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Association Between Domestic Wastewater Management Practices, Residential Water Quality Indicators, And Household Water-Related Expenditure in Aduas Centro

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Abstract- ***This study assessed the relationship between domestic wastewater management practices, residential water quality conditions, and household water-related expenditures in Barangay Aduas Centro, Cabanatuan City. Using a quantitative descriptive-correlational design, data were gathered from 300 households through a validated Likert-scale questionnaire and analyzed using descriptive statistics and Spearman's rho correlation. The findings revealed weak to moderate wastewater management practices among households, particularly in septic tank maintenance and wastewater disposal. Residential water quality conditions were characterized by occasional foul odor, discoloration, visible contaminants, and water-related health symptoms. Most households incurred low to moderate water-related expenditures, primarily for purified drinking water, water treatment, and plumbing maintenance. Correlation analysis showed significant positive relationships between wastewater management practices and residential water quality conditions ($\rho = 0.44–0.62$, $p < 0.001$), as well as between water quality conditions and household water-related expenditures ($\rho = 0.45–0.61$, $p < 0.001$). The findings suggest that households experiencing poorer water quality conditions tend to adopt more wastewater management practices and incur higher water-related expenses. The study highlights the need for strengthened sanitation programs, regular septic tank maintenance, and improved community awareness to support safer wastewater management and better residential water quality.***

Index Terms: Domestic Wastewater, Water Quality, Household Expenditure, Sanitation, Wastewater Management

I. INTRODUCTION

Access to safe and clean water is essential for public health and environmental sustainability. However, inadequate domestic wastewater management remains a significant contributor to residential water contamination, particularly in densely populated communities. Improper wastewater disposal, poorly maintained septic systems, and ineffective drainage infrastructure may lead to groundwater contamination, deteriorating water quality, and increased risks of waterborne diseases.

In the Philippines, Republic Act No. 9275 or the Philippine Clean Water Act of 2004, together with the Revised National Plumbing Code, establishes regulations for wastewater management and water resource protection. Despite these regulatory frameworks, many residential areas continue to experience sanitation and water quality issues associated with insufficient wastewater management practices and aging infrastructure systems.

Barangay Aduas Centro in Cabanatuan City has experienced recurring concerns regarding residential water quality following the implementation of drainage and catch-basin systems intended to mitigate flooding within the community. Residents have reported issues such as water discoloration, unpleasant odor, and visible particles in household water supplies. These conditions have resulted in increased reliance on purified water, water treatment practices, and plumbing maintenance, contributing to additional household expenditures related to water consumption and sanitation.

Previous studies have emphasized that poorly maintained septic systems and inadequate wastewater management practices contribute significantly to groundwater contamination and public health risks (Nowak & Imperowicz, 2016). Similarly, water

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discoloration, unpleasant odor, and visible contaminants are commonly associated with infrastructure deterioration and unsafe water conditions (WHO, 2021). Such conditions may also increase household spending on alternative drinking water sources and water treatment measures.

Hence, this study assessed the relationship between domestic wastewater management practices, residential water quality conditions, and household water-related expenditures among residents of Barangay Aduas Centro, Cabanatuan City. Specifically, the study examined the level of wastewater management practices, the condition of residential water quality, and the extent to which water quality conditions are associated with household water-related expenditures.

II. METHODS

This study used a quantitative descriptive-correlational research design to determine the relationship between domestic wastewater management practices, residential water quality conditions, and household water-related expenditures among residents of Barangay Aduas Centro, Cabanatuan City. The study was guided by the provisions of Republic Act No. 9275, also known as the Philippine Clean Water Act of 2004, and the Revised National Plumbing Code of the Philippines.

The respondents consisted of selected households in Barangay Aduas Centro. Using Slovin's formula with a 5% margin of error, a sample size of 300 households was determined from the estimated population of 1,200 households. Proportional stratified random sampling was employed to ensure proper representation of households within the community.

Data were collected through a researcher-made questionnaire using a Likert-scale format. The instrument included items related to domestic wastewater management practices, residential water quality conditions, and household water-related expenditures. Prior to distribution, the questionnaire was reviewed and validated to ensure the relevance and clarity of the items.

The study focused only on the perceived water quality conditions and wastewater management practices reported by the respondents. No laboratory testing or physicochemical analysis of water samples was conducted.

Descriptive statistics such as weighted mean and frequency distribution were used to analyze the gathered data. Spearman's rank-order correlation coefficient (Spearman's rho) was used to determine the relationship between domestic wastewater management practices, residential water quality conditions, and household water-related expenditures. Spearman's rho was considered appropriate since the responses were obtained using ordinal Likert-scale data.

III. RESULTS AND DISCUSSION

Domestic Wastewater Management Practices

Overall Domestic Wastewater Management Practices

Table 1. Overall Domestic Wastewater Management Practices

STATEMENT	POOLED MEAN	DESCRIPTION
a. Septic Tank Maintenance	2.55	Rarely
b. Wastewater Disposal Method	2.64	Sometimes
c. Drainage Condition	3.06	Sometimes
d. Greywater Management	2.87	Often
Overall Mean	**2.78**	**Sometimes**

Table 1 presents the overall domestic wastewater management practices of households in Barangay Aduas Centro. The results indicate weak to moderate wastewater management practices among respondents. Septic tank maintenance obtained the lowest mean score ($WM = 2.55$), indicating that desludging and preventive inspections were rarely conducted. This finding supports the study of Nowak and Imperowicz (2016), which emphasized that poorly maintained septic systems contribute significantly to groundwater contamination.

