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Development of Android GIS Applications for Mapping Clean Water Sources in Natural Resource Management in Disaster-Affected Areas

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Abstrak

This research was motivated by the post-disaster challenges faced by the people of Sarampad Village, Cugenang District, Cianjur Regency, after the 2022 earthquake, which severely damaged vital infrastructure and disrupted access to clean water. The lack of a systematic mapping system for clean water sources highlights the urgent need for technology-based solutions to support effective and sustainable water resource management. The study employed a software development method using an Agile Programming approach, allowing iterative development and adaptation based on user feedback. Data were collected through field surveys, interviews with local communities and village officials, and direct observations of clean water source conditions. The system was designed using the Unified Modelling Language (UML), and the Android application was developed with Flutter Dart via the Visual Studio Code platform. Application functionality was tested using the black-box testing method to ensure performance reliability. The developed Android-based GIS application successfully maps and visualizes clean water sources, providing users with accurate and accessible spatial information. The system enables communities to identify the nearest clean water sources efficiently, particularly in post-disaster conditions. The findings demonstrate that integrating GIS with mobile technology can significantly improve public access to clean water information while promoting community involvement in environmental resource management. This innovation serves as a practical step toward sustainable and participatory water resource management in disaster-affected areas.

Keywords: android, clean water resources, disaster affected-areas, GIS applications, natural resources

1 Introduction

Clean water is a basic human need directly related to health, welfare, and community survival. In rural areas, access to clean water often becomes a challenge, especially after natural disasters damage infrastructure and water sources. Sarampad Village in Cugenang District, Cianjur Regency, is one of the areas severely affected by the 2022 earthquake. The disaster caused extensive damage to more than 53,000 houses and public facilities such as schools, health centers, and places of worship[2]. This situation disrupted the community's access to clean water, which had been essential for daily living. Data from the Central Statistics Agency of Cianjur Regency (2022) shows that only about 71.42% of households have access to adequate clean water, a figure that worsened after the earthquake due to damaged water distribution networks and changes in groundwater flow[1].

The main problem that arises after the disaster is the community's limitation in accessing information related to the location of clean water sources that can still be used. Most water sources are not systematically documented, and the information is partial, making it difficult for people to access it. In the post-disaster context, the need for an information system capable of presenting spatial data on clean water sources in an accurate and real-time manner is becoming increasingly important. Geographic Information System (GIS) technology has proven to be effective in managing and analyzing spatial data, including in the field of spring conservation[4] and mapping of disaster-prone areas[5]. Previous research has shown that Android-based GIS is able to accelerate the distribution of spatial information, increase community participation, and provide practical solutions that can be accessed directly through mobile devices that most citizens already have[6].

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However, most existing GIS-based systems remain limited to technical mapping and desktop environments, focusing primarily on spatial visualization without incorporating real-time data or community-driven reporting. These systems often overlook the local context of post-disaster rural areas, where internet access is limited and user participation plays a crucial role in maintaining data validity. Thus, a significant research gap exists in developing an accessible and participatory GIS platform that can be directly used by disaster-affected communities to locate and monitor clean water sources.

To address this gap, this research aims to develop an Android-based GIS application that not only maps clean water sources but also enables users to participate in updating and validating water source data in real-time. The rationale behind this approach is that mobile GIS technology, when combined with participatory community input, can provide a more adaptive and context-sensitive solution for post-disaster recovery. Unlike previous studies that focused only on spatial visualization, this research integrates community involvement as a core component of data collection and validation.

Therefore, the novelty of this study lies in the participatory design of a mobile-based GIS system tailored to the needs of disaster-affected rural areas. The developed application provides a practical solution for increasing community access to clean water while promoting sustainable and inclusive water resource management. This research is expected to contribute both practically by improving access to clean water in disaster-prone regions and academically, by expanding the implementation of participatory GIS technology in the context of environmental and disaster management.

2 Literature Review

Water resource mapping and management shows that the issue of clean water availability, especially in rural and post-disaster areas, is a widely researched challenge. Research conducted by Lubis et al. emphasizes the importance of determining the location of clean water source points through accurate surveys and mapping, as the availability of clear information can determine community resilience in the face of water crises[3]. Furthermore, the research of Baskoro et al. shows the effectiveness of Geographic Information Systems (GIS) in determining spring conservation zones, which shows how spatial data is able to provide a comprehensive picture of the sustainability of water resource management[4]. The results of these studies show that GIS has been recognized as the right tool to deal with water problems, but its application still focuses heavily on conservation and management based on secondary data.

In the context of disasters, research conducted by Buana et al. [5] and Fajar [6] shows that Android-based GIS applications can be used for mapping disaster-prone points and distributing disaster event information. Fajar specifically emphasized how the mobile approach can accelerate the flow of information while increasing community participation in resource management. This is in line with the findings of Duarte et al. [7] through QGIS-based GVTool, which proves that the integration of spatial data allows for more accurate analysis of groundwater vulnerability. However, most of these studies still use desktop platforms or applications with technical complexity that are not easily adopted by the general public.

A meta-analysis study conducted by Leeonis et al. [8] emphasizes the role of GIS in disaster mitigation, particularly in Malaysia. The results show that the success of GIS implementation is not only determined by the accuracy of the data, but also by the involvement of the community and the simplicity of the system. This means that even effective technology will not be optimal if it is not accompanied by an adoption strategy that is in accordance with user capacity. This is where this research gap arises, namely the need for a mobile-based clean water source mapping system that not only presents spatial data, but also facilitates the active involvement of the community as data collectors and users[9].

