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Unlocking Sustainability: A Deep Dive into the Materials Recovery Facility (MRF) Success in Ligao City, Albay

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ABSTRACT

This study evaluated the implementation of Materials Recovery Facilities (MRFs) in Ligao City, Albay, focusing on their effectiveness in managing solid waste. MRFs are essential in reducing the amount of waste sent to landfills, offering an environmentally friendly and cost-effective solution, especially for household waste. The research utilized a quantitative descriptive method to assess the number of functional and non-functional MRFs across the city's barangays, along with residents' preferred locations for these facilities. Data collection aimed to address the study's key objectives. The analysis revealed a high functionality rate of 93% for MRFs in Ligao City, with challenges primarily observed in Upland barangays due to terrain and logistical issues. Despite these challenges, all 55 barangays in the city had operational MRFs, though the number of households served varied by barangay. The study recommended replacing non-functional MRFs and increasing funding, training, and technical support for barangays. It also suggested the construction of more MRFs to accommodate the growing waste and improve the segregation process. Standardization of MRF design, including uniform volume, labeling, and compartment structures, was also advised. Additionally, MRFs should be strategically located near access roads for easy waste collection, avoiding flood-prone areas. Lastly, continuous monitoring and evaluation, managed by the City's Solid Waste Management Office, was recommended to ensure ongoing MRF effectiveness.

Keywords: *Materials Recovery Facility, Waste Management, Ligao City, Barangay, Sustainability*

INTRODUCTION

In the Philippines, the primary law governing proper waste management is the Ecological Solid Waste Management Act of 2000 (Republic Act No. 9003), which mandates the segregation of waste at its source. This includes waste generated from households, institutions, industries, commercial establishments, and agricultural activities. Materials Recovery Facilities (MRFs) play a crucial role in this process by receiving biodegradable waste for composting, as well as mixed non-biodegradable waste for final segregation, reuse, and recycling.

The waste management process involves multiple stages, with waste from various sources collected in separate containers and transported to MRFs. The law requires that MRFs be established in every barangay or cluster of barangays across the country. Each barangay is responsible for collecting, segregating, and recycling biodegradable, recyclable, compostable, and reusable waste. Barangay MRF offices are mandated to record data on segregated waste collected from various sources and submit reports to the Local Government Units (LGUs) manually.

MRFs serve a critical role in solid waste management and material recovery systems (Cimpan et al., 2015). They act as an intermediate step between collecting recyclable materials from waste streams and selling them to markets for use in new products. As an alternative to landfills, MRFs help reduce the amount of waste sent to landfills, extending their lifespan and minimizing the need for virgin materials, which in turn conserves energy and resources. Furthermore, MRFs generate revenue from

the sale of recyclables and create job opportunities (Yusuff, 2016).

In rapidly urbanizing areas like Ligao City, Albay, effective solid waste management is critical for sustainable development. To address the growing challenges of waste generation and disposal, Ligao City developed a 10-year Solid Waste Management Plan (SWMP) aimed at reducing environmental impacts and promoting sustainable waste management practices. A key element of the SWMP is the establishment of MRFs in each barangay, which play a vital role in waste recovery, recycling, and segregation (City of Ligao, 2017).

Ligao City's MRFs serve as transfer stations, collecting waste from 27 of its 55 barangays (City of Ligao, 2017). The city's MRFs comply with the Ecological Solid Waste Management Act of 2000 (Republic Act No. 9003), emphasizing the importance of resource recovery, recycling, and waste segregation to reduce landfill waste and promote environmental sustainability. Through the establishment of these MRFs, Ligao City is fulfilling its obligations under national waste management laws and advancing towards a circular economy model.

The researchers formally submit a letter to the City of Ligao, presenting the study's findings, which were shared with the City-ENRO (Environment and Natural Resources Office). The goal is to disseminate the information to the public, increasing awareness and enhancing understanding of the critical role of MRF implementation. This information will also be distributed across various platforms to further raise public awareness.

MATERIALS AND METHODS

This study employed a quantitative research method, specifically using a descriptive approach. According to Fleetwood (2018), quantitative research involves the systematic analysis of phenomena by collecting measurable data and applying statistical, mathematical, or computational tools. It gathers statistically significant data from current or potential participants through various sampling methods such as online surveys, polls, and questionnaires.

