Analysis of the Effect of Using a Natural Water Filter on the Efficiency of Household Expenditure and Customer Satisfaction at Perumda Tirtanadi in Hamparan Perak Sub-District

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Clean water is a basic human need that plays a vital role in supporting health, comfort, and quality of life. Although piped water services are available through Perumda Tirtanadi, some customers still undergo additional treatment using natural water filters to improve respondents' perceptions of the quality of their daily water use. In addition to improving respondents' perceptions of water quality, the use of natural water filters also has the potential to provide economic benefits through savings on household expenses and increased customer satisfaction with clean water services. This study aims to analyze the effect of the use of natural water filters on household water expenditure efficiency and customer satisfaction at Perumda Tirtanadi in Hamparan Perak District. The study used a quantitative approach with descriptive and explanatory methods. Data were obtained by distributing questionnaires to 100 respondents selected using a purposive sampling technique. Data analysis was performed using descriptive statistics and natural linear regression. The results showed that the utilization rate of natural water filters was in the high category with an average value of 4.14. Household expenditure efficiency was also in the high category with an average value of 4.02, while the level of customer satisfaction had an average value of 3.90. The results of the regression analysis indicate that the use of natural water filters has a positive and significant effect on household expenditure efficiency and customer satisfaction with a significance value of less than 0.05. These findings indicate that the use of natural water filters can be an effective alternative to improve respondents' perceptions of the quality of water used by the community, reduce household expenditure, and increase customer satisfaction with Perumda Tirtanadi services. Therefore, the use of natural water filters can support efforts to provide more efficient and sustainable clean water at the household level.

Keywords: water filter, expenditure efficiency, customer satisfaction, clean water.

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1. Introduction

Clean water is a basic need that significantly determines people's quality of life, public health, and the sustainability of urban development. Sustainable clean water provision is a crucial part of urban facility planning and improving the quality of life [1]. The availability of water that meets physical, chemical, and microbiological standards is a key indicator of the success of public services in the water resources sector. However, many developing countries still face challenges in ensuring safe water quality at the household level. A WHO and UNICEF report indicates that access to safe drinking water services is determined not only by the availability of piped infrastructure but also by the quality of the water received by users at the point of consumption [2].

In Indonesia, urban drinking water services are largely provided by regional water companies, including the Regional Public Company (Perumda) Tirtanadi in North Sumatra Province. Although piped water service coverage continues to increase, the quality of water received by customers often declines during

distribution due to the condition of the pipe network, the age of the infrastructure, sedimentation, and secondary contamination in the distribution system. The sustainability of clean water supply systems requires an integrated approach that considers environmental, economic, and social aspects [3]. Various studies have shown that water quality at the point of household consumption can differ from the quality of water leaving the treatment plant due to distribution factors [4].

These water quality issues encourage people to perform additional treatment independently before using the water for daily needs. One widely implemented technology is a natural water filter that utilizes filtration media such as silica sand, gravel, activated carbon, zeolite, or a combination of other media. This technology falls into the household water treatment category and is considered effective in improving respondents' perceptions of water quality at the household level, with relatively low cost and high operational ease [5].

Various international studies have shown that household filtration technology can reduce turbidity levels, improve water sensory quality, and reduce the risk of microbiological contamination. Research by [5] demonstrated that household filtration systems are a practical and sustainable solution for providing safer drinking water to the community. These findings are supported by [6], who stated that household-level water treatment technology can improve respondents' perceptions of water quality while providing significant health benefits to users.

Beyond technical benefits, the use of natural water filters also has the potential to provide economic benefits to households. In practice, many piped water customers still incur additional costs for purchasing gallons of water, bottled water, or undergoing further treatment such as boiling. These expenses constitute a significant component of household consumption costs, especially in urban communities with high water consumption rates. Household spending efficiency can be achieved through the use of technology that reduces operational costs without reducing the benefits obtained [7]. Natural water filters can be viewed as a form of household investment that has the potential to reduce water consumption costs in the long term.