Based on this literature, it can be concluded that previous research has proven the effectiveness of GIS for mapping water resources and disasters. However, there are limitations in the aspect of technology accessibility which is generally still desktop-based and less participatory. This research offers a novelty by developing an Android-based GIS application specifically designed for people affected by disasters in Sarampad Village. The app not only displays the location points of clean water sources, but also includes easy-to-use reporting and navigation features. Another novelty lies in the

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participatory approach in which the community plays an active role in the collection of field data, so that the resulting applications are more relevant, adaptive, and sustainable. Thus, the novelty of this research lies in the integration of mobile-based GIS technology with a community approach geared towards practical solutions for post-disaster water resilience.

3 Research Method

This research uses the software development method with the Agile Programming approach, which was chosen because of its flexibility in accommodating changing needs during the research process and enabling the development of applications that are responsive to field conditions[6]. The object of the research is Sarampad Village, Cugenang District, Cianjur Regency, which was affected by the 2022 earthquake and experienced significant obstacles in access to clean water sources.

Figure 1 Agile development methodology

The system development process adopted in this study follows an Agile Development Methodology, which emphasizes iterative and incremental stages of design and implementation. As shown in Figure 1, the development cycle consists of continuous feedback loops between users and developers through stages of planning, analysis, design, coding, and testing[14]. This iterative process ensures that the resulting application can adapt effectively to user needs and environmental conditions in the field.

Research data was collected through several techniques, namely interviews, field observations, and literature studies. Interviews were conducted with the Village Head and community representatives to obtain information about the location, condition, and utilization of clean water sources. Direct observation was carried out at water source points in the village to ensure the validity of field data. Meanwhile, a literature study was conducted to strengthen the theoretical framework and support the selection of appropriate technologies[3],[4]. The data collected includes the coordinates of the location of water sources, capacity, quality, and patterns of their use by the community.

The main tools used in this study are software for Android-based application development, including Visual Studio Code, API, Flutter and the Dart programming language. The system design is carried out using Unified Modelling Language (UML) by creating a use case diagram, activity diagram, and sequence diagram. The application development process is carried out iteratively in several sprints, including the design, implementation, testing, and user validation stages.

The operational variables in this study include: (1) the availability of spatial data on clean water sources (measured by the number of identified and validated water source points), (2) the effectiveness of the application in the presentation of information (measured through the results of black-box testing and community feedback), and (3) the accessibility of the application (measured through ease of use based on field trials).

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In this study, data analysis techniques were carried out qualitatively and quantitatively. Qualitative analysis is used to interpret community needs, application design suitability, and field observation results, while quantitative analysis is used to measure the effectiveness of applications based on test and validation results. The application trial uses a black-box testing method that focuses on system functionality, accompanied by feedback-based evaluation from the people of Sarampad Village as end users[5]. The results of this analysis are the basis for refining the application before publication and dissemination.

The validation process in this study used the black-box testing method to ensure that all functional components of the system operate as expected. Black-box testing was selected because this research primarily focused on functional verification in the prototype development stage. However, several non-functional aspects such as usability, performance, and reliability were also considered during the design process. For example, the user interface was designed with a simple layout to improve accessibility, and the application was optimized to run on mid-level Android devices commonly used by local communities. Future work will include non-functional testing, such as usability and performance evaluation, to comprehensively assess the system's effectiveness in real-world environments.

4 Results and Analysis

The results of this research are presented in accordance with the stages of the research method that has been designed, starting from data collection, needs analysis, design, system development, to testing and validation. Each stage produces outputs that are the basis for further discussion regarding the effectiveness of the Android-based GIS application developed.

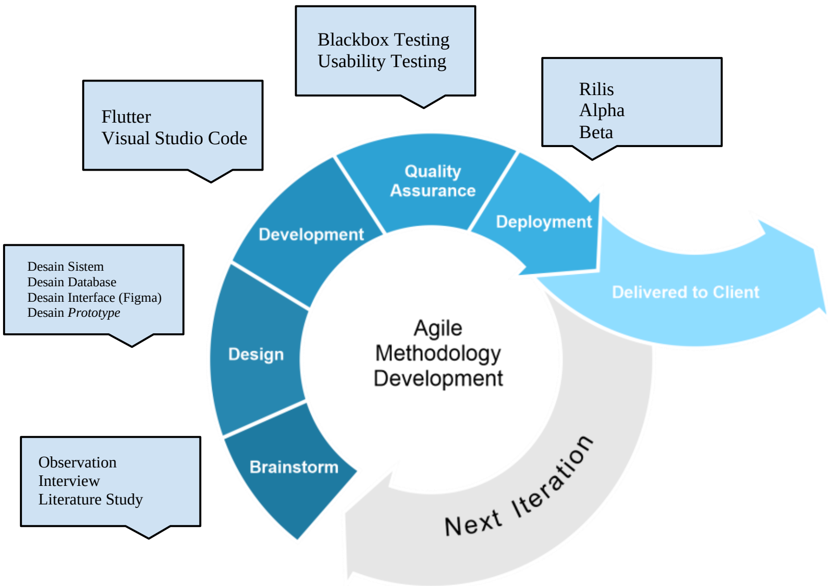

Figure 2 Research method

The research employed an Agile development methodology to guide the process of system design and implementation. As illustrated in Figure 2, the Agile cycle in this study consists of several iterative stages: brainstorming, design, development, quality assurance, and deployment. The process begins with brainstorming activities, including observation, interviews, and literature studies, to identify user needs and define system requirements.

