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RESEARCH ARTICLE

AN ANALYSIS OF SOLID WASTE MANAGEMENT EFFICIENCY IN MULTIPLE URBAN AREAS: A CASE STUDY

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Abstract

This study examines the solid waste management (SWM) practices in urban schools in the Philippines, focusing on Baguio City and Benguet. Through on-site observations, interviews, and document analysis, we identify challenges and best practices and offer recommendations to enhance SWM efficiency. Our findings highlight awareness, engagement, and infrastructure gaps while showcasing successful student-led initiatives. This research aims to inform policymakers, educators, and community members, contributing to more sustainable urban environments.

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Introduction:-

One of the most important issues and a global challenge for the environment and human health is solid waste management (SWM). In the Philippines, this issue has become increasingly significant due to the surge in solid waste generation driven by improving living standards, rapid economic growth, and industrialization, particularly in urban areas such as Baguio City and Benguet, where population density amplifies waste generation and disposal issues. This observation aligns with the trends highlighted by the Philippine Senate Economic Planning Office (SEPO) in 2017.

In addressing solid waste management challenges, it is imperative to consider the Sustainable Development Goals (SDGs) set forth by the United Nations. Specifically, SDG 11 focuses on improving solid waste management and contributes to making cities more sustainable by reducing pollution, enhancing public health, and creating more livable urban environments (United Nations, n.d.). Within this context, social theories offer valuable insights into the dynamics of waste management systems and community engagement.

Effective solid waste management in urban areas is crucial for public health, environmental sustainability, and overall quality of life. As stated by Abubakar, Maniruzzaman, and Dano, et.al. (2022), SWM effectively reduces negative health and environmental effects, preserves resources, and makes cities more livable. Yet, unsustainable waste management practices have a detrimental impact on environmental sustainability and public health. This effect is compounded by rapid urbanization as well as institutional and financial limitations.

SWM in developing countries has become more complex due to factors like urbanization, inequality, and economic growth; cultural and socioeconomic characteristics; policy, governance, and institutional challenges; and external influences, (Marshall & Farahbakhsh, 2013). With rapid urbanization and escalating waste production, the need for efficient waste management strategies becomes increasingly urgent.

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Effective waste management strategies foster economic development, unity among communities, and resident well-being along with increasing urban cleanliness. As Naira, 2023 stated the well-being and health of communities and the planet as a whole depend on efficient waste management. A crucial aspect of modern society is waste management, which entails collecting, transporting, and disposing of waste materials generated by humans. As the population grows, garbage production also increases resulting in substantial environmental and health impacts. Therefore, efficient waste management techniques are vital to reduce these effects and advance sustainability.

The current challenges in SWM encompass a range of issues that impact urban areas globally. Guerrero, Maas, &Hogland, 2013 cited the increasing amount of waste generated, the financial constraints on the municipal budget from the high expenses of managing it, and the lack of knowledge about the variety of factors influencing the various stages of waste management are the main reasons why SWM is a challenge for city authorities in developing countries. Along with the municipality, the citizens are held jointly responsible. Establishing an efficient and effective system requires having a thorough awareness of all the stakeholders and their roles within the structure. In developing nations, effective communication amongst stakeholders like schools is critical to the establishment of a waste management system in urban areas.

Efficient waste management is crucial not only for maintaining cleanliness within the school premises but also for instilling environmental awareness and responsibility among students and staff. Proper waste management practices in schools are imperative for preventing environmental pollution and associated health risks (Nkan, Asuquo, and Anam, 2018). Moreover, educational institutions also play a pivotal role in promoting waste reduction, recycling, and composting initiatives (Ojeda-Benítez, et.al., 2019).

Furthermore, integrating waste management education into school curricula can positively influence students' environmental attitudes and behaviors (Ojolo, Adewole, & Oladele, 2017). Therefore, beyond addressing immediate waste management challenges, schools have the opportunity to foster a culture of sustainability among their students, preparing them to become responsible stewards of the environment.

