IJETRM

International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

WASTEWATER MANAGEMENT AND DISPOSAL PRACTICES AMONG INFORMAL URBAN SETTLER HOUSEHOLDS

Athena Jo A. Avila
Chona B. Desierto
Daniel J. Mediante
Maricar A. Retonel
Jayzon A. Tongcaling
Graduate Students, College of Development Management Graduate Program, University of Southeastern Philippines, Mintal Campus, Davao City, Philippines

_____

ABSTRACT
This study examines factors affecting wastewater management and disposal practices among informal settler households, focusing on how these affect management and the environment. The study utilizes Exploratory Factor Analysis (EFA) in a non-experimental quantitative design. This assesses the validity and reliability of instruments designed to measure handling practices, drawing on a sample of 150 respondents. A comprehensive survey was conducted to gather data on various aspects and uncover underlying influences within this population.

The researchers determined five dimensions: Awareness and Responsibility, Infrastructure Deficiency, Financial Constraints, Community and Household Action, and Government and Environmental Impacts. These dimensions influence the practices of the respondents and provide insights into their behaviors. This knowledge enables them to make more informed decisions about environmental impacts and enhance their economic well-being.

Keywords:
Wastewater Management, Informal Settlers

_____

INTRODUCTION

Globally, 4.2 billion people lack access to safely managed sanitation. Furthermore, 80 percent of the world's wastewater flows back into the ecosystem without being treated or reused, posing a threat to access to safely managed drinking water. [1] That is why one of the Sustainable Development Goals of the United Nations is SDG 6, which aims to ensure clean water and sanitation among its member states. In the Philippines, thirty-three percent of water pollution comes from domestic sources. [2] here have been improvements. Compared to the 42.9% of household water that was safely treated in 2020, UN studies show that 66.6% of household water was treated in 2022. Despite these improvements, there are still obstacles to the Philippines' adoption of proper water disposal methods. As a developing country, the presence of poverty and the existence of informal settlements make comprehensive water disposal a challenge.

According to the Philippine Statistics Authority, slum or informal settlements are defined as households occupying housing units/lots without the owner's consent. [3] Informal settler families (ISFs) are estimated at around 3.7 million and have inadequate infrastructure and service delivery, including water and sanitation. [4] While many studies have already recognized that there is a relationship between the urban population of informal settlers and access to water and sanitation, there are still many gaps to be filled when it comes to understanding localized water disposal practices. Davao City, which is considered the sixth among highly urbanized cities in the Philippines [5], should be studied regarding the water disposal practices of its residents, especially among the ISFs. Thus, this study aims to help localize the studies to further understand the city's contribution to the bigger goal of achieving Sustainable Development Goal 6 (SDG 6), which focuses on ensuring the availability and sustainable management of water and sanitation for all.

OBJECTIVE OF THE STUDY

IJETRM

International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

This study intends to determine the dimensions of wastewater management practices among informal settlers. The identified factors are analyzed and utilized to develop a framework. In addition, the study seeks to provide insights into how informal settler households manage their wastewater and disposal, and financial constraints.

The study employed Exploratory Factor Analysis (EFA) and surveyed a sample of 150 informal settler households in Davao City. A researcher-designed, 30-item questionnaire using a 5-point Likert scale was administered, with each item centered on exploring waste disposal practices of domestic waters among this demographic. The collected data were systematically tallied, summarized, and statistically analyzed using SPSS Statistics, a software suite tailored for data management, complex analysis, multivariate assessments, business intelligence, and criminal investigation. Among the analytical methods applied, the Kaiser-Meyer-Olkin (KMO) test was used to measure the adequacy of partial correlations between variables, and the correlation matrix's identity was verified through Bartlett's test of sphericity (Noora Shrestha, 2021). In addition, the Scree Plot and Scree Test were employed, providing a line plot of eigenvalues that visualizes the range of factors analyzed (George Thomas Lewith, 20.