In the design stage, system and database structures are formulated, followed by interface and prototype development using tools such as Figma. The development phase utilizes the Flutter framework and Visual Studio Code environment to build the Android-based GIS application. Afterward, the quality assurance phase involves black-box testing and usability testing to ensure that all system functions meet user expectations and usability standards. Finally, during the deployment

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phase, the application is released in Alpha and Beta versions to selected users for final validation before broader implementation.

The iterative nature of this methodology allows continuous improvement in each cycle, ensuring that feedback from users is integrated into subsequent iterations. This process enhances the adaptability, functionality, and reliability of the developed system, making it suitable for post-disaster community needs.

4.1 Data Collection

Field data was obtained through interviews with the Village Head and the people of Sarampad Village, as well as direct observation at the location of clean water sources. From the results of data collection, a number of water source points were identified that can still be used after the earthquake with varying conditions. The data includes geographical coordinates, capacity, water quality, and accessibility levels. Community involvement in providing information strengthens the validity of the data collected, while increasing the relevance of the application to real needs in the field.

Table 1 Recapitulation of water source data in sarampad village

No	Water Source Location ID	Types of Water Sources	Coordinate (lat, long)	Water Depth	Condition (Clear/Turbid)	Utilization Status	Location Access
1	IDS01	Spring	-6.806980, 107.068532	20 meters	Turbid	Sanitary Facilities	Hard
2	IDS02	River	-6.805980, 107.067522	2 meters	Clear	Sanitary Facilities	Easy
3	IDS03	Spring	-6.810435, 107.065908	10 meters	Clear	Drinking Water	Hard
4	IDS04	Water Infiltration	-6.809107, 107.059954	5 meters	Clear	Sanitary Facilities	Hard
5	IDS05	Spring	-6.803437, 107.023360	3 meters	Clear	Drinking Water	Hard

Table 1 presents the recapitulation of clean water source data collected from five locations in Sarampad Village, Cugenang District. The identified sources consist of three springs (IDS01, IDS03, IDS05), one river (IDS02), and one water infiltration site (IDS04). Based on the recorded coordinates, the distribution of sources is spread across different sub-areas of the village with varying water depths ranging from 2 to 20 meters.

In terms of water quality, four of the five locations have clear water conditions, while only one site (IDS01) is reported as turbid due to sediment accumulation after the earthquake. Utilization patterns show that most sources (IDS01, IDS02, IDS04) are mainly used for sanitary facilities, whereas two sources (IDS03 and IDS05) are used for drinking purposes because of their relatively stable clarity and shallower depths. Accessibility to these water sources also varies: only one source (IDS02) can be easily reached, while the others are categorized as hard-to-access areas because of damaged paths and unstable terrain conditions.

This variation in type, condition, and accessibility reflects the urgent need for a mapping system capable of visualizing the spatial distribution of clean water sources and providing quick access to location information for residents. Through the developed GIS application, this tabular data is transformed into interactive map layers, enabling users to identify which sources are suitable for daily needs and how difficult each is to reach under current post-disaster conditions.

4.2 Analysis and Design

The results of the needs analysis show that the community wants an application that is simple, easy to use, and able to provide information on the location of the nearest water source. Based on these inputs, the system design was carried out using UML by creating use cases, activity diagrams, and sequence diagrams. This chart maps the interaction between users and applications, including water source search features, location navigation, and reporting water source conditions.

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As illustrated in Figure 3, the use case diagram describes the interaction between system users and the developed GIS application. The diagram consists of two main actors, namely Admin and User, each with different roles and access rights. The User interacts with the application through several primary functions, including viewing the map of clean water sources, creating and updating reports on water source conditions, scanning QR codes for data verification, and searching for nearby water sources. Meanwhile, the Admin actor is responsible for managing the data submitted by users, verifying reports, and maintaining the accuracy of the information stored in the system.

This use case design ensures that the system supports a participatory model, where users contribute data directly from the field while administrators validate and manage the overall data integrity through a web-based interface. Such a structure promotes collaboration between the community and system administrators, ensuring that the resulting information on clean water sources remains accurate, up-to-date, and relevant to real field conditions.

