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Governance of Solid Waste Management and Public Cleansing Services During a Disaster Crisis of Disease Outbreak in the State of Kedah

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ABSTRACT
Solid waste management and public cleaning play an important role in city sustainability, especially after the enactment of the Solid Waste Management and Public Cleaning Act 2007 (Act 672). However, during catastrophic crises such as epidemics, the management of these services faces various challenges that jeopardise the effectiveness of the operations. This study focuses on the tadbir urus management of residual pepejal and public cleaning in Negeri Kedah during the outbreak crisis. Qualitative methods were used through unstructured interviews with SWCorp Negeri Kedah, the local authorities (MBAS), and the concession company E-Idaman Sdn. Bhd. The study was also supported by a research question involving 700 respondents from 13 regions in Kedah with a response rate of 45.75%. Dapatan shows tadbir urus perkhidmatan is implemented collaboratively between the three parties through joint monitoring, strengthening of key performance indicators (KPIs), use of the ISPEMOS and SPKK monitoring systems, and the implementation of public awareness campaigns. A total of 81% of respondents expressed satisfaction with the services provided during the crisis period. However, around 14% to 15% of respondents were of the opinion that alignment and communication between stakeholders still needed to be improved. The main challenges identified included poor coordination between agencies, limited communication with the public, and shortages of human resources and logistics during the crisis. Respondents also suggested suggestions for improvement, including the use of smart technologies such as digital monitoring systems and smart sensors (57.7%), investment in waste management infrastructure (60.4%), and expansion of awareness campaigns to the public (59.2%). As a way forward, this study suggests the establishment of a new management model based on integrated digital monitoring systems and integration of Geographic Information System (GIS) technology. This approach is believed to improve the efficiency, effectiveness, and actionability of public waste management and cleanup services, especially in anticipating future crises.
Keywords: *governance, solid waste management, public cleansing, crisis, GIS*

INTRODUCTION

The management of residual waste and public cleaning has been an important aspect of city sustainability since the enactment of the Deed of Management of Residual Waste and Public Cleaning 2007 (Akta 672). During crises such as the COVID-19 pandemic, Kedah recorded a 30% increase in residuals, putting a strain on the existing system.

Key issues are known to include logistical limitations, lack of real-time data integration, coordination weaknesses between agencies, and the absence of a unified monitoring system. Previous studies have also found that unsystematic residual management contributes to public health risks and environmental pollution (Wilson, 2013; Poritosh Roy et al., 2021).

In this context, the use of Geographic Information Systems (GIS) is seen as improving management efficiency with real-time monitoring, optimisation of citation routes, and alignment of agency rents. The goal of this study is to create a management model that is more adaptable, transparent, and robust in order to meet the challenges posed by the Kedah crisis.

METHODOLOGY

The objective of this study is to find problems and difficulties in managing solid waste and public cleaning services during a disease outbreak.Data was collected through a qualitative research design using unstructured interviews, involving three main respondents: SWCorp Negeri Kedah, the concession company Environment Idaman Sdn. Bhd., and the Alor Setar City Council (MBAS). This study uses four main elements in the implementation of the framework, namely governance, actors, community

involvement, and conceptual framework. Service oversight by SWCorp Negeri Kedah is carried out in three main stages, namely before, during, and after implementation.

We chose three main respondents: SWCorp Negeri Kedah, the concession company Environment Idaman Sdn. Bhd., and the Alor Setar City Council (MBAS). These three organisations play important roles in the ecosystem of solid waste management and public cleaning services in the state of Kedah. As the regulatory body, SWCorp agency appointed under Act 672, is responsible for supervision, monitoring contract compliance, and reporting service performance. In contrast, E-Idaman is the primary implementing party responsible for field operations, such as public cleaning, transfer station management, and solid waste collection. As the local authority, MBAS is essential to planning, coordinating local operations, and acting as the main point of contact between SWCorp and the concessionaire and the community.