Conditions in Hamparan Perak District indicate that the quality of water from Perumda Tirtanadi received by customers' homes is not always clean. Initial field observations conducted in Klambir V Kebun, Hamparan, Perak Regency, found that some customers' homes experienced changes in water clarity, color, and odor during certain periods, particularly in the morning and afternoon, as well as after water distribution disruptions. This situation prompted some customers to undergo additional household water treatment before using the water for drinking and other household purposes. Although the treated water supplied by Perumda Tirtanadi meets drinking water standards at the treatment plant, changes in water quality during distribution remain a significant concern for customers as they directly impact public trust in Perumda Tirtanadi's services.

Hamparan Perak District is one of the service areas supplied by Perumda Tirtanadi and is characterized by a rapidly growing residential area on the outskirts of Medan. The district had 2,714 registered customers of Perumda Tirtanadi, with the highest concentrations located in Hamparan Perak Village (835 customers) and Klambir Lima Kebun Village (750 customers) [16]. These figures indicate that piped water has become an important source of domestic water supply for local communities, although service coverage remains uneven across villages. Most customers install or routinely use natural home water filters, while other households purchase bottled water for consumption. This empirical condition suggests that household water filtration has become a common adaptive strategy to improve respondents' perceptions of water quality while potentially reducing household water expenditure. However, scientific evidence regarding the effect of using natural household water filters on household expenditure efficiency

and customer satisfaction among Perumda Tirtanadi customers is still limited, particularly in Hamparan Regency, Perak. Furthermore, the quality of water received by customers is closely related to their level of satisfaction with the water provider's service. Service quality theory states that customer satisfaction is formed through a comparison between customer expectations and the service performance received [8]. In the drinking water sector, satisfaction indicators are determined not only by the continuity of water distribution and pressure, but also by quality aspects such as clarity, color, odor, and taste [9]. When customers experience improved water quality after using a natural filter, their perception of the water provider's service can become more positive, thereby increasing overall satisfaction levels.

Hamparan Perak District is an area experiencing rapid residential development and a high dependence on clean water services. Most residents in this area are customers of Perumda Tirtanadi, who use piped water for daily domestic needs. However, variations in public perception regarding the quality of the water they receive are still found, prompting some customers to undergo additional treatment using natural water filters.

2. Literature Review and Problem Statement

The use of household water treatment technology has become a widely used approach to improve water quality in the community. Household water filter technology can increase access to safer and more suitable water for use by the community, especially in areas that still face limited water quality to meet daily needs [5]. The effectiveness of water treatment technology is greatly influenced by the level of use and community compliance in utilizing the water filter technology sustainably [6]. Furthermore, a systematic review [10] indicates that various household water treatment technologies have good capabilities in improving the microbiological quality of water, thus potentially improving public health and well-being. These findings indicate that natural filtration technology not only has technical benefits in improving water quality but also has the potential to have social and economic impacts on user households.

Conversely, research on drinking water services indicates that customer satisfaction is influenced by various factors related to the quality of service received. Customer perceptions of the quality of drinking water service are a key determinant of customer satisfaction [8]. In the drinking water supply sector, factors such as water quality, distribution continuity, water pressure, and service responsiveness are important indicators influencing customer satisfaction [9]. Sustainable drinking water supply governance requires an integration of technical, economic, and customer satisfaction aspects to increase public trust in drinking water service providers [1]. However, most previous research has focused on the effectiveness of filtration technology in improving water quality or on drinking water service aspects separately. Research that integrates the use of natural water filters with household spending efficiency and customer satisfaction in a single analytical model is still relatively limited, particularly for customers of regional water companies in Indonesia.

