DESIGN OF A WEB-BASED PAMSIMAS APPLICATION WITH WHATSAPP GATEWAY NOTIFICATION IN LUBUK BEGALUNG VILLAGE USING SIMPLE ADDITIVE WEIGHTING (SAW)

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Abstract - The Community-Based Drinking Water and Sanitation Supply Program (Pamsimas) aims to improve access sto clean water and proper sanitation in rural areas. However, administrators often face challenges in managing water bill payments, which are still handled manually and lack notification systems, resulting in frequent payment delays. This study proposes the development of a web-based billing application integrated with a WhatsApp Gateway notification system to enhance the timeliness and transparency of payments. Using the Simple Additive Weighting (SAW) method, the system prioritizes customers based on bill amount, payment delays, and payment frequency. This approach is intended to improve administrative efficiency and customer convenience in managing rural water supply services in Kampung Lubuk Begalung. The application is expected to support better payment management and strengthen the sustainability of the Pamsimas program by reducing late payments and increasing community awareness of timely payment obligations.

Keywords—Pamsimas, Information System, WhatsApp Gateway Notification, SAW Method.

I. INTRODUCTION

The Community-Based Drinking Water and Sanitation Supply Program (Pamsimas) is an initiative by the Indonesian government aimed at improving public access to safe drinking water and proper sanitation. This program is implemented by the Ministry of Public Works and Housing (PUPR) in collaboration with local governments and communities. Pamsimas focuses on developing drinking water and sanitation systems in rural and urban areas that lack adequate infrastructure.

Active community participation in planning, implementation, and maintenance of infrastructure is a key factor in the program's success. Through Pamsimas, the government aims to ensure sustainable access to drinking water and sanitation services while promoting clean and healthy living behaviors.

Since its inception in 2008, Pamsimas has successfully expanded access to drinking water and sanitation services in approximately 12,000 villages across 233 districts/cities [1]. One of the villages benefiting from this program is Kampung Lubuk Begalung, located in Kenagarian Aur Begalung Talaok, Bayang District, Pesisir Selatan Regency. The Pamsimas program in this village began in 2019 and continues to enhance access to clean water services for the community.

However, administrators face challenges in managing water bill payments. The manual payment process requires residents to visit the office or wait for the administrators to remind them personally at their homes. The lack of a notification system often causes residents to forget or delay their payments, which affects Pamsimas' administration and the smooth operation of the clean water service.

To address this issue, integrating information technology presents a potential solution. Developing a web-based Pamsimas water bill payment application with notifications via WhatsApp Gateway can enhance efficiency and user convenience. WhatsApp notifications allow residents to receive real-time reminders about their bills, payment confirmations, and other important information, reducing late payments and raising awareness of timely bill payments.

Additionally, to assist administrators in determining customer billing priorities, implementing the Simple Additive Weighting (SAW) method can be an effective solution. SAW is a Decision Support System (DSS) technique used to rank alternatives based on multiple criteria by assigning weights and calculating a total score for each option. In the context of customer billing, relevant criteria include bill amount, payment

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delays, and payment frequency. Using the SAW method, administrators can objectively and systematically determine billing priorities.

Previous research has explored the application of the SAW method in billing prioritization. For example, in the journal "Decision Support System for Installment Billing Prioritization" [2], the SAW method was used to prioritize installment collections in cooperatives. The study found that SAW effectively helps determine billing priorities objectively and accurately [3].

Therefore, the purpose of this study is to design and implement a web-based billing application integrated with WhatsApp notifications and the SAW method to improve billing efficiency in the Pamsimas program in Kampung Lubuk Begalung.

II. METHODOLOGY

A. Application

Applications are essential tools in the advancement of information and communication technology. Generally, an application is software designed to assist users in completing specific tasks on various digital platforms [4][5]. Rather than discussing general-purpose software like Microsoft Word or mobile banking, this study focuses on a web-based application tailored for the management of community water billing. This application aims to streamline administrative processes by automating billing notifications and assisting in priority assessments for collections. Applications of this kind are particularly valuable in community service programs such as Pamsimas, where efficiency, accessibility, and responsiveness to user needs are critical.

