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WEB GIS for Mapping the Locations of Licensed Midwifery Practices in the Asahan Region

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ABSTRACT

The advancement of digital technology has significantly impacted the healthcare sector, offering innovative ways to improve service accessibility and quality. One such advancement is the use of Geographic Information Systems (GIS), which enables the integration and visualization of spatial and non-spatial data. This research focuses on the development of a Web GIS platform designed to map the locations of licensed midwifery practices in Asahan Regency. The primary goal is to provide the public with easier access to valid health service information and to assist local authorities in monitoring and managing these services more efficiently. The system was developed using PHP (CodeIgniter framework), MySQL for data storage, and Leaflet for interactive mapping functionalities. Using a qualitative research methodology, data were collected through observation, interviews with relevant stakeholders, and literature review. The system displays midwife practice locations along with critical attributes such as licensing information, service types, and operational hours. It also features user interaction capabilities through a review and feedback mechanism. The innovation presented in this study lies in the integration of legality data into a public-facing, interactive spatial information platform—an aspect rarely addressed in existing health GIS applications in Indonesia. Testing demonstrated that the system meets functional requirements, ensures ease of use, and delivers accurate, real-time information. The developed system offers a replicable model that can be applied in other regions to support transparent and informed decision-making in maternal healthcare services.

Keywords: Web GIS; licensed midwifery practices; mapping; geographic information system; Asahan Regency

1. INTRODUCTION

Technological advancements in the digital era have had a significant impact on various aspects of life, including the healthcare sector. Technology is now not just a supporting tool, but has revolutionized the way we work, interact and make decisions. One technology that continues to develop and make a major contribution in the health sector is the Geographic Information System (GIS) (Asanto, 2024)(Fathurrahman & Samsu, 2021). GIS is a computer-based system that allows the integration of spatial data with other attributes, facilitating data analysis and visualization more efficiently and accurately (Angreini & Supratman, 2021)(Iskandar et al., 2024). The application of GIS in the health sector, such as mapping health facilities, not only increases efficiency, but also provides information that is more accessible to the public and related institutions, which supports data-based decision making (Fajriyah, 2023)(Restu Wardani & Maulana Malik Jamil, 2020).

Previous research shows that GIS has been widely used in various sectors, such as spatial planning, natural resource management, and environmental assessment. In the context of healthcare, GIS has an important role in mapping health facilities and identifying patterns that can be used to improve service quality (Askarim, 2022)(Arif Setiawan et al., 2021)(Geografis, 2024). However, although GIS has been applied globally, its utilization in the Indonesian health sector, especially in mapping licensed midwife practices, is still limited and not optimally integrated. This is a void that must be filled, especially in the context of developing a system that is more accessible to the public. One of the main challenges is the lack of integration between data on the location of midwife practices managed by the One-Stop Investment and Integrated Services Office (DPMPTSP) and other information systems. This means that information on the legality of midwife practices and available services cannot be easily accessed by the community.

Limited access to information on licensed midwife practices poses a risk to maternal and child safety, as the public cannot easily verify whether a midwife practice is licensed or not. In addition, previous studies have not specifically identified the use of Web GIS systems in this context to improve supervision and access to information on licensed midwife practices, leaving room for innovation in this study. Several previous studies have identified the importance of mapping and visualizing health services to improve accessibility and quality of services (Maisa et al., n.d.). Therefore, the

application of a Web GIS system to map the location of licensed midwife practices in the Asahan region is very relevant and innovative, especially in providing solutions to information access problems that have been faced by the community.

This research focuses on developing a Web GIS system to map the location of licensed midwife practices, which is an innovation in the context of health in Indonesia. The system uses technologies that have proven effective in other sectors, such as PHP with the CodeIgniter framework, MySQL for the database, and Leaflet for interactive map creation (Tendean et al., 2023)(Lahia et al., 2021). The advantage of this research is the comprehensive integration of the system that allows access to more transparent and structured information, which has not been adequately available in Indonesia. This makes a real contribution in addressing the existing gap in the utilization of GIS in the health sector in Indonesia. By utilizing GIS technology, this research will not only provide benefits for the community, but also for related institutions in improving the efficiency of monitoring midwife practices. This research will also contribute to the development of GIS technology in the health sector, which is expected to become a model for similar applications in other regions in Indonesia. The utilization of GIS to improve access to information and supervision in the health sector can have a significant positive impact on the overall quality of health services in Indonesia, which has not been done optimally by existing research or systems.

This research is expected to be the first step towards creating a system that is more comprehensive and in accordance with the needs of the community, as well as strengthening the application of GIS technology in the Indonesian health sector. With this system, it will be easier for the public to choose the right health services, while related institutions can monitor and plan for more optimal service development in the future.

