participatory, gender-sensitive process approach promoting robust awareness campaigns and educational initiatives. Residents and citizens, bulk waste generators, villages & panchayats have actively participated in waste segregation, sorting, transportation and sending it to recyclers. This is developing local ownerships at all levels. The below **Figure 2** what have been the partnerships with institutions and Stakeholders under the Project. Details at

Sr. No.	Stakeholders linked	Cumulative *(From September 2022-May 24)*
1	Educational Institutions in the district	13
2	Green Volunteers	31
3	Bulk Waste Generators	180
4	Kabadiwalas	15
5	Resident Welfare Association	23
6	SHGs	116
7	Safai Mitras (Waste Pickers)	436
8	Womens	6500

Figure 2: Stakeholders working under this Project -

Different Information, Education & Communication (IEC) Activities conducted at **Figure 3** below. **04** Resource Recovery and Recycling (RRR) camps were conducted with **240** participants by the project. This is seen as an ongoing activity in the project.

Sr. No.	Activity Name	Cumulative *(From September 2022)*	
		Nos	No. of individuals sensitized
1	Awareness Campaigns	119	4,265
2	Capacity building workshops	08	467
3	Training	41	514
4	Health Camp	08	626
Total		**176**	**5,872**

Figure 3: Different Information, Education & Communication (IEC) Activities

The project serves to be an **ideal model to demonstrate RURAL-URBAN** Convergence.

The **project is building an ecosystems approach** – practical policies implementation, encouraging stakeholders towards better material resource use efficiency; ensure circular approaches of extended product life-cycle, closed loops, repairability and recovery models. GOI in plastics EPR law has given multiple choices in disposal systems to Producers-Importers-Brand Owners

(PIBOs) to meet their plastics obligations. The Project is also sending the non-recyclables from MRF for co-processing in cement plants, as improved resource efficiency approaches.

The project strategy at Samastipur is show-casing in its implementation in cities to build a resilient, inclusive, scalable model. Exploring, putting into practice innovative systems operating procedures (SOPs), experiences, learning's for dry and plastic waste in a city, town, block, panchayat, village.

a. Promoting, mutually acceptable, local ownerships for positive behavioural change - IEC campaigns, awareness drives between stakeholders.
b. Institutionalizing, systemic approaches to promote stakeholder engagement, participation; improve efficiency, transparency, and traceability in collection systems through SHGs & Entrepreneurs
c. Ensuring, sustainability (business models through purchase and sale of waste or putting value to waste) through effective monitoring, reporting, and digital mechanisms for operations at each of its panchayat centres in all blocks of Samastipur.
d. Inclusion, dignity, respect and empowerment of the Informal Sector, largely the waste pickers (Safai sathis) and small aggregators in plastics waste ecosystem through fair and just wages, and better price. In the process all 120+engaged Safaii sathis have gained more than 25-70 % increase in their incomes.

The strategy engenders new directions-learnings from range of stakeholders, donors, and corporate initiatives in the domain of waste management. The program promotes sharing, exposure, knowledge, skills, and practices between stakeholders, to optimize costs, maximise materials use efficiency at the Swachh Centres. As can be seen in **Figure 4** © there is a symbiotic relation between different stakeholders in an ecosystem.

Figure 4: Different stakeholders links by the CEE-HDFC Bank Project.

The project has been able to reach **5,872 individuals in Samastipur**. Economic benefits were evident through more jobs, increased incomes of the invisible safaii sathis (waste-pickers), in the waste management sector, supporting local livelihoods and economic development.

The project has introduced Plastic Lao Thaila Pao (PLTP) and Reverse Vending Machine (RVMs) for encouraging the collections and incentivizing stakeholders using cloth bags:

- HDFC Bank and Centre for Environment Education (CEE), in partnership with DRDA Samastipur inaugurated two **Reverse Vending Machine (RVMs)** in the **District Collectorate and Patel Chowk. A** total of 5160 PET bottles and 1310+ nos. of plastic bags has been collected.
- **1 Plastic Lao Thaila/Mask Pao (PLTP/MP) stalls were inaugurated at Town Hall, Samastipur.** Till March 2023, at PLTP/MP, 11,283 Individuals were Sensitized; 11,132 individuals Visited Stall, 4,118 Cloth Bags Distributed, 4,963 Masks Distributed and 5,227 Kgs Plastic waste collected.

4. Infrastructure and Technological Advancements Evaluation of infrastructure and technology integration revealed strengths and areas for enhancement:

- **Waste Processing Units (WPUs)**: Efficient operation of WPUs in processing and recycling plastic waste, contributing to overall waste management effectiveness.
- **Technological Innovations**: Adoption of modern technologies such as IoT for waste monitoring and data analytics for performance assessment, enhancing operational efficiencies.
- **Infrastructure Development**: Need for additional investments in infrastructure to support scalability and accommodate growing waste management needs.

Assessment by Infrastructure and Technological Advancements:

An MRF shed of 5600 sq ft at the cost of Rs 1.10 crores is established in partnership with the SMC and at **Figure 5** below. More than 10 safai sathis have gained direct employment working at centre on a daily average and nearly 100+ linked for collection in the rural-urban convergence.

