

Evaluating the Operational Efficiency of Lahore Waste Management Company (LWMC):

A Comprehensive Analysis

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Abstract

Lahore Waste Management Company LWMC, established in 2011, outsourced its solid waste management (SWM) operations to Turkish firms initially, resulting in an increase in solid waste collection from 76% to 96% between 2011 and 2018. However, after terminating contracts with Turkish firms due to administrative and legal issues, LWMC adopted a hybrid model involving locally hired contractors, leading to a decline in solid waste collection to 67% in 2021. Therefore this research has analyzed the difference between the operational models of Turkish and local contractors regarding waste collection efficiency. The research has performed a regression analysis based on a mixed-method approach, utilizing both qualitative and quantitative data. Primary data were collected through a structured questionnaire administered to 68 respondents using a Likert scale, supplemented by open-ended questions for qualitative responses. The study recommends that LWMC initiates an ISWM model encompassing recycling, composting, energy production, and waste reduction to enhance operational efficiency. Additionally, the promulgation of an SWM law is suggested to empower LWMC with enforcement and fine-levying capabilities, thereby increasing its revenue sources and reducing dependence on provincial loans. Greater autonomy and professionalism in LWMC's SWM approach are proposed to develop an efficient and sustainable business model for improved operational efficiency.

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1. Introduction

Municipal solid waste (MSW) poses a threat to public health and the environment if it is not safely managed from separation, collection, transfer, treatment, and disposal or recycling and reuse (Vinti et al., 2021). The Lahore Waste Management Company (LWMC) on 19th March 2010 was created by the Government of Punjab under Section 42 of the Companies Ordinance 1984 to manage SWM requirements of Lahore city on modern lines at par with international standards (Iqbal et al., 2023). LWMC replaced the erstwhile Solid Waste Management Department (SWMD) established in 1992 operating at a daily waste collection efficiency of 62% against a maximum waste production of 3000 tons (LWMC, n.d). A Services and Assets Management Agreement (SAAMA) was signed in June 2011 between the SWMD and LWMC for a period of 15 years to achieve mutually agreed key performance indicators (KPIs) relating to waste management operations including manual and mechanical washing, sweeping, primary waste collection (door to door), secondary waste collection (container-based), transportation to and disposal at designated landfill sites. International best practices require LWMC to adopt an ISWM model (The World Bank, n.d.) by switching over from the least preferred option of disposal of waste in landfills to the preferred option of prevention of solid waste production; however, the dream remains far from reality.

Figure 1.
Integrated Waste Management



Source: The World Bank, (n.d)

LWMC designed its own SWM system with the help of a Turkish consulting firm M/s. ISTAC and decided to adopt an outsourcing model to perform solid waste collection operations. (Iqbal et al., 2023). Accordingly, in November 2011,

two Turkish companies namely M/s Albayrak and M/s. Ozpak were hired through international competitive bidding to perform SWM operations alongside the eastern and western sides of Ferozepur Road, Lahore respectively comprising 138 Union Councils. The contracts with both the firms were signed with a total cost of the project amounting to US\$ 320 million for seven years (84 Months). As a result, from 2011 to 2017 the daily average solid waste collection showed a considerable increase against the total waste generated. In 2011, per day waste collected was 75% of the waste generated which increased steadily reaching the highest mark of 96% in 2017. Then in 2018, the scenario changed.

Following court cases questioning the need for establishment of public sector companies, a change in political government and initiation of a forensic audit of LWMC highlighting irregularities in procurement of Turkish firms, outsourcing contracts with foreign firms were discontinued. Hence, LWMC resorted to a hybrid model under which the primary waste collection operations were to be performed by LWMC whilst the secondary waste operations were to be executed by locally hired contractors. (Javed & Riaz, 2020). The need for a sudden change in the operational model of LWMC remains a matter of continuous debate in concerned quarters. However, in terms of daily waste collection against the waste generated, the company has shown a considerable decline in its performance. In late 2018 the daily waste collection fell from 96% to 78% and further reached the lowest performance level of 67% by the close of 2021. (Sajjad et al., 2015). Therefore, this research aims to comprehend the deficiencies in waste management. This study aims to be of use to policy-makers and practitioners alike as it suggests a way forward to achieve maximum efficiency in the operations of LWMC besides adopting an ISWM model. The scope of research is limited to the evaluation of SWM operations performed by LWMC during the pre- and post-2018 periods which are distinguished by outsourced and hybrid operational models respectively. The outsourcing model was implemented through Turkish firms while the hybrid model has been jointly implemented by the LWMC and locally hired firms. An organizational view of the operational efficiency of LWMC has been obtained seeking views of the different management tiers of the company.

1.1. Problem Statement:

Based on the average generation rate of municipal solid waste (*i.e.*, 0.65 kg/capita/day), the daily production of MSW in this city would reach 7150 tons/day (Azam et al., 2020). LWMC has experimented with different operational models to perform the operations of washing, sweeping, solid waste collection, storage, transportation and disposal. However, after more than 12 years of its establishment, LWMC's daily solid waste collection remains around 4555 tons *i.e.*, 62% of the total solid waste produced (LWMC, *n.d.*). This situation is not only negatively impacting the overall outlook of the city but has also left its residents prone to various health hazards.



2. Literature Review

Literature relevant to the topic was reviewed and the gist of it is summarized as below:

Masood et al. (2014) studied SWM in Lahore and found that the operational model involved a systematic quantitative and qualitative assessment of physical components and governance features. The study showed that collection coverage of urban waste produced was around 68%. The system lacked controls over the disposal facility with no recycling system. Citizens' inclusiveness was lacking as the system did not focus on broad-based stakeholder consultations in the decision-making process. Waste management cost was estimated to be around US\$20 per ton of waste. The study recommends recycling the waste lifted along with increasing public awareness as well as integrating the informal sector to make the existing system financially self-sustaining. However, the study lacks the analysis of LWMC's operational models and their impact on waste collection efficiency.

Batool and Chaudhry (2009) state in their research that prior to the establishment of the LWMC, political and public interference adversely affected the efficiency of the SWMD. According to them local public was least cooperative with sanitary workers and staff and lacked awareness related to the health and social problems associated with the SWM operations. The study did not provide any analysis of LWMC's operational models before and after 2018, involving Turkish firms and locally hired contractors.

Gupta et al. (1998) hold that Indian municipal corporations deal with SWM, in addition to a number of other tasks. However, they lack professionalism and do not perform the responsibilities of waste collection, transportation and disposal effectively. All these SWM operations have problems with infrastructure, maintenance, and up gradation resulting in poor performance. The worst performing operational efficiency is witnessed in waste collection function. This particular study has provided overview of the Indian Municipal corporation, which identifies the deficiencies in the structure, however as the study is old it has only focused on the issues which are general in understanding.

Similarly recent studies performed by Cheela et al. (2021) in six cities (New Delhi, Ahmedabad, Indore, Visakhapatnam, Bhopal and Udaipur) revealed that database on waste compositions, skilled human resources, political will power, lack of infrastructure, and improper operation and maintenance systems are the significant constraints in developing and implementing integrated waste management systems in councils. The per capita waste generation in cities varied from 0.47 to 0.97 kg per day. Door-to-door collection of waste is being implemented by New Delhi, Ahmedabad, Indore, and Visakhapatnam. At the same time, Bhopal and Udaipur are in the planning stage.

Vidanaarachchi et al. (2006) found that only 24% of the urban households had access to the waste collection which was only 2% when it came to the rural communities. The study revealed that capacity of waste collecting municipalities was lower than the desired levels in proportion to the waste generated. They also note that improvement in solid waste collection efficiency was direly needed to respond to the growing urban demands, in particular.

Navarro-Esbri et al. (2002) highlight that for ensuring successful planning and effective performance of the municipal solid waste removal, a good understanding and accurate prediction of the waste generated in a certain locality is a prerequisite. They reveal that instead of relying on the traditional approach of calculating waste generation using demographic and socio-economic factors, a time series analysis of total waste generated presents the real picture. They propose a prediction or forecasting methodology based on a non-linear dynamic technique. This includes comparing the performance of waste collection with a seasonal Auto-Regressive and Moving Average (ARIMA) method for the prediction of waste generation.

Khan et al. (2019) presents an overview of the current state of solid waste management in Lahore, Pakistan. Utilizing the UN-Habitat city profiling methodology, a systematic evaluation incorporating both quantitative and qualitative assessments is conducted. Governance aspects of the existing waste management infrastructure are scrutinized, shedding light on the present system's strengths and weaknesses. Notably, the focus is primarily on waste collection and transportation, with an annual production of 74,000 tons of organic compost. The Lahore Waste Management Company (LWMC) is critiqued for its limited inclusivity in decision-making processes and poor performance in governance features. It is observed that the formal waste management system lags behind the informal sector, which operates independently and often inconsistently with established waste management framework. The gap identified in the literature is that the insufficient integration and coordination between the formal waste management system represented by LWMC and the informal sector. While acknowledging the prominence of the informal sector in waste management activities, there is a clear lack of alignment with formal policies and objectives.

Batool and Ch (2009) presents a comprehensive analysis of waste generation, composition, collection, transportation, and disposal practices in their paper. The research evaluates the current waste management system, which collects only 60% of the total waste generated, resulting in significant uncollected waste scattered across various urban areas. Despite facing challenges such as inadequate infrastructure and regulatory shortcomings, the study proposes an improved waste management system using the IWM-2 model, aiming for 100% waste collection. However, the analysis overlooks specific deficiencies or barriers hindering the effective implementation of such a system, such as



financial constraints, institutional capacities, and public participation.

Sadeef et al. (2016) in their paper provided a thorough analysis aimed at informing the development of an integrated solid waste management (ISWM) plan for the city. The study reveals the significant organic and recyclable components within Lahore's waste stream, highlighting the economic opportunities presented by materials like glass, paper, and plastic. Moreover, the authors estimate substantial energy potentials from organic waste, indicating the feasibility of anaerobic digestion and refuse-derived fuel (RDF) technologies. The paper overlooked potential challenges in implementing such solutions, such as technological constraints, financial considerations, and social acceptance issues.