RESULTS AND DISCUSSION
This section presents the factor analysis findings conducted on the 30-item wastewater management survey, using statistical techniques such as the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity. This section displays the analysis and interpretation of data.
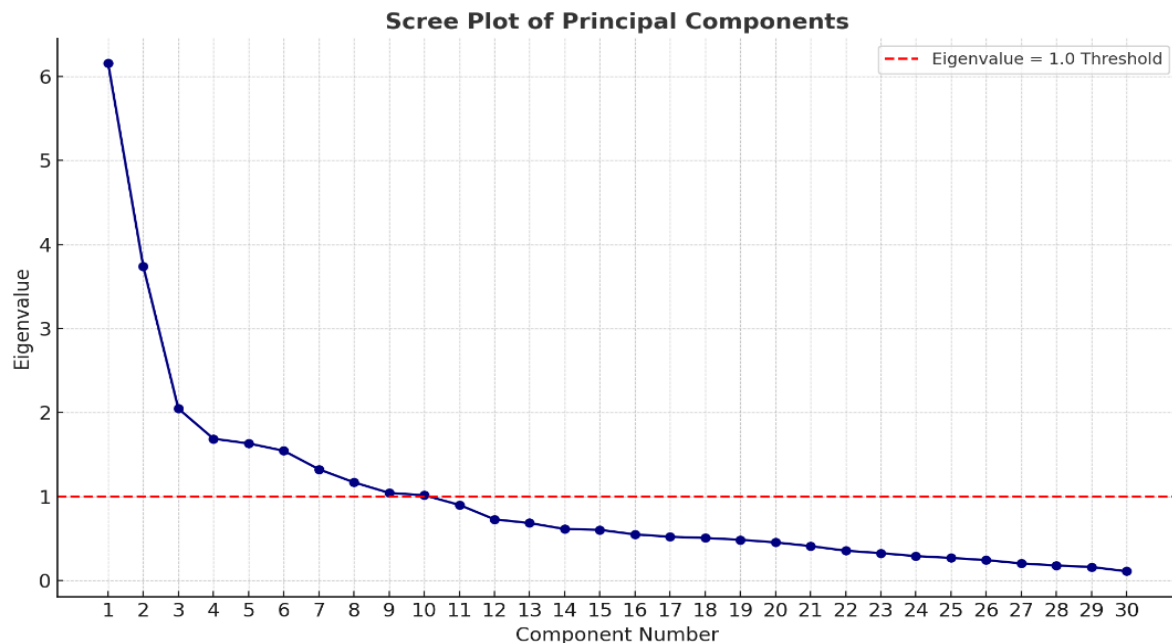
KMO and Bartlett's Test
Table 1 displays the results of the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity to illustrate the suitability of the dataset for factor analysis. The KMO (Kaiser-Meyer-Olkin) measure of sampling adequacy generated a value of 0.707, which, according to Kaiser, reflects that the data has "good" factorability and facilitates factor analysis. Chi-Square = 1887.892, with degrees of freedom at 435; p-value = 0 according to Bartlett's Test of Sphericity, indicating that this correlation matrix was not an identity matrix. The results indicate that factor analysis is appropriate for assessing underlying constructs among the observable factors.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.707
Barlett's Test of Sphericity	Approx. Chi-Square	1887.892
	Df	435
	Sig.	.000

Table 1. KMO and Bartlett's Test

Scree Plot
The scree plot depicts the eigenvalues of the 30 survey components, noting the point of diminishing returns in explaining variance. A sharp drop occurs in the first five elements, then the line begins to level off; this is an "elbow" in the line at Component 5. This indicates that the most important variance in the data is reasonably captured by the first five components, in line with the Kaiser criterion that states it is appropriate to retain factors with an eigenvalue greater than 1. The red dashed line on the plot indicates this threshold, and the components beyond it offer only a marginal contribution. Therefore, the scree plot supports the retention of five principal components, which align with the total variance explained and strengthen the structure of factors generated from the analysis.

IJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

Figure 1. Scree Plot Rotated Component Matrix

Analysis of Variance Percentage

The Total Variance Explained table illustrates the five components were extracted through Principal Component Analysis (PCA) using Varimax rotation. Each of these components provided more than one eigenvalue and explained 50.88% of the data variability. The proportions of explained variance (50.88%) fulfill the accepted standards of social and behavioral sciences for constructs that feature multidimensional complexity. The application of the Varimax rotation technique resulted in improved factor analysis interpretability because it maximized the relationship between variables that belong to the same component without creating unwanted overlaps between different components. This distribution pattern demonstrates an orderly and balanced model, which reveals that wastewater management practices and attitudes of participants extended into five distinct categories: awareness (12.22%), infrastructure (11.96%), financial capacity (9.95%), community action (9.04%), and governance (7.71%). These collectively account for more than half of the variability in responses, making the model both statistically robust and practically meaningful. As a result, the findings can be used confidently to inform interventions, programs, and policies aimed at improving wastewater management among informal settlers.

Component	Initial Eigenvalues	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.15	6.15	20.51	20.51	3.67	12.22	12.22
2	3.74	3.74	12.47	32.98	3.59	11.96	24.19
3	2.05	2.05	6.82	39.81	2.99	9.95	34.14
4	1.69	1.69	5.63	45.44	2.71	9.04	43.17
5	1.63	1.63	5.44	50.88	2.31	7.71	50.88

Extraction Method: Principal Component Analysis (PCA)
Table 2. Total Variance Explained

IJETRM

International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

Rotated Component Matrix

Awareness and Responsibility. Table 3 displays the factor loadings of seven survey items that belong to the first dimension, *awareness & responsibility*, a hybrid thematic factor reflecting the respondents' environmental awareness and perceived civic duty regarding wastewater disposal behavior. The item *"The government should strictly enforce rules on wastewater disposal"* received the highest loading coefficient of 0.732. The item *"When wastewater is not properly disposed of, it causes health problems in our community"* received a loading coefficient of 0.701. The statement *"I understand that throwing wastewater anywhere can cause health problems"* received 0.580. The item *"I think wastewater should go through treatment before being released into rivers and lakes"* received 0.574. The item *"I worry that wastewater might be contaminating our drinking water"* received 0.557. Lastly, within the awareness and responsibility dimension, the items *"If we had financial support from the government, we would improve our wastewater disposal system"* and "*I believe wastewater should be treated before being released into the environment"* both received 0.522.

Factor	Attributes	Loading
Awareness and Responsibility	Item 29 - The government should strictly enforce rules on wastewater disposal.	.732
	Item 24 - When wastewater is not properly disposed of, it causes health problems in our community.	.701
	Item 09 - I understand that throwing wastewater anywhere can cause health problems.	.580
	Item 26 - I think wastewater should go through treatment before being released into rivers or lakes.	.574
	Item 25 - I worry that wastewater might be contaminating our drinking water.	.557
	Item 21 - If we had financial support from the government, we would improve our wastewater disposal system.	.522
	Item 11 - I believe wastewater should be treated before being released into the environment.	.522

Table 3: Rotated Component Matrix with Grouped Attributes of Awareness and Responsibility

Our findings reveal that informal settlers understand the government's need to enforce wastewater management and disposal regulations strictly. They recognize that improper disposal can lead to health issues within the community, which is why they know they should not dispose of it carelessly. Furthermore, they believe that wastewater should undergo treatment before being released into rivers, lakes, and the environment. They understand that untreated water can contaminate water sources and their drinking water. Consequently, they are seeking financial support from the government for a better wastewater management system.

This study supports Amarille and Balomaga's (2023) study, noting that two-thirds of their respondents perceive that their local government unit must manage or improve water quality and treat domestic wastewater. They observed that the awareness among Surigao respondents stems from a fear of water-related diseases affecting their residents.