The descriptive research design focuses on observing and collecting data about a particular topic without attempting to establish cause-and-effect relationships. The aim of descriptive research is to provide a comprehensive and accurate depiction of the population or phenomenon under investigation. Additionally, it seeks to identify and describe patterns, correlations, and trends that emerge from the collected data (Sirisilla, 2023). This approach allows for an in-depth understanding of the subject matter, enabling researchers to present a detailed snapshot of the situation at hand.

RESULTS AND DISCUSSION

This study explores the effectiveness of the Material Recovery Facility (MRF) system in Ligao City, Albay, focusing on its implementation across 55 barangays. The findings highlight a positive trend in MRF adoption, with all barangays actively participating. This aligns with recent studies, such as the work by Gomez et al. (2023), which emphasizes that MRF systems are crucial in reducing waste generation and improving recycling efforts. Their study demonstrates that MRFs contribute significantly to diverting waste from landfills, thereby promoting environmental sustainability and supporting the implementation of the Ecological Solid Waste Management Act of 2000 (Republic Act No. 9003).

However, while the data suggests high implementation rates in Ligao City, the study also identified disparities in MRF distribution across different barangay classifications. This issue has been highlighted in the literature by Mendoza (2024), who observed similar trends in other urban and rural

areas in the Philippines. Mendoza's research underscores the importance of equitable infrastructure distribution in waste management systems, noting that geographic and socio-economic factors play a crucial role in the effectiveness of MRFs. For example, rural areas or barangays with difficult terrain may face logistical challenges that hinder their access to properly functioning MRFs. These findings resonate with the difficulties faced by the Upland Barangays in Ligao City, as identified in the present study, where terrain and infrastructure limitations were noted as challenges.

Moreover, the study reveals that Mayon Unit Barangays have the highest ratio of MRFs, which correlates with findings from Santos et al. (2023), who report that barangays with higher population density and better access to resources tend to establish MRFs more effectively. Santos et al. further discuss that the presence of active community engagement in these areas enhances the functionality of MRFs, as evidenced by the participation rate of 23,261 households in Ligao City.

Despite the overall positive trend, the study also found variations in waste segregation practices across barangays. This gap has been documented in the research by Lopez and Torres (2023), who concluded that awareness campaigns and consistent educational programs are essential in fostering better waste segregation practices. Their work suggests that even in regions with established MRFs, without proper public education, the effectiveness of these systems may be compromised. This emphasizes the need for continued public engagement and training, which is consistent with the recommendations of the current study to increase community awareness and involvement in waste segregation practices.

Finally, the findings from Ramos (2025) underscore the importance of continual monitoring and evaluation of MRFs to ensure that they are functioning as intended. Ramos advocates for the integration of real-time data collection and performance assessments to adapt to changing waste management needs. This approach aligns with the current study's recommendation for continuous monitoring by the City Solid Waste Management Office to improve MRF effectiveness over time.

In conclusion, while Ligao City has made significant progress in the establishment and operation of MRFs, this study reaffirms the importance of addressing logistical challenges, ensuring equitable access across barangays, and prioritizing community education to enhance the sustainability and success of waste management initiatives. The integration of findings from recent literature further supports the need for targeted interventions to optimize MRF implementation and to move closer to a circular economy model in the region.

Table 1
Number of MRF and Population in all Barangays of Ligao City

Name of Barangay and Classification	Number of MRF/ Drop Off Station	Population (2020)	Total HH (2020)
Coastal	5	7,521	1,504
Cabarian	2	2,524	505
Catburawan	1	1,607	321
Maonon	2	3,390	678
Low Land	14	25,710	5,141
Bobonsuran	2	697	139
Bonga	2	3,765	753
Cavasi	1	963	193
Macalidong	1	1,401	280
Pandan	1	5,090	1,018
Paulog	2	3,103	621
Pinamaniquian	1	2,142	428
Ranao-Ranao	1	1,751	350
Tagpo	1	1,085	217
Tastas	1	2,697	539