3. Method

Approach

This research uses a quantitative approach with a survey method to analyze the effect of using natural water filters on the efficiency of household expenditure and customer satisfaction at Perumda Tirtanadi. A quantitative approach was chosen because it is able to produce measurements that are objective, structured, and can be analyzed statistically to identify relationships between research variables. Quantitative methods are very suitable for testing cause-and-effect relationships between variables

through numerical measurements and statistical analysis [11]. Quantitative research allows researchers to obtain an empirical picture of the phenomenon under study through systematic and measurable data collection [14].

Research Location

The research location is in the Klambir V Kebun area, Hamparan Perak District, Deli Serdang Regency, with the research target being Perumda Tirtanadi customers who use natural water filters for household water use. The research population consists of costumer of Perumda Tirtanadi who have used natural water filters to support their daily clean water needs. The research sample was determined using a purposive sampling technique, namely selecting respondents based on certain criteria that were relevant to the research objectives. The number of samples used was 100 respondents, which was considered to have met the minimum requirements for statistical analysis for quantitative research and was able to represent the characteristics of the population studied [13].

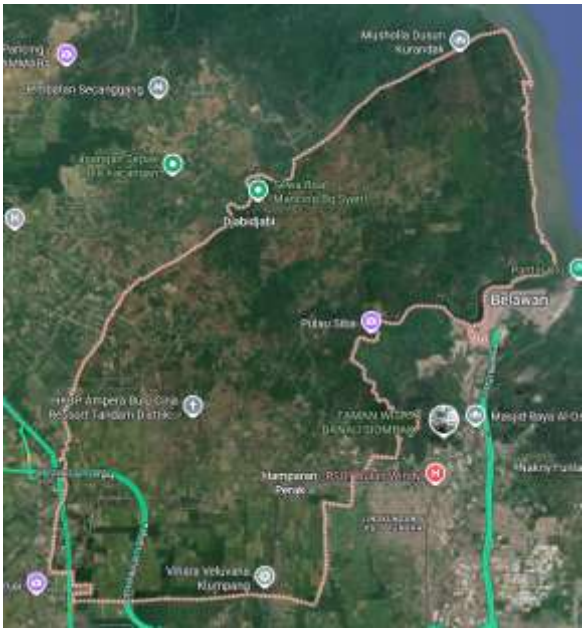

Figure 3.1. Hamparan Perak District, Deli Serdang

Research Instrument Development and Validation

Research data was collected using a questionnaire developed through several stages. The development process began with a review of previous research on household water treatment technology, household expenditure efficiency, and customer satisfaction with drinking water services [8][6][10]. The selected indicators were then adapted to the characteristics of Perumda Tirtanadi customers in Hamparan Perak Regency.

The questionnaire used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Three research variables were measured in this study. The independent variable, Utilization of Natural Water Filters (X), consisted of four indicators: frequency of filter use, ease of use, perceived benefits, and suitability of the filter for household water needs. The first dependent variable, Household Expenditure Efficiency (Y_1), was measured using three indicators: reduction in drinking water expenditure, reduction in household water treatment costs, and household expenditure efficiency. The second dependent variable, Customer Satisfaction (Y_2), consists of five indicators: perceived water quality, odor-free water, water pressure, continuity of water supply, and satisfaction with services provided by Perumda Tirtanadi. Operational definitions of each variable are presented in Table 3.1:

Table 3.1. Table of Operational Definitions of Each Variable

Variable	Indicators	Number of Indicators	Scale
Natural Water Filter Utilization (X)	Frequency of utilization, Ease of use, Perceived benefits, Suitability for household needs	4	Likert (1–5)
Household Expenditure Efficiency (Y_1)	Reduction in drinking water expenditure, Reduction in water treatment costs, Household expenditure efficiency	3	Likert (1–5)
Customer Satisfaction (Y_2)	Water quality, Odor-free water, Water pressure, Continuity of water supply, Customer service	5	Likert (1–5)

Instrument Validity and Reliability Testing

Before conducting the main statistical analysis, the questionnaire was evaluated to determine its validity and reliability. Instrument validity was examined using the Pearson Product-Moment correlation test, which measures the correlation between the scores on each questionnaire item and the total score of the corresponding variable. An item was considered valid if the calculated correlation coefficient (r-count) exceeded the critical value (r-table = 0.196, n = 100, $\alpha = 0.05$). Items with a significance value below 0.05 were also considered valid [13].