2. RESEARCH METHODS

This research uses a qualitative approach with the aim of providing deeper insight into the application of a web-based Geographic Information System (GIS) to visualize the location of licensed midwife practices in the Asahan region (Syahputri et al., 2023)(Marcelino et al., 2024). This approach was chosen because of its focus on analysis, design, and development of GIS-based systems that can be accessed by the public and related institutions.

2.1 Research Outline

The research framework contains systematic stages in the implementation of research. The aim is to provide guidelines that make it easier for researchers to complete this study in a structured way (Ardiansyah et al., 2023) (Singgrit et al., 2022). The research framework used is as follows:
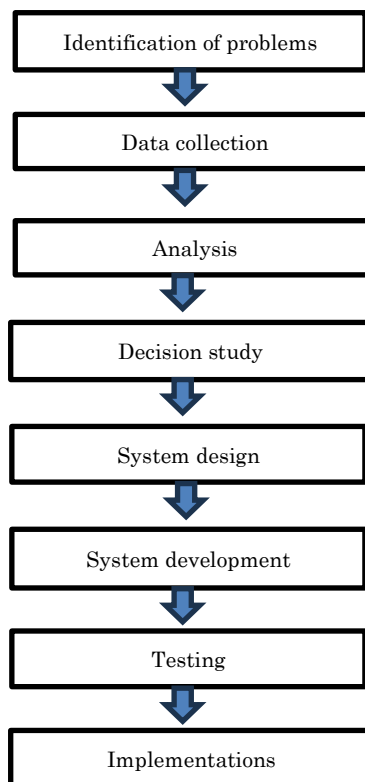

Figure 1. Research Framework

Based on the research framework described above, the researcher describes each stage in the completion of this research as follows:

1. **Problem Identification**

   At this stage, the main problem was identified - namely, the lack of visualization of the location of licensed midwife practices in Asahan, where data is only stored in standard documents. This makes it difficult for the public to access information regarding the legality of midwife practices, available services, and operating hours. This problem increases the risk of using substandard health services, which can jeopardize the safety of mothers and children.

2. **Data Collection**

   This stage involved collecting data through observation and interviews with relevant institutions, such as the One-Stop Investment and Integrated Services Agency (PMPTSP), as well as community members who needed information about licensed midwife practices. The data collected includes the location of the practice, types of services offered, operating hours, legal status of the practice, and other relevant information needed to develop a web-based GIS system.

3. **Analysis**

   The data collected was then analyzed to determine the needs of the system. This analysis included identifying why a web-based GIS system was needed, how it could help people access information more easily, and what relevant data should be used in the interactive map. It also includes identifying challenges related to the lack of centralized and integrated information.

4. **Decision Study**

   A decision study was conducted to determine the best solution based on the results of the analysis. In this phase, researchers evaluate various alternative solutions to address the problem, such as document-based information systems or simple applications. After considering the advantages and disadvantages of each alternative, researchers chose the implementation of a web-based GIS as the most effective solution to provide more efficient and integrated access to information for the community and related institutions.

5. **System Design**

   This phase includes the technical design of the system to be developed. It starts with the creation of UML diagrams, such as use case diagrams, class diagrams, activity diagrams, sequence diagrams, system information flows, flowcharts, and entity relationship diagrams (ERDs). This step ensures that the system design is aligned with user needs and research objectives, specifically the visualization of the location of licensed midwife practices and the integration of information related to services and legality status.

6. **System Development**

   In this phase, the system is developed based on the design that has been made before. The system was built using PHP programming language with CodeIgniter framework, MySQL database, and Leaflet library for map visualization. The development process included creating a backend for data management, a frontend for the user interface, and spatial data integration to support interactive map features. The system is designed to be easily accessible to the public and provide accurate information.

7. **Testing**

   At this stage, the developed system is tested to ensure that all features function properly. Testing is done to evaluate whether the web-based GIS system meets the needs identified in the analysis and design stages. The goal is also to ensure that the system delivers accurate information and is easily accessible to the community and related institutions.

8. **Implementation**

   The final stage is the implementation of the system into the user environment. The tested system is installed and prepared for use by the community and related institutions in Asahan. Documentation and training are provided to ensure users can utilize the system effectively. This stage also includes initial monitoring to ensure the smooth operation of the system.

9. **Conclusions and Suggestions**

   In this phase, the researcher draws conclusions based on the entire research process. These conclusions explain whether the developed web-based GIS system has successfully addressed the identified problems, such as improving access to information about the location of licensed midwife practices, types of services, operating hours, and legality of practices. In addition, suggestions are given for further development, such as adding real-time data or integrating with other health services to improve the sustainability and future benefits of the system.