Infrastructure Deficiency. Table 4 outlines the results of the factor analysis, identifying infrastructure deficiency as a key dimension affecting wastewater practices. This factor brings together five items that reflect the recurring challenges communities face due to poor or absent sanitation infrastructure. Leading this group is the statement *"The lack of drainage forces us to find our own ways to get rid of wastewater,"* which shows the highest factor loading at 0.827. This is followed by *"We often deal with clogged or overflowing drains in our area,"* with a loading of 0.764, pointing to persistent blockages that disrupt proper disposal. The third item, *"We sometimes have to create makeshift solutions (like small canals or pits) to dispose of our used water,"* has a loading of 0.680, emphasizing how residents' resort to temporary and potentially unsafe disposal practices.

Another item, *"Since we don't have access to proper disposal, wastewater often just ends up in the streets or open areas,"* with a factor loading of 0.642, further illustrates how untreated water is discharged in public spaces due to lack of alternatives. Finally, the item *"Our home is far from any wastewater disposal system, making it difficult to manage used water"* received a factor loading of 0.576, highlighting spatial exclusion as a core issue.

IJETRM

International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

Factor	Attributes	Loading
Infrastructure Deficiency	Item 05 - The lack of drainage forces us to find our own ways to get rid of wastewater.	.827
	Item 03 - We often deal with clogged or overflowing drains in our area.	.764
	Item 06 - We sometimes have to create makeshift solutions (like small canals or pits) to dispose of our used water.	.680
	Item 08 - Since we don't have access to proper disposal, wastewater often just ends up in the streets or open areas.	.642
	Item 02 - Our home is far from any wastewater disposal system, making it difficult to manage used water.	.576

Table 4: Rotated Component Matrix with Grouped Attributes of Infrastructure Deficiency

The lack of infrastructure is common among informal settlements. Based on our study's results, the absence of drainage forces informal settler families to find creative ways to dispose of wastewater. They often contend with clogged or overflowing drains, leading them to construct makeshift solutions for disposing of water waste. However, wastewater is not always managed effectively, resulting in the wastewater ending up in the streets or open areas. Consequently, managing used water in these areas proves to be challenging.

The results on infrastructure deficiency align with findings by Corpuz (2025), who emphasized that the widespread discharge of untreated wastewater and groundwater contamination in the Philippines are direct consequences of a lack of wastewater infrastructure. This affirms that inadequate drainage and distant access to disposal systems force communities to resort to unsafe practices, increasing public health risks. Similarly, Kebede and Tadesse (2023) found that in several towns in Ethiopia, the absence of integrated sanitation planning and coordination among stakeholders leads to unmanaged wastewater and solid waste being dumped into storm drains, further supporting the systemic nature of the problem. Moreover, Rahman and Sultana (2022) stressed that in Bangladesh, infrastructural limitations force residents to rely on makeshift disposal methods due to the absence of modern sewage systems and proper sludge treatment facilities. These studies collectively reinforce the claim that infrastructural barriers, rather than just a lack of awareness, are major drivers of unsafe wastewater behaviors in underserved communities, and resolving them requires significant infrastructure investment and inclusive urban planning.

Financial Constraints. Table 5 shows five (5) items that fall under the third dimension, the financial constraints of informal settlers, and their corresponding loading coefficients. As shown, the item *"Our community would like to have a shared wastewater facility, but we can't afford it.'* obtained the highest loading coefficient of 0.761. This is supported by the succeeding items on the challenges affecting financial.

The item *"If there were cheaper options for treating wastewater, we would use them"* obtained a loading coefficient of 0.733. The item *"Paying for proper wastewater disposal services is too expensive for us"* obtained a loading coefficient of 0.601. The item *"We would like to install a septic tank or proper drainage, but it costs too much"* obtains a loading coefficient of 0.594. Moreover, the item *"Our daily expenses come first, so wastewater management is not a priority"* obtained a 0.550 loading coefficient.