Iqbal et al. (2023) sheds light on the low priority given to the SWM sector by the Pakistani Government, with a focus on manual sweeping and waste collection rather than integrating treatment and disposal options. Through an analysis of SWM practices in eleven major cities of Pakistan using Waste-aware benchmarking indicators, the study identifies strengths and weaknesses in local municipalities and Waste Management Companies (WMCs). While efforts have been made to strengthen the sector, the current model falls short of meeting the targets of Nationally Determined Contributions (NDCs) and Sustainable Development Goals (SDGs). However, the paper fails to address specific challenges or barriers hindering the integration of waste treatment and disposal options into the SWM system, such as financial constraints, policy gaps, and institutional capacities. Addressing these gaps is crucial for developing a sustainable and efficient waste management regime in Pakistan, aligning with national and international sustainability goals.

The World Bank (n.d.) has reported that world's annual solid waste generation is 2.01 billion tones. Around the world, an average of 0.74Kg waste is produced per person per day with the range being from 0.11 to 4.54 kg. While high income societies comprise just 16 percent of the world's population, they generate about 34 percent world's waste (683 million tons). Low-income countries are collecting about 48 percent of urban waste, but the figure drastically drops to 26 percent in rural areas. Income levels have a positive correlation with waste generation which decreases initially at low-income levels but then increases at a rapid rate compared to that of high-income levels. Solid waste's aggregate quantity in low-income countries is predicted to increase by more than three times by 2050. Local bodies in HICs spend less than 10 percent of their budgets on collection, with a far greater proportion going to treatment and disposal of Municipal waste management (Kaza et al., 2018).

3. Research Methodology

An organizational view of the operational efficiency of LWMC has been taken employing a mixed method approach based on qualitative and quantitative data. Primary data have been collected through a structured questionnaire (**Annex-I**) using the Lickert scale besides posing open ended questions to 68 respondents comprising lower, middle and senior management levels of both office and field settings. Secondary sources have also been reviewed including journals, websites, books and official reports. Quantitative data have been analyzed using descriptive statistical technique while the qualitative data have been analyzed through content analysis technique manifested in a PEST analysis. T-Test regression analysis has been used to test the null hypothesis stating, "there is no difference between the operational models of Turkish and local contractors with regard to waste collection efficiency" and the alternate hypothesis stating, "there is a significant difference between the operational models of the Turkish and local contractors with regard to waste collection efficiency."

3.1. Research Question:

What are the gaps in the existing operational model of LWMC responsible for its sub-optimal performance and how these can be minimized to achieve maximum solid waste removal in Lahore?

3.2. Organization of the Paper

The paper is divided into three distinct sections. The first section undertakes an institutional analysis of LWMC from the viewpoint of "5 Ms i.e. men, material, methods, money and machines." The second section analyses the two different operational models (methods) adopted by LWMC to perform its operations in pre- and post-2018 scenario namely outsourcing model to foreign firms and hybrid model (a mix of self-operations and outsourcing to local contractors) to learn whether the difference between the two is significant or not with regard to waste collection efficiency. This section also undertakes an operational gap analysis of the existing operational model of LWMC from the viewpoint of its employees. The third section comprises content analysis of the qualitative data manifested in a PEST analysis categorizing responses under political, economic, social and technical aspects.

3.3. Institutional Analysis of LWMC

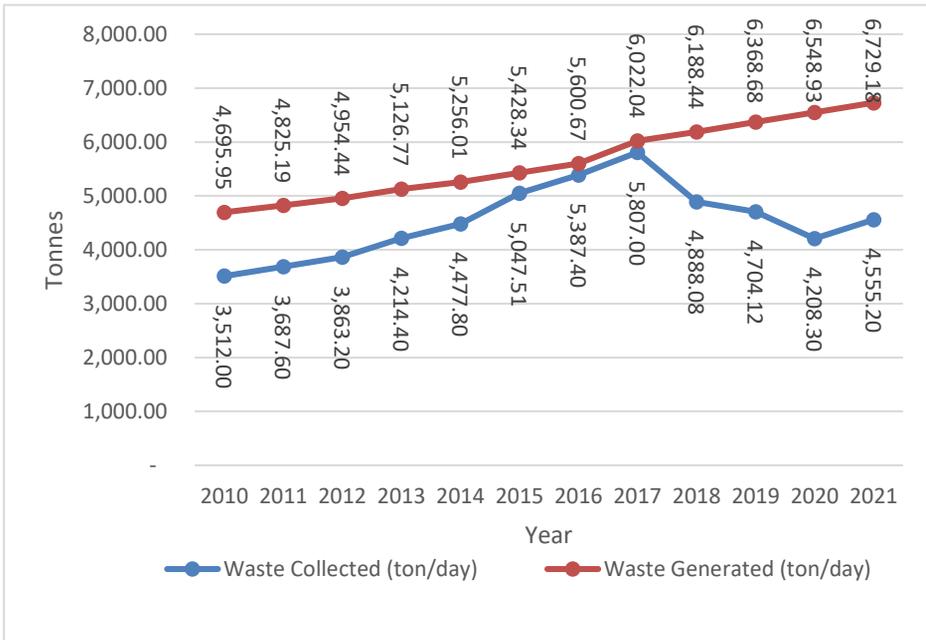
An institutional analysis of LWMC was undertaken based on "5 Ms i.e. men, material, methods, money and machines." This section elaborates upon four of these component: the material (solid waste), money (financial management), men (human resource) and machines (equipment and vehicles) The methods (operational models of solid waste collection) are described under Section II.



3.4. Solid Waste Generation and Collection

The population of Lahore is projected to rise to 12.78 million in 2022 from 11.1 million in 2017; it is growing at a rate of 3% annually (Bureau of Statistics, 2017). With the increase in population, the waste generation also increases thereby requiring continuous improvement of capacity of LWMC to keep the efficiency of waste collection to the highest possible level. In 2010 when LWMC took over from SWMD, the daily solid waste collection was 3512 tons against a waste generation of 4695 tons i.e. 74% of the total waste produced (LWMC, n.d.). LWMC developed its system of solid waste collection with the help of consulting firm M/s ISTAC and showed continuous improvement in waste collection efficiency. From 2010 to 2017 a steady increase in waste collection was witnessed. As opposed to 75% of the total waste collected in 2010, the total waste collected in the metropolitan rose to 96%, reaching the highest possible efficiency level.

Figure 2.
Waste collected/generated (ton/day)

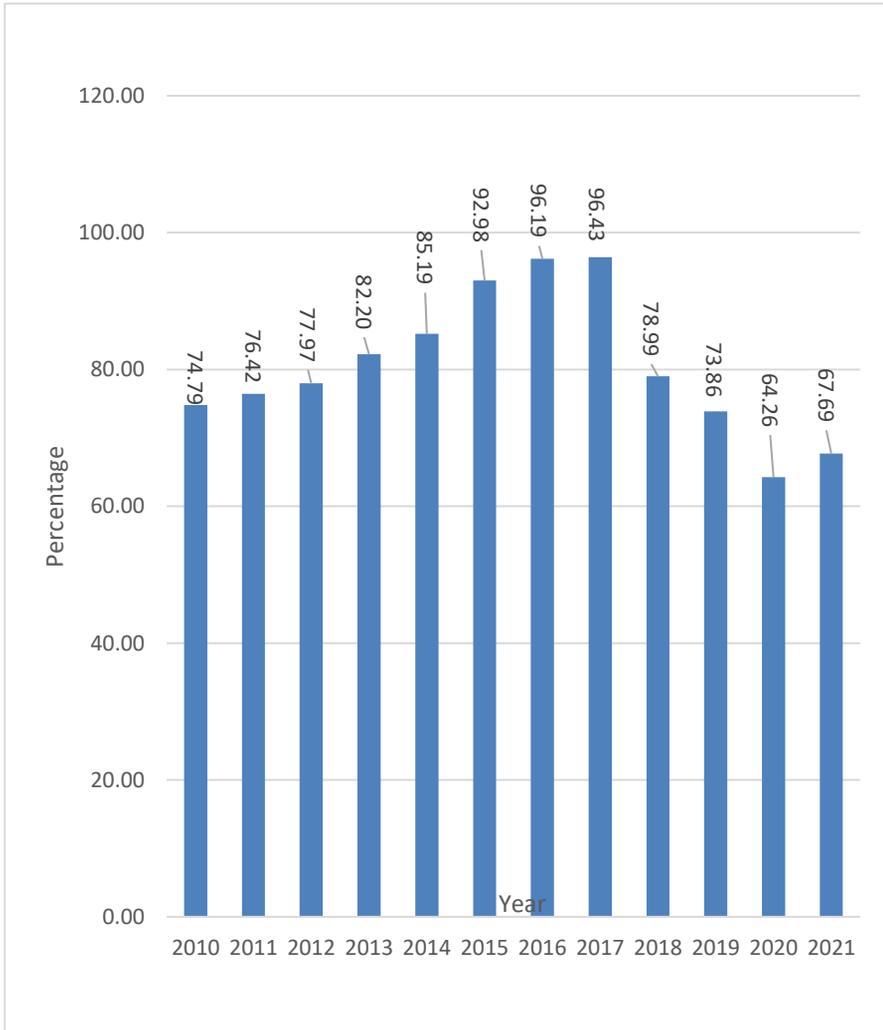


Note: Lahore Waste Management Company, (n.d)

However, in the post-2018 scenario, waste collection started witnessing a steep decline and the gap between waste collected and waste generated started increasing continuously. By the end of 2021, LWMC has been collecting only

67.69% of the total waste generated on a daily basis reaching a level lower than where it was 10 years ago. It may be noted that the data of solid waste generated and collected is based on formula of 0.74kg waste produced per person multiplied with population (The World Bank, n.d.). This necessitates making realistic calculations of solid waste production through primary data for informed decisions making.

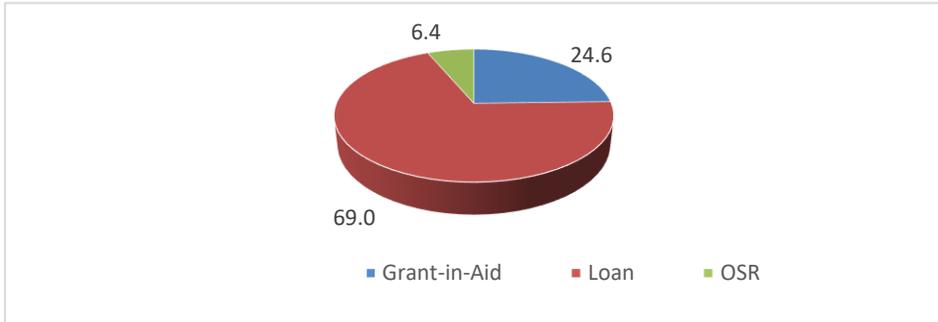
Figure 3.
Daily Percentage Waste Collection Vs Generation



Note: Lahore Waste Management Company, (n.d.)