These three organisations were chosen because they cover every aspect of solid waste management governance, from local planning and community engagement (MBAS) to technical and operational implementation (E-Idaman) to regulatory and supervisory level (SWCorp). As a result, the data and information gathered from these three respondents enable the study to obtain a comprehensive picture of the problems, difficulties, and gaps in coordination that exist in the current management system, particularly when it comes to disease outbreaks and disaster crises.

Prior to implementation, oversight is conducted through the ISPEMOS and SPKK systems, alongside public awareness campaigns. During implementation, monitoring is carried out on concession holders to ensure services comply with guidelines and agreements. Monitoring mechanisms include the enforcement of Key Performance Indicators (KPIs) and complaint management through the SPKK system. Promotional activities such as waste segregation campaigns at the source and National Recycling Day were also carried out. After implementation, monitoring reports, inventory data verification, and daily reports are prepared to ensure the effectiveness of services. Overall, this study emphasises the importance of effective and systematic monitoring to ensure the effectiveness of solid waste management and public sanitation services in meeting community needs during disease outbreak crises.

RESULTS AND DISCUSSION

In this study, interviews and questionnaires were used complementarily to obtain more comprehensive and in-depth data related to the implementation of solid waste management and public sanitation during the disease outbreak crisis. Unstructured interviews allow researchers to obtain detailed perspectives, experiences, and explanations from key stakeholders, namely SWCorp Negeri Kedah, E-Idaman Sdn. Bhd., and the Alor Setar City Council (MBAS), regarding management issues, implementation challenges, and inter-agency coordination. Meanwhile, surveys were used to support and validate the findings of the interviews by collecting quantitative or semi-qualitative data related to perceptions, satisfaction levels, and the effectiveness of policy implementation from a broader range of respondents.

The relationship between these two methods allows for data triangulation, where information from interviews is used to refine items in the questionnaire, while the results of the questionnaire serve to confirm the interpretation of interview findings. This approach simultaneously enhances the accuracy, reliability, and validity of the study findings in formulating a more effective GIS based solid waste management model.

Regulation of Services by the Solid Waste and Public Cleansing Management Corporation (SWCorp)

The Solid Waste Management and Public Cleaning Corporation (SWCorp) of Kedah State oversees solid waste management and public cleaning services in three main stages: before, during, and after implementation. Before implementation, oversight is carried out through two main systems, namely ISPEMOS (Integrated Single Platform for Enforcement, Monitoring, and Operational System) and SPKK (Public Cleanliness Monitoring System). At this stage, enforcement officers review inventory data and conduct public awareness campaigns to ensure the readiness of services. During implementation, monitoring of concession holders is carried out to ensure the smooth operation of solid waste collection and public cleaning activities. Key Performance Indicator (KPI) enforcement is conducted to assess concession holders' compliance. Additionally, complaint resolution is carried out through two channels: manually and via SPKK. Awareness campaigns such as SAS (Separation of Waste at Source), Value Food No Waste, and National Recycling Day were also held to raise public awareness of more effective waste

management. After implementation, monitoring reports and KPI monitoring of the concessionaire were conducted to assess the effectiveness of the service. Inventory data is reviewed to ensure the accuracy of information, and daily activity reports are provided for immediate follow up actions. Additionally, in post-flood waste cleanup, SWCorp follows the Guidelines of No. 13 of 2023 by making initial preparations based on weather forecasts and identifying high-risk areas to ensure more efficient and effective management.

The Role of the Local Authority (PBT)

The Alor Setar City Council (MBAS) is responsible for ensuring the provision of services during the disease outbreak crisis through guidance, monitoring, and financial assistance. MBAS also collaborates with health agencies in the areas of sanitation and hygiene management while enforcing waste collection regulations and ensuring effective communication with residents. If necessary, additional manpower will be allocated while cleaning and waste collection activities are monitored on a regular basis. The increase in service complaints is identified as stemming from insufficient resources, low resident compliance, ineffective communication, and extreme weather conditions. Local authorities also acknowledge that the quality of Solid Waste Management and Public Cleaning Services (PSPA) depends on the effectiveness of coordination between MBAS and the federal government.

The Role of the Concessionaire (E-Idaman Sdn. Bhd.)