Governments play a vital role in waste management by creating policies, providing resources, and promoting sustainable practices. Strict enforcement of environmental regulations, waste reduction policies, and comprehensive waste management plans are crucial for effective waste management.

Republic Act (RA) 9003, the country's law on SWM, otherwise known as the Ecological Waste Management Act of 2002, serves as a policy framework for the country's solid waste management challenges. It also provides local government units (LGUs) with institutional mechanisms and mandates to cope with and manage waste effectively. Notably, the City Government of Baguio established a linkage between government and non-government entities, to ensure continuity, effectiveness, and efficiency of programs and projects that align with the Ecological Solid Waste Management Plan.

Solid Waste Management, as defined in RA 9003, encompasses various activities, including generation, storage, collection, transfer and transport, processing, and disposal of solid wastes. Nabor and Cruz (2022) cited that the school categorizes solid waste as comprising discarded food waste, plastics, paper, and packaging materials, as well as waste generated from school operations such as papers, boxes, and other visual materials deemed no longer useful, but the school cannot find or identify a designated place on where to discard it.

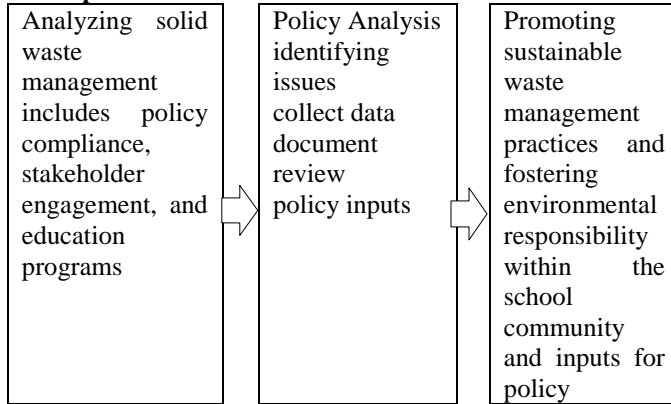
Despite these legislative efforts, educational institutions in urban areas like Baguio City, face similar challenges in managing solid waste effectively. These challenges stem from increasing waste generation associated with daily activities. Thus, this research proposal aims to conduct a policy analysis of the solid waste management system of these schools in urban areas to identify opportunities for improvement.

Purpose of the research

The purpose of the study is to examine solid waste management practices used in schools as an example of urban waste management; and to make recommendations and provide insights on sustainable waste management approaches. The research therefore adopts a case study design consisting of on-site visits and interviews that are used to show what SWM is all about, its weaknesses and ways how it can be improved. Hence, the anticipated outcome of this research paper is to assist decision-makers, educators, and community members in adopting efficient SWM policies for similar urban areas.

Efficient solid waste management practices can catalyze collective action and collaboration among stakeholders through increased awareness and understanding, thereby leading to the implementation of practical and sustainable solutions. Moreover, the sharing of successful strategies with one another can help other schools and barangays adopt efficient waste control programs by following the methods used at best-practice schools leading to a domino effect of progressive transformation throughout the hood.

Conceptual Framework



Methodology:-

The methodology employed in this study encompasses case study approaches. Initial data collection involves on-site observations and tailored approach interviews with key stakeholders. Through these interactions, insights into the current waste generation patterns, collection methods, disposal practices, and existing infrastructure will be gained.

This study adopts a multiple case study design to analyze and compare the solid waste management (SWM) systems of selected schools in urban areas, like Baguio Central School, a mega school; Manuel A. Roxas Elementary School, a large school; and Crystal Cave Elementary School as a small school. This approach allows for a detailed examination of each case and the identification of common themes and differences across different contexts.

Case study sites will be carefully selected to represent a range of urban settings, considering factors such as population size, socio-economic status, geographical location, and existing waste management infrastructure. The inclusion of diverse urban areas ensures a comprehensive examination of SWM systems, capturing the complexity and variability inherent in urban waste management.