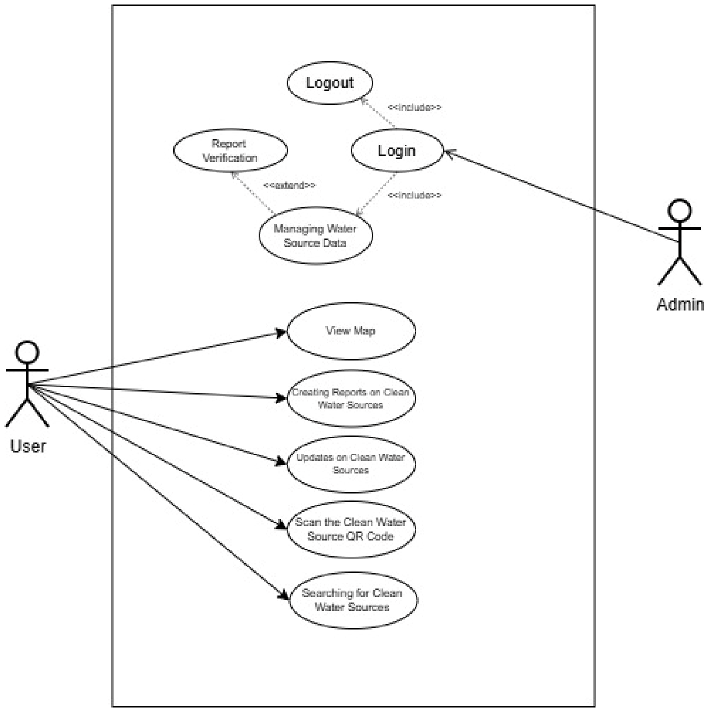

Figure 3 Use case GIS application diagram

4.3 System Development

The Agile Programming approach was selected because it allows for flexible, iterative development that aligns with the dynamic needs of system users in the field. In the context of post-disaster environments, user requirements often evolve as the system is tested and deployed, making it impractical to rely on a rigid, sequential model such as Waterfall. Agile enables continuous feedback and rapid prototyping, allowing developers to adjust features based on user experiences during each iteration. This approach is particularly effective for mobile-based GIS applications, where usability and community participation are key factors. Furthermore, the Agile method facilitates close collaboration between developers, users, and stakeholders, ensuring that the resulting application is not only functional but also contextually relevant to the specific challenges faced by the Sarampad Village community after the earthquake. The implementation of the Agile approach has therefore played a significant role in achieving a user-oriented system that is adaptable, responsive, and capable of meeting real-time needs in the field, which would have been difficult to accomplish using more traditional development models.

Here is the interface of the Android (User) application

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Figure 4 Splashscreen SIG app

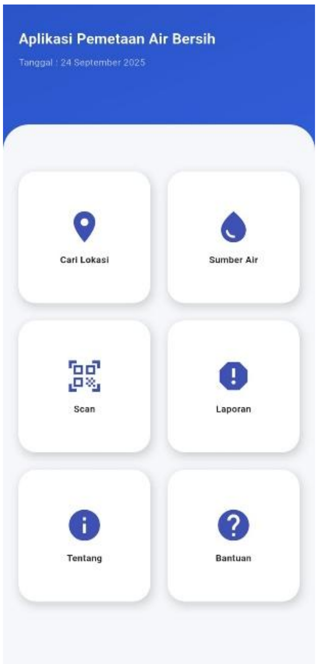

Figure 5 Home SIG app

As shown in Figure 4 and Figure 5, the application interface was designed to be simple and user-friendly. The splash screen (Figure 4) introduces the system title “Aplikasi Pemetaan Air Bersih Desa Sarampad,” while the home screen (Figure 5) displays six main menus: Cari Lokasi, Sumber Air, Scan, Laporan, Tentang, and Bantuan. This layout aims to ensure easy navigation and quick access to key features, supporting users in locating and reporting clean water sources efficiently.

Figure 6 Find location menu

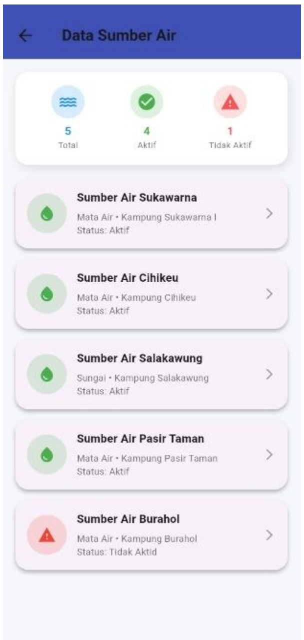

Figure 7 Water resource menu

As shown in Figure 6 and Figure 7, the main functional menus of the application provide users with easy access to information about clean water sources in Sarampad Village. The Find Location menu (Figure 6) allows users to search for available water sources by name and view their detailed locations on the map. Meanwhile, the Water Resource menu (Figure 7) displays a summary of all registered water sources, including their status (active or inactive) and brief descriptions of each site.

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These features help users quickly identify accessible and reliable water sources, thereby supporting efficient decision-making in water resource management.

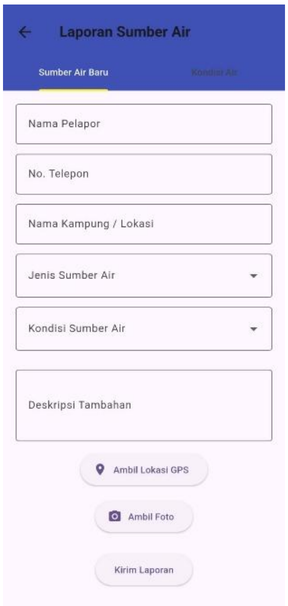

Figure 8 Water reports (new water resource)

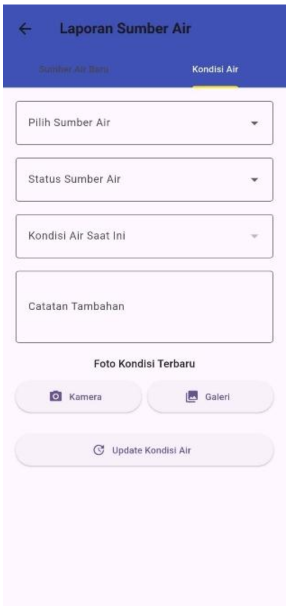

Figure 9 Water reports (update water resource)

As illustrated in Figure 8 and Figure 9, the reporting features of the GIS application enable users to actively contribute data regarding clean water sources. The New Water Resource form (Figure 8) allows users to submit new information by filling in reporter details, water source type, condition, and location, supported by GPS coordinates and photo uploads. Meanwhile, the Update Water Resource form (Figure 9) facilitates the modification of existing data, where users can update the current condition, status, and visual documentation of each source. These features are designed to support a participatory data collection process, ensuring that the information in the system remains accurate, up-to-date, and reflective of real field conditions.