Figure 4.
Distribution of Loans

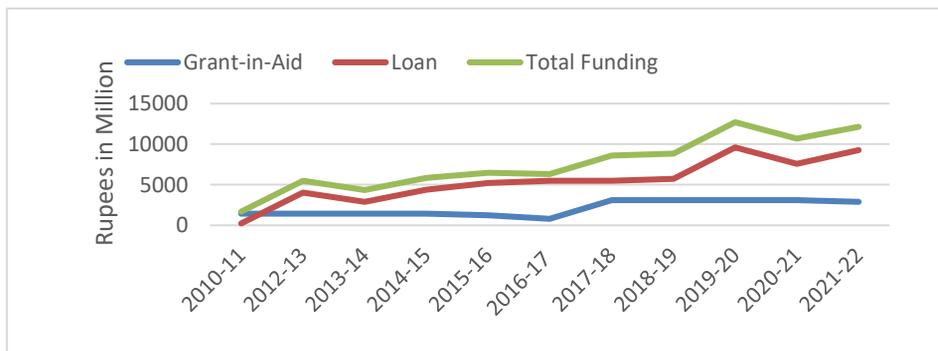


Note: Lahore Waste Management Company, (n.d)

3.5. Financial Management of LWMC

Since its establishment in 2010, LWMC has relied heavily on loans advanced by the provincial government under agreements signed and updated every year. By way of annual averages, 69% funding is received in the form of loans while 25% is budgeted as grant in aid. LWMC has been expected to raise its Own Source Revenues (OSRs) to increase its repayment capacity. However, the same has never happened. LWMC started operations back in 2011 with a loan amount of Rs. 4030 million which has kept increasing every year, reaching the highest level of Rs. 12.8 billion at the close of Financial Year 2021-22 registering a percentage increase of 219%. This puts a serious question mark on the sustainability of the organization in the long run.

Figure 5.
Budgetary Allocations to LWMC Over the Years

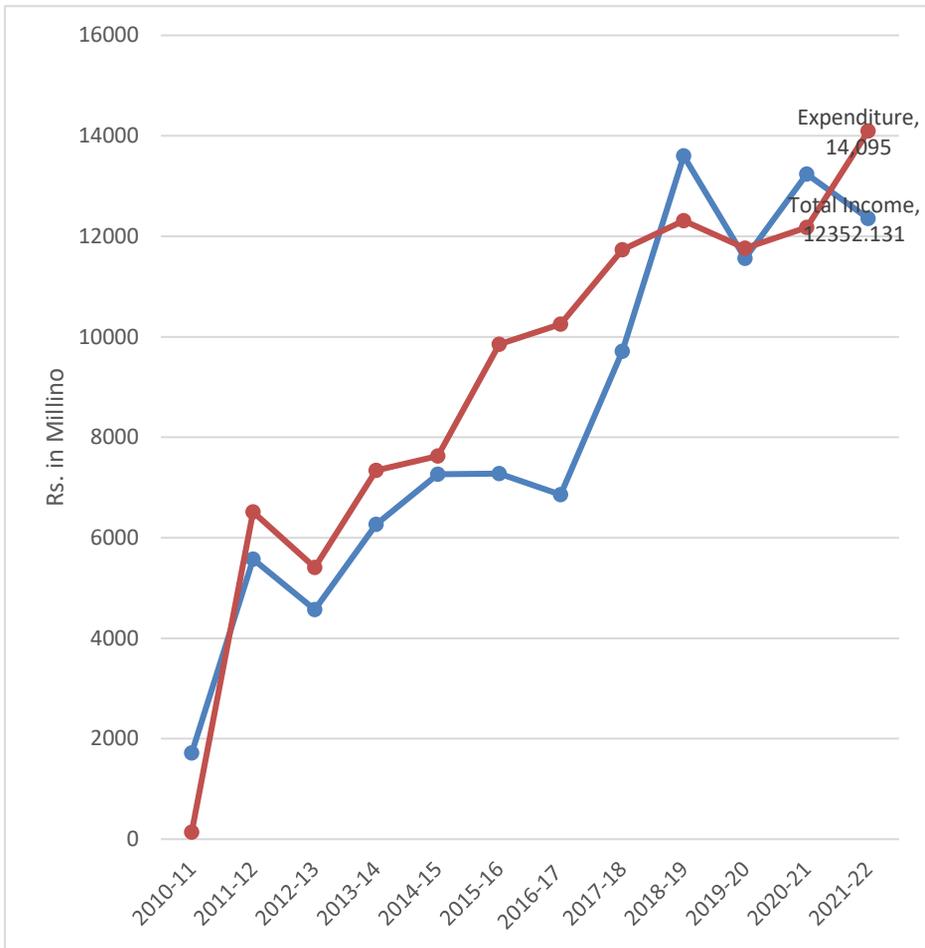


Note: Lahore Waste Management Company, (n.d)

LWMC’s expenditure has also been showing an exponential rise over the last 10

years. The company has been spending over and above its budgetary allocations except from financial years 2018-19 onwards when the provincial government decided to curtail costs by doing away with the contracts executed with the foreign firms on exorbitant rates of US\$20 per tons of waste. In order to keep pace with the increasing solid waste collection targets every year, LWMC cannot rely on loans alone. It needs to seriously think about generating its OSRs with innovative approaches. Otherwise, continuous debt accumulation will push the company to default, if no re-payment strategy is evolved.

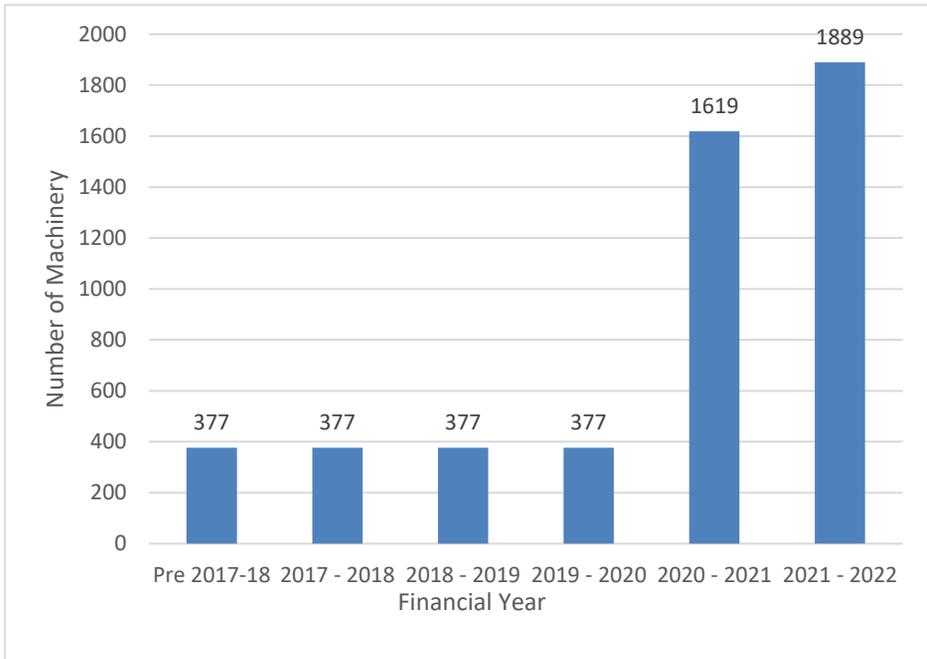
Figure 6.
Expenditure vs Income



Note: Lahore Waste Management Company, (n.d)



Figure 7.
Total Machinery

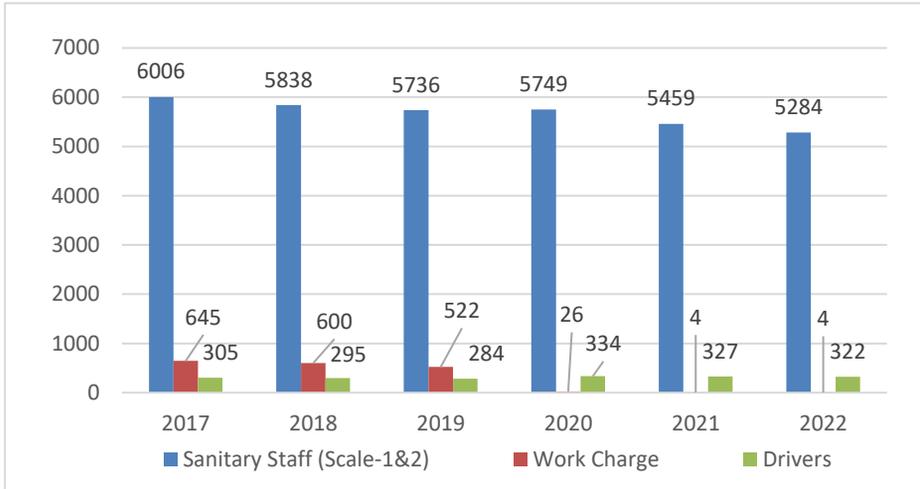


Note: Lahore Waste Management Company, (n.d)

3.6. Machinery and Equipment

By 2017-18, LWMC had realized its shortage of machinery. At the time, the total machinery count available was only 377. A well chalked out procurement plan commensurate with the field requirements was implemented by LWMC increasing the number of machinery substantially. The number was increased from 377 to 1619 by FY 2020-21 reaching 1889 in FY 2021-22. Hence, LWMC tried to address the gaps in machinery considerably. However, in order to operate this machinery and keep it functional the availability of skilled workforce and availability of professional repair and maintenance service is a must. It has been noted that out of 1889 machines, 499 were not in use. 184 were under fabrication while another 315 were condemned and needed to be auctioned out (LWMC, n.d). Similarly, a shortage of skilled HR to operate this machinery posed a threat to the operational efficiency of organization. Whatever machinery and vehicles were purchased in 2012 by Turkish firms had outlived their life till 2020 and, therefore, LWMC planned to enter into a massive procurement of new fleet. At the time of data collection, 80% of the procurement of 933 equipment and vehicles had been completed and vehicles had been added to the LWMC fleet.