Figure 5" MRF site and cleaning the areas around the MRF.

Details about Installed Machines at the MRF for smooth sorting operations are as below and also shown at **Figure 6.** Much care has also been taken to provide safe drinking water, washing and bathing facilities after the works for safaii sathis, medical kit is there and also provisions for safe sanitation (separate toilets for men and women at the MRF centre.

1. **Weighbridge and weighing scale** – Incoming and outgoing waste is weighed with printed receipts for transparency, and accuracy in reporting, and also to determine the correct weight of the materials for making and receipt of payments. It has a capacity to weigh 30 metric tons in one transaction.
2. **Conveyor Belt** - This is a slow-moving wide flat belt. The speed of the belt is controlled as per need. The dry waste is put on the belt through the incline belt; later on both sides of the belt safai mitras (waste pickers) are given clear training on what to pick up on the conveyor belt. Six safai sathis are designated spots on each side of the belt. Clear instructions are given on what type of waste to secure from the belt. Clear directions help create operational efficiency in the segregation of different types of waste. Fractions of materials segregated are respectively put into the bags directly. This acts as a cost-effective segregation and improves efficiency once the people start getting trained; reducing drudgery. The machine is powered by an electric motor of 05 Horse Power (HP) on the conveyor and 3 HP on the incline. It has a capacity of 500 kgs/hr, a length of 10 meters (flat conveyor) and a length of 5.3 meters (incline conveyor).
3. **Bailing Machine** - Vertical-type single-shaft oil-pressing balers are used to compress any materials that require a reduction in volume. We can put all types of plastics, paper, cardboard, and cloth for bailing. Later each bale is separately transported to the Recyclers and Cement Factories as the case be. These machines reduce volumes and thus impact cost savings in logistics. The machine is powered by an electric motor of 10 Horse Power (HP), with a capacity of 300 kgs/hr.
4. **Air Blower Machine** - A high-pressure machine used to separate dust, and contamination from the plastic waste to be recycled. All the collected flexibles, thin and multi-layered packaging plastics are put into the machine for the removal of dust. There is a dust arrestor which acts to check the dust to float in the air. This helps to have ambient conditions on air quality. The machine is powered by an electric motor of 15 Horse Power (HP), with a capacity of 100 kgs/hr.
5. **Plastic Grinding Machine** – Also known as a Shredding machine is required to shred rigid, thin flexibles, polyethylene plastic bags, including multi-layered packets to the required sizes. The size of the shredding is determined by the buyer. The shredding is done by using different types of blades and always an in-house blade-sharpener is put in place. The machine is powered by an electric motor of 30 Horse Power (HP), with a capacity of 250 kgs/hr. Also, an additional Plastic Grinder machine powered by an electric motor of 20 Horse Power (HP), with a capacity of 200 Kgs/hr is installed.

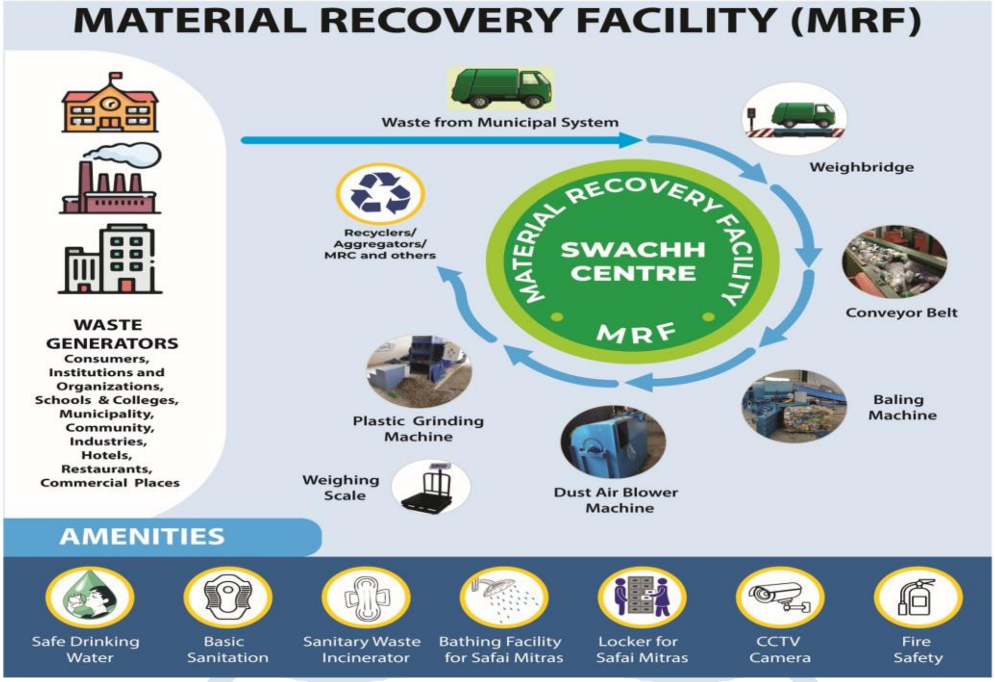


Figure 6: MRF showing the different semi-automatic machines installed for better operations.