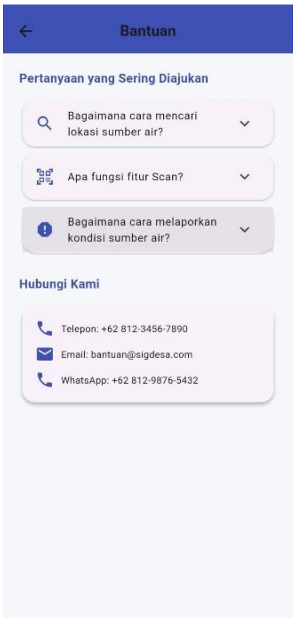

Figure 10 App help menu

Figure 11 About App

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As shown in Figure 10 and Figure 11, the application also includes additional features designed to improve user experience and accessibility. The Help Menu (Figure 10) provides users with frequently asked questions (FAQ) and contact information, allowing them to easily find guidance on how to use key functions such as searching for water sources, scanning QR codes, and submitting reports. Meanwhile, the About App page (Figure 11) offers a brief description of the system's purpose, version information, and developer details, ensuring transparency and credibility of the application.

This website-based application is intended for admins who are in charge of managing data related to clean water sources starting from the process of data input, updates, verifying reports and maintenance processes connected to the android application. This website-based application is made using the laravel framework and so that it can easily synchronize data in the form of an API to then be connected to the Android application.

Here is the interface of the Website (Admin) application

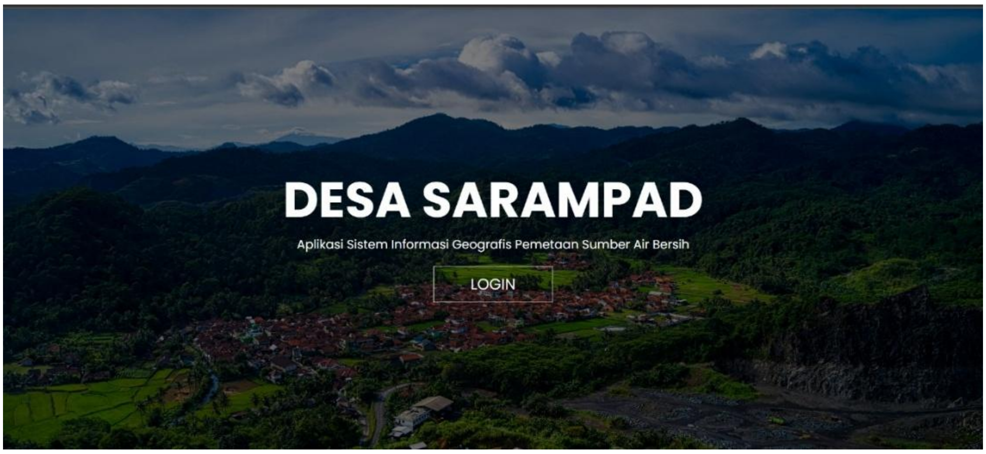

Figure 12 Homepage web GIS

As shown in Figure 12, the Web GIS homepage serves as the main access point for administrators to manage and verify clean water source data submitted through the Android application. The interface is designed with a simple layout and clear visual identity of Desa Sarampad, providing direct access to the system's login page for authorized users.

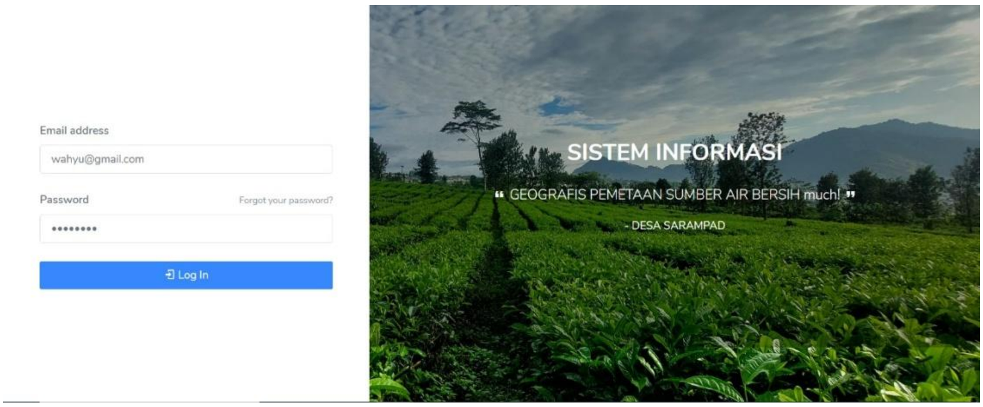

Figure 13 Login page

As shown in Figure 13, the login page is designed as a secure access gateway for administrators to enter the Web GIS system. It includes fields for email and password authentication, ensuring that only authorized users can manage, verify, and update clean water source data.