Figure 8.
Field Sanitary and Driving Staff



Note: Lahore Waste Management Company, (n.d)

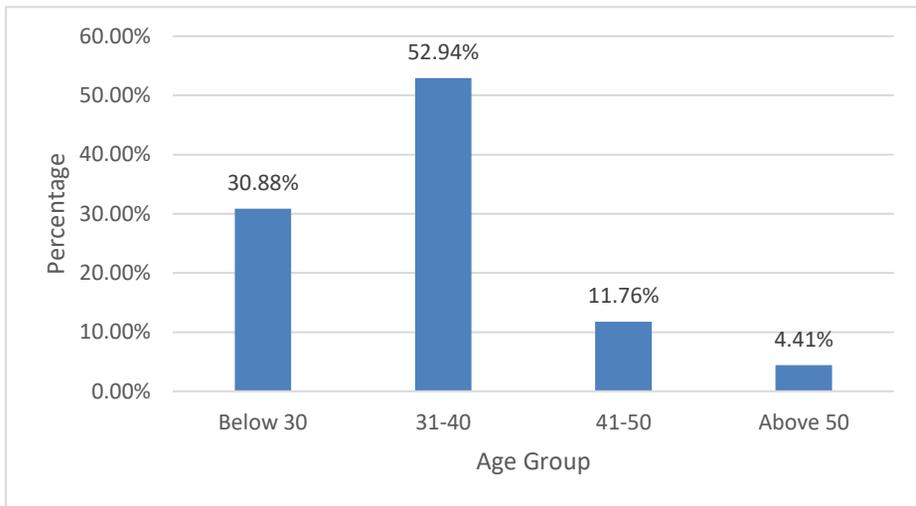
3.7. Human Resource Position

At LWMC's head office, 33 of 160 positions are vacant. At the field level, 18,738 employees of various categories primarily the sanitary staff - both contractual and daily wagers - are working. When the Turkish firms stopped functioning, they disengaged their sanitary staff numbering 11842. However, LWMC rehired this labour at the direction of the provincial government. To keep the vehicles running and waste collection operations continuing, sanitary staff and drivers are most critical. The data reflects that sanitary staff in post 2018 scenario remained consistently available above the threshold of 5000 on an average. However, fluctuations in work charge and drivers are seen. In 2017 305 drivers were in place, increasing to 322 by 2022. The number of work-charge employees kept on reducing from 645 in 2017 to merely 02 in 2022.

3.8. Significance of Operational Models on Waste Collection

LWMC has a well-defined hierarchy. Employees are clearly divided into top, middle and lower management cadres. After pre-testing, a structured questionnaire was circulated to 68 office and field management level officers to learn how they viewed both the operational models vis-à-vis waste collection efficiency of LWMC. All of them responded through email as well as through a WhatsApp facility. All questionnaires were accepted for analyses as none was found to be incorrectly filled. A majority (53%) belonged to the age bracket of 31-40 years; 79% of them were male while the remaining 21% were females.

Figure 9.
Distribution of Respondents by Age

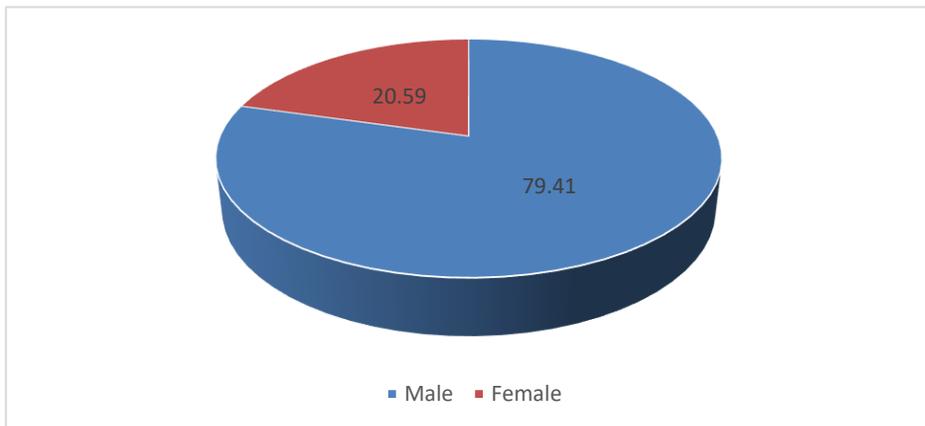


Note: Lahore Waste Management Company, (n.d)

3.9. LWMC's Performance under Different Operational Models

From 2011 to 2018, Turkish firms performed the operations of sweeping, washing, solid waste collection, storage, transportation and disposal.

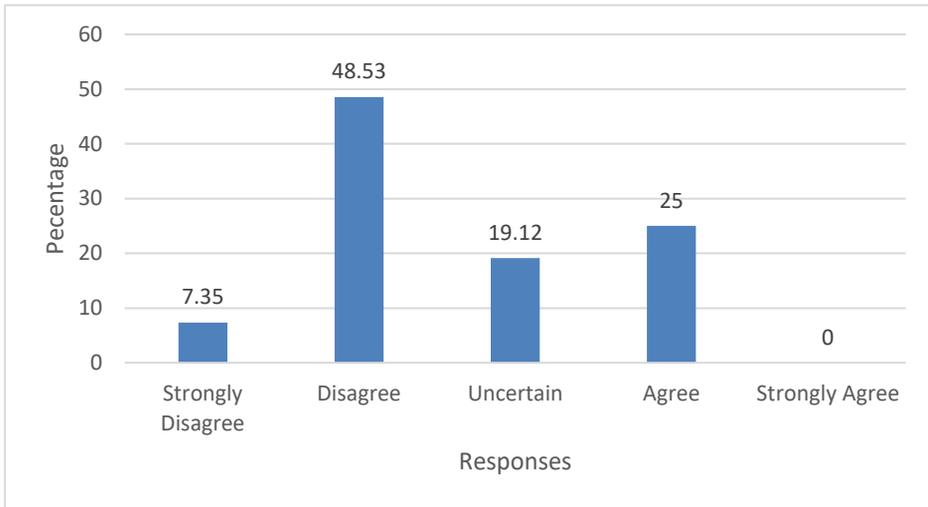
Figure 10.
Respondents by Gender



Note: Lahore Waste Management Company, (n.d)

Figure 11.

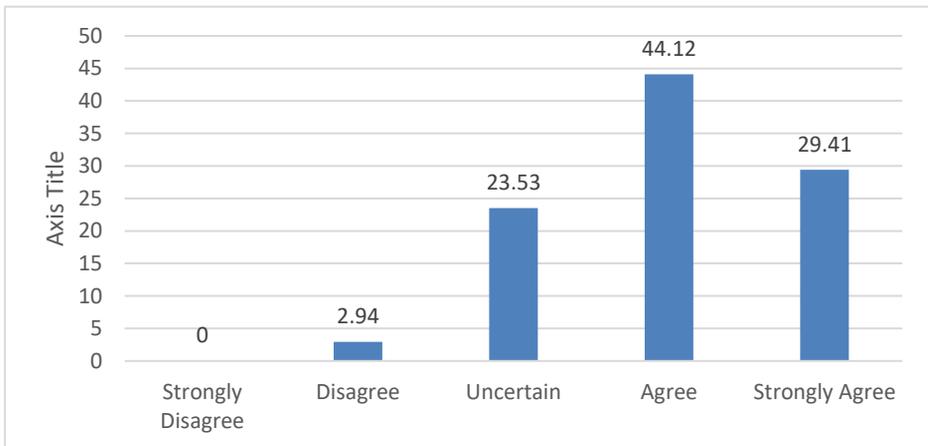
Q. 1: LWMC' Performance was Better under Out-sourcing to Turkish Firms



Note: Lahore Waste Management Company, (n.d)

Figure 12.

Q.2: LWMC's Performance under Hybrid Model was better



Note: Lahore Waste Management Company, (n.d)

It has been noted earlier that in the 2011-18 period solid waste collection showed an exponential increase. However, the post-2018 period is known for declining solid waste collection. Employees were asked to rate their responses separately that whether LWMC performed better under the outsourcing regime managed by the Turkish firms or under the hybrid operational model wherein primary



waste collection function was done by the LWMC's own workforce and the secondary waste collection was being done by the locally hired firms. Varying opinions were recorded: 48.53% disagreed with the statement that LWMC performed better under Turkish firms. While 19.12% were uncertain about the statement, just 25% of the respondents agreed with the statement. Similarly, on the question that LWMC's performance was better under its own hybrid model a vast majority (73.5%) expressed positive views (agreed = 44.12%, strongly agreed 29.41%). While 23.53% of the respondents were uncertain in making any statement, a mere 2.94% of the respondents opted to disagree with the statement that LWMC was performing well under the hybrid model. In order to know whether the mean scores were significantly different or not a T-test was calculated which is represented as below:

The results indicate mean value of 2.616 for operations by Turkish Firms, meaning thereby that on the whole the respondents disagreed with the statement that LWMC's performance was better under Turkish firms. The mean value for locally hired firms is 4.000 which means employees agree with the statement that LWMC was performing better under the existing model. However, the P-value (Sign, 2-tailed) is .000 which shows both the variables have been significantly different from each other. It means performance of LWMC under Turkish and locally hired firms was affected differently. The above results lead to rejection of the null hypothesis which says there was no difference between the operational models of Turkish and locally hired firms. The alternate hypothesis is, therefore, accepted, meaning thereby that the operational models adopted by both the firms differed significantly causing different quantity of solid waste collected. Turkish firms appear to be more efficient in solid waste collection.