2.2 Data Collection Techniques

The strategies used to obtain the information needed in a study are called data collection techniques. The information collected can be secondary data obtained from existing sources or primary data collected directly from the source(David tan,

2021)(Adellia & Prajawinanti, 2021). This data is then analyzed to produce findings and conclusions that are in accordance with the research objectives. An optimal and efficient data collection process is essential to ensure that the research results are accurate and reliable (No & September, 2024)(Risdiana Chandra Dhewy, 2022). The data collection techniques used in the research of mapping licensed midwife practices in the Asahan region include the following:

1. **Observation:** Observation is carried out by directly observing the process of data collection from related institutions, such as the One-Stop Investment and Integrated Services Office (PMPTSP), to obtain data related to the location of licensed midwife practices.
2. **Interview:** Interviews were conducted with competent resource persons from related parties, such as officers at PMPTSP, to obtain information regarding data on the location of midwife practices, legal status, and types of services provided.
3. **Literature Study:** Secondary data was obtained through a literature study that included books, articles, and journals related to GIS, health service mapping, and web-based information systems.

2.3 Time and Place of Research

This research was conducted at the Asahan Regency Public Service Mall Office, specifically at the Asahan Regency Investment and One-Stop Integrated Service (DPM PTSP), which is located at Jalan Jenderal Sudirman No. 123, Kisaran, Asahan Regency, North Sumatra. This location was chosen because DPM PTSP stores important data related to licensed midwife practices in Asahan Regency.

2.4 Current System Workflow

The current system flow refers to a series of steps or processes followed in managing and presenting information in an existing system. This process includes how data is collected, processed, and presented, as well as how the information is accessed and used by related parties, such as administrators and users (Rohman & Brilian, 2023). In existing systems, these flows may still rely on manual or limited methods, which can affect the efficiency and speed of information management and access (Pranoto et al., 2024)(Febri et al., 2024). Currently, information management regarding the location of licensed midwife practices in Asahan Regency is still carried out using a system that relies on simple documents, such as PDF files. The existing system workflow involves several stages, with the main role being carried out by the admin at the Asahan Regency Investment and One-Stop Integrated Service (DPMPTSP) Office, as well as the community as information users. The following is a flowchart of the location of licensed midwife practices on the existing system at DPMPTSP Asahan.

Table 1. Data on the Location of Licensed Midwife Practices in Asahan Region

No	Name of Midwife Practice	Address	License Number
1.	Midwife Practice Citra Rahim Panjaitan	Praktik Bidan Citra, Dusun VI Desa Pematang Sei Baru Kecamatan Tanjung Balai Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0244/VII/2023
2.	Midwife Practice Bd. Yuspita, S.Keb	Praktik Bidan Yuspita, S.Keb, Jl. Lubuk Palas Pasar II Dusun II Kecamatan Air Joman Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0243/VII/2023
3.	Practicing Midwife Rakhmaini	RS. Setio Husodo, Jl. Sisingamangaraja No. 67 Kelurahan Kisaran Timur Kecamatan Kota Kisaran Timur Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0248/VII/2023
4.	Midwife Practice Mei Rizka Khairani	RSU. Wira Husada, Jalan Kartini No 209 Kelurahan Sendang Sari Kecamatan Kota Kisaran Barat Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0249/VII/2023
5.	Practicing Midwife Rina Safitri	RS. Setio Husodo, Jl. Sisingamangaraja No. 67 Kelurahan Kisaran Timur Kecamatan Kota Kisaran Timur Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0247/VII/2023
6.	Midwife Practice Hardianti Tambunan	RSU. Wira Husada, Jalan Kartini No 209 Kelurahan Sendang Sari Kecamatan Kota Kisaran Barat Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0246/VII/2023
7.	Practicing Midwife Retno Dian Utami, A.Md.Keb	RSU. Wira Husada, Jalan Kartini No 209 Kelurahan Sendang Sari Kecamatan Kota Kisaran Barat Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0245/VII/2023
8.	Practicing Midwife Vanny Elisabet Sibaran	RSU. Wira Husada, Jalan Kartini No 209 Kelurahan Sendang Sari Kecamatan Kota Kisaran Barat Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0250/VII/2023
9.	Midwife Practice Khairani Purba	UPTD. Puskesmas Sidodadi, Jl. Ir. Sutami No. 05 Kelurahan Sei Renggas Kecamatan Kota Kisaran Barat Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0251/VII/2023
10.	Practicing Midwife Fifi Ria Ningsih Safari	Praktik Bidan Eliza Bestari Sinaga, Jl. Murai No. 16 E Lk. II Kelurahan Gambir Baru Kecamatan Kota Kisaran Timur Kabupaten Asahan.	500.16.7.2/SIPB/DPMPTSP/ 12-09/0252/VII/2023

The following is the flow of information systems currently used in the Asahan Regency Public Service Mall (MPP):