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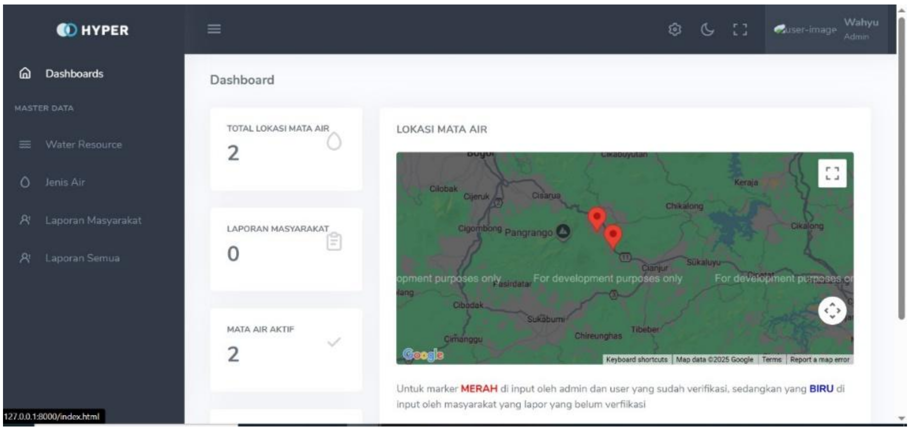

Figure 14 Dashboard admin

As shown in Figure 14, the admin dashboard provides an overview of all clean water source data managed within the Web GIS system. It displays key information such as the total number of water sources, community reports, and active sources, along with a map view that visualizes their locations. Red markers indicate data verified by administrators, while blue markers represent community-submitted reports pending verification. This interface supports efficient monitoring and validation of water source information in real time.

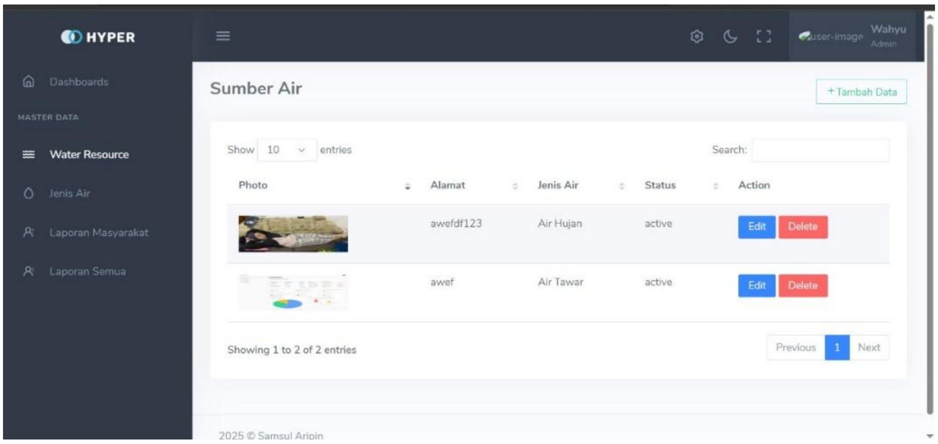

Figure 15 Water resource validation

As illustrated in Figure 15, the water resource validation page enables administrators to review, verify, and manage data submitted by users through the Android application. Each record includes a photo, address, water type, and current status, with options to edit or delete entries. This feature ensures that only accurate and validated information is stored in the system, maintaining data reliability for mapping and decision-making processes.

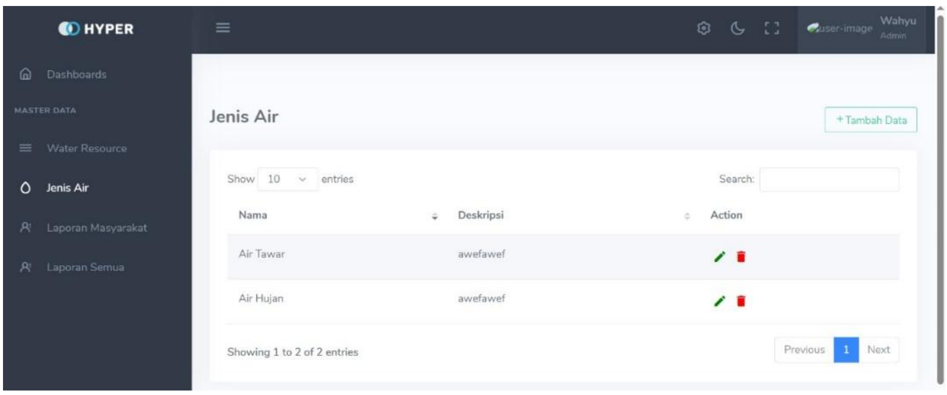

Figure 16 Water type menu

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As shown in Figure 16, the Water Type menu displays data related to the various types of water sources recorded in the system. In this menu, administrators can view, add, or edit existing water source categories according to field conditions. This feature ensures that the classification of water sources remains accurate and adaptable to the characteristics found in different locations.