Table 1.
LWMC's Operational Performance under Different Operational Models

	Mean	SD	Std. Error mean	95% Confidence Interval of the Difference		t	df	Sign (2 Tailed)
				Lower	Upper			
1) Outsourcing to Turkish Firms (Mean=2.6176)	-1.38	1.39	.16	-1.71	-1.04	-8.18	67	.00
2) Hybrid Model (Mean=4.0000)								

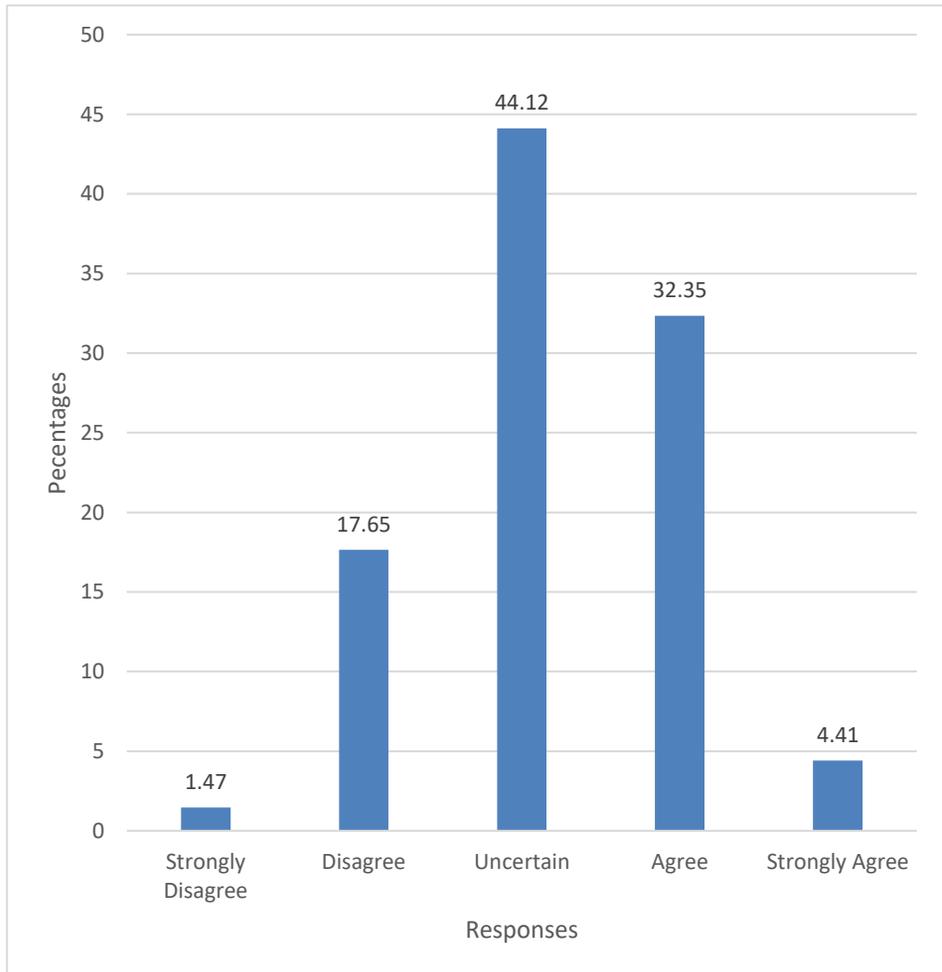
Note: SD= standard deviation, t= t test, df= degrees for freedom

3.10. Public Feedback about LWMC's performance

Respondents were asked to express their personal opinion about public feedback i.e. what were their views on public opinions regarding operational performance of LWMC in pre- and post-2018 periods. In this regard, 44.12% were uncertain about public's feedback; 32.35% agreed and another 4.41% strongly agreed that public's feedback was better under the Turkish firms' outsourcing regime. Just 17.65% disagreed with the statement. Just 1.47% strongly disagreed with the statement.

Figure 13.

Q.3: Public Feedback was Better under Out-Sourcing to Foreign Firms

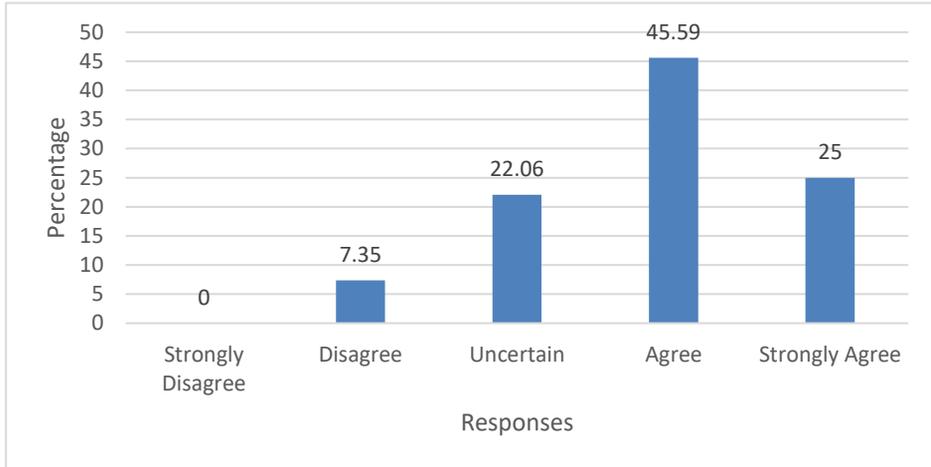


Note: Lahore Waste Management Company, (n.d)



Figure 14.

Q.4: Public Feedback was better under Hybrid Model



Note: Lahore Waste Management Company, (n.d)

Employees were also asked to rate their responses regarding the public feedback on existing operational model as per their own personal opinion. In order to ascertain how significantly the public feedback differed for two operational models in pre- and post-2018 scenario t-test was calculated. Results are represented as below:

Table 2.

Public Feedback on Both the Models

	Mean	SD	Std. Error mean	95% Confidence Interval of the Difference		t	df	Sign (2 Tailed)
				Lower	Upper			
3) Public Feedback in pre-2018 regime (Mean=3.2059)	-.67	1.37	.16	-1.00	-.34	-4.05	67	.00
4) Public Feedback in pre-2018 regime (Mean=3.8824)								

Note: SD= standard deviation, t= t test, df= degrees for freedom

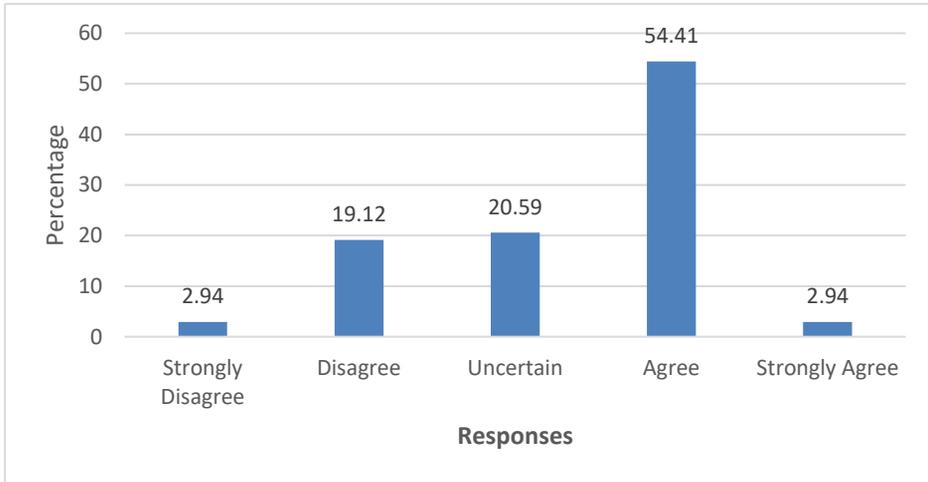
The P-value of T-Test shows public feedback on both the operational models differed significantly.

3.11. Changing operational models led to organizational confusion

In order to understand the significance of operational models and their relationship with operational efficiency of LWMC, the employees were asked whether they felt that change in operational models has led to confusion? In response, majority (54%) agreed with the statement. However, 20.59% were neutral and another 19.12% disagreed.

Figure 15.

Q.5: Changing Operational Models Created Confusion



Note: Lahore Waste Management Company, (n.d)

3.12. Employee's Motivation under Out-sourcing Model

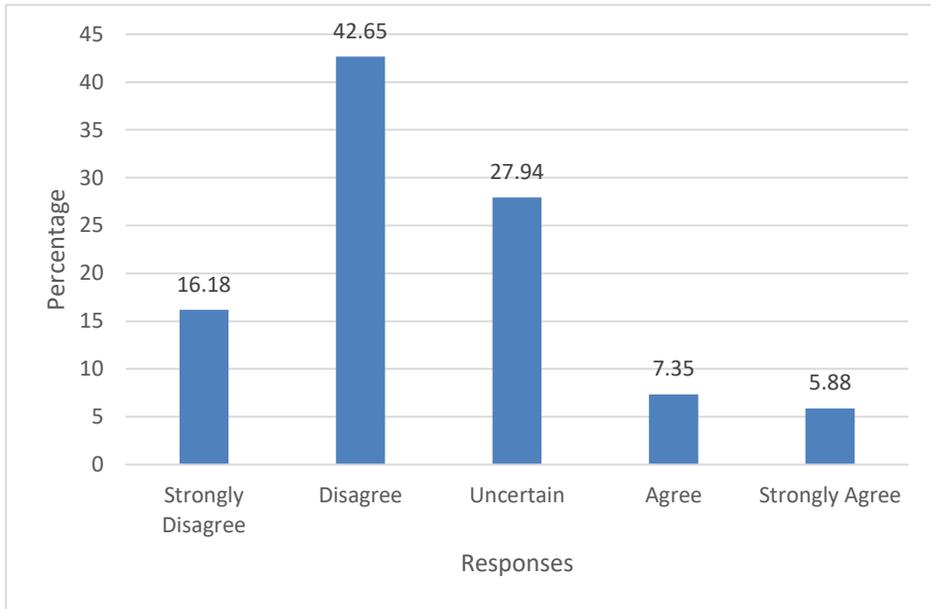
When asked whether the motivation of employees was higher under the pre-2018 period, 58.83% of the respondents disagreed or strongly disagreed with the statement. While 27.94% were uncertain or neutral in response, a small number of 13.23% agreed or strongly agreed with the statement.

This leads to inference that despite higher waste collection efficiency under the outsourcing to Turkish firms, the motivation level of employees was on the lower side. This could be one of the reasons that why employees did not view Turkish operational model to be the better one despite its higher performance in terms of daily solid waste collected. The reasons for lower motivation level need to be explored in further research. Relationship of factors such as the findings of forensic audit of LWMC, court cases and changing political priorities can also be studied in this regard.