The instrument's reliability was then evaluated using Cronbach's Alpha to determine the questionnaire's internal consistency. A Cronbach's Alpha coefficient of 0.70 or higher indicates satisfactory reliability.

The validity test results show that all 12 questionnaire items have correlation coefficients ranging from 0.689 to 0.782, exceeding the critical value of 0.196, indicating that all items are valid for measuring the intended construct. Furthermore, the reliability analysis shows that the variable Utilization of Natural Air Filters reaches a Cronbach's Alpha coefficient of 0.842, Household Expenditure Efficiency reaches 0.816, and Customer Satisfaction reaches 0.879. Since all Cronbach's Alpha coefficients exceed the recommended threshold of 0.70, the questionnaire is considered reliable and suitable for further statistical analysis.

4. Results and Discussion

This section presents the results of data analysis obtained from 100 respondents of Perumda Tirtanadi customers in Hamparan Perak District who use or know about the use of natural water filters. Analysis was carried out to describe the characteristics of respondents, the level of use of natural water filters, the efficiency of household expenditure, and the level of customer satisfaction [15]. This research also tests the effect of using a natural water filter on household expenditure efficiency and customer satisfaction using natural linear regression analysis. The research results are presented in tabular form and interpreted based on theory and relevant previous research to obtain a more comprehensive understanding of the benefits of using natural water filters for the Perumda Tirtanadi customer community.

Respondent Characteristics

The research involved 100 respondents from Perumda Tirtanadi customers in Hamparan Perak District who use or know about the use of natural water filters. The majority of respondents were male (54%) and were in the productive age group 36–50 years (44%). Most respondents had a high school education level (52%), while the other 48% were college graduates. This characteristic shows that respondents have a relatively good level of understanding of household water treatment technology so they are able to provide an objective assessment of the benefits of using a natural water filter.

Table 4.1. Respondence Characteristic

Characteristic	Total	Persentage (%)
Men	54	54,0
Women	46	46,0
20-35 years old	38	38,0
36-50 years old	44	44,0
> 50 years old	18	18,0
Senior High School	52	52,0
University	48	48,0

The validity of the instrument

The validity of the instrument was evaluated using the Pearson Product-Moment correlation coefficient, which measures the correlation between each questionnaire item and the total score of the corresponding variable. An item was considered valid when the calculated correlation coefficient exceeded the critical value (rcount > rtable = 0.361; n = 30; α = 0.05) and the significance value was less than 0.05 [13]. The instrument's reliability was then examined using Cronbach's Alpha, where an alpha coefficient greater than 0.70 indicates satisfactory internal consistency and reliable measurement. Validity of the instrument presented in table 4.2 :

Table 4.2. Table of Validity of the Instrument

Variable	Number of Items	Corrected Item–Total Correlation	Decision
Natural Water Filter Utilization	4	0.648–0.864	Valid
Household Expenditure Efficiency	3	0.582–0.791	Valid
Customer Satisfaction	5	0.601–0.842	Valid

The instrument evaluation results showed that all questionnaire items met validity criteria, with corrected item-total correlation coefficients ranging from 0.582 to 0.864. Furthermore, all study variables demonstrated good internal consistency. The variable "Utilization of Natural Water Filters" obtained a Cronbach's Alpha coefficient of 0.846, Household Expenditure Efficiency obtained a Cronbach's Alpha coefficient of 0.812, and Customer Satisfaction obtained a Cronbach's Alpha coefficient of 0.874. These findings indicate that the research instrument is valid and reliable, making it suitable for measuring respondents' perceptions regarding the utilization of natural water filters, household expenditure efficiency, and customer satisfaction.