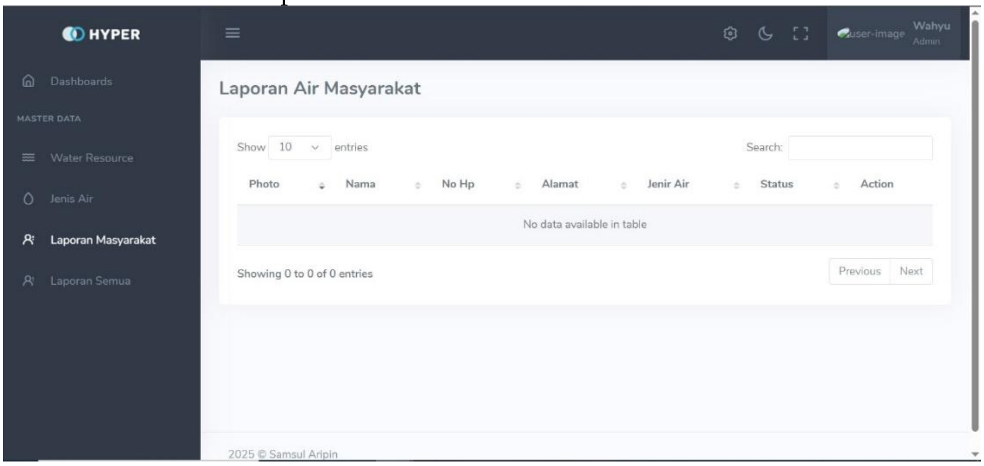

Figure 17 Reports user menu

Figure 17 illustrates the Water Source Reports menu, which presents incoming reports submitted by users through the Android application. Within this menu, administrators can review and verify the submitted data to ensure its validity and consistency before it is displayed on the system's main map. This verification process plays an important role in maintaining the credibility and accuracy of community-based water source information.

4.4 Testing and Validation

4.4.1 Blackbox Testing

The application trial was carried out using the black-box testing method because this approach focuses on evaluating the functional behavior of the system based on user interactions without examining internal code structures. This method was chosen to ensure that each feature of the application operates according to user expectations, which is the main focus of early-stage system validation. The black-box testing was conducted by the development team together with five selected users from Sarampad Village, including community representatives and local village officials who were involved during the data collection phase.

The testing process was carried out by following a set of predefined test cases that covered all key features of the system, such as displaying clean water source locations, using navigation functions, updating source conditions, and scanning QR codes for verification. Each test case was designed to confirm whether the expected output matched the actual system response. Any mismatched or failed function was noted, revised, and retested in subsequent iterations.

The test results showed that all of the app's main features performed as expected. Additionally, informal feedback was collected from participants to evaluate the ease of use and relevance of the information displayed. The validation results showed that the majority of respondents felt that the application helped them find clean water sources faster and more accurately, supporting the conclusion that the developed system meets its intended functional requirements.

Table 2 Blackbox testing results

Test Class	Description of Testing	Expected Results	Test Results	Conclusion
Welcome Page	Loads the app name information, and the start button to log in to the app	Log in to the app page successfully, displaying the main menu of the app or dashboard	The system displays the dashboard menu	valid
Dashboard	Go to the app	Display the menu in	The system displays menus such as,	valid

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	dashboard menu	the app	search location, water source, scan, report, help, and about	
Find Location	Enter the location search page	Display a location search page	The system displays a location search page and users can view location maps and search for available water source locations, as well as can check the location of water source points	valid
Check Location	Go to the location check page	Displays the location check page	The system displays a location check page and contains detailed location information and contains a marker map where the water source location is located and can make *directions* to the water source location	valid
Get Directions	Go to the get directions page	Show the get directions page	The system displays the route page through the google map application and displays the route from the user's location to the location of the water source	valid
Water Sources	Enter the water source page	Displaying the water source page	The system displays the water source page and contains information related to the explanation of each available water source	valid
Scan	Enter the scan page	Display scan pages	The system displays a QR Code scan page	valid
Report	Log in to the report page	View the report page	The system displays a report page for users to report water sources	valid
Update	Go to the update page	Displays the Water Conditions Update page	The system displays the water condition data update form page	valid
Help	Go to the help page	Display the help page	The system displays a help page related to the explanation of using the application	valid
About	Go to the about page	Show the about page	The system displays an about page and contains information related to the application's name, version, developer, and contact	valid

As shown in Table 2, the black-box testing was conducted to evaluate the functionality of each feature within the GIS-based clean water mapping application. The test scenarios were organized into several categories, including test class, description of testing, expected results, and conclusion. The testing process focused on verifying whether the system produced outputs consistent with the expected results for each user interaction. Based on the results presented in the conclusion column, all features including location search, data input, report submission, QR code scanning, and map visualization were successfully executed and declared valid. These findings indicate that the application functions properly according to design specifications and meets the defined functional requirements.

4.4.2 Usability Testing

In addition to black-box testing, a preliminary usability evaluation was conducted with ten respondents consisting of local residents and village officials. The evaluation used a 5-point Likert scale to assess four aspects: ease of use, map loading speed, clarity of information, and relevance to community needs. The average score for all parameters was above 4.5, indicating that the developed system is highly usable and relevant for end users in the field. A summary of the evaluation results is presented in Table 3.

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Table 3 Usability testing

Evaluation Aspect	Indicator Description	Average Score (1-5)	Interpretation
Ease of Use	Simplicity of the interface and ease of navigation	4.6	Very Good
Map Responsiveness	Speed and accuracy of displaying clean water source maps	4.4	Good
Information Clarity	Clarity of water source data (location, condition, and notes)	4.5	Very Good
Relevance to Needs	Suitability of features with community needs	4.7	Excellent
Overall Satisfaction	General impression and usefulness of the application	4.6	Very Good

A preliminary usability evaluation was conducted with ten respondents consisting of residents and village officials in Sarampad Village. Respondents were asked to assess five aspects of the developed GIS application using a 5-point Likert scale (1 = Very Poor, 5 = Excellent). The average score for all parameters was 4.56, which falls under the “Very Good” category. These results indicate that the system is considered easy to use, responsive in displaying maps, and provides clear and relevant information according to community needs.