A comprehensive study of solid waste management (SWM) systems in particular urban areas requires the use of a variety of data-gathering methods. Please remember the following text: "This will involve on-site visits aimed at observing the solid waste management facilities and the infrastructure that supports them." a detailed understanding of operational dynamics and challenges. Data saturation will be prioritized, ensuring depth and comprehensiveness in the analysis by conducting interviews and observations until redundancy is reached. Furthermore, a thorough review and analysis of relevant documents, such as SWM policies, regulations, reports, and records, will be conducted to complement on-site observations.

Participants of the study

Participant selection will prioritize diversity within each case study site, considering factors such as role within the school community, and length of tenure to ensure a comprehensive understanding of solid waste management practices and challenges.

Semi-structured interviews will be conducted with key stakeholders, including teachers, school administrators, and barangay local government officials covering the school. These interviews will provide insights into the roles, perspectives, and interactions within the SWM system, shedding light on governance structures, stakeholder dynamics, and challenges faced.

Research instruments

The research instruments utilized in this study will be tailored to the specific needs of the research questions and the

data collection methods employed. These may include interview guides, observation checklists, and document analysis frameworks.

Data analysis

Qualitative data collected from on-site visits, interviews, and document analysis will undergo rigorous thematic analysis to identify common themes, patterns, and disparities across case study sites.

Relevant documents such as school waste management plans, policy documents, reports, and records will be reviewed and analyzed. Document analysis will provide additional context and background information on SWM policies, regulations, and initiatives, enriching the qualitative data collected through interviews.

Ethical consideration

Before the survey and interview, a consent letter was obtained from the participants. The study's intention was explicitly discussed, and every prospective participant was obtained from all participants, ensuring they understood the purpose of the study and their rights as participants. Confidentiality and anonymity are maintained to protect participants' privacy. Additionally, the research aims to minimize any potential harm to participants and ensures that their voices are accurately represented in the findings.

Statement of the Problem

Solid waste management is a critical issue at schools in urban areas, with implications for environmental sustainability and public health. To address this challenge effectively, the following specific research questions are formulated:

1. What are the challenges faced by the teachers and/or barangay officials in implementing solid waste management?
2. What are the best practices by the school and/or barangay in sustainable waste management practices?
3. What are the possible implications of SWM in the following?
 - a. policy making
 - b. waste management practices
 - c. urban sustainability and environmental protection

Results and Discussion:-

Challenges in implementing Solid Waste Management

Awareness and Engagement

A common challenge found in small, large, and mega schools is the significant gap in awareness and engagement among students regarding sustainable waste management practices. According to Debrah, (2021), formal education is essential for increasing public knowledge of solid waste management. It indicates that pupils who are taught about sustainable waste management techniques typically exhibit greater levels of awareness and involvement than students who do not receive this type of instruction.

Despite the integration of waste segregation into the curriculum of all subjects, many students exhibit a lack of discipline and awareness about the importance of proper waste disposal. This issue is compounded by the large number of students, making it difficult to ensure that all are knowledgeable and compliant with waste segregation protocols. As respondents noted,

"With the big number of students, not all students know to dispose of properly their garbage even waste segregation is incorporated/integrated into all their subjects."

The analysis of policy documents and records indicates that while educational posters and announcements during flag-raising ceremonies have been implemented as part of awareness campaigns, these measures alone are insufficient. Daily reminders in each classroom about proper waste disposal and segregation could enhance student compliance and awareness. This is supported by Romualdo et.al. (2022), who states that school administrators must maintain high standards of integrating SWM in the learning process through campaigns, incentives, partnerships, organizational resources, and equity to prioritize programs and advocacies on solid waste management.