Table 4.3. Reliability Test Results

Variable	Cronbach's Alpha	Interpretation
Natural Water Filter Utilization	0.846	Reliable
Household Expenditure Efficiency	0.812	Reliable
Customer Satisfaction	0.874	Reliable

Utilization Rate of Natural Water Filters

The research results shows that the use of natural water filters is in the high category with an overall average value of 4,14. The indicator with the highest value is the benefits of water filters (4,25), which shows that respondents feel real benefits from using filters in improving household water quality. Meanwhile, the ease of use indicator obtained an average value of 4,08 indicating that this technology is relatively easy for the public to implement.

Table 4.4. Level of Natural Water Filter Utilization

Indicator	Mean
Frequency of use	4.12

Indicator	Mean
Ease of use	4.08
Benefits of water filters	4.25
Suitability to household needs	4.10
Average	4.14

Household filtration technology can improve the perception of water quality as well as being a practical solution for water treatment at the household level [5]. Household water treatment technology will be very effective if used consistently by the community [10].

Efficiency of Household Expenditures

The average household expenditure efficiency score is 4,02 which shows that respondents feel the economic benefits of using a simple water filter. Reducing drinking water expenditure received the highest score (4,05), followed by overall household expenditure efficiency (4,02).

Table 4.5. Household Expenditure Efficiency

Indicator	Mean
Reduction in drinking water expenses	4.05
Reduction in water treatment costs	3.98
Household expenditure efficiency	4.02
Average	4.02

These results shows that the use of natural water filters provides direct economic benefits to households. This technology allows households to reduce their dependence on bottled water and additional water treatment processes that require higher costs. Household expenditure efficiency theory, which states that appropriate technology can reduce household operational costs without reducing the benefits received [7].

Customer Satisfaction

The research results show that customer satisfaction is included in the high category with an average score of 3,90. Water quality received the highest score (4,15), while water pressure received the lowest score (3,72).

Table 4.6 Customer Satisfaction Level

Indicator	Mean
Water quality	4.15
Odor-free water	4.08
Water pressure	3.72
Continuity of water supply	3.80
Customer service	3.76
Average	3.90

These findings indicate that the main benefits of a simple water filter are felt in terms of improving the physical quality of water rather than improving the performance of the distribution service system. These findings support the SERVQUAL theory developed [8] who emphasized that perceived service quality is the main determinant of customer satisfaction.

The Effect of Natural Water Filter Utilization on Household Expenditure Efficiency

The regression analysis revealed that the utilization of simple water filters has a positive and significant effect on household expenditure efficiency, with a regression coefficient of 0.682 and a significance level of 0.000.

Table 4.7. Regression Results for Household Expenditure Efficiency

Variable	B	t	Sig
Constant	1.245	3.120	0.002
Water Filter Utilization	0.682	8.451	0.000

The regression equation obtained is:

$$Y_1 = 1.245 + 0.682X$$

This equation indicates that every one-unit increase in simple water filter utilization will increase household expenditure efficiency by 0,682 units. The coefficient of determination (R^2) was 0,421, meaning that 42,1% of the variation in household expenditure efficiency can be explained by the utilization of simple water filters.

The Effect of Simple Water Filter Utilization on Customer Satisfaction

The regression analysis also showed that simple water filter utilization has a positive and significant effect on customer satisfaction, with a regression coefficient of 0.541 and a significance level of 0.000.

Table 4.8. Regression Results for Customer Satisfaction

Variable	B	t	Sig
Constant	1.587	3.541	0.001
Water Filter Utilization	0.541	6.732	0.000

The regression equation obtained is:

$$Y_2 = 1.587 + 0.541X$$

The coefficient of determination (R^2) was 0,357, indicating that 35,7% of the variation in customer satisfaction can be explained by the utilization of natural water filters.