A. Pamsimas (Community-Based Drinking Water and Sanitation Provision)

Pamsimas (Penyediaan Air Minum dan Sanitasi Berbasis Masyarakat) is a government program in Indonesia designed to improve access to safe drinking water and sanitation facilities, particularly in rural and underserved urban areas. Implemented by the Ministry of Public Works and Housing (PUPR), it emphasizes community participation in planning, implementation, and maintenance to ensure sustainability and self-management.

1. Pamsimas Bukit Dama Indah

One of the beneficiaries of this program is Bukit Dama Indah, a settlement in Lubuk Begalung Village, Nagari Aur Begalung Talaok, Bayang District, Pesisir Selatan Regency. The Pamsimas infrastructure in this village was established in 2019 through the Rural Drinking Water Grant Program (Dana Hibah Air Minum Perdesaan) under the national budget (APBN) in the 2021 fiscal year.

Fig 1. Pamsimas Bukik Dama Indah

B. WhatsApp Gateway Notification

A WhatsApp Gateway enables automatic, programmatic communication through the WhatsApp platform by integrating with external systems via API [7]. In this study, the WhatsApp Gateway is implemented to automate the delivery of water billing notifications to residents. This approach leverages WhatsApp's wide user base in Indonesia, ensuring messages such as bill reminders and confirmations are promptly received and read.

Compared to traditional communication methods (e.g., SMS or in-person collection), WhatsApp notifications significantly improve efficiency and responsiveness. System administrators benefit from reduced manual work, while users gain timely reminders that help avoid overdue payments. Moreover, WhatsApp enables two-way communication, allowing residents to respond with payment confirmations or questions—making it a practical and scalable solution for public service interactions.

Although similar communication technologies have been used in other contexts, this study applies WhatsApp Gateway specifically within the rural public utility service domain, addressing the unique communication habits and technological literacy levels of local communities.

C. System Development Method

This study adopts the Waterfall Model, a classic and structured software development methodology. Each phase—requirements, design, implementation, testing, deployment, and maintenance—is executed sequentially [8]. This model ensures that project requirements are clearly defined and documented before proceeding to the development stage, which is particularly beneficial for public-sector projects where compliance and documentation are critical.

The Waterfall Model is selected due to its simplicity and suitability for systems with stable requirements, such as the Pamsimas billing application. Its structured approach also supports thorough verification at each stage, minimizing risk and ensuring quality outcomes in community service implementations.

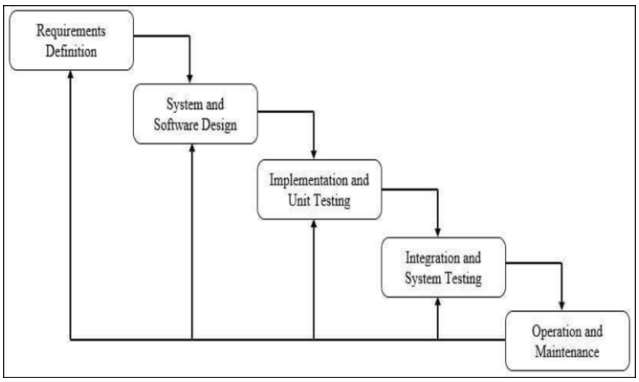

Fig 2. Waterfall Mode

D. Simple Additive Weighting (SAW)

The Simple Additive Weighting (SAW) method is a widely recognized multi-criteria decision-making technique used in Decision Support Systems (DSS). It calculates a weighted sum of normalized performance ratings to rank alternatives [9]. The normalization process allows different types of criteria (e.g., bill amount, payment timeliness, frequency) to be compared on a common scale.

The steps in SAW include:

1. Determining criteria (e.g., total bill, delay period),
2. Assigning weights to each criterion,
3. Normalizing the decision matrix based on benefit or cost types,
4. Calculating the final score for each alternative.

The alternative with the highest score is prioritized in the billing process.

SAW offers several advantages, including simplicity, structured prioritization, and logical transparency [10][11]. It has been effectively used in various sectors, particularly for ranking or selection problems in cooperative and loan payment systems.