Factor	Attributes	Loading
Financial Constraints	Item 18 - Our community would like to have a shared wastewater facility, but we can't afford it.	.761
	Item 17 - If there were cheaper options for treating wastewater, we would use them.	.733
	Item 16 - Paying for proper wastewater disposal services is too expensive for us.	.601
	Item 20 - We would like to install a septic tank or proper drainage, but it costs too much.	.594

IJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

	Item 19 - Our daily expenses come first, so wastewater management is not a priority.	.550

Table 5: Rotated Component Matrix with Grouped Attributes of Financial Constraints

According to our findings, the informal settlers are open to sharing a wastewater treatment facility, but financial constraints hinder their ability to pursue this initiative. If they can discover more affordable options, they would prefer those. However, proper wastewater disposal services are expensive for them. While they would benefit from suitable septic tanks or adequate drainage, these solutions are beyond their financial reach. They prefer to concentrate on managing their daily expenses and view wastewater management as a lower priority.

The results on financial constraints agree with Chaitkin et al. (2022), who stated that the demand for water and sanitation services for the underserved requires universal and equitable access to safe and affordable services, but public, corporate, and donor funding is insufficient to cover capital, operational, and maintenance expenses. Furthermore, population growth, urbanization, climate change, and environmental degradation will increase the financial gap, straining water resources (Li et al., 2022).

Community & Household Action. Table 6 shows the Rotated Component Matrix with grouped attributes of Community and Household Action where a significant core factor among the three parameters expresses community-related wastewater management practices. The measurement results through factor loadings indicate the highest coefficient of 0.705 for the item *"I believe it is my responsibility to properly manage wastewater in my household"*. Followed by the item, *"I have learned about proper wastewater disposal from community programs, news, or social media"*. Obtained a loading coefficient of 0.670. This unified pattern from 0.589 to 0.705 defines personal responsibilities in addition to informal learning and adaptive reuse practices, showing extensive household responsibility for wastewater control and how community programs, along with media services, function as disseminators of wastewater management knowledge. The item *"To save money, we sometimes reuse wastewater (e.g., for cleaning or watering plants)"*, obtaining a loading coefficient of 0.589, shows that people's practice of saving costs through water recycling.

Factor	Attributes	Loading
Community & Household Action	Item 30 - I believe it is my responsibility to properly manage wastewater in my household.	.705
	Item 10 - I have learned about proper wastewater disposal from community programs, news, or social media.	.670
	Item 23 - To save money, we sometimes reuse wastewater (e.g., for cleaning or watering plants).	.589

Table 6: Rotated Component Matrix with grouped attributes of Community and Household Action

Looking at the results, residents of informal settlements in Davao City believe they are responsible for properly managing wastewater in their households. They learn the proper methods for wastewater management and disposal through community programs, news, or even social media. One practice they engage in within their community is conserving water by reusing it for cleaning or watering plants.

The United Nations Environment Programme (UNEP, 2022) supports the findings that localized actions, particularly at the household level, can significantly reduce environmental burdens when supported by informal education and grassroots initiatives. Similarly, UNEP (2022) emphasizes that effective knowledge exchange through digital and community channels is key to encouraging behavior change. Moreover, the practice of reusing wastewater to save money reflects a growing trend of domestic water recycling, which the World Health Organization (WHO) acknowledges as an emerging adaptive strategy in low-resource settings (WHO & UNICEF,

2021). These findings show that a culture of informed citizens, empowered through both formal and informal avenues, can help improve sustainable home wastewater practices.

Government & Environmental Impacts. Three items in Table 7 with the group Attributes of Government & Environmental Impacts" reveal the importance of institutional backing and infrastructure in wastewater management systems. The item *"The government has provided some help in setting up drainage or wastewater disposal systems here'* received the highest loading coefficient of 0.753. Followed by the item *"Our community has been informed about how to handle wastewater properly."* received a loading coefficient of 0.536. And item "*We have a proper drainage system where our wastewater can safely flow"* obtained a 0.506 loading coefficient.