E-Idaman Sdn. Bhd. is a concession company mandated to carry out solid waste management and public cleaning services in the State of Kedah in accordance with the provisions of the Solid Waste Management and Public Cleaning Act 2007 (Act 672). E-Idaman is in charge of collecting, moving, and getting rid of solid waste, which includes waste from homes, businesses, and institutions. Waste collection happens on a set schedule, and the waste is taken to carefully managed sanitary disposal sites to lower the risk of polluting the environment.

E-Idaman also cleans public areas like markets, parks, and other public spaces. They do this by sweeping roads, cleaning drains, cutting grass, and other tasks. These services must be put into place in order to keep the environment as clean as possible and protect public health. The Solid Waste Management and Public Cleaning Corporation (SWCorp) sets key performance indicators (KPIs) that the concession company must follow to make sure that service quality stays at an acceptable level. Monitoring systems like the Integrated Solid Waste Performance Monitoring System (ISPEMOS) and the Corporate Communication Management System (SPKK) keep an eye on operational performance all the time.

In terms of governance, E-Idaman works with SWCorp and local governments to run public awareness programs about recycling and sustainable waste management. E-Idaman is very important for keeping waste management and public cleaning services running smoothly during crises like disease outbreaks. They do this by following standard operating procedures (SOPs) that are in place to keep workers and the community safe.This concession company's overall role is very important for supporting urban sustainability goals and the health of the community, especially when it comes to dealing with waste management problems during crises.

The results of this interview analysis show that during crises, SWCorp, PBT, and the concessionaire must work closely together to handle solid waste and public cleaning services.Although there are monitoring and enforcement systems in place, challenges such as resource shortages, concessionaire non-compliance, and communication with the public need to be addressed to improve the efficiency of these services.

Survey Study

This research used observation to analyze the attitudes of residents living within the solid waste management and public cleaning service zones for more than three years in Kedah, Malaysia. The objectives were to evaluate the behavioral outcomes of the community and the concession companies' service delivery effectiveness. Observational data indicated a lack of concern among residents with regard to solid waste management. This lack of concern appeared to arise due to insufficient relevant public information and the mismanagement of public resources. Poor service typified by broken sanitation systems and weak regulation enforcement further aggravated the situation. Along with the observational study, a structured survey was carried out. Out of 1,530 distributed questionnaires, 700 were returned as valid which marked a 45.75% response rate. Of the responding population, 63.9% were male and 36.1% were female. The larger share (65.4%) was aged between 31 and 40 years (Table 1). Respondents were

from communities under 12 local authorities (Pihak Berkuasa Tempatan, PBT) across the state of Kedah (Table 2).

Table 1: Distribution of Respondents by Gender

Gender	**Number of Respondents**	**Percentage** (%)
Male	450	63.9
Female	250	36.1
Total	709	100.0

Table 2: Distribution of Respondents by District and Local Authority (PBT)

No	**District / Local Government Area**	**Number of Respondents**
1	Kota Setar / Alor Setar City Council (MBAS))	178
2	Kubang Pasu / Kubang Pasu Municipal Council (MPKP)	34
3	Kulim / Kulim Municipal Council (MPK)	100
4	Bandar Baharu / Bandar Baharu District Council (MDBB)	12
5	Langkawi / Langkawi Tourism City Municipal Council (MPLBP)	133
6	Pendang / Pendang District Council (MDP)	20
7	Yan / Yan District Council (MDY)	13
8	Sik / Sik District Council (MDS)	13
9	Padang Terap / Padang Terap District Council (MDPT)	14
10	Baling / Baling District Council (MDB)	14
11	Kuala Muda / Sungai Petani Municipal Council (MPSPK)	139
12	Kulim Hi-Tech Industrial Park Local Government Area	30
Total		700

Table 3: Concessionaires Involved

Concession	**Number of Respondents**
E-Idaman Sdn. Bhd	700

Table 4: Findings of the Solid Waste Management and Public Cleaning Survey in the State of Kedah