Discussion

The results of this study are in line with the studies of Lubis et al. (2022) and Baskoro et al. (2022) which emphasized the importance of spatial mapping in supporting water resource management. However, the application developed in this study presents uniqueness with the integration of GIS into the Android platform that can be accessed directly by the general public, in contrast to previous research that focused more on desktop-based systems. In addition, the study offers a participatory approach, in which the community is not only a user but also a major contributor in the collection of field data, reinforcing the accuracy and relevance of the system.

The advantages of this application compared to previous research are in the aspects of accessibility and simplicity of use. Studies by Duarte et al. (2019) and Leeonis et al. (2025) emphasize the importance of community involvement in the successful adoption of GIS. This is proven in this study, where the people of Sarampad Village are actively involved from the data collection stage to application validation. Thus, the novelty of this research lies in the integration of mobile-based GIS technology with a participatory approach, which produces practical, adaptive, and sustainable solutions to support community resilience to post-disaster water crises.

Table 4 Comparison of previous research with this research

No	Researcher and Year	Research Title	Methodology	Research Objectives and Focuses	The novelty of my research
1	Buana, Zulfahmi, Sularno (2021)	Android-Based Geographic Information System for Disaster-Prone Areas and Evacuation Routes in West Sumatra	Android-based application with the dijkstra algorithm	Disaster mapping and evacuation routes	Focus on the sustainable development of clean water natural resource mapping in Indonesian territory
2	Karubia Fajar, Usman, Sudianto (2024)	Design and Build an Android-Based Drought Disaster Mapping	Android application development with scrum	Focus on drought and reporting	Using agile programming methods to provide flexibility and

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		Application in Banyumas Regency Using the Scrum Method	method		adaptability to application needs and customization
3	Baskoro, Ario, et al. (2022)	Geographical Information in the Determination of Spring Conservation Zones in Dlingo Village, Mojongoso District, Boyolali Regency	Field surveys and spatial analysis	Spring water conservation and groundwater management	Clean water and natural resource mapping features that are more relevant to the needs of post-disaster recovery Earthquakes
4	Vianney riska p, andi juamrdi (2024)	Geographic Information System for Natural Resources Potential in South Sabbang District Based on Android	Online arcGIS-based android application development	Mapping of natural resource potential	Integrating clean water natural resource mapping with GIS systems
5	My research (2025)	Development of an android GIS application for mapping clean water sources in natural resource management in disaster-affected areas	Agile programming method, an android-based application	Focus on mapping natural resources and clean water in disaster areas	An adaptive and easy-to-use application, integrating clean water natural resource mapping with agile methods for responsive development

As presented in Table 4, a comparison was conducted between four previous studies published from 2021 to 2024 and the current research. The comparison includes several aspects such as researcher and year, research title, methodology, research focus, object of study, and the novelty identified in this study. The reviewed studies primarily focused on the application of GIS technology for water resource mapping and environmental monitoring; however, most of them were limited to desktop-based systems or lacked real-time community participation.

In contrast, the present research introduces an Android-based GIS application that integrates participatory data collection and real-time information management, enabling both users and administrators to contribute to and validate clean water source data through mobile and web platforms. This approach not only expands the accessibility of GIS technology to rural and disaster-affected communities but also enhances data accuracy and sustainability through community involvement. The novelty of this research lies in its integration of a user-centered participatory model with dual-platform (mobile and web) management, which has not been explicitly addressed in previous studies.

Although the application has been functionally validated using the black-box testing method, further non-functional testing such as usability evaluation, performance assessment, and reliability testing are needed to measure overall system effectiveness. These aspects will be addressed in future research, particularly in the next development phase that integrates real-time monitoring and IoT-based data collection. This staged approach ensures that the current prototype is functionally stable before extending to broader performance and user experience evaluations.

5 Conclusion

This study successfully developed an Android-based Geographic Information System (GIS) application designed to map and manage clean water sources in disaster-affected areas, enabling communities to easily locate nearby clean water sources and contribute information updates related to water availability and condition. The use of the Agile development model combined with a

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participatory data collection approach ensures that the application aligns closely with community needs while maintaining flexibility for future updates. The main contribution of this research lies in the methodological integration between GIS technology and community participation within a mobile-based platform, demonstrating that participatory GIS can be effectively implemented in post-disaster contexts and providing a framework that can be adopted by other researchers or local governments in different regions. The findings also offer practical implications for enhancing disaster recovery strategies and sustainable water resource management through accessible, community-driven technologies. However, this study has several limitations, as the validation process mainly focused on functional testing through black-box and usability evaluations, and implementation was limited to one village area. Future research should therefore include non-functional testing such as performance, reliability, and scalability assessments, as well as the integration of IoT sensors for real-time monitoring, with broader deployment across multiple villages to enable cross-regional data comparison and cloud-based synchronization. Overall, this research contributes both practically and methodologically by presenting a participatory, Android-based GIS model that addresses post-disaster challenges in clean water management, serving as a foundation for future studies in developing adaptive, data-driven systems that support sustainable and community-based environmental resource management.

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