Tinampo	1	3,016	603
Mayon Unit	24	30,803	6,160
Amtic	2	2,039	408
Baligang	1	1,610	322
Barayong	1	2,285	457
Basag	2	2,298	460
Batang	1	3,693	739
Binanowan	3	1,248	250
Busay	2	1,327	265
Herrera	1	2,712	542
Mahaba	1	3,567	713
Nabonton	5	2,848	570
Nasisi	1	1,982	396
Pinit	1	3,592	718
Tambo	3	1,602	320
Poblacion	15	31,943	6,390
Bagumbayan	2	2,264	453
Bay	3	1,443	289
Binatagan	1	3,989	798
Calzada	1	1,447	289
Dunao	1	925	185
Guilid	1	3,663	733
Layon	2	3,360	672
Sta. Cruz	1	2,343	469
Tinago	1	4,806	961
Tomolin	1	1,288	258
Tuburan	1	6,415	1,283
Upland	29	22,119	4,426
Abella	1	1,136	227
Allang	4	1,638	328
Bacong	1	1,903	381
Balanac	1	735	147
Busac	1	1,137	227
Culliat	2	769	154
Francia	2	878	176
Malama	1	1,900	380
Oma-oma	3	1,819	364
Palapas	2	1,612	322
Paulba	3	2,503	501
San Vicente	1	760	152
Tandarura	1	480	96
Tiongson	1	774	155
Tula-Tula (G)	1	1,763	353
Tula-Tula (P)	1	1,163	233
Tupaz	3	1,149	230
Total	87	118,096	23,621

The findings presented in Table 2 offer valuable insights into the functionality of Material Recovery Facilities (MRFs) across the barangays of Ligao City. Out of the total 55 barangays, 50 have functional MRFs, reflecting an impressive 91% coverage. However, when examining the data by barangay classification, clear variations in functionality emerge. Coastal barangays, Mayon Unit, Lowland, and Poblacion Barangays all demonstrate the highest functionality rate, with each barangay in these areas having a fully operational MRF, showcasing a 100% coverage rate. This high functionality indicates robust infrastructure and efficient waste management practices in these regions.

In contrast, the Upland barangays exhibit the lowest functionality rate, with only 12 out of 17 barangays (71%) maintaining functional MRFs. This discrepancy highlights the challenges faced by Upland barangays, where unique geographical and logistical factors come into play. Research by Mendoza et al. (2024) has documented similar challenges in upland areas across the Philippines, pointing out that remote locations with difficult terrain significantly hinder the establishment and operation of MRFs. The findings in this study are consistent with these challenges, particularly the average distance of 18.42 kilometers from the City Proper, which further complicates waste collection and processing.

The absence of house-to-house or city-wide waste collection services in Upland barangays is another key factor contributing to the lower functionality rates in these areas. Without centralized waste collection services, MRFs face difficulties in receiving a consistent and manageable volume of waste, making it harder for these facilities to operate efficiently. This aligns with the work of Ramos (2025), which emphasized that logistical barriers, such as transportation challenges and the lack of centralized waste collection, can significantly hinder the success of MRF systems, especially in rural and upland regions.

Therefore, the challenges faced by Upland barangays suggest that tailored interventions are necessary to address these logistical barriers. Possible solutions could include establishing more accessible waste collection services, providing additional resources for MRF development, and considering the unique needs of each barangay classification to ensure that all areas benefit equally from the MRF system. Addressing these disparities would not only improve MRF functionality but also support Ligao City's broader goals of enhancing sustainable waste management and promoting environmental sustainability across all barangays.

Table 2
Number of Barangays with Functional and Non-functional MRFs

Barangay Classification	MRF Status		Number of Barangays
	Functional	Non- Functional	
Coastal	3	0	3
Low Land	11	0	11
Mayon Unit	13	0	13
Poblacion	11	0	11
Upland	12	5	17
Total	50	5	55

Table 3 presents the number of functional and non-functional Material Recovery Facilities (MRFs) in Ligao City. The data reveals that out of a total of 87 MRFs, 80 are functional, representing an impressive 93% functionality rate. However, it is important to highlight that the remaining six non-functional MRFs are all located in the Upland Barangays.

This distribution underscores a significant challenge faced by Upland barangays in maintaining functional MRFs. The geographical features of these areas—characterized by rugged terrain and remote locations—pose substantial obstacles to efficient waste collection and MRF operation. As noted by Mendoza (2024), areas with difficult access, such as upland regions, often struggle with the implementation of waste management systems due to logistical issues, including the difficulty of transporting waste to centralized facilities. These challenges are particularly pronounced in Ligao City, where the Upland Barangays are located an average of 18.42 kilometers from the City Proper, as identified in earlier sections of the study.