Objective	**Things to be Evaluated**	**Percentage** (%)	**Summary of Findings**
Effectiveness of Solid Waste Management and Public Cleansing	Satisfaction with solid waste management	81.4%	Generally satisfied, but there is still room for improvement during the crisis (5.5%–9.3%).
	The collection method is working smoothly.	80.5%	
Coordination and Cooperation	Effective coordination between government and private agencies	70.1%	There is good coordination, but it still needs to be improved (14.5%).
	Public cleaning activities are carried out regularly.	81.0%	However, 9%–12.7% of respondents assessed the level of coordination as still weak.
Cleanliness Measures and Community Awareness	Satisfaction with the level of public cleanliness	81.1%	The community is satisfied, but 8.7% suggest more frequent sanitation in high-risk areas.

	Active community maintaining cleanliness	69.3%	Community involvement is still low (12.6%–13.8%).
Communication and Information Delivery	Confidence in government information	75.9%	Communication still needs to be improved, especially the collection schedule (9%–12%).
	Suggestions for using social media, signage, education	10.9%	
Governance and Government Policy	Government ensures collection is on schedule	77.3%	Delays still occur (6.6%–11.3%), complaints are increasing, and the quality of concession services is unsatisfactory.

The findings of the survey

The residents' views with respect to the five objectives such as the effectiveness of solid waste and public cleansing techniques and service delivery management, cooperation at and between the stakeholder levels, compliance with community education, information and communication systems, two-way communication and information processes, and governance and policy relating to services has been captured in the survey and presented in Table 4.

Effectiveness of Solid Waste Management and Public Cleansing

The study found that 81.4% of respondents were satisfied with the management of solid waste, while 80.5% said that the collection method was running smoothly. However, 5.5% to 9.3% of respondents believed there was room for improvement, particularly in waste collection operations during crises. These findings align with previous studies highlighting the challenges of waste management in pandemic situations, natural disasters, and vector-borne diseases (Poritosh Roy et al., 2021; Rume & Islam, 2020). For example, the COVID-19 pandemic has increased medical waste such as PPE, while weaknesses in waste management are associated with disease risks such as dengue and malaria (Wilson, 2013; Sujatha et al., 2021). Additionally, effective waste management is crucial for post-disaster risk mitigation (Brown et al., 2022). The use of GIS is known to optimise solid waste collection through efficient route planning and reduce costs and health risks (Asefa et al., 2022). Therefore, this study emphasises the importance of GIS applications in solid waste management during crises in the state of Kedah.

Coordination and Cooperation

The study found that 70.1% of respondents agreed that there was good coordination between government agencies and the private sector in managing solid waste and public cleaning, but 14.5% felt that it still needed to be improved. Surveys show that up to 81% of respondents reported public waste disposal services like garbage collection and sanitation work are done regularly, however 9% to 12.7% of respondents percieved coordination between various government agencies responsible to be lacking. These findings corroborate earlier research indicating coordination difficulties in pandemics and disasters, where a lack of government coordination in dealing with garbage collection during the pandemic created serious health risks (Poritosh Roy et al., 2021; Brown et al., 2022). Chronic lack of coordination fueled the increased potential for water and diseases transmitted by poisons because of inadequate waste management after the disaster (Malaysian Ministry of Health, 2015). Improving the lack of coordination between relevant government agencies and the private sector is important to achieve a more effective and resilient system of solid waste and public sanitation management especially during times of crisis and after disasters.

Cleanliness Measures and Community Awareness

The study found that 81.1% of respondents were satisfied with the level of public hygiene, but 8.7% suggested that sanitation should be carried out more frequently in high-risk areas. Only 69.3% stated that their community was actively maintaining hygiene, while 12.6% to 13.8% considered involvement to be low. The lack of awareness about cleanliness is known to potentially affect waste management and increase the risk of vector-borne diseases, consistent with the findings of Wilson (2013), Sujatha et al. (2021), and Nor Faiza M.T et al. (2019). Therefore, an integrated approach combining regular sanitation and community awareness enhancement should be emphasised to ensure the effectiveness of solid waste management and disease control, particularly in high-risk areas.