Discussion

This study shows that the use of natural household water filters has a positive and statistically significant effect on household expenditure efficiency and customer satisfaction. However, the magnitude of the effect differs between the two dependent variables. The coefficient of determination indicates that the use of natural water filters explains 42.1% of the variation in household expenditure efficiency, while its contribution to customer satisfaction is 35.7%.

The stronger effect on household expenditure efficiency can be explained by the direct economic benefits derived from household water treatment. Respondents reported that the use of natural water filters reduced their reliance on bottled water and the need to repeatedly boil water before consumption. As a result, households experienced reduced expenditures related to bottled water purchases, fuel, and electricity consumption. This finding is consistent with the household consumption theory [7] which states that households continually adjust their expenditure patterns in response to increased access to essential public services. When low-cost water treatment technologies become available, households can reallocate some of their expenditures to other essential needs while still maintaining safe drinking water consumption.

Household water treatment technologies only yield health and economic benefits if used consistently over time [6]. Point-of-use water treatment technologies improve drinking water safety while reducing dependence on alternative water sources. This study extends previous findings by showing that, in the context of Perumda Tirtanadi customers, natural water filters contributed not only to improved perceptions of water quality but also to measurable increases in household expenditure efficiency [5]. This suggests that household filtration technology should be viewed not only as a health intervention but also as a household economic adaptation strategy in areas where perceptions of piped water quality still vary.

Although the use of natural water filters significantly increased customer satisfaction, the effect was smaller than its effect on household expenditure efficiency. These results reflect the multidimensional nature of customer satisfaction in public water services. Customer satisfaction is determined not only by the quality of the product received but also by several service dimensions, including reliability, responsiveness, assurance, empathy, and tangibility [8]. In this study, respondents gave the lowest average score for water pressure (3.72) and relatively moderate scores for service continuity (3.80) and customer service (3.76), indicating that technical and operational aspects of the distribution system remain important determinants of customer satisfaction despite improvements in household water quality.

These findings suggest that improving household water quality through natural water filtration alone cannot fully meet customer expectations regarding piped water services. Stable water pressure, uninterrupted distribution, prompt complaint handling, and transparent communication regarding water quality remain important components of overall service quality. Consequently, customer satisfaction should be interpreted as a combined outcome of household water treatment practices and the operational performance of Perumda Tirtanadi.

From a practical perspective, these findings offer several important implications for the development of clean water services. First, Perumda Tirtanadi should strengthen distribution system management to minimize pressure fluctuations and improve service continuity, thereby reducing customer reliance on additional water treatment at home. Second, regular monitoring and public dissemination of water quality information should be implemented to increase public trust in piped drinking water. Third, community education programs promoting appropriate household water treatment technologies can serve as a complementary strategy to improve public health while reducing household expenses. Finally, integrating distribution infrastructure improvements with community-based water treatment initiatives can contribute to more sustainable urban drinking water management, particularly in rapidly developing suburban areas like Hamparan Perak.

5. Conclusion

1. The utilization of simple water filters among Perumda Tirtanadi customers in Hamparan Perak District was relatively high and provided positive benefits in improving household water quality, reducing household expenditures, and increasing customer satisfaction.
2. The results of the regression analysis demonstrated that simple water filter utilization has a positive and significant effect on both household expenditure efficiency and customer satisfaction. However, the effect on household expenditure efficiency ($R^2 = 0.421$) was stronger than its effect on customer satisfaction ($R^2 = 0.357$), indicating that the economic benefits of filter utilization are more directly perceived by households.
3. These findings are consistent with previous studies by [6] and [5] which reported that household water treatment technologies can improve water quality while generating economic benefits. The

results also support the service quality perspective of [8] which emphasizes that customer satisfaction is influenced by multiple factors beyond product or technology utilization alone.