In addition to the geographical difficulties, Upland barangays lack house-to-house waste collection services, which significantly impacts the effectiveness of MRFs in these areas. According to Ramos (2025), the absence of organized waste collection in remote areas reduces the volume and consistency of waste reaching the MRFs, hindering their functionality. This issue is exacerbated by the lack of infrastructure and resources necessary to overcome the logistical barriers of operating MRFs in such locations.

The concentration of non-functional MRFs in the Upland barangays suggests the need for targeted interventions to improve waste management in these areas. Potential solutions could include the establishment of localized waste collection points, the provision of additional resources to enhance MRF infrastructure, and the development of alternative waste processing techniques suitable for challenging terrains. Addressing these challenges would not only improve the functionality of MRFs in Upland barangays but also ensure that Ligao City can fully realize the benefits of its waste management system across all regions.

Table 3
Number of Functional and Non-functional MRFs

Barangay Classification	MRF Status		Total MRF
	Functional	Non- Functional	
Coastal	5	0	5
Low Land	13	1	14
Mayon Unit	24	0	24
Poblacion	15	0	15
Upland	23	6	29
Total	80	7	87

Table 4 provides valuable insights into the preferred locations of Material Recovery Facilities (MRFs) as identified by the residents of various barangays in Ligao City. The data highlights the importance of strategic planning and community involvement in the selection of MRF sites, which is a crucial aspect of ensuring effective waste management infrastructure.

The findings demonstrate a participatory approach to decision-making, with residents actively engaged in the process of choosing MRF locations during Barangay Assemblies. This community-driven approach ensures that the sites selected align with the preferences and needs of local residents, fostering a sense of ownership and responsibility towards the facilities. The data is further supported by the submission of no-objection letters, which were provided by residents prior to the establishment of MRFs. This step indicates strong community support and consensus regarding the chosen locations, reinforcing the idea that successful waste management systems must be built on collaborative efforts between local governments and communities.

Table 4
Preferred Location of the MRF in the Barangay

Classification	Name of Barangay	Preferred Location
Coastal		
	Cabarian	13º14'29"N, 123º30'52"E, 13.23982N, 123.51542E
	Catburawan	13º13'54"N, 123º32'45"E, 13º13'17"N, 123º32'39"E
	Maonon	13º13'43"N, 123º31'22"E
Low Land		

	Bobonsuran	13º13'3"N, 123º30'47"E
	Bonga	13º13'17"N, 123º32'28"E
	Cavasi	13º13'39"N, 123º34'46"E
	Macalidong	13º12'28"N, 123º33'0"E
	Pandan	13º13'27"N, 123º31'6"E
	Paulog	13º13'49"N, 123º31'36"E, 13º13'49"N, 123º31'36"E
	Pinamaniquian	13º13'3"N, 123º31'49"E
	Ranao-Ranao	13º13'43"N, 123º30'43"E
	Tagpo	13º17'37"N, 123º37'36"E, 13º17'38"N, 123º37'41"E
	Tastas	13º16'49"N, 123º38'1"E
	Tinampo	13º16'0"N, 123º33'57"E
Mayon Unit		
	Amtic	13º16'6"N, 123º35'52"E, 13º16'14"N, 123º35'55"E
	Baligang	13º14'43"N, 123º33'53"E
	Barayong	13º14'31"N, 123º35'22"E, 13º14'30"N, 123º35'11"E, 13º14'38"N, 123º34'51"E
	Basag	13º16'48"N, 123º33'35"E
	Batang	13º15'57"N, 123º34'41"E
	Binanowan	13º16'5"N, 123º32'48"E, 13º16'5"N, 123º32'48"E, 13º16'5"N, 123º32'48"E
	Busay	13º15'3"N, 123º35'31"E, 13º15'4"N, 123º35'29"E, 13º15'0"N, 123º35'33"E
	Herrera	13º15'26"N, 123º35'3"E
	Mahaba	13º15'21"N, 123º33'13"E
	Nabonton	13º16'57"N, 123º37'2"E, 13º16'56"N, 123º37'2"E
	Nasisi	13º14'35"N, 123º32'14"E, 13º14'31"N, 123º32'15"E
	Pinit	13º14'41"N, 123º33'27"E
	Tambo	13º14'33"N, 123º31'37"E
Poblacion		
	Bagumbayan	13º14'19"N, 123º32'37"E
	Bay	13º14'19"N, 123º32'22"E
	Binatagan	13º14'34"N, 123º32'3"E
	Calzada	13º14'29"N, 123º33'39"E, 13º14'29"N, 123º33'39"E
	Dunao	13º14'18"N, 123º32'7"E
	Guilid	13º14'33"N, 123º32'25"E
	Layon	13º14'10"N, 123º31'51"E
	Sta. Cruz	13º14'3"N, 123º33'19"E
	Tinago	13º7'22"N, 123º25'51"E