Unlike previous studies that focused on cooperative installment prioritization [2][3], this study applies the SAW method within a rural public utility service setting, where behavioral, infrastructural, and digital literacy challenges are distinct. The integration of SAW into a web-based application for community water service billing demonstrates a novel approach to optimizing service operations through automated and objective prioritization mechanisms.

E. Unified Modeling Language (UML)

Unified Modeling Language (UML) is a graphical language used to visualize, specify, construct, and document the components of object-oriented (OO) software development systems. UML provides a standardized blueprint for describing systems, including business process concepts, class structures in specific programming languages, database schemas, and the components required in a software system. In this design, four UML diagrams are used: Use Case Diagram, Activity Diagram, Sequence Diagram, and Class Diagram.

1. *Use Case Diagram*

The use case diagram for this web-based Pamsimas system involves two actors who use the application: the administrator and the customer. Each actor has their own specific roles, such as managing user accounts, viewing bills, and managing service data. For more details, refer to the use case diagram of the Pamsimas system below.

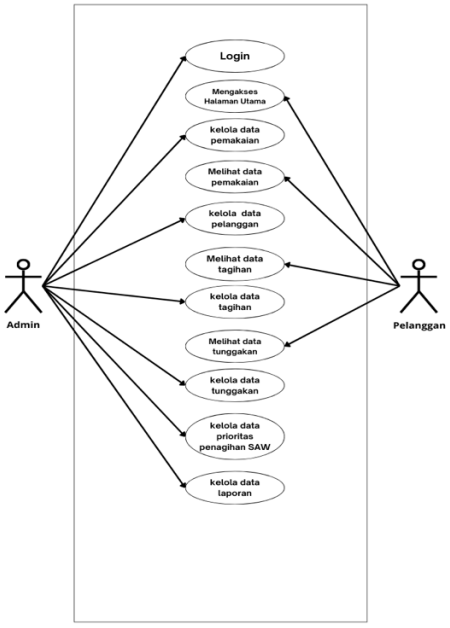

Fig 3. Use Case Diagram

2. *Activity Diagram*

An Activity Diagram is a diagram that models the workflow or sequence of activities in a process, referring to the existing Use Case Diagram. The Activity Diagram describes the functionality of a use case by illustrating the flow of activities that provide value to the actor.

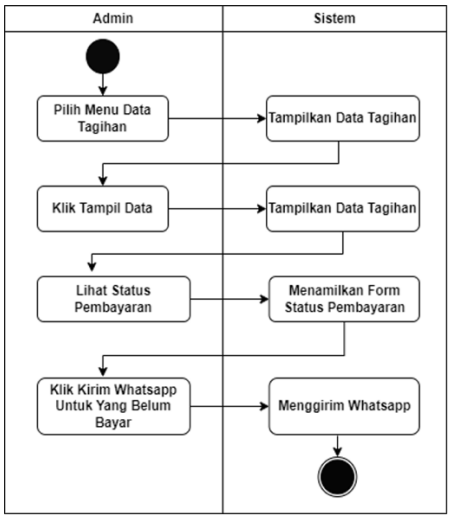

Fig 4. Use Case Diagram

This is the design of the Billing Activity Diagram. The diagram describes the activities of the admin in managing customer billing data. Additionally, if a customer is late in making a payment, the admin can send a reminder alert or WhatsApp notification to the customer through the application or website.

3. Class *Diagram*

This Class Diagram illustrates the system structure by defining the classes that will be created to build the system. The details can be seen in the diagram

below:

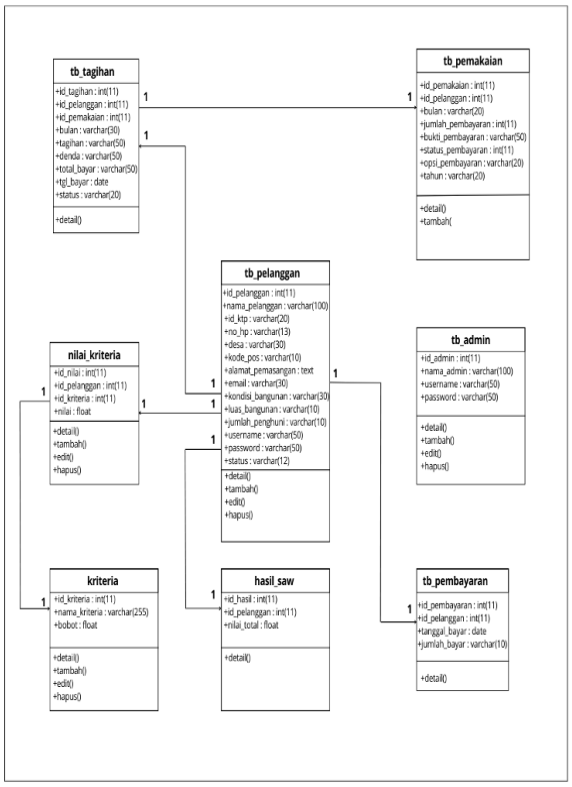

Fig 5. Class Diagram

III. RESULTS AND DISCUSSION

A. Results and Discussion

Based on the design and implementation stages described in the previous chapter, this chapter presents the results of the system implementation and testing. The implementation results will be analyzed to evaluate the performance, effectiveness, and usability of the application in supporting the web-based Pamsimas water bill payment process with WhatsApp Gateway notifications.

1. Main Page

The main page displays menus for customer registration, usage simulation, system information, and customer login.

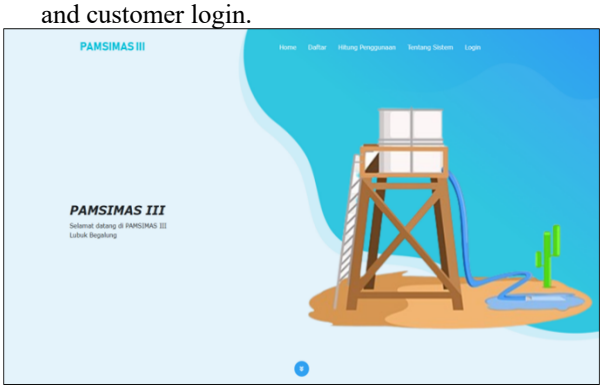

Fig 6. Main Page

2. Customer Registration Page

On this page, customers register to create an account and gain access to the system.

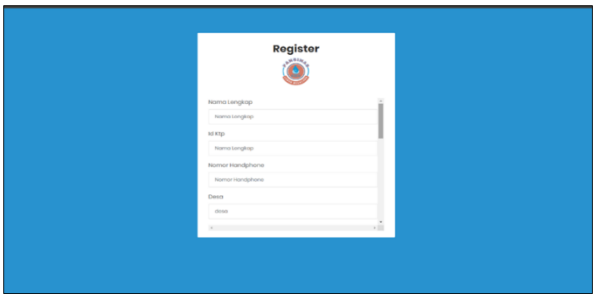

Fig 7. Customer Registration Page

3. Customer Login Page

On this page, customers log in to the system by entering their username and password. If the login is successful, they will be redirected to the customer dashboard. If the login fails, they will be returned to the login page.

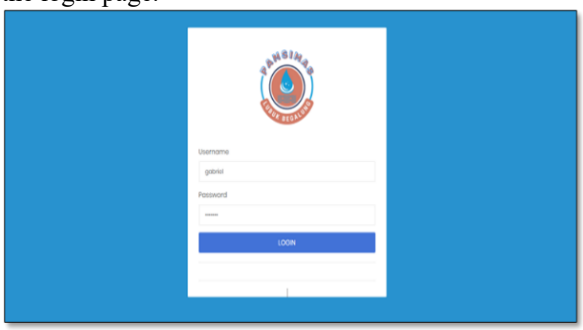

Fig 8. Customer Login Page

4. Customer Dashboard Page

This page displays the customer dashboard menu, which includes usage data, billing data, and overdue payment data.