4. The study highlights the practical importance of simple water filters as an affordable household water treatment technology that can contribute to both economic efficiency and improved perceptions of water quality. Therefore, the promotion of simple water filter utilization may serve as a complementary strategy to support sustainable drinking water management and enhance community welfare.
5. This study is limited by its focus on a single study area and the use of one main explanatory variable. Future research is recommended to include broader geographic coverage, larger sample sizes, and additional variables such as service quality, water consumption behavior, socioeconomic conditions, and distribution system performance to provide a more comprehensive understanding of factors influencing household water management and customer satisfaction.

6. References

[1] Lubis, R. P., Harahap, R. H., & Zuska, F. “Model of Sustainable Drinking Water Governance at Tirta Kualo Regional Drinking Water Corporate in Tanjungbalai City, Indonesia”. International Journal of Sustainable Development & Planning, 17(8). Vol. 17, No. 8, pp. 2421-2426. 2022. https://doi.org/10.18280/ijsdp.170809

[2] WHO & UNICEF. Progress on Household Drinking Water, Sanitation and Hygiene 2000–2022: Special Focus on Gender. Geneva: World Health Organization and United Nations Children's Fund. 2023

[3] Lubis, R. P. Best Future Penyedia Air Bersih Berkelanjutan Sebagai Perencanaan Di Wilayah Perkotaan. CV. Cattleya Darmaya Fortuna. 2024.

[4] Bivins, A., Sumner, T., Kumpel, E., Howard, G., Cumming, O., Ross, I., Nelson, K., & Brown, J. ‘Estimating infection risks and the global burden of diarrheal disease attributable to intermittent water supply using QMRA’. Environmental Science & Technology, 51(13), 7542–7551. American Chemical Society, 2017.

[5] Sobsey, M. D., Stauber, C. E., Casanova, L. M., Brown, J. M., & Elliott, M. A. ‘Point of Use Household Drinking Water Filtration: A Practical, Effective Solution for Providing Sustained Access to Safe Drinking Water in the Developing World”. *Environmental Science & Technology*, 42(12), 4261–4267. 2008.

[6] Brown, J., & Clasen, T. “High adherence is necessary to realize health gains from water quality interventions”. PLoS ONE, 7(5), e36735. Public Library of Science. 2012.

[7] Deaton, A. The Analysis of Household Surveys: A Microeconometric Approach to Development Policy. Washington DC: World Bank Publications. [1997]

[8] Parasuraman, A., Zeithaml, V. A., & Berry, L. L. “SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality”. Journal of Retailing, 64(1), 12–40. 1998

[9] Van den Berg, C., & Danilenko, A. “The IBNET Water Supply and Sanitation Performance Blue Book. Washington DC: World Bank”. 2017

[10] Rao, G., Wells, E., Reynolds, C., Yoo, R., Kowalsky, E., DeFrance, J., Linden, K., & Brown, J. Systematic Review of the Microbiological Performance of Household Water Treatment Technologies. Environmental Science & Technology, 59(41), 21776–21789. American Chemical Society. 2025

[11] Creswell, J. W. “*Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (4th ed.)”. Thousand Oaks, CA: Sage Publications. 2014

[12] Sekaran, U., & Bougie, R. “*Research Methods for Business: A Skill-Building Approach* (7th ed.)”. Chichester, United Kingdom: John Wiley & Sons. 2016

[13] Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. *Multivariate Data Analysis* (7th ed.). Harlow, England: Pearson Education Limited. [2014]
[14] Sugiyono. " *Metode Penelitian Kuantitatif, Kualitatif, dan R&D"*. Bandung: Alfabeta. 2019
[15] Lubis, R. P., & Sugiarto, A. "Edukasi Pemanfaatan Air Hujan Untuk Sumber Air Bersih Masyarakat Sebagai Perencanaan Wilayah Desa Klambir V Kebun, Kecpamatan Hamparan Perak Deli Serdang". Jurnal Masyarakat Indonesia (Jumas), 3(02), 134–139. 2024
[16] BPS Kabupaten Deli Serdang, Kecamatan Hamparan Perak Dalam Angka 2021