These factor loadings indicate that the latent construct is correlated moderately to strongly with the measured items between 0.506 and 0.753. Individuals acknowledged government wastewater system development efforts through Item 07 based on the high value of its factor loading (.753). Item 13 shows how wastewater handling information spreads among the community, whereas Item 01 indicates the existence of proper drainage infrastructure.

Factor	Attributes	Loading
Government & Environmental Impacts	Item 07 - The government has provided some help in setting up drainage or wastewater disposal systems here.	.753
	Item 13 - Our community has been informed about how to handle wastewater properly.	.536
	Item 01 - We have a proper drainage system where our wastewater can safely flow.	.506

Table 7: Rotated Component Matrix with Grouped Attributes of Government & Environmental Impacts

The study shows that informal settlers believe the government has provided some assistance in establishing drainage or wastewater disposal in their communities. They also feel that their community is educated on how to manage wastewater properly. Additionally, there is an effective drainage system in place that allows their wastewater to flow safely. These findings indicate that they recognize the government's support, and some of the infrastructure developed by the government is utilized for wastewater management.

Thus, this element demonstrates social awareness about how government activism, alongside infrastructure implementations, sustains proper wastewater functions. The World Health Organization, in partnership with UNICEF, indicates that access to proper sanitation and drainage serves as both a public health foundation and a major sustainability element (WHO & UNICEF, 2021). As agreed by Duran and Mariñas (2024), their study demonstrated that institutional support is crucial in integrating sustainability into higher education curricula, indicating that trust in educational institutions enhances the adoption of sustainable practices. Furthermore, study results also confirm the pivotal role of public information campaigns in enhancing community compliance with environmental norms, particularly in wastewater management. In the Philippines, Dela Rosa (2024) emphasizes the necessity of community-based management programs and public awareness to address the country's wastewater challenges.

Framework based on the Findings
Presented in Figure 2 is the framework developed based on the findings. The researchers found out that the five major determinants influencing wastewater management and disposal practices among informal settlers are (1) Awareness and Responsibility, (2) Infrastructure Deficiency, (3) Financial Constraints, (4) Community and Household Action, and (5) Government and Environmental Impacts. These interconnected factors reflect both individual-level behaviors and structural limitations, offering a holistic view of the challenges surrounding wastewater management in marginalized communities.

IJETRM

International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

The framework visually emphasizes that wastewater management and disposal practices are shaped by internal (awareness, responsibility, household action) and external (government support, infrastructure access, affordability) factors or conditions. It emphasizes how each factor significantly affects wastewater practices. This suggests that long-term solutions must be multisectoral in improving systems and empowering households with knowledge and the means to act sustainably.

Figure 2. Framework Developed Based on Findings

CONCLUSION

Based on the findings, the researchers concluded that the factors affecting the wastewater management and disposal practices among informal settler households are: Awareness and Responsibility, Infrastructure Deficiency, Financial Constraints, Community and Household Action, and Government and Environmental Impacts.

RECOMMENDATION

The findings of this analysis deliver an extensive perspective about wastewater management and disposal behaviors within resident communities. Environmental and health-related awareness exists at a high level in the area, but the infrastructure limitations and financial constraints create important gaps. For effective wastewater management programs in low-income or informal settlements, all components are necessary, including infrastructure development, together with financial help and community awareness efforts supported by clear policy implementation. The research findings support community engagement in decision-making processes because local initiatives respond effectively to information-based input when undertaken within supportive settings.

Future programs should adopt these themes to develop sustainable interventions for locations with compromised sewage infrastructure and situations where home practices matter most in environmental effects.