Figure 16.

Q.6: Employees Motivation was Higher Under Outsourcing to Turkish Firms



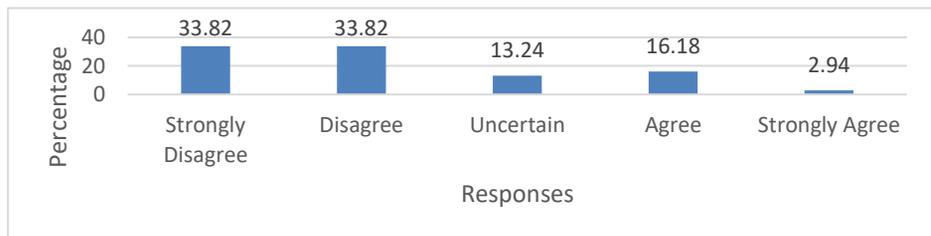
Note: Lahore Waste Management Company, (n.d)

3.13. Gap Analysis of the Existing Operational Model

In order to understand the operational gaps from the viewpoint of respondents, further questions related to different SWM operations and institutional functioning were asked. The responses are described as under:

Figure 17.

Q.7: LWMC has Shortage of Machinery and Equipment



Note: Lahore Waste Management Company, (n.d)

3.13.1. Shortage of Sufficient Functional Equipment & Machinery for Waste Lifting

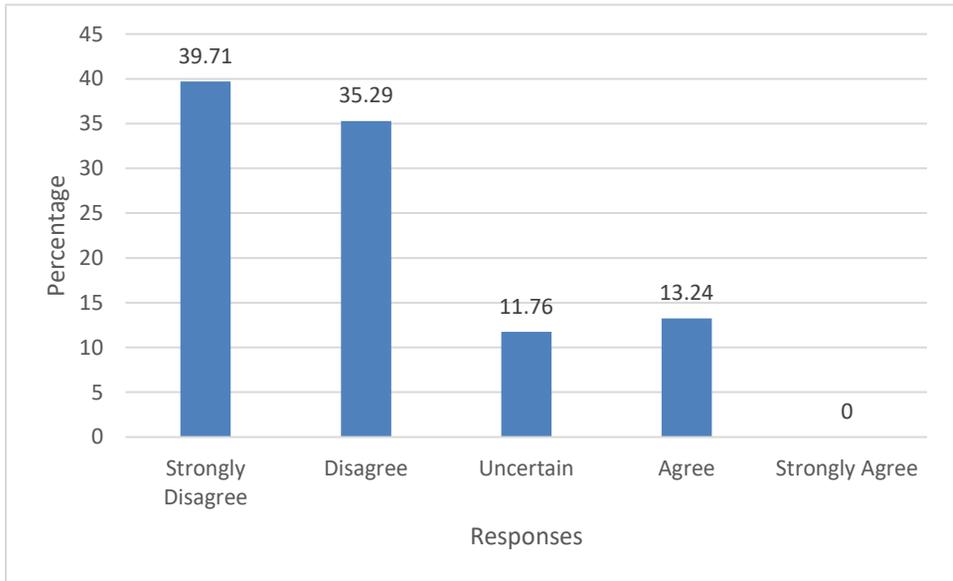
67.64% respondents disagreed to strongly disagreed with the statement that there was a shortage of machinery or equipment. However, 19.12% agreed with shortage of machinery, while 13.24% were uncertain or neutral about the statement.

3.13.2. Shortage of Sufficient Sanitary Staff for Waste Lifting

75% of the respondents disagreed or strongly disagreed with the statement that LWMC had a deficiency in sanitary staff availability. Still 11.76% were neutral or uncertain and 13.24% felt LWMC needed more sanitary staff to perform operations of LWMC effectively.

Figure 18.

Q.8: LWMC is Having Shortage of Sufficent Sanitary Staff



Note: Lahore Waste Management Company, (n.d)

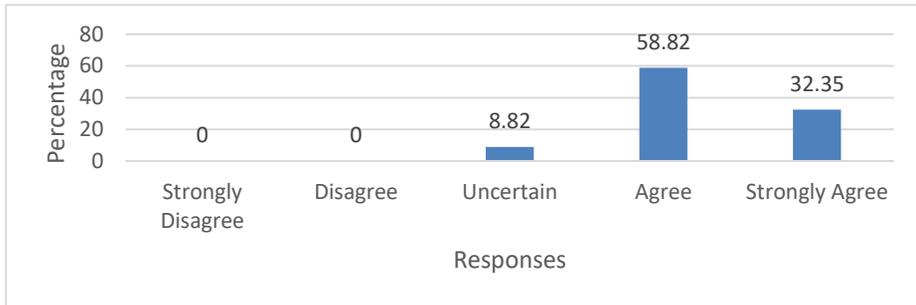
3.14. Dutifulness and Responsiveness of LWMC's Sanitary Workers

When asked whether sanitary staff of LWMC was dutiful and responsive in the performance of solid waste removal operations, 58.82% of the respondents said so. Another 32.35% of the respondents strongly agreed to the same statement. Only 8.82% were uncertain about the statement.



Figure 19.

Q.9: LWMC's Sanitary Staff is Dutifull and Responsive



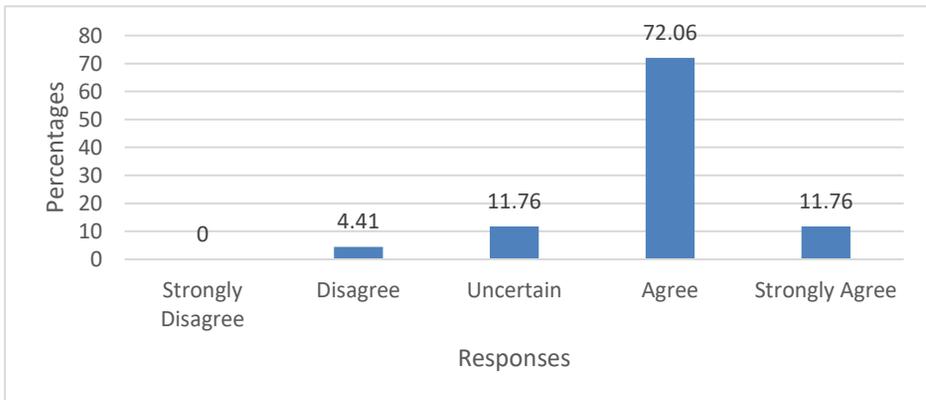
Note: Lahore Waste Management Company, (n.d)

3.15. Sanitary Supervisor's Performance

A massive 83.82% of the respondents agreed or strongly agreed with the statement that sanitary supervisors of LWMC were performing their duty satisfactorily. Although 11.76% were uncertain, a small number (4.41%) did not endorse the statement that sanitary supervisors were performing their duty satisfactorily.

Figure 20.

Q. 10: Sanitary Supervisors Perform Duty Satisfactorily



Note: Lahore Waste Management Company, (n.d)

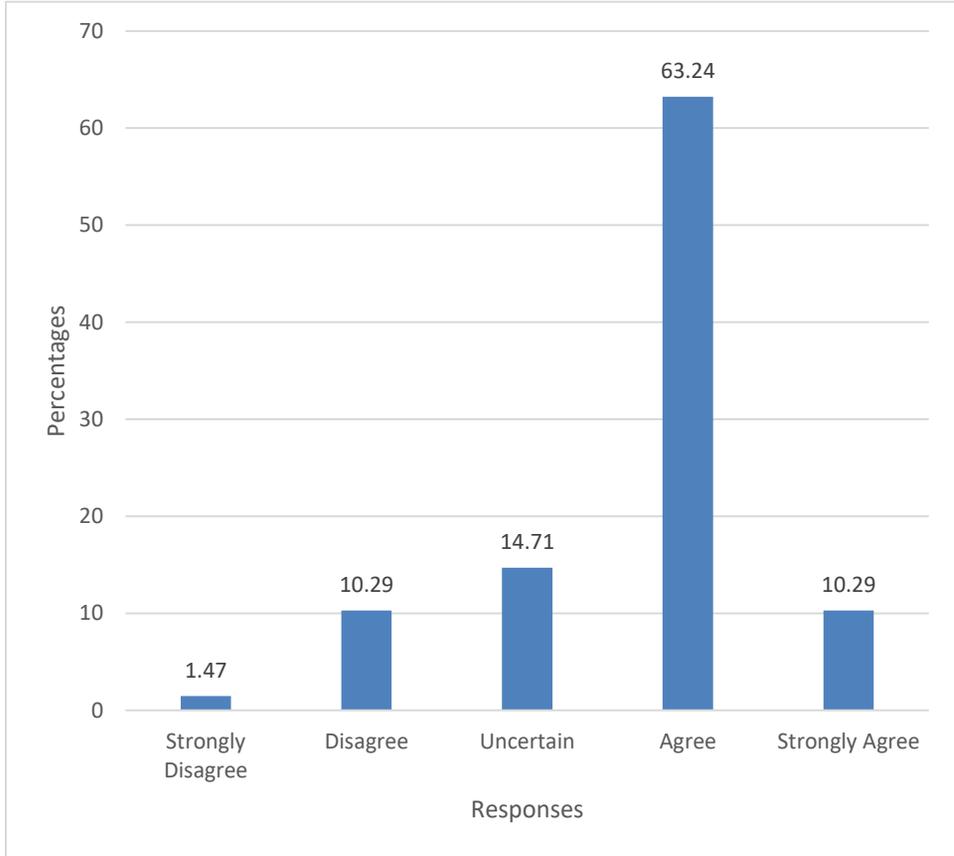
3.16. Professionalism of LWMC's Workshops:

LWMC has five workshops namely Outfall North, Outfall South, Children Hospital, Thokar Niaz Baig and Lakhodair. When asked whether these workshops were working professionally, 63.24% agreed and 10.29% strongly

agreed. While 14.71% were uncertain or neutral to this query, 10.29% disagreed with the statement, meaning that in their opinion LWMC's workshops were not professionally managed. A small (1.47%) strongly disagreed with the statement.

Figure 21.