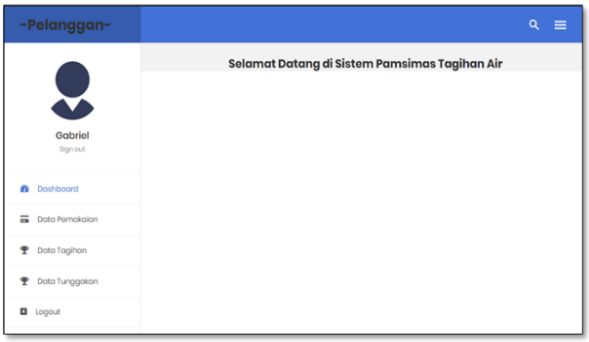

Fig 9. Customer Dashboard Page

5. Customer Usage Data Page

This page displays the customer's water usage data, which can only be viewed by the customer.

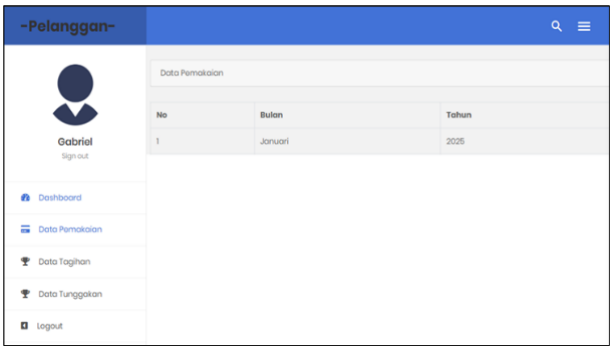

Fig 10. Customer Usage Data Page

6. Customer Billing Data Page

On this page, customers can view their payment status and make payments either via bank transfer or direct payment. For bank transfers, customers are required to upload proof of transfer through this menu.

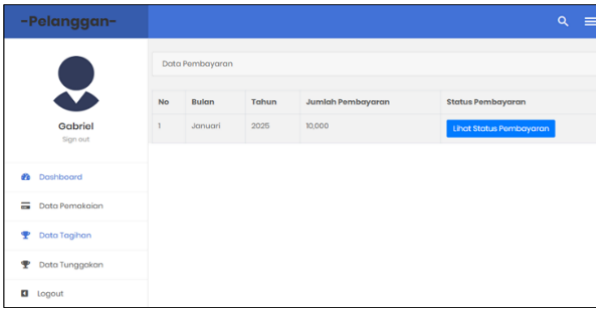

Fig 11. Customer Billing Data Page

7. Admin Login Page

On this page, the admin logs into the system by entering a username and password. If the login is successful, they will be redirected to the admin dashboard. If the login fails, they will be returned to the login page.

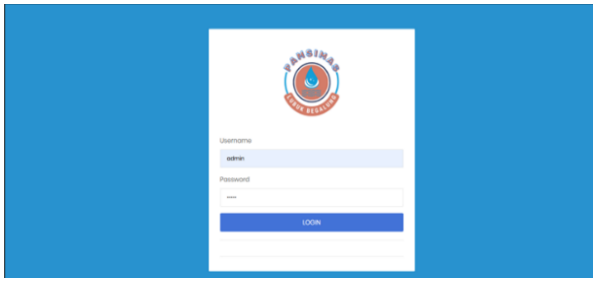

Fig 12. Admin Login Page

8. Admin Dashboard Page

This page contains several menus for the admin, including usage data, customer data, billing data, overdue payment data, decision support system (SAW), admin data, and reports.

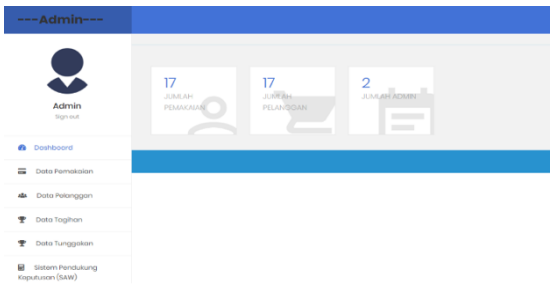

Fig 13. Admin Dashboard Page

9. Admin Usage Data Menu Page

On this page, the admin can view and input customer usage data on a monthly basis.