With the Material Recovery Facility (MRF) now operational and functioning, the necessary **licensing document for the Movable Weighbridge (30 Tons)** has been obtained at the MRF location. This step significantly enhances the credibility of the weighing process carried out at the weighbridge and fosters confidence among our stakeholders. WPUs were found to operate efficiently, supported by technological innovations such as IoT for waste monitoring and data analytics. Robust monitoring system with CCTVs is established at MRF level and Village/ Panchayat level. List of machines at MRF at **Figure 7** below.

Sr. No.	Machine Name	Capacity	Remarks
1	Weighing Scale	200 Kgs, 600 Kgs	Installed and Operational (From January 2023)
2	Movable Weigh Bridge	Maximum 30 tons	
3	Flat Conveyor Belt – Length 10 meter	Capacity - 500 Kgs/hour	
4	Incline Conveyor Belt – Length 5.3 meter (with 16-degree inclination)	Capacity - 500 Kgs/hour	
5	Plastic Grinder (Motor capacity 30 horsepower)	Capacity – 250 Kgs/hour	
6	Plastic Grinder (Motor Capacity 20 Horsepower)	Capacity – 200 Kgs/hour	
7	Air Blower (Motor Capacity 15 Horsepower)	Capacity – 100 Kgs/hour	
8	Bailing Machine (Motor Capacity 10 Horsepower)	Capacity – 300 Kgs/hour	

Figure 7: List of different machines with capacities at MRF Samastipur

WPUs were found to operate efficiently, supported by technological innovations such as IoT for waste monitoring and data analytics. Robust monitoring system with CCTVs is established at MRF level and Village/ Panchayat level.
Five (05) types of Registers (Inward and Payment, Outward and Receipt, Expenditure Register, Visitor Register, Attendance Register) and **6 types of Record Books** (Infrastructure/ Fixed Asset, Machine Maintenance Record, Accident or Fire Incident, Safai Mitra Record Book, Recyclers/Kabadiwala Details, Self-help group (SHG)) maintained **at MRF level as shown in Figure 8 below**. SHG details Registers are maintained at the Village/Panchayat level, with also having the records of despatch to the MRF. All materials are purchased by the Navjagriti the partner.

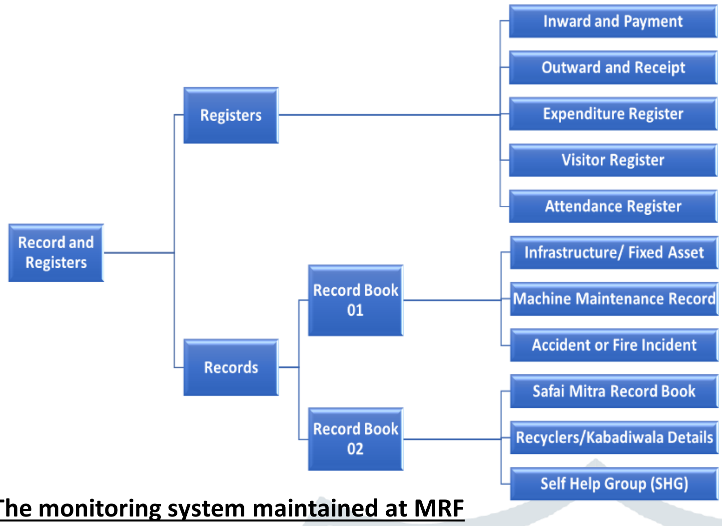


Figure 8: The monitoring system maintained at MRF

Means of Verification:

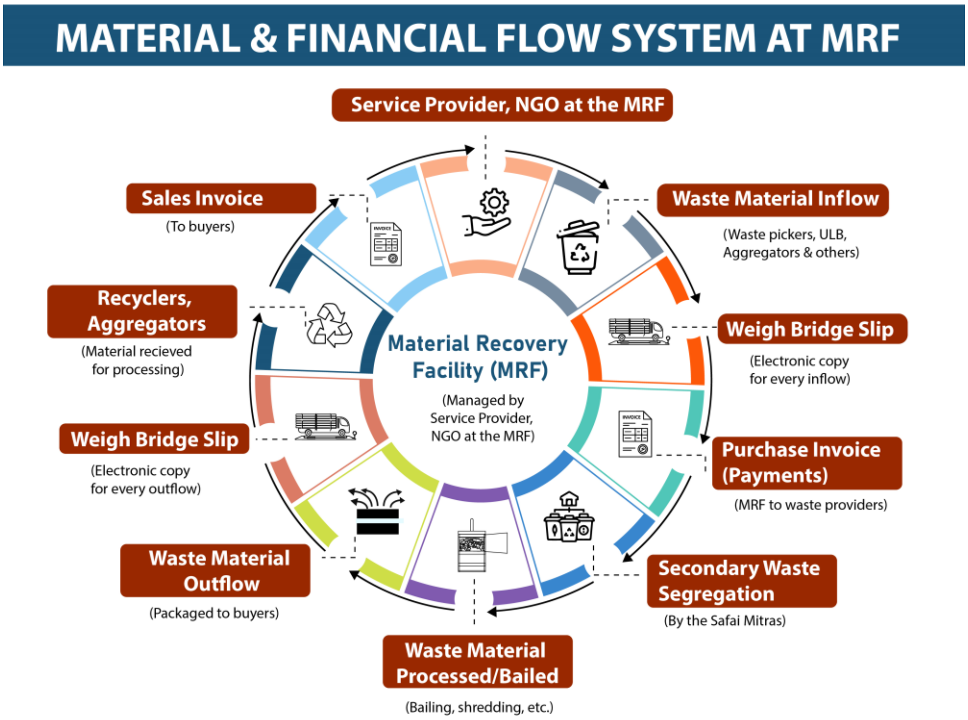
The project follows a very robust model as explained earlier and in 2 aspects as mentioned below.