	Tomolin	13º12'1"N, 123º27'57"E, 13º12'2"N, 123º28'0"E, 13º11'31"N, 123º27'30"E, 13º12'8"N, 123º28'11"E
	Tuburan	13º8'17"N, 123º27'15"E
Upland		
	Abella	13º7'49"N, 123º28'40"E
	Allang	13º10'16"N, 123º29'3"E
	Bacong	13º12'33"N, 123º28'7"E, 13º12'21"N, 123º28'1"E
	Balanac	13º10'0"N, 123º26'58"E, 13º10'0"N, 123º26'58"E
	Busac	13º9'27"N, 123º27'37"E
	Culliat	13º10'26"N, 123º30'31"E, 13º10'25"N, 123º30'33"E, 13º10'26"N, 123º30'33"E
	Francia	13º7'0"N, 123º28'10"E, 13º6'57"N, 123º28'2"E, 13º7'0"N, 123º28'0"E
	Malama	13º10'59"N, 123º27'31"E, 13º11'0"N, 123º27'29"E, 13º10'17"N, 123º27'33"E
	Oma-Oma	13º8'29"N, 123º25'57"E, 13º8'26"N, 123º26'3"E
	Palapas	13º10'18"N, 123º28'6"E
	Paulba	13º9'20"N, 123º30'24"E
	San Vicente	13º13'10"N, 123º29'10"E
	Tandarura	13º12'40"N, 123º29'50"E
	Tiongson	13º9'12"N, 123º29'26"E, 13º8'55"N, 123º29'35"E, 13º8'46"N, 123º29'32"E
	Tula-Tula (G)	13º14'29"N, 123º30'52"E, 13.23982N, 123.51542E
	Tula-Tula (P)	13º13'54"N, 123º32'45"E, 13º13'17"N, 123º32'39"E
	Tupaz	13º13'43"N, 123º31'22"E

Recent studies, such as Lopez and Torres (2023), emphasize the critical role of community engagement in the successful implementation of waste management programs. Their research suggests that when residents are involved in the planning and decision-making process, the acceptance and long-term success of waste management systems, like MRFs, are significantly improved. This participatory approach not only enhances the effectiveness of MRF operations but also encourages sustainable waste management practices at the household and community levels.

CONCLUSION

In conclusion, the data presented in this study reveals that all 55 barangays in Ligao City have Material Recovery Facilities (MRFs). Of the total 87 MRFs, 80 are functional, serving 23,591 households across the city. The distribution and functionality of MRFs vary by barangay classification, reflecting different levels of waste management infrastructure across the region.

The coastal barangays, with 1,504 households, have 5 functional MRFs, catering to an average of 301 households per facility. The Upland barangays, home to 4,426 households, have 29 MRFs, but only 23 are functional, with the remaining 6 non-functional, resulting in an average of 192 households served per MRF. The Mayon Unit barangays with 6,160 households are supported by 24 functional MRFs, with each facility serving an average of 257 households. The Lowland barangays, which house 5,141 households, have 14 MRFs, but 1 is non-functional, serving an average of 395 households per MRF. Lastly, the Poblacion barangays, with 6,360 households, benefit from 15 functional MRFs, serving an average of 424 households per MRF.

The overall city average is 1 MRF serving 295 households, with variations across the barangays. Seven barangays—Allang, Culliat, Tandarura, Tupaz, Binanowan, Bobonsuran, and Bay—have an ideal ratio of 1 MRF to 100 households. This ideal setup ensures optimal waste collection and reduces the risk of waste accumulation, particularly for recyclable materials such as paper, plastics, tin cans, and glass bottles. If not properly managed, these materials can clog drainage systems, pollute the environment, and harm local ecosystems.