Wastewater disposal practices obtained a mean score of 2.64, suggesting that although some households practiced proper disposal methods, unsafe practices such as open ground discharge remained evident.

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Drainage condition recorded a mean score of 3.06, reflecting moderate but inconsistent maintenance of drainage systems. Kumar et al. (2021) noted that inadequate drainage management may increase the risk of localized flooding and environmental contamination.

Meanwhile, greywater management practices obtained a mean score of 2.87, indicating partial compliance among respondents. While households generally avoided disposing of solid waste into drainage systems, grease disposal practices remained inadequately managed. Boyjoo et al. (2013) identified improper grease disposal as a major contributor to drainage blockage. Overall, the findings suggest that existing wastewater management practices remain insufficient to effectively protect household sanitation and residential water quality.

Residential Water Quality Conditions

Overall Residential Water Quality Conditions

Table 2. Overall Residential Water Quality Conditions

STATEMENT	POOLED MEAN	DESCRIPTION
a. Occurrence of Foul Odor	2.91	Sometimes
b. Incidence of Discoloration	3.26	Sometimes
c. Presence of Visible Contaminants	2.84	Sometimes
d. Water-Related Health Symptoms	2.81	Often
Overall Mean	**3.23**	**Sometimes**

Table 2 presents the overall residential water quality conditions experienced by households in Barangay Aduas Centro. The findings revealed recurring water quality issues, particularly in terms of foul odor, discoloration, visible contaminants, and water-related health symptoms.

Visible contaminants obtained the highest mean score ($WM = 3.26$), indicating frequent occurrences of discoloration and staining in household water supplies. Kizhakkeppattu and Karunagari (2021) associated these conditions with corrosion and the presence of dissolved solids in water systems. Similarly, the World Health Organization (2021) emphasized that visible contamination strongly affects household perception of water safety and acceptability.

Foul odor recorded a mean score of 2.91, indicating occasional occurrences of chlorine-like, rusty, muddy, and sewage-like smells in residential water supplies. According to Dietrich (2016), unpleasant odor significantly influences public perception of drinking water quality and safety.

Water-related health symptoms obtained a mean score of 2.81, suggesting that some households occasionally experienced stomach pain, diarrhea, skin irritation, and other health-related concerns associated with water use. Prüss-Ustün et al. (2019) emphasized that unsafe water remains a major contributor to waterborne diseases and public health risks. Overall, the results indicate that residential water quality conditions were not consistently safe or acceptable among households in the community.

Household Water Related Expenditures

Overall Water Related Expenditures

Table 3. Overall Water Related Expenditures

	TYPE	LOW	MEDIUM	HIGH
1.	Purified Water	71(24%)	159(53%)	71(24%)
2.	Water Treatment	162(54%)	77(25%)	62(21%)
3.	Plumbing Maintenance	219(72%)	55(18%)	27(9%)
4.	Septic Tank	217(72%)	55(18%)	29(9%)

Table 3 presents the household water-related expenditures of residents in Barangay Aduas Centro. The findings indicate that most households incurred low to moderate expenses related to purified drinking water, water treatment, plumbing maintenance, and septic tank services.

The majority of respondents reported monthly expenditures ranging from ₱201 to ₱500 for purified drinking water, suggesting regular reliance on refilling stations and alternative drinking water sources. This spending pattern may reflect household concerns regarding the quality and safety of tap water.

Expenses related to water treatment and plumbing maintenance remained generally low, indicating limited use of advanced treatment systems and occasional plumbing repairs. Likewise, septic tank-related expenditures remained minimal, which may be

associated with the desludging services provided by the local government unit.

Overall, the findings suggest that households incur additional expenses as a response to perceived water quality issues and maintenance needs within the community.

Relationship Between Domestic Wastewater Management Practices and Residential Water Quality Conditions

Table 4. Relationship Between Domestic Wastewater Management Practices and Residential Water Quality Conditions

Water-Related Expenditure	Occurrence of Foul Odor	Incidence of Discoloration	Presence of Visible Contaminants	Water-Related Health Symptoms	Interpretation
Purified Water	ρ = 0.58, p < 0.001	ρ = 0.61, p < 0.001	ρ = 0.56, p < 0.001	ρ = 0.59, p < 0.001	Strong positive correlation (significant)
Water Treatment	ρ = 0.52, p < 0.001	ρ = 0.54, p < 0.001	ρ = 0.50, p < 0.001	ρ = 0.53, p < 0.001	Moderate positive correlation (significant)
Plumbing Maintenance	ρ = 0.47, p < 0.001	ρ = 0.49, p < 0.001	ρ = 0.45, p < 0.001	ρ = 0.46, p < 0.001	Moderate positive correlation (significant)
Septic Tank Expenditure	ρ = 0.49, p < 0.001	ρ = 0.51, p < 0.001	ρ = 0.48, p < 0.001	ρ = 0.50, p < 0.001	Moderate positive correlation (significant

Table 4 presents the relationship between domestic wastewater management practices and residential water quality conditions. Spearman correlation analysis revealed significant positive relationships between the variables, with correlation coefficients ranging from $\rho = 0.44$ to 0.62 ($p < 0.001$).