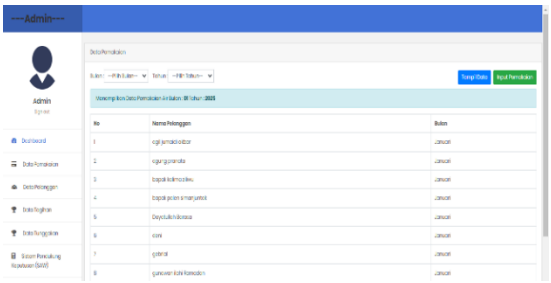

Fig 14. Admin Usage Data Menu Page

10. Admin Billing Management Page

On this page, the admin can view billing data, payment statuses, and send billing notifications to each customer via WhatsApp.

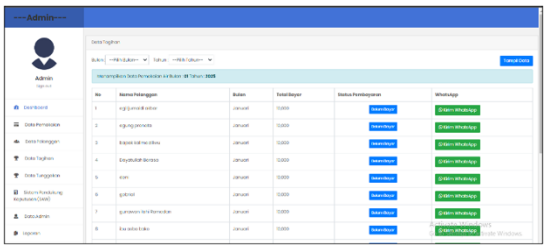

Fig 15. Admin Billing Data Menu Page

11. Admin Outstanding Payments Data Menu Page

On this page, the admin can only view outstanding payment and customer payment statuses.

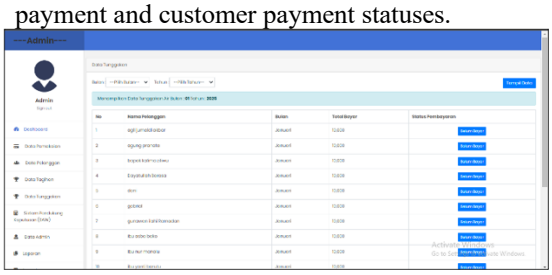

Fig 16. Admin Outstanding Payments Data Menu Page

12. Decision Support System (SAW) Page – Admin

On this page, the admin performs calculations to determine customer billing priorities using the SAW (Simple Additive Weighting) method. The admin first adds the necessary criteria, then inputs the criteria values for each customer. After that, the system automatically performs the calculation when the "Calculate SAW" button is clicked. The system normalizes the values and generates the final result based on the computation.

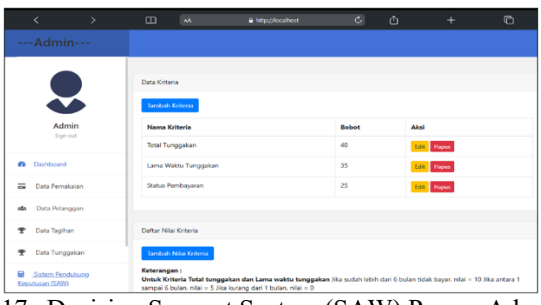

Fig 17. Decision Support System (SAW) Page – Admin

13. Admin Data Management Page

On this page, the admin can add, edit, and delete admin account data.

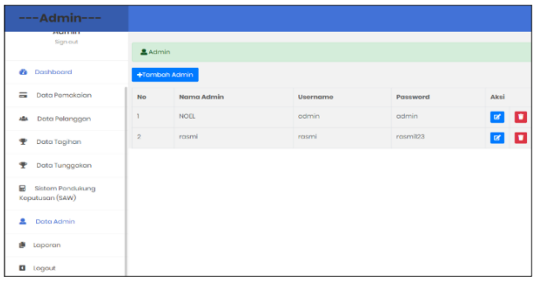

Fig 18. Admin Data Management Page

14. Reports Page

On this page, the admin can print report data.

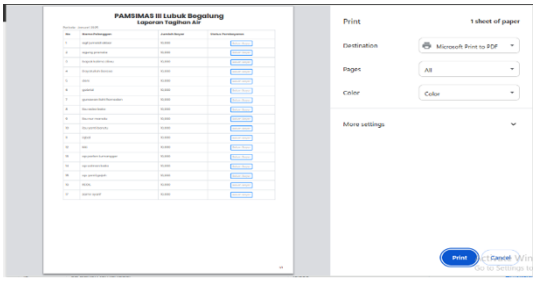

Fig 19. Reports Page

SYSTEM TESTING

System testing uses GTmetrix which aims to evaluate the performance and access speed of a website. Testing is done by entering the system URL on the GTmetrix home page. Figure 12 shows an example of testing with GTmetrix.