Q.11: LWMC's Workshops are Professionally Well Managed



Note: Lahore Waste Management Company, (n.d)

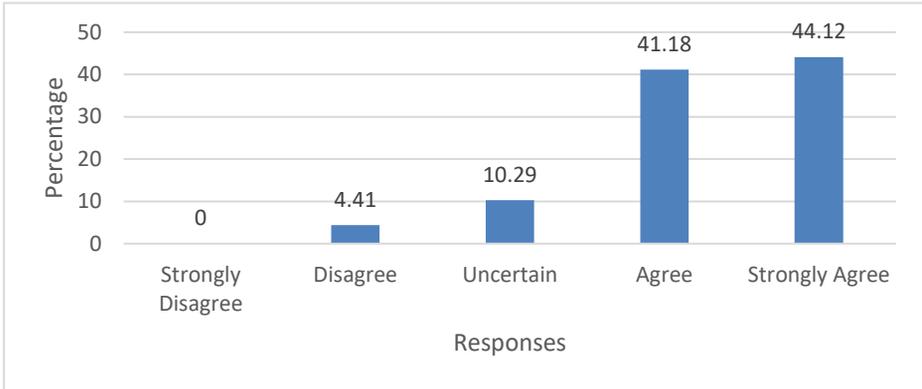
3.17. LWMC's Success in Increasing Citizen's Participation

Research studies have indicated that cleanliness or SWM of localities is not possible without due participation of citizens (Batool & Chaudhry, 2009). Accordingly, the question was asked whether the citizen's participation in cleanliness of the city had increased. In this regard, 85.3% agreed or strongly agreed with the statement. While 10.29% were uncertain and a small number (4.41%) disagreed.



Figure 22.

Q.12: Citizen's Participation in Cleanliness has Increased



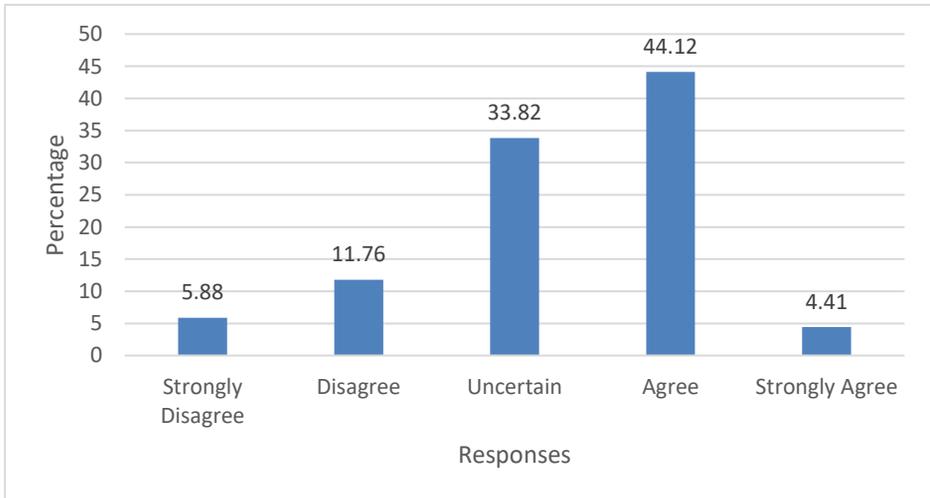
Note: Lahore Waste Management Company, (n.d)

3.18. Independence in Decision Making

More than half of the employees (51.46%) were uncertain, disagreed or strongly disagreed with the statement that LWMC was autonomous and independent in its decision making. On the other had a good 48.53% respondents agreed that LWMC had independence and autonomy in its decision making.

Figure 23.

Q.13: LWMC's Autonomy and Independence in Decision Making



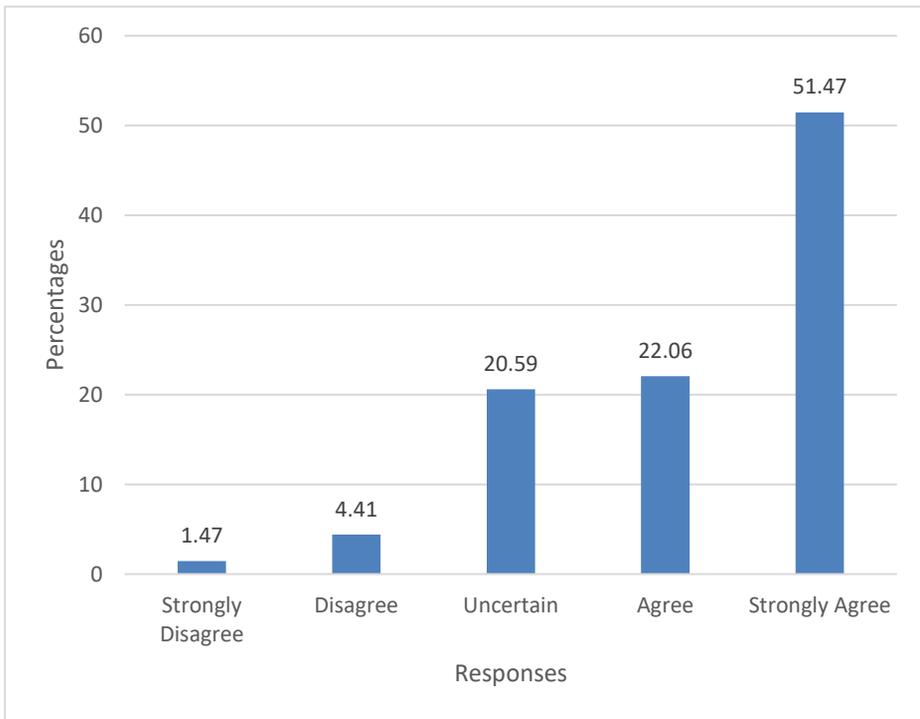
Note: Lahore Waste Management Company, (n.d)

3.19. Fee Collection from Public

As LWMC has been heavily relying on loans from the Provincial Government which additionally provided grant-in-aid, a question was asked whether they thought a fee should be collected against the services rendered in order to make LWMC self-sustainable. A vast majority (73.53%) endorsed the statement. While 20.59% were uncertain, a small number (4.41%, 1.47%) disagreed or strongly disagreed with the idea of fee collection from general public.

Figure 24.

Q.14: LWMC Should Collect Service Charges



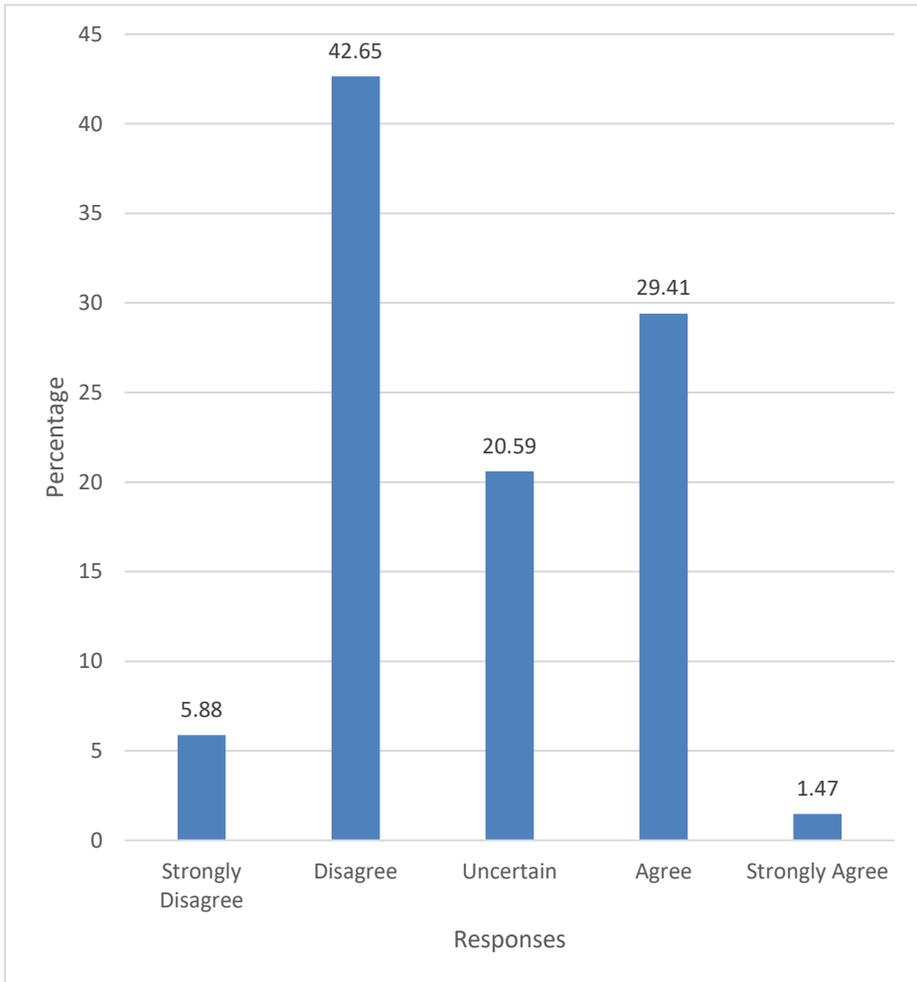
Note: Lahore Waste Management Company, (n.d)

3.20. Recruitment of More Field Staff

Less than half of the respondents (48.45%) disagreed with the statement that LWMC was in need of recruiting more staff. In their opinion LWMC possessed sufficient field staff to perform the field operations. However, 30.87% of the respondents either agreed or strongly agreed with recruiting more field level employees to perform field operations of LWMC.

Figure 25.