Financial: Purchase Invoice: It is raised at the time of purchase of waste materials from various sources by the Service Provider. Sales and Tax Invoice: It is raised at the time of sales of waste materials to various sources by the Service Provider

Operational: Weighing Slip: A weigh slip must be issued and records be maintained by the weighbridge operator after weighing of the Vehicles at the MRF.

Financial Cycle:

The financial process cycle shows the path of financial transactions occurring during the inflow and outflow of materials at the Material Recovery Facility (MRF). The Weigh Bridge Slip, issued for both inbound and outbound movements, along with Purchase and Sales, Tax invoices. This is a system for transparency and traceability for better EPR. Digitization, records-keeping of both inward-incoming, purchase and outward-outgoing, sale of materials and plastics. Proper weighment systems through electronic weigh scales slips for all inward and outward movement of materials as shown below in the **Figure 9** below.



<u>Figure 9:</u> Financial Model - all inward and outward movement of materials

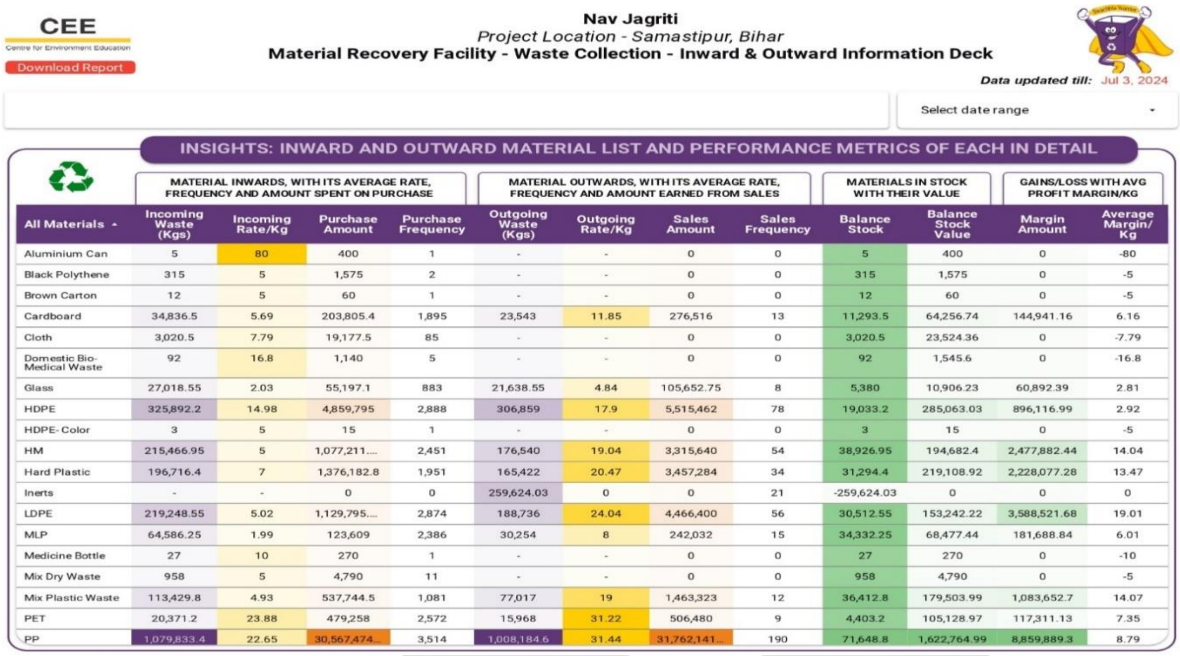
Live Inward/ Outward Dashboard is maintained with full traceability and there are live CCTV cameras are installed to view operations from the MRF in project.

Link for live Dashboard - https://lookerstudio.google.com/u/0/reporting/ccfde989-3554-4a90-aba3-29a7ee0bf467/page/v1wRD

Screenshots of live dashboard as shown in the below **Figure 10, 11, 12 & 13.** This is analysed on weekly basis in the monitoring department of the project, on real-time data. Operations and management of MRF & MRC related activities by the service providers (SPs) has provided cost-effectiveness. Many challenges need to be addressed continuously around SP and local stakeholders' ownerships through the use of appropriate machine applications;

<u>Figure 10</u>: Screenshots of live dashboard at MRF in Samastipur on the collection types of plastics.

