

Water Consumption Patterns as Risk Factors for Plumbing System Failures and Inefficiency in Brgy. Sumacab Este, Cabanatuan City, Nueva Ecija

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Abstract- *This study examined household water consumption patterns as risk factors for plumbing system failures and inefficiency among residential households in Brgy. Sumacab Este, Cabanatuan City. The study utilized a quantitative-descriptive research design involving 100 household respondents selected through stratified random sampling. Data were gathered using a validated survey questionnaire focusing on water consumption behavior, plumbing system failures, and plumbing system efficiency. Descriptive statistics, Pearson Product-Moment Correlation, and Multiple Linear Regression Analysis were used to analyze the collected data. Findings revealed that household water consumption patterns were generally high with an overall mean of 3.86, while plumbing system failures were moderately experienced with an overall mean of 3.65. Plumbing system efficiency was rated low with an overall mean of 2.17. Correlation analysis showed a significant relationship between water consumption patterns and plumbing system failures ($r = 0.446, p < 0.05$), while no significant relationship was found between water consumption patterns and plumbing inefficiency ($r = 0.013, p > 0.05$). Regression analysis further revealed that frequency of water use significantly affected plumbing failures and inefficiency. The findings indicate that household water usage behavior contributes to plumbing failures and affects overall system performance.*

Index Terms- *Plumbing system, Water consumption, Plumbing failures, Water pressure, Residential households*

I. INTRODUCTION

Water is an essential resource in residential households and is continuously used for cooking, bathing, cleaning, and sanitation. In the Philippines, increasing population growth, urbanization, and rising domestic water demand have placed significant pressure on residential plumbing systems, particularly in highly populated communities.

Many provinces and urban areas experience common plumbing-related problems such as low water pressure, pipe leakage, drainage blockages, and inefficient water distribution due to excessive and simultaneous household water usage. According to the World Health Organization (2017), domestic water consumption increases because of sanitation requirements, household activities, and population growth. Similarly, the American Society of Civil Engineers (2021) explained that aging plumbing systems combined with heavy water demand contribute to reduced system efficiency and recurring plumbing problems.

Despite the growing concern regarding residential plumbing performance, limited local studies have specifically examined the relationship between household water consumption behavior and plumbing system failures in community-based residential settings. Existing studies commonly focus on water supply management and infrastructure conditions, but few investigate how daily household water usage patterns contribute to plumbing inefficiency and system deterioration. (Cominola et al., 2023; Morrison & Friedler, 2015).

In Brgy. Sumacab Este, Cabanatuan City, many households experience unstable water pressure, drainage blockages, and frequent plumbing maintenance concerns. However, limited studies have examined how household water consumption patterns influence plumbing system performance within residential settings (Cominola et al., 2023). This study aimed to determine whether household water usage behavior contributes to plumbing failures and inefficiency.

Specifically, the study sought to:

1. Determine the prevailing household water consumption patterns;
2. Identify common plumbing system failures experienced by households;
3. Assess the level of plumbing system efficiency;
4. Determine the relationship between water consumption patterns and plumbing system failures and inefficiency; and
5. Identify the significant risk factors affecting plumbing system performance.

The findings of this study may help homeowners, engineers, and future researchers improve residential plumbing practices and promote efficient water management.

II. METHODS

A. Research Design

The study utilized a quantitative-descriptive research design to assess household water consumption patterns as risk factors for plumbing system failures and inefficiency. Structured survey questionnaires were used to collect measurable data from residential households.

B. Locale and Respondents of the Study

The study was conducted in Brgy. Sumacab Este, Cabanatuan City. The respondents were adult household representatives aged 18 years old and above, preferably homeowners or heads of households knowledgeable about household plumbing conditions.

Based on the 2024 estimated population of 4,698 individuals in Brgy. Sumacab Este. According to the Philippine Statistics Authority (PSA), the average Philippine household size of 4 to 5 persons, the estimated number of households ranges from 940 to 1,175. For this study, the researchers used an estimated population of 1,000 households as the basis for sampling.

Using this estimation:

$$4,698 \div 5 \approx 940 \text{ households}$$

$$4,698 \div 4 \approx 1,175 \text{ households}$$

Using Slovincs Formula with a 10% margin of error and an estimated household population of 1,000 households, the computed sample size was 100 respondents.

$$\text{Slovincs Formula: } n = N/(1+Ne^2)$$

where:

n = sample size

N = estimated total population (households)

e = margin of error (10%)

C. Data Gathering Instrument

The research instrument consisted of a structured questionnaire divided into four parts:

- i. Household profile;
- ii. Water consumption patterns
- iii. Plumbing system failures; and
- iv. Plumbing system efficiency.

The questionnaire underwent validation by experts in engineering-related fields to ensure content validity and reliability.

D. Data Analysis Techniques

The gathered data were analyzed using frequency counts, percentages, weighted mean, Pearson Product-Moment Correlation, and Multiple Linear Regression Analysis. Statistical analysis was conducted to determine significant relationships and contributing risk factors affecting plumbing performance.