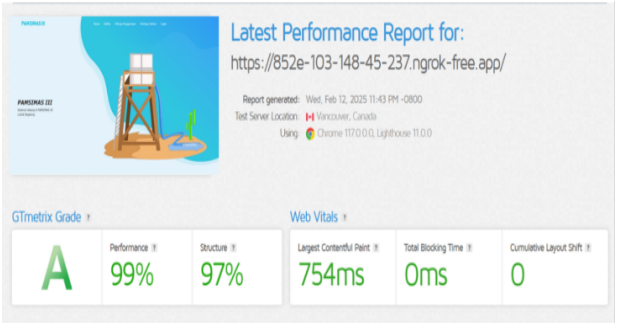

Fig 20. GTmetrix Testing

Based on the results of testing conducted on the website https://852e-103-148-45-237.ngrok-free.app/ using GTmetrix, it can be concluded that the site demonstrates excellent performance, achieving a GTmetrix Grade of A. More specifically, the site recorded a Performance score of 99% and a Structure score of 97%, indicating highly optimized loading speed and an efficient page structure.

The Web Vitals analysis provides essential insights into the user experience when accessing the website. The Largest Contentful Paint (LCP) was measured at 754 ms, indicating that the largest element on the page loads very quickly, thereby enhancing the perceived loading speed of the site.

Furthermore, a Total Blocking Time (TBT) of 0 ms indicates that there was no blocking of the main thread during page load, demonstrating that the website can respond to user interactions without significant delay.

In addition, the Cumulative Layout Shift (CLS) score of 0 signifies that there were no unexpected layout shifts during the loading process, ensuring visual stability and a comfortable experience for users.

The testing was carried out using Google Chrome version 117.0.0.0, supported by Lighthouse version 11.0.0, ensuring that the analysis was conducted using modern tools that align with the latest web standards.

Table 1
GTmetrix Testing

Category	Value	Description
GTmetrix Grade	A	The site performance is excellent.
Performance	99%	The site has highly optimal loading speed.
Structure	97%	The page structure is efficient and well-optimized.
Largest Contentful Paint (LCP)	754 ms	The largest element on the page loads very quickly, improving the perceived speed.
Total Blocking Time (TBT)	0 ms	No time was lost due to main thread blocking, ensuring optimal responsiveness.
Cumulative Layout Shift (CLS)	0	No layout shifts occurred during loading, ensuring visual stability and user comfort.

Browser Used	Chrome 117.0.0.0	The testing was conducted using the latest version of Google Chrome.
Lighthouse Version	11.0.0	Analysis was performed using a modern tool that meets current web standards.

IV. CONCLUSIONS

Based on the results of the research and implementation conducted, the following conclusions can be drawn:

1. The water bill payment system in Kampung Lubuk Begalung was previously carried out manually, resulting in delays in payment and creating challenges in administrative management for Pamsimas administrators. This manual process often led to inefficient data handling and inconsistent follow-ups.
2. The absence of an automated notification system caused many customers to forget or delay their payments. This issue significantly disrupted the continuity and operational reliability of the community's clean water services.
3. The development of a web-based billing application integrated with WhatsApp Gateway notifications proved to be an effective solution. After implementation, approximately 80% of users made timely payments upon receiving automated WhatsApp reminders, compared to only 40% prior to the system. This not only improved the efficiency of the billing process but also allowed residents to access billing information more conveniently from their mobile devices.
4. The application of the Simple Additive Weighting (SAW) method in the system successfully supported administrators in prioritizing customer billing based on objective criteria such as outstanding amounts, frequency of delays, and total usage. Administrators reported a 30% reduction in the time required to identify priority customers, and expressed that the system greatly facilitated decision-making and customer management.
5. Overall, the integration of web technology, automated notifications, and a structured decision-support algorithm (SAW) has enhanced the transparency, responsiveness, and operational effectiveness of the Pamsimas service in Kampung Lubuk Begalung.

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