Yes, the success of any initiative lies when 'all stakeholders' taking ownerships; processes determine desired results. The fear factor of Government at times actually enhances performances and fiasco (at times) reinforces the implementing partners (project and service providers) to keep a healthy ecosystem. Today, Governments – as policy makers and regulators also need to fast realize that policy layout, facilitation and monitoring can be a state function; but certainly, with changing paradigms implementation of programs need professionals play. Such sharing of roles provides better efficiency, learnings and checks conflict of interests-defensive approach. We need to move fast on the global agendas, where debates are all in pull factor. Of course, there cannot be one fit for all.



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Nav Jagriti
Project Location - Samastipur, Bihar
Material Recovery Facility - Waste Collection - Inward & Outward Information Deck

Data updated till: Jul 3, 2024

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INSIGHTS: INWARD AND OUTWARD MATERIAL LIST AND PERFORMANCE METRICS OF EACH IN DETAIL

	MATERIAL INWARDS, WITH ITS AVERAGE RATE, FREQUENCY AND AMOUNT SPENT ON PURCHASE				MATERIAL OUTWARDS, WITH ITS AVERAGE RATE, FREQUENCY AND AMOUNT EARNED FROM SALES				MATERIALS IN STOCK WITH THEIR VALUE		GAINS/LOSS WITH AVG PROFIT MARGIN/KG	
All Materials	Incoming Waste (Kgs)	Incoming Rate/Kg	Purchase Amount	Purchase Frequency	Outgoing Waste (Kgs)	Outgoing Rate/Kg	Sales Amount	Sales Frequency	Balance Stock	Balance Stock Value	Margin Amount	Average Margin/Kg
Aluminium Can	5	80	400	1	-	-	0	0	5	400	0	-80
Black Polythene	315	5	1,575	2	-	-	0	0	315	1,575	0	-5
Brown Carton	12	5	60	1	-	-	0	0	12	60	0	-5
Cardboard	34,836.5	5.69	203,805.4	1,895	23,543	11.85	276,516	13	11,293.5	64,256.74	144,941.16	6.16
Cloth	3,020.5	7.79	19,177.5	85	-	-	0	0	3,020.5	23,524.36	0	-7.79
Domestic Bio-Medical Waste	92	16.8	1,140	5	-	-	0	0	92	1,545.6	0	-16.8
Glass	27,018.55	2.03	55,197.1	883	21,638.55	4.84	105,652.75	8	5,380	10,906.23	60,892.39	2.81
HDPE	325,892.2	14.98	4,859,795	2,888	306,859	17.9	5,515,462	78	19,033.2	285,063.03	896,116.99	2.92
HDPE- Color	3	5	15	1	-	-	0	0	3	15	0	-5
HM	215,466.95	5	1,077,211....	2,451	176,540	19.04	3,315,640	54	38,926.95	194,682.4	2,477,882.44	14.04
Hard Plastic	196,716.4	7	1,376,182.8	1,951	165,422	20.47	3,457,284	34	31,294.4	219,108.92	2,228,077.28	13.47
Inerts	-	-	0	0	259,624.03	0	0	21	-259,624.03	0	0	0
LDPE	219,248.55	5.02	1,129,795....	2,874	188,736	24.04	4,466,400	56	30,512.55	153,242.22	3,588,521.68	19.01
MLP	64,586.25	1.99	123,609	2,386	30,254	8	242,032	15	34,332.25	68,477.44	181,688.84	6.01
Medicine Bottle	27	10	270	1	-	-	0	0	27	270	0	-10
Mix Dry Waste	958	5	4,790	11	-	-	0	0	958	4,790	0	-5
Mix Plastic Waste	113,429.8	4.93	537,744.5	1,081	77,017	19	1,463,323	12	36,412.8	179,503.99	1,083,652.7	14.07
PET	20,371.2	23.88	479,258	2,572	15,968	31.22	506,480	9	4,403.2	105,128.97	117,311.13	7.35
PP	1,079,833.4	22.65	30,567,474...	3,514	1,008,184.6	31.44	31,762,141...	190	71,648.8	1,622,764.99	8,859,889.3	8.79

Figure 11: Screenshots of live dashboard at MRF in Samastipur on the inward & outward sale and movement on the collection types of plastics.