Q.15: More Sanitary Staff is to be Recruited at LWMC



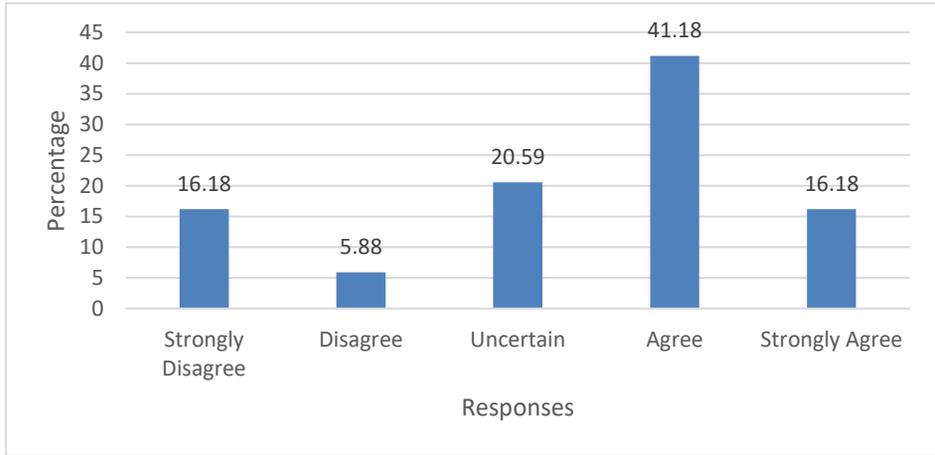
Note: Lahore Waste Management Company, (n.d)

3.21. Purchase of More Equipment & Machinery

When asked about the need to purchase more equipment and machinery for LWMC to enhance effectiveness of field operations 57.36% agreed to strongly agreed. While 22.06% of the respondents disagreed or strongly disagreed with the proposal and believed LWMC was not in need of procuring more equipment or machinery, 20.59% of the respondents were neutral or uncertain about the statement asked.

Figure 26.

Q.16: More Machinery & Equipment is to be Purchased for LWMC



Note: Lahore Waste Management Company, (n.d)

3.22. Synthesis

From the above operational gap analysis following results can be deduced

- It appears that LWMC is not facing any significant resource constraint in terms of men or machinery. However, there are issues with materials, methods and money aspects.
- LWMC is collecting much less waste than optimal levels.
- It is also lacking in autonomy in decision making.
- It means LWMC's decision to draw an efficient operational model is subject to changing political priorities as happened in pre- and post 2018 scenarios. This poses a serious threat to the operational efficiency of LWMC.
- An ISWM model is purely a technical matter requiring professional dedication and commitment which should be dealt with on technical parameters. A respondent mentioned that, "Solid waste management is purely a technical matter but this is unfortunate that we are limited to only solid waste collection ignoring other important aspects of integrated solid waste management being followed in the developed world."
- LWMC's operations have become limited to mere solid waste collection and disposal landfill sites; these need to be broadened to bring the situation at par with international requirements of ISWM.

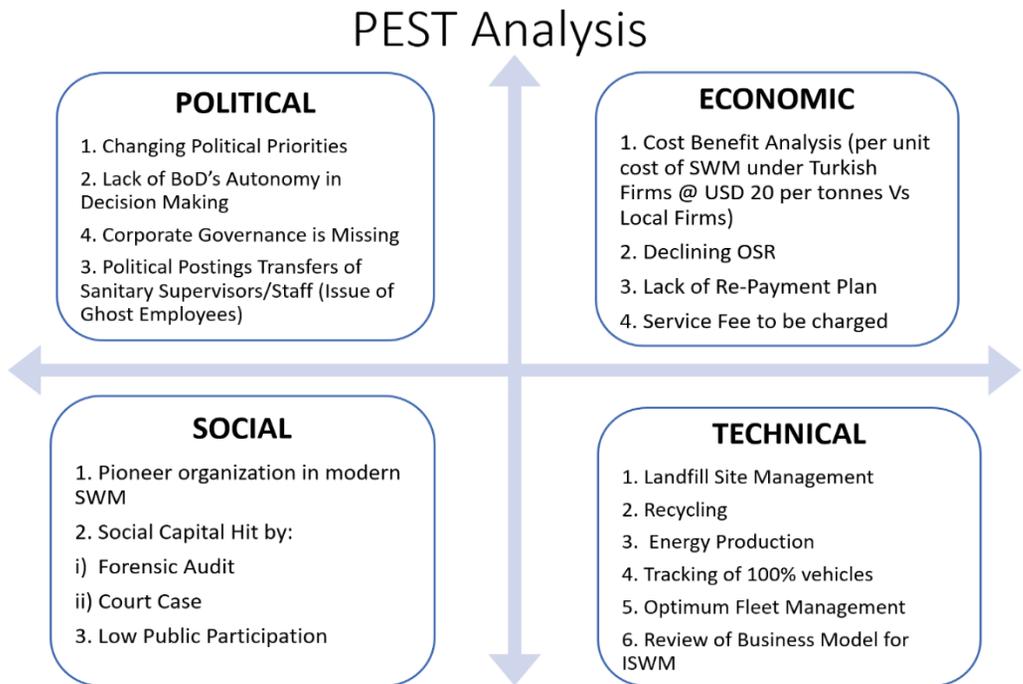
- A considerable number of respondents were of the view that workshops should be made more professional with increased use of technology in fleet management as a respondent commented. *“In this digital age LWMC needs to grow on modern lines.”* Employees of LWMC also felt the company should be enabled to levy service fee to become financially stable.

3.23. PEST Analysis

The qualitative responses of respondents have been summarised in this PEST Analysis under four distinct heads: Political, Economic, Social and Technical:

Figure 27.

PEST Analysis



3.24. Issues and Challenges

From the preceding analysis, the following issues and challenges come to the fore:

3.24.1. Lack of an Integrated Solid Waste Management Model

LWMC is more focused on solid waste collection, storage and disposal. International best practices requiring upgradation of LWMC's operational

model including recycling, reuse, energy production, waste minimization and waste prevention are yet to be adopted.

3.24.2. Lack of Corporate Governance in BoD

LWMC is a company but corporate governance practices are missing. Its Board of Directors is lacking in independent directors having relevant experience of SWM. The company does not have any ISWM strategy approved and steered by the BoD.

3.24.3. Lack of Financial Stability

A majority (69%) of the company's finances comprise provincial loans making it a highly unsustainable financial entity. The company does not have a stable revenue generation or repayment plan, let alone a robust one.

3.24.4. Lack of Modern Digital Technology

Nearly 30% of the SWM fleet of vehicles lacks a tracking system. Fuel consumption versus waste collection is not regularly monitored against any set parameters. Field workshops do not have a uniform system of operations and vary in degree of professionalism.

3.24.5. Lack of Reliable Data on Solid Waste

The fact that reliable data is a sine qua non of informed decision-making cannot be overemphasized. LWMC has never undertaken any measures to have a town-wise estimation of solid waste generation through primary data collection. Its figures are arrived at simply by multiplying the population by the assumed figure of 0.74kg waste produced per person. This is certainly not the way to reach an informed decision or learn what exactly the amount of waste produced in Lahore is.

4. Conclusion

The evaluation of the Lahore Waste Management Company's (LWMC) operations presented in this study unveils a complex interplay between operational models, institutional frameworks, and overall performance in achieving efficient solid waste management (SWM) for the metropolitan city of Lahore. Through a mixed-method approach, combining quantitative data analysis and qualitative insights from key stakeholders within the organization, this research provides a holistic assessment of LWMC's strengths, weaknesses, and areas for improvement. One of the central findings highlights the significant impact of operational model adopted for SWM, and LWMC on its waste collection efficiency. The data reveals that the outsourcing model implemented through Turkish firms from 2011 to 2018 resulted in a substantial increase in solid waste collection, peaking at 96% of the total waste generated in 2017. However, the abrupt termination of these contracts in 2018 and the subsequent adoption of a hybrid model involving locally hired contractors led to a steep



decline in waste collection efficiency, plummeting to a mere 67% by the end of 2021 (LWMC, *n.d.*). LWMC lacks an ISWM approach operating even at the least preferred level of waste collection and disposal, let alone the most preferred options of reuse, recycling, energy production, waste reduction and prevention. The absence of corporate governance has denied LWMC attaining autonomy, independent decision making, financial sustainability, and technological advancement which are essential for achieving maximum operational efficiency in waste management. Compounding these challenges is the absence of reliable data on solid waste generation and collection in Lahore. LWMC has historically relied on a simplistic calculation based on population figures, failing to account for factors such as seasonal variations, geographical spread, and the nature of localities, hindering informed decision-making and effective monitoring of SWM operations.

The research findings underscore the multifaceted nature of the challenges faced by LWMC in achieving maximum operational efficiency and aligning with international standards of Integrated Solid Waste Management (ISWM). While the choice of operational model plays a significant role, addressing the underlying systemic issues and institutional constraints is crucial for LWMC's transformation and sustainable growth.

5. Recommendations

Based upon the analysis obtained from data presented in the preceding sections and keeping in view the issues and challenges besetting LWMC, the following set of recommendations and way forward is suggested for improving the operational efficiency of LWMC:

5.1. Integrated Solid Waste Management (ISWM)

An ISWM approach must be adopted by LWMC through a professionally developed business model. Aspects of recycling of waste, production of energy from solid waste, waste reduction and prevention should be an integral part of the business plan of LWMC. The company may build upon its previous experience of the composting project launched from 2006 to 2016 at the Mehmood Booti land fill site. Community involvement for waste minimization and waste prevention can be made possible with effective use of social media and public awareness campaigns to promote a responsive citizenry.

5.2. Institution of Corporate Governance at BoD

Instead of SECP, LWMC has been registered with the Registrar of Joint Stock Companies LWMC lacks in effective regulatory controls. The BoD of LWMC needs to fill this void by setting stringent key performance indicators. A visionary business plan in line with international best practices must be devised to lift the company from the least preferred to the most preferred aspects of

SWM at par with international standards.

5.3. Efficient Financial Planning

A well thought out own source revenue generation plan must be devised to decrease reliance on provincial loans. A phased repayment plan should be chalked out to make LWMC financially sustainable. Provision of technical assistance to other governments and agencies is a potential area which LWMC can tap in this regard. A Solid Waste Management Act is the need of time. Such legislation should enable LWMC in effective enforcement of municipal functions, imposition of penalties, power to levy taxes and user fees etc.

5.4. Use of Modern Digital Technology

A real time monitoring and evaluation system should be put in place. A MIS (management information system) for workshops, fleet management, HRM (human resource management) should be effectively deployed and utilized for increased transparency and efficiency. Adoption of user-fee payment applications and citizens' complaint and feedback handling systems, ideally through outsourcing to independent call centers, is the way forward.

5.5. Collection of Reliable Data on Solid Waste

LWMC needs to launch a project for a realistic recording of the town-wise solid waste generation and collection, ideally through primary data collection. The factors such as seasonal variations, geographical spread, nature of locality (e.g. industrial, residential etc.) should be given due consideration in these estimations. Such a database would help LWMC reach informed decision making besides effective monitoring of SWM operations.

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