III. RESULTS AND FINDINGS

This chapter presents the analysis, interpretation, and discussion of the data gathered from the respondents regarding household water consumption patterns, plumbing system failures, and plumbing system efficiency in Brgy. Sumacab Este, Cabanatuan City. The results were analyzed using weighted mean, Pearson Product-Moment Correlation, and Multiple Linear Regression Analysis to determine the significant relationships and risk factors affecting plumbing system performance. The findings are presented in tables followed by corresponding interpretations and discussions

Table 1. Prevailing Household Water Consumption Patterns in Terms of Frequency of Water Use.

WATER CONSUMPTIONS PATTERNS	MEAN	REMARKS
Our household frequently uses water throughout the day.	4.45	Strongly Agree
Water usage increases during laundry or general cleaning days.	4.09	Agree
Multiple household members use water at the same time.	3.86	Agree
Water usage is highest during peak hours (morning/evening)	3.9	Agree
Faucets and fixtures are used repeatedly throughout the day.	4.29	Strongly Agree
Showers or baths usually take a long time.	4.02	Agree
Washing dishes or clothes requires extended water use.	3.88	Agree
Faucets are sometimes left running unintentionally.	3.18	Neutral
Appliances (washing machine, etc.) are used along with faucets.	3.85	Agree
Multiple fixtures are used at the same time.	3.71	Agree
Kitchen and bathroom fixtures are used simultaneously.	3.99	Agree
We turn off faucets when not in use.	4.43	Strongly Agree
Grease, food waste, or debris are disposed into sinks.	2.92	Neutral
Water is reused for cleaning or other purposes.	3.46	Agree
OVERALL:	3.86	Agree

The results show that respondents generally have high household water consumption patterns, particularly in frequent water use throughout the day, repeated use of faucets and fixtures, and simultaneous water usage among household members. The overall weighted mean of 3.86 indicates that most households consume water frequently as part of their daily activities such as

bathing, laundry, cooking, and cleaning. These findings suggest that continuous and overlapping water usage may place additional stress on residential plumbing systems, which can affect water pressure, system efficiency, and overall plumbing performance.

Table 2. Common Plumbing System Failures Experienced by Households in Terms of Physical Plumbing Defects and Water Pressure Performance

PLUMBING SYSTEM FAILURES	MEAN	REMARKS
Water dripping is frequently observed.	4	Agree
Drains become clogged.	3.7	Agree
Water drains slowly in sinks or bathrooms.	3.79	Agree
Pipe blockages occur.	3.55	Agree
Water pressure is low.	3.64	Agree
Water flow weakens during peak hours.	4.03	Agree
Water pressure suddenly changes.	3.19	Neutral
Pipes are cracked or damaged.	3.67	Agree
Faucets or showerheads are worn out.	3.34	Neutral
Plumbing fixtures require repair or replacement.	3.62	Agree
OVERALL:	3.65	Agree

The findings reveal that respondents commonly experience plumbing issues such as leakage, clogged drains, weak water flow, and pipe deterioration, indicating that plumbing problems are common

among households in the study area. Weak water flow during peak hours obtained the highest mean, suggesting that simultaneous household water usage increases water pressure demand and affects the

consistency of water distribution. These findings imply that excessive and overlapping water usage

contributes to stress and reduced performance of residential plumbing systems.

Table 3. Plumbing System Efficiency as Indicators of Plumbing System Performance and Inefficiency.

PLUMBING SYSTEM INEFFICIENCY	MEAN	REMARKS
Water flows consistently from household fixtures without sudden interruptions.	2.4	Disagree
The water pressure in our household is stable throughout the day.	2.15	Disagree
The plumbing system efficiently distributes water to different fixtures.	2.14	Disagree
Our plumbing system provides sufficient water supply for daily needs.	2.23	Disagree
Multiple fixtures can be used at the same time without affecting water flow.	2.12	Disagree
Water distribution across fixtures is consistent and without delay.	2.24	Disagree
Our plumbing system does not frequently require repairs.	2.07	Disagree
Water fixtures (faucets, shower heads) function properly and efficiently.	2.24	Disagree
There are minimal occurrences of low water pressure in our home.	2.12	Disagree
There are no noticeable leaks in our plumbing system.	2.43	Disagree
Drainage systems in our household function smoothly without blockages.	1.77	Strongly Disagree
OVERALL:	2.17	Disagree

Results show that plumbing efficiency among households is generally low, indicating that many residential plumbing systems experience performance-related problems. Drainage systems functioning without blockages received the lowest mean, suggesting that clogged or slow drainage is one of the most common plumbing concerns in the study area. This may be caused by frequent water usage,

improper disposal of waste materials, and insufficient maintenance of drainage systems. The findings imply that poor plumbing efficiency affects the consistency of water flow and the overall reliability of household plumbing systems.