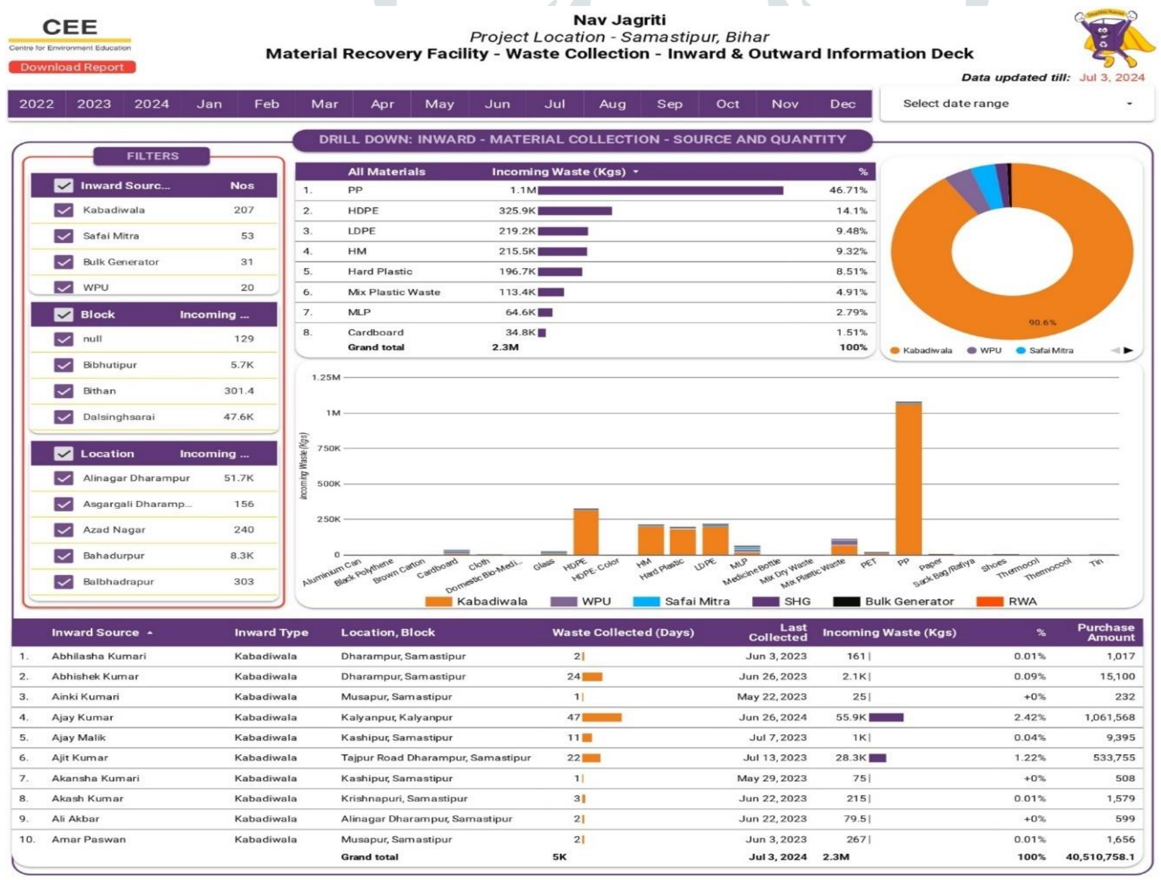

Figure 12: Screenshots of live dashboard at MRF in Samastipur with further alaysis on what materials from where.