Communication and Information Delivery

The study found that effective communication plays an important role in solid waste management and public sanitation, with 75.9% of respondents trusting government information, but 9% to 12% believing that the delivery of information, particularly regarding waste collection schedules, is still insufficient. As many as 10.9% suggested improvements through social media, signage, and education in schools. These findings align with the study by Poritosh Roy et al. (2021) and the Malaysian Ministry of Health (2015), which indicate that communication weaknesses during a crisis can undermine the effectiveness of waste management and increase the risk of disease. Therefore, proactive communication strategies through various channels need to be implemented to support the use of technology such as GIS (Asefa et al., 2022) and strengthen community collaboration in waste management during crises**.**

Governance and Government Policy

The research showed that 77.3% of respondents accepted that the government ensured waste collection is done on time. However, there are still delays (6.6%–11.3%) which suggests that there are still optimal operational efficiencies that can be achieved. The results also showed that the concessionaire did not effectively perform waste collection and public toilet cleaning services. Poor control of waste and drainage systems led to rampant waste dumping and pollution of waterways. Based on the submissions received and the failure to comply with the KPIs set by SW Corp, the level of concession service satisfaction was equally low. These results are consistent with the research by Poritosh Roy et al. (2021) which emphasized the inadequacy of government policy handling during the pandemic which resulted in heightened health risks for workers due to uncontrolled PPE disposal, as well as Wilson (2013) and the Malaysian Ministry of Health (2015) which cited the lack of adequate waste management as the cause of pollution as well as the rise of diseases caused by vectors and contaminated water. Hence, the focus is more on efficient management, employing systems such as GIS technology (Asefa et al., 2022), and controlled concession supervision are crucial in achieving practicable solid waste management and public sanitation.

CONCLUSION

The solid waste management and public cleansing services in the state of Kedah during the disease outbreak crisis serves as a case study for this report's key conclusions. As a result of the study, the following key problems have emerged the effectiveness of waste management, the collaboration between private and public sectors, community engagement, and implementation. By and large, the local government appears to have remarkable dedication toward successful solid waste management and public sanitation even during the period of crisis.However, there are still challenges in the implementation and enforcement of policies that require improvement. Among the key findings of this study is the efficiency of solid waste management, with the majority of respondents satisfied with the implementation of solid waste management. Nevertheless, there is still room for improvement in terms of timeliness and efficiency of waste collection. The second finding is the coordination between government agencies and the private sector, which shows that there are good coordination efforts, but coordination between the government, local authorities (PBT), and concession companies needs to be strengthened. Some respondents felt that the private sector was not fully involved in ensuring optimal public cleanliness. Thirdly, communication and community involvement, namely government communication with the public, could still be improved, particularly in terms of informing the public about waste collection schedules and necessary cleanliness measures. Public awareness and participation in waste management are still low and need to be improved through public education campaigns and programmes. Fourth, proactive measures and more flexible policies: the government has taken immediate steps to address solid waste issues, but some procedures remain inflexible in handling changing emergency situations, such as the need for a more

comprehensive and systematic emergency action plan. Fifth, a new waste management model is recommended, which involves a more modern waste management model utilising smart technology such as digital monitoring systems and community apps for reporting waste-related issues. Closer collaboration between the government, private sector, and community is necessary to ensure more efficient and systematic waste management.

Considering the implications and recommendations based on this study, the government needs to strengthen its management approach by emphasising communication, coordination, and technological innovation in solid waste management and public cleaning. Some key recommendations include improving two-way communication systems with the community to ensure clearer and more effective information delivery. Utilising smart technology in monitoring and waste management to enhance transparency and operational efficiency. Increasing community involvement through awareness campaigns and incentives to encourage better public cleanliness practices. Strengthening collaboration between government agencies, PBT, and the private sector to ensure more systematic and comprehensive public cleaning services. Overall, this study emphasises the importance of a more flexible, inclusive, and innovative management model to ensure that solid waste management and public cleaning function optimally, especially in crisis situations such as disease outbreaks.

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