Infrastructure and Resources

The on-site observation, interview conducted, and review of reports and records from barangay officials identified significant challenges related to the lack of adequate infrastructure and resources for implementing solid waste management effectively. A primary issue is the limited area for waste disposal, as respondent noted,

"The barangay has a limited area or space for waste disposal"

The absence of adequate infrastructure, such as well-maintained and appropriately located MRFs, severely impacts the effectiveness of waste management systems in these barangays. The limited space for waste disposal compounds this issue, making it challenging to manage the volume of waste generated by the schools and the community. According to McAllister (2015), infrastructure investment is necessary to improve SWM in nations that are developing.

The presence of MRFs within residential areas leads to odor problems, which in turn causes community dissatisfaction and resistance to waste management initiatives. This highlights the need for strategically located and well-managed waste facilities that minimize negative impacts on the community.

Best Practices in Sustainable Waste Management

During the analysis and interviews, it was observed that only the mega school had a specific practice where each student brought their trash bag every day. This practice was not mentioned as a best practice in the small and big/large schools. Despite this, both small and big/large schools actively engage in the Youth for Environment in Schools Organization (YES-O) and the Supreme Elementary Learner Government (SELG), which help in the campaign drive for waste management through student-led initiatives and projects.

"Students are being required to bring their trash bag every day."

The mega school's practice of having each student bring their trash bag every day stands out as an individualized approach to waste management, fostering a sense of personal responsibility among students, this practice could be extended to other schools. However, the absence of similar practices in small and large schools suggests a gap that could be filled by adopting this strategy across all schools. Implementing this practice could enhance student engagement and accountability in waste management. In this practice, however, was suggested to monitor the proper segregation of the students.

The involvement of YES-O and SELG in all schools signifies the importance of student-led initiatives in promoting waste management. These organizations play a crucial role in raising awareness and fostering a culture of environmental responsibility among students. Encouraging such initiatives can lead to more innovative and effective waste management practices.

A notable positive aspect highlighted in the interviews was the good collaboration between barangay officials and the schools. This collaboration includes well-coordinated schedules for waste collection, which are properly observed by both parties. This indicates that effective waste management requires strong coordination and open communication between barangay officials and schools. Effective waste management requires better coordination and open communication between barangay officials and schools.

"Collaboration and open communication between barangay officials and schools are well-coordinated."

Effective coordination and communication between barangay officials and schools are critical for successful waste management. The observed collaboration ensures that waste collection schedules are adhered to, preventing the accumulation of waste and maintaining a cleaner school environment. Benosa, (2021) emphasizes the importance of effective coordination and communication between barangay officials and schools for successful waste management. To ensure the successful implementation and oversight of sustainable SWM practices in schools, LGUs can help to deepen and support this collaboration.

Implications for Solid Waste Management

Policy Making

Respondents suggested that strict implementation of SWM laws is needed. Schools that do not follow regulations should face consequences. As one respondent emphasized:

"Punishment to those who are not properly following the law should be strictly implemented"

To guarantee stakeholder participation in SWM services, appropriate modifications must be made to the laws and policies. According to Joseph, (2006), it could be necessary to impose deterrent penalties for violating the law. Moreover, schools that properly implement SWM could receive incentives or rewards from the local government unit (LGU). As respondent noted:

"The local government unit can provide incentives or rewards to schools that implement SWM properly"

Government policies should include incentives for schools that adopt sustainable waste management practices. Financial support, recognition programs, and technical assistance can motivate schools to implement and maintain effective SWM systems. According to Bose, 2020, schools can develop a sense of accountability and responsibility through recognition programs. For instance, schools can be rewarded and acknowledged for their excellent waste management or recycling rates, which may inspire other schools to adopt similar strategies. And also, according to Soomoro, (2023), providing monetary incentives can motivate educational institutions to implement SWM practices.

The integration of incentives for schools that successfully implement SWM is a promising approach to encourage compliance and foster a culture of sustainability. Financial incentives can help schools cover the costs of waste management infrastructure and resources, while recognition programs can boost the morale of students and staff.