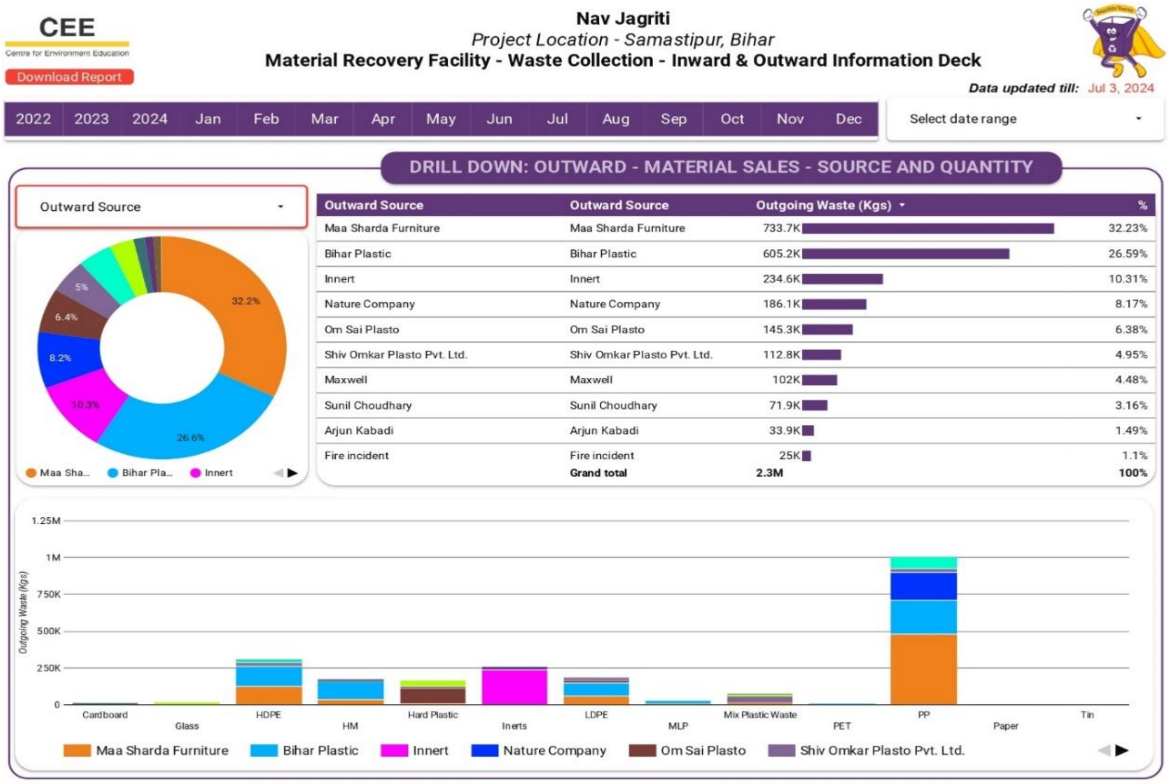

Figure 13: Screenshots of live dashboard at MRF in Samastipur inward-outward materials.

5. Policy and Governance Assessment of policy frameworks and governance structures identified opportunities for policy enhancements:

- **Regulatory Compliance**: Adherence to waste management regulations and policies, with recommendations for strengthening enforcement mechanisms.
- **Policy Support**: Advocacy for extended producer responsibility (EPR) schemes and incentives to promote sustainable waste management practices.
- **Government Partnerships**: Collaboration with local and state governments to streamline policies and foster a supportive regulatory environment.

Assessment on Policy and Governance:

Insurance for plant, machinery, and stock for a Basic cover of **Rs. 2,35,00,000** has been done **from April 2023 till April 2024**. **Group Medical Insurance** for manpower has been done for 11 members **from April 2023 to April 2024** with **basic cover of Rs. 1,00,000 per member**. Insurance coverage for equipment, machinery, inventory, and personnel offers protection against unexpected events and ensures comprehensive inclusivity.

Government Partnership has enabled the project to achieve convergence under the project from government and Service Provider as the details given below.

- The Samastipur administration's Convergence support for the project have extended beyond monetary contributions. Their support has remarkable contributions which includes **provisions for space** (land for MRF), **Utilities** (Electric and water connection), **Provided PLTP Kiosk space**, **distributed 16 Dustbins** at the MRF Centre and **conducted 2 workshops** at the Collectorate Office.
- The Samastipur Administration's in-kind convergence in the form of Utilities of vehicles and resources under the project ranges to **₹ 67,73,000/-** and in-kind convergence by Service Provider is **₹ 26,16,600/-**.

The Partnerships developed under the project have helped the project achieve –

i. Awards and Recognition:

○ **On 26th January 2023**; the Samastipur administration recognized the efforts of the project for establishing the MRF; vide an **Appreciation Letter to HDFC Bank, CEE, and Nav Jagriti, given by Sh. Shravan Kumar, Hon'ble Minister of Rural Development, Govt. of Bihar**.

○ **Nav Jagriti** has been awarded 1st prize in **'Plastic Recycling Facility' category** by **Plastic Recycling Conference Asia (PRCA), 2023** for its efforts in implementing the "Rural & Urban Landscape Free of Dry & Plastic Waste" project in Samastipur, Bihar.

○ **Samastipur Municipal Corporation** has been awarded **2nd prize in the Local Body Champion (under 2 lakh population) category by Plastic Recycling Conference Asia (PRCA), 2023** for the outcomes of works under the "Rural & Urban Landscape Free of Dry & Plastic Waste" project in Samastipur, Bihar.

○ **On 26th January 2024**, the Samastipur Administration recognized the efforts of the project for establishing the MRF; vide an **Appreciation Letter to Project Co-ordinator, Nav Jagriti given by the Mayor, Samastipur Municipal Corporation**.

ii. Urban – Rural Convergence

○ With the successful collection of waste from Urban areas in Samastipur City, the **Samastipur District Administration has asked the project to establish waste collection systems from 20 Blocks and 347 GPs/ villages** to achieve a unique Urban-Rural Convergence under the Model.

Recommendations included strengthening regulatory frameworks, advocating for extended producer responsibility (EPR), and fostering partnerships with government bodies to ensure supportive policy environments.

6. Challenges and Recommendations The audit report outlined challenges encountered during the implementation phase and provided strategic recommendations for improvement:

- **Technological Integration**: Recommendations for enhancing technological capabilities to improve waste tracking, operational efficiencies, and resource utilization.
- **Capacity Building**: Continued investment in training and capacity building for stakeholders, including waste management personnel and community leaders, to sustain project momentum.
- **Community Outreach**: Strategies for expanding community outreach and engagement efforts to ensure continued public support and participation in waste management initiatives.

Challenges and Recommendations:

Challenges identified included the need for enhanced technological integration and Capacity Building at State and block level. Recommendations focused on standardizing operational models, improving technological capabilities, and investing in capacity building for stakeholders.

7. Conclusion:

Integrated Dry Waste Management in Samastipur, Bihar underscores the initiative's achievements in environmental stewardship, community engagement, and infrastructure development. While celebrating successes, the report emphasizes the importance of addressing challenges and implementing recommendations to ensure sustainable waste management practices and long-term impact across the region.