REFERENCES

[1]   United Nations Department of Economic and Social Affairs. (2025). Water and sanitation. https://sdgs.un.org/topics/water-and-sanitation
[2]   Tuddao, V. B., Jr., & Gonzales, E. (2024). Updates of water environment governance in the Philippines. Department of Environment and Natural Resources & Environmental Management National Capital Region.

iJETRM

International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

[3]   Philippine Statistics Authority. (2023). Metadata of the refined list of sustainable development goals indicators for the monitoring in the Philippines. https://psa.gov.ph/system/files/psa-board/Annex%20BR-10-20230629-01.pdf

[4]   United Nations Human Settlements Programme. (2023). UN-Habitat Philippines country report 2023. Mandaluyong City, Philippines.

[5]   Department of Trade and Industry. (2025). 2023 rankings – Cities and municipalities competitive index. Retrieved April 26, 2025, from https://cmci.dti.gov.ph/rankings.php

[6]   Poblador, N. G., & Coritico, E. G. (2021). Awareness and practices on domestic wastewater sanitation of select coastal barangays in Surigao City, Philippines. ResearchGate. https://www.researchgate.net/publication/353118254

[7]   Corpuz, J. C. G. (2025). Wastewater management in the Philippines: A call for localized solutions and policy integration. Environmental Health Insights, 19, 1–10. https://doi.org/10.1177/11786302241311529

[8]   Kebede, A., & Tadesse, T. (2023). Challenges of sanitation in developing countries—Evidenced from a study of fourteen towns, Ethiopia. BMC Public Health, 23, Article 1234. https://doi.org/10.1186/s12889-023-12345-6

[9]   Rahman, M. M., & Sultana, N. (2022). Assessment of urban sanitation status and management gaps in a metropolitan city, Bangladesh: Potential challenges to achieve SDG 6. Frontiers in Water, 2, Article 950887. https://doi.org/10.3389/frwa.2022.950887

[10]   Li, L. C., Stringer, M., & Dallimer, M. (2022). The impacts of urbanization and climate change on the urban thermal environment in Africa. Environmental Research Letters, 17(6), 064012. https://doi.org/10.1088/1748-9326/ac6b61

[11]   Chaitkin, M., McCormick, S., Torreano, J. A. S., Amongin, I., Gaya, S., Hanssen, O. N., Johnston, R., Slaymaker, T., Chase, C., Hutton, G., & Montgomery, M. (2022). Estimating the cost of achieving basic water, sanitation, hygiene, and waste management services in public healthcare facilities in the 46 UN designated least-developed countries: a modelling study

[12]   Field, A. (2013). Discovering statistics using IBM SPSS statistics (4th ed.). Sage.

[13]   Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). Multivariate data analysis (7th ed.). Pearson Education Limited.

[14]   Jenkins, M. W., & Scott, B. (2007). Behavioral measures of household decision-making and sanitation demand, and potential benefits from social marketing in Ghana. Social Science & Medicine, 64(12), 2427–2442. https://doi.org/10.1016/j.socscimed.2007.03.010

[15]   World Health Organization (WHO), & United Nations Children's Fund (UNICEF). (2021a). *Progress on household drinking water, sanitation, and hygiene from 2000 to 2020: Five years into achieving the SDGs*. https://washdata.org/report/jmp-2021-wash-households

[16]   United Nations Environment Programme. (2022). Wastewater knowledge exchange and collaboration: Improving decision-making through shared understanding. https://www.unep.org/resources/report/wastewater-knowledge-exchange-and collaboration-improving-decision-making-through

[17]   World Health Organization (WHO), & United Nations Children's Fund (UNICEF). (2021b). Progress on household drinking water, sanitation and hygiene 2000–2020: Five years into the SDGs. https://washdata.org/report/jmp-2021-wash-households

[18]   Dela Rosa, C. J. (2024). Wastewater management in the Philippines: Challenges, policies, and sustainable solutions. ResearchGate. https://www.researchgate.net/publication/385753842

[19]   Duran, D. C., & Mariñas, J. F. (2024). Institutional support and sustainability integration in Philippine higher education curricula. Sustainability, 16(9), Article 3677. https://doi.org/10.3390/su16093677