Waste Management Practices

Effective waste management practices improve the cleanliness and hygiene of the school environment, creating a healthier space for students and staff. This is following the report by the World Health Organization (WHO) emphasizes the importance of effective waste management practices in maintaining a clean and healthy environment. It highlights the benefits of proper waste disposal, including reducing litter, pest infestations, and health hazards, which ultimately contribute to a more conducive learning environment. A respondent noted:

"Effective solid waste management (SWM) facilitates various programs and projects, such as creating child-friendly schools and promoting clean and green school environments."

Ongoing education and training programs for students are crucial for the success of SWM initiatives in the school. In the study conducted by Molina and Catan, (2021), students are sufficiently informed about the meaning of solid waste, the consequences of improper disposal, activities that are prohibited by solid waste, school initiatives related to solid waste, the significance of solid waste management, and students' responsibilities. Students, however, know very little about the various rules that are pertinent to the management of solid waste. These results imply that extensive informational campaigns about rules pertaining to solid waste management should be carried out by educational institutions and other interested parties.

Daily reminders in every classroom are need for the students to internalize the proper waste disposal. As according to Debrah, (2021) consistent exposure to information through various means, including regular announcements in every classroom and campaign, to enhance knowledge and skills related to sustainable waste management.

Urban Sustainability and Environmental Protection

Effective solid waste management (SWM) practices play a crucial role in creating cleaner urban environments by reducing waste accumulation, minimizing pollution, and preventing health hazards. This improvement in urban cleanliness not only enhances the quality of life for residents but also fosters a healthier community. As emphasized by Paermana et al. (2015), in their study highlights the importance of waste reduction and waste separation in maintaining a clean and healthy environment. Also, Arteaga et.al. (2023) emphasize the importance of effective waste management practices in maintaining a clean and healthy environment, which ultimately contributes to a more conducive learning environment. As respondent noted:

"As barangay official, implementing SWM practices is by effectively managing waste disposal to improve the cleanliness and environmental health of our community."

By addressing SWM challenges and promoting sustainable practices, schools can make significant contributions to achieving SDG 11 and creating more inclusive, safe, resilient, and sustainable cities and communities.

Conclusion: -

There is a significant gap in awareness and engagement among students regarding sustainable waste management practices. Continuous education and reminders are essential to instill discipline and proper waste disposal habits

among students.

Schools face challenges due to inadequate infrastructure and resources for effective waste management. This includes limited disposal areas and the absence of Material Recovery Facilities (MRFs), highlighting the need for improved waste management infrastructure.

While some schools implement individual responsibility practices and student-led initiatives, there is room for improvement in promoting personal accountability and driving campaigns on waste management.

Good collaboration between barangay officials and schools regarding waste collection schedules is observed. However, ongoing communication and coordination are necessary to maintain an efficient waste management system.

There is a suggestion for strict implementation of SWM laws and incentives for schools that properly implement SWM. Government policies should include financial support, recognition programs, and technical assistance to motivate schools to adopt sustainable waste management practices.

Recommendations:-

Encourage local government units (LGUs) to develop and expand incentive programs for schools implementing sustainable SWM practices. This could include financial grants, awards, and public recognition to incentivize compliance.

Enhance coordination and communication between barangay officials and schools through regular meetings and workshops. This collaboration will ensure that waste management efforts are effectively implemented and maintained.

Advocate for government policies that provide comprehensive support for SWM in schools, including financial support, technical assistance, and educational resources. These policies should create an enabling environment for schools to adopt and sustain effective waste management practices.

Involve the wider community in supporting and promoting SWM initiatives in schools. This can be achieved through outreach programs, awareness campaigns, and partnerships with local residents and businesses.

Establish mechanisms for monitoring and evaluating the effectiveness of SWM practices in schools. Regular assessments will help identify areas for improvement and ensure schools maintain high standards of waste management.

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