It highlights substantial achievements in environmental conservation, community engagement, and economic development. By addressing identified challenges and implementing strategic recommendations, the initiative can further its impact, promote sustainable waste management practices, and serve as a model for future endeavours in Bihar and beyond.

The **Project's 6-fold inter-connected functions** approach of Materials, People, Skilling, Systems & Processes, Sustainability and Knowledge-Information as shown in the **Figure 14 below** - promotes a holistic circular approach as shown below in Figure 4 ©. Simple steps are combined together in a more intensive approach with emphasis on quality, quantity and a time frame (QQT). This encourages in each city community participation & ownerships which has led to

Improve Source Segregation in the urban City Municipal Corporation and rural areas of 20 blocks allotted,

Strengthen Dry, including plastics of all types waste collection, segregation transportation mechanism

Maximize resource recovery by facilitating establishment of the Integrated Facility - MRF

Promote backward linkages (collection, purchase from informal sector) in the supply chain to strengthen the collection of all types of plastics.

Establish forward, market (recyclers, bulk waste generators {BWGs}) Linkages and backward as recyclers, refurbishes etc.

Promote community engagement and ownership ("Jan-Andolan")

Develop sustainable business model to promote social security, job creation and impact the livelihoods of the local women SHG groups and other informal sector stakeholders.

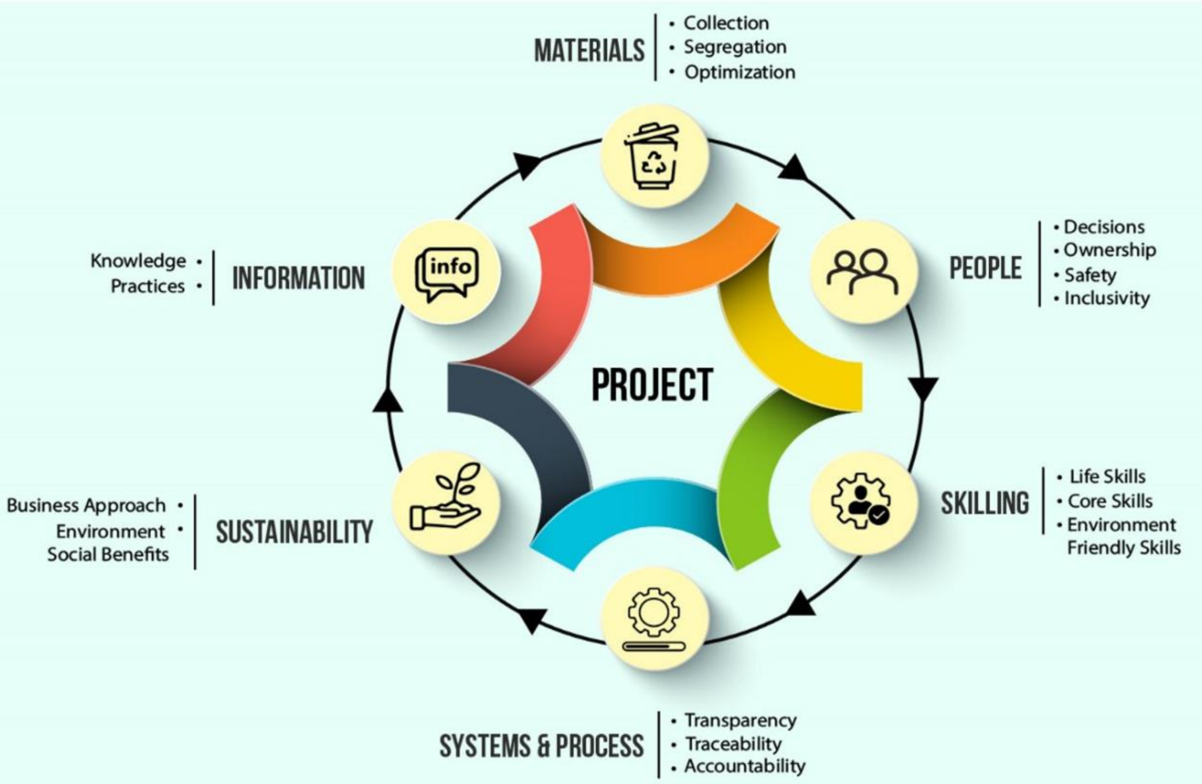

Figure 14: Project's 6-fold inter-connected for holistic circular approach

The project through all its processes and systems are addressing **14 of the 17, UN Sustainable Development Goals.** Much of the emphasis as discussed in the paper helps to achieve the benefits for all stakeholders in the ecosystem. The actions, activities will address the goals as explained below.

Increased incomes, access to services and opportunities for Safai Sathis – **Goal 1.**

Empowering women Safai Mitras through inclusion & improved livelihood creation**. Goals 5,8 and 10.**

Minimization of waste to landfills, reduction in greenhouse gases, marine litter, and safe handling of waste. **Goals 3, 6, 13, 14 and 15.**

Circular economy in waste, innovation and technology, energy recovery and promoting extended producer's responsibility. **Goal 7,9, 11 and 12.**

Partnership's alliances, engagement efficiency and efficacy at every level**. Goal 17.**