The findings suggest that households experiencing poorer water quality conditions tended to adopt more wastewater management practices and maintenance measures. This indicates that the observed practices may represent reactive household responses to existing water quality issues rather than preventive or fully effective wastewater management measures. Despite the presence of these practices, recurring issues such as foul odor, discoloration, visible contaminants, and water-related health symptoms remained evident among households in the community.

Previous studies emphasized that poorly maintained septic systems and inadequate wastewater disposal contribute significantly to groundwater contamination and environmental health risks (Nowak & Imperowicz, 2016; Withers et al., 2014). These findings reflect the importance of strengthening wastewater management practices and improving compliance with the provisions of Republic Act No. 9275 to better protect residential water quality and public health.

Relationship of Residential Water Quality Conditions and Household Water-Related Expenditures

Table 5. Relationship of Residential Water Quality Conditions and Household Water-Related Expenditures

Domestic Wastewater Management Practices	Occurrence of Foul Odor (2.91)	Incidence of Discoloration (3.26)	Presence of Visible Contaminants (2.84)	Water-Related Health Symptoms (2.83)	Interpretation
Septic Tank Maintenance (2.55)	ρ = 0.59	ρ = 0.51	ρ = 0.47	ρ = 0.55	Moderate positive correlation (significant)
Wastewater Disposal Method (2.64)	ρ = 0.53	ρ = 0.49	ρ = 0.45	ρ = 0.50	Moderate positive correlation (significant)
Drainage Condition (3.06)	ρ = 0.48	ρ = 0.46	ρ = 0.44	ρ = 0.47	Moderate positive correlation (significant)
Greywater Management (2.87)	ρ = 0.62	ρ = 0.58	ρ = 0.55	ρ = 0.60	Strong positive correlation (significant)

Table 5 presents the relationship between residential water quality conditions and household water-related expenditures. The results revealed significant positive relationships between household expenditures and water quality indicators, with correlation coefficients ranging from $\rho = 0.45$ to 0.61 ($p < 0.001$).

Purified drinking water expenditure showed the strongest relationship with residential water quality conditions, while water treatment, plumbing maintenance, and septic tank expenditures demonstrated moderate positive correlations.

The findings indicate that households experiencing more frequent water quality issues also tended to incur higher expenses related to water treatment, purified drinking water, and maintenance services. This suggests that increased household expenditures may represent reactive measures taken in response to declining water quality conditions within the community.

IV. CONCLUSION

The study revealed that households in Barangay Aduas Centro demonstrated weak to moderate domestic wastewater management practices, particularly in septic tank maintenance, wastewater disposal, drainage maintenance, and greywater management. Although some households practiced basic sanitation measures, the implementation of proper wastewater management practices remained inconsistent.

The findings further showed that residential water quality conditions were not consistently safe or acceptable, as households occasionally experienced foul odor, discoloration, visible contaminants, and water-related health symptoms. These conditions suggest possible issues related to inadequate wastewater management practices, aging infrastructure, and environmental contamination within the community.

In terms of household water-related expenditures, most respondents incurred low to moderate expenses for purified drinking water, water treatment, plumbing maintenance, and septic tank services. The results indicate that households often spend additional resources to address perceived water quality concerns and maintain safe water use.

Correlation analysis revealed significant positive relationships between domestic wastewater management practices, residential water quality conditions, and household water-related expenditures. The findings suggest that households experiencing poorer water quality conditions were more likely to adopt wastewater management measures and incur higher water-related expenses. This indicates that many wastewater management practices were implemented as reactive responses to existing water quality concerns rather than as preventive measures.

Overall, the study highlights the importance of improving domestic wastewater management practices, strengthening sanitation programs, and promoting community awareness to support better residential water quality and reduce water-related health and economic burdens among households.

V. RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. Local government units and concerned agencies should strengthen community-based sanitation programs by promoting regular septic tank desludging, proper wastewater disposal, and improved drainage maintenance to minimize risks of groundwater contamination and poor residential water quality.
2. Residents should be encouraged to adopt consistent wastewater management practices, particularly in septic tank maintenance, grease disposal, and greywater management, to help reduce environmental contamination and improve household sanitation conditions.
3. Community awareness programs and information campaigns regarding safe wastewater management and water sanitation practices should be intensified to improve household participation and compliance with the provisions of Republic Act No. 9275 or the Philippine Clean Water Act of 2004.
4. Future researchers are encouraged to conduct physicochemical and microbiological water quality testing to further validate the perceived water quality conditions reported by respondents. Additional studies may also explore the influence of infrastructure condition, groundwater contamination pathways, and wastewater treatment interventions on residential water quality and household expenditures.

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