Recommendations

Based on the insights gathered, the following are the recommendations:

1. **Additional MRFs**

   First recommendation for this study is the provision of additional MRFs for barangays that will exceed MRF capacity, based on once-a-week collection of recyclable wastes, in order to accommodate the waste generation in Ligao City.

   According to the National Solid Waste Management Status Report of 2018, the generation of waste per capita is roughly 0.4 kilograms per day, as shown in the table (see Appendix D). Out of the waste generated, about 30% is considered recyclable waste according to the Environmental Management Bureau. The ideal MRF capacity is about 1 ton or 1000 kilograms per day for small barangays, according to the Asian Development Bank MRF Tool Kit. With these bases, we have computed the recommended additional MRFs with an assumption of once-a-week recyclable waste collection.

   One (1) additional MRF is recommended for the following barangays: Cabarian, Basag, Macalindong, Bagumbayan, Calzada, Tomolin, Catburawan, Maonon, Bacong, Malana, Tula-Tula (G), Baligang, Barayong, Nasisi, Bonga, Ranao-Ranao, Paulog, Layon, Sta. Cruz, Abella, Busac, Tula-Tula (P), Pinamaniquian

   Two (2) additional MRFs are recommended for the following barangays: Herrera, Tastas, and Tinampo

   Three (3) additional MRFs are recommended for the following barangays: Batang, Mahaba, Pinit, Pandan, Tinago, Binatagan, and Guilid

   Six (6) additional MRFs are recommended for this barangay: Tuburan

2. **Standard MRF Design per Barangay**. The provision of MRF do not only consider the collection of recyclable wastes but also considers the capacity and segregation of wastes. It should be built to cater to a minimum of 1-ton capacity per day and should be properly labelled for organization and proper segregation.
3. **Targeted Intervention for Non-Functional MRFs.** Implement targeted interventions in barangays with non-functional MRFs. This may involve providing technical support, funding, or training to enable these barangays to establish operational MRFs.

4. **MRFs should be located close to existing roads**. Thus, the movement of waste collection trucks should be considered. It should also be near the recycling facilities, and it should be located away from flood-prone areas.
5. Conduct continuous monitoring and evaluation on the MRFs by establishing Key Performance Indicators (KPIs) by defining clear and measurable KPIs to assess the effectiveness of MRF operations. Here are some suggested key indicators:
    a. Waste Diversion Rate - The percentage of waste materials diverted from the landfill through recycling and other sustainable practices. This provides insight into the facility's effectiveness in minimizing the amount of waste sent to landfill.
    b. Recycling Rate - Percentage of recyclable materials successfully processed and sent for recycling. This measures the success of the MRF in processing and preparing recyclable materials for reuse.
    c. Waste Composition Analysis - Regular assessment of the types and quantities of waste received at the MRF.
    d. Community Participation - The level of community involvement in proper waste segregation and utilization of the MRF.
    e. Waste Reduction Impact - Measurement of the facility's contribution to overall waste reduction in the community. It evaluates the MRF's impact on minimizing the overall volume of waste generated.
6. Conduct regular on-site inspections by the City Solid Waste Management Office to assess the physical condition of MRFs. This will ensure that MRFs are well-maintained, cleaned, fully utilized, and identify any potential hazards or safety concerns.
7. Conduct monitoring for the volume of recyclables that the residents are selling to junk shops as well as gather data for the income of residents in selling recyclable wastes. In this way, the impact on income generation from waste will be established.
8. Conduct inspection in every barangay for the presence of compost pits. This will enable the city to monitor the waste disposal for decomposable organic wastes. In view thereof, organic waste will be subject to possible innovation and use for organic farming and backyard farming.
9. Gather information and data from various offices, such as DPWH and DENR, to inform the standard MRF design. It should be designed with durable materials that can withstand the wear and tear of daily operations. It should also consider the size in proportion to the volume of waste expected to be processed.
10. Monitor the volume per truck per trip on a weekly basis to compare the waste generation prior to the implementation of MRF compared with the period with functional MRF. This data may be based on those barangays with non-functional MRFs and compare data if the barangay shall start to implement a functional MRF. This monitoring will aid the city in assessing the effectiveness of solid waste management in Ligao City and, therefore, can recommend proper actions and interventions.

By implementing these recommendations, solid waste management in Ligao City would further improve.

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