CORRELATION

Table 4. Relationship Between Water Consumption Patterns and Plumbing System Failures and Inefficiency

Variables	Correlation Coefficient (r)	p-value	Remarks	Interpretation
Relationship of Water Consumption Patterns And Plumbing System Failures	0.446	0.000003	Significant at $p < .05$	Reject Ho
Relationship of Water Consumption Patterns And Plumbing System Inefficiency	0.013	0.9003	Not Significant at $p < .05$	Accept Ho
Relationship of Age and Plumbing System Failure	0.007	0.942	Not Significant at $p < .05$	Accept Ho
Relationship of Age and Plumbing System Inefficiency	-0.074	0.465	Not Significant at $p < .05$	Accept Ho
Relationship of Number of Household members and Plumbing System Failure	-0.066	0.514	Not Significant at $p < .05$	Accept Ho
Relationship of Number of Household members and Plumbing System Inefficiency	-0.046	0.653	Not Significant at $p < .05$	Accept Ho
Relationship of Age of Plumbing system and Plumbing System Failure	-0.125	0.216	Not Significant at $p < .05$	Accept Ho
Relationship of Age of Plumbing system and Plumbing System Inefficiency	0.109	0.282	Not Significant at $p < .05$	Accept Ho

The results indicate a moderate positive relationship between water consumption patterns and plumbing system failures. This suggests that increased frequency and simultaneous use of household fixtures contribute to higher plumbing stress and a greater occurrence of plumbing problems. Frequent and overlapping water usage may place excessive demand on pipes, faucets, and drainage systems, leading to issues such as weak water pressure, leakage, clogged drains, and pipe deterioration. These findings imply that household water usage behavior plays an important role in affecting the condition and performance of residential plumbing systems.

Table 5. Regression Analysis of Risk Factors Affecting Plumbing Failures

Variables	Coefficient	t-value	p-value	Interpretation
Frequency	0.287	3.031	0.003	Significant
Duration	-0.122	-1.149	0.254	Not Significant
Simultaneous Usage	0.067	0.623	0.535	Not Significant
Practices	0.168	1.900	0.061	Not Significant

REGRESSION

Table 6. Regression Analysis of Risk Factors Affecting Plumbing Inefficiency

Variables	Coefficient	t-value	p-value	Interpretation
Frequency	-0.165	-3.101	0.003	Significant
Duration	0.065	1.099	0.275	Not Significant
Simultaneous Usage	0.124	2.054	0.043	Significant
Practices	-0.026	-0.527	0.599	Not Significant

The regression analysis showed that frequency of water use significantly affects plumbing failures. Frequent fixture usage increases system stress and contributes to recurring plumbing issues such as leaks, clogged drains, and unstable water pressure. Continuous and repeated use of household plumbing fixtures may accelerate pipe wear and reduce the overall efficiency of the plumbing system. These findings suggest that high water usage frequency is one of the major factors contributing to residential plumbing problems.

The findings reveal that frequency and simultaneous usage significantly contribute to plumbing inefficiency. Frequent and overlapping use of household fixtures increases the demand for water distribution, which may affect the consistency of water flow and pressure within the plumbing system. Simultaneous usage of faucets, showers, and other fixtures can place excessive stress on pipes and drainage systems, leading to reduced plumbing performance and efficiency. These findings suggest that high water consumption behavior plays a significant role in causing inefficiency in residential plumbing systems.

IV. CONCLUSIONS AND RECOMMENDATIONS

Conclusion

1. Household water consumption patterns among the respondents were generally high, as reflected in the frequent and continuous use of water for daily household activities. Simultaneous fixture operation and increased water demand during peak hours further indicate intensive residential water usage within the study area.
2. Residential households commonly experienced plumbing system failures involving weak water flow, clogged drainage systems, leakage, and pipe deterioration. These recurring conditions suggest that many plumbing systems are subjected to continuous operational stress and maintenance-related concerns.
3. The level of plumbing system efficiency among households was generally low, particularly in terms of water pressure stability, drainage performance, and water distribution consistency. The findings indicate that existing residential

plumbing systems may not be operating under optimal conditions.

4. A significant relationship was found between household water consumption patterns and plumbing system failures, indicating that increased water demand contributes to the occurrence of plumbing-related problems. However, no significant relationship was established between water consumption patterns and plumbing inefficiency, suggesting that inefficiency may be more influenced by infrastructural and maintenance-related factors.
5. Frequency of water use emerged as the most significant factor affecting plumbing system failures among households. Moreover, both frequency and simultaneous water usage significantly contributed to plumbing inefficiency, highlighting the influence of intensive household water demand on plumbing system performance.

Recommendations

1. Households are encouraged to practice responsible and efficient water usage to help reduce excessive stress on residential plumbing systems.
2. Regular inspection and maintenance of plumbing fixtures and drainage systems should be conducted to minimize recurring plumbing failures.
3. Improvement of residential plumbing infrastructure and water distribution systems is recommended to enhance overall plumbing efficiency.
4. Greater emphasis should be placed on proper plumbing maintenance and infrastructural improvement to address plumbing inefficiency within households.
5. Future researchers are encouraged to include additional technical and engineering-related variables to further strengthen the analysis of plumbing system performance.

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