1. DPMPTSP admins are responsible for managing information related to licensed midwife practices. This information is provided in PDF format.
2. After data on the location of verified and licensed midwife practices is obtained, the admin uploads the PDF file to the DPMPTSP MPP website.
3. Users who want to find information about the location of licensed midwife practices can access the DPMPTSP MPP website.
4. On the website, users can view information about licensed midwife practice locations that have been uploaded by the admin in PDF format.
5. In addition, users can search for verified and registered midwife practice locations based on their specific needs

2.5 Proposed System Flow

The proposed system flow is a series of processes designed to integrate and present information more efficiently through a web -based platform (Maulidda & Jaya, 2021). The system manages data in a structured manner, enabling the collection, storage, and access to data on the location of licensed midwife practices through an interactive map. Workflows include data management by admins, information retrieval by users, and interaction through search and review features to increase transparency and efficiency of information management (Husin Sariangsah, 2024)(Harahap et al., 2024).

The proposed system for visualizing the location of licensed midwife practices in the Asahan region uses a web-based Geographic Information System (GIS), with the following flow:

1. DPMPTSP admin accesses the system web page.
2. Admin selects the login menu to enter the system.
3. Admin enters the username and password that has been registered to access the admin dashboard.
4. After successfully logging in, the system displays the admin dashboard which contains controls for managing licensed midwife practice data.
5. Admins can manage licensed midwife practice data, including adding, editing, or deleting registered practice data.
6. The user accesses the system web page.
7. After entering the main page, the user can see the various menus available in the system.
8. The user selects a menu that displays information related to the location of licensed midwife practices.
9. If the user does not have an account, they can register to create a new account in the system.
10. After User enters username and password to login to the system.
11. After successfully logging in, users can search for licensed midwife practice locations that they want to review.
12. The system displays data on the location of licensed midwife practices that have been verified.
13. The user can write a review for the selected licensed midwife practice and submit it to the system.
14. The review submitted by the user will be displayed on the corresponding page, providing useful feedback for other users.

2.6 System Development

The purpose of this system development is to build a web-based platform that integrates data on the location of licensed midwife practices in Asahan Regency and presents it visually using Geographic Information System (GIS) technology. This system was developed using the PHP programming language, CodeIgniter framework, and MySQL for data management, while Leaflet was used to display interactive maps (Maharani, 2024). Admins from the One-Stop Investment and Integrated Services Office (DPMPTSP) are responsible for managing information related to the location, type of service, operating hours, and legality of midwife practices, which will then be displayed on an interactive map that can be accessed by the public. The system is equipped with search and data filtering features, making it easier for users to find midwife practices that suit their needs. In addition, validation and authentication mechanisms are implemented to ensure that the data displayed remains accurate and secure. Users can also provide feedback or reviews of the services they receive, which will be valuable input for future system development. After passing the testing phase, the system will be implemented and monitored to ensure its smooth operation.

3. RESULTS AND DISCUSSION

The test results of the Web GIS system show that features such as location search, service data management, and interactive map display work well. This is in line with the findings of (Maharani, 2024), who developed a similar system to map MSME locations and proved that the use of Leaflet and MySQL is effective in presenting spatial data in real time. However, the main difference lies in the object and complexity of the data-this study is more complex because it has to integrate legality, operating hours, service types, and community feedback. When compared to the study by (Tendean et al., 2023), which mapped mine sites based on GIS, the approach used in this study shows that GIS is not only useful for industrial spatial purposes, but also has major implications in improving the quality of public services in the health sector. What these studies have in common is the use of GIS as a visualization and decision-making tool, but the differences lie in the integration of features and application domains. This research also complements the findings of(Lahia et al., 2021), where the Android-based GIS application emphasizes user mobility in finding pharmacy locations. Meanwhile, this research prioritizes the disclosure of midwifery service information through a more far-reaching web-based platform. In other words, this research not only contributes to the development of GIS systems in the health sector, but also expands the scope of its application in the context of legality and public interaction. The implications of developing this system are quite broad. First, it increases the transparency of health services by presenting information that was previously not easily accessible. Second, the system opens up new opportunities for further research, such as the integration of real-time data or the development of automated recommendation features based on the user's location. Third, the system can be replicated in other areas as a pilot model for utilizing GIS for the public health sector.

3.1 System Implementation

After the system development is completed, the next step is to conduct functional testing to ensure that all features run according to the needs and specifications that have been determined. The implementation process is then carried out by applying the system so that it can be used by DPMPTSP staff, to ensure that this WebGIS-based platform is able to map the location of licensed midwife practices effectively and support the monitoring and decision-making process in health services. The WebGIS system developed in Asahan District is equipped with several key features, such as location search, service filtering, and interactive maps that improve accessibility and ease of navigation for users.

3.1.1 Login Page

The login allows admins to manage data relating to licensed midwifery practices, while users can search for practices and submit reviews. Users can log in to the system using a username/email and password, with options available to create a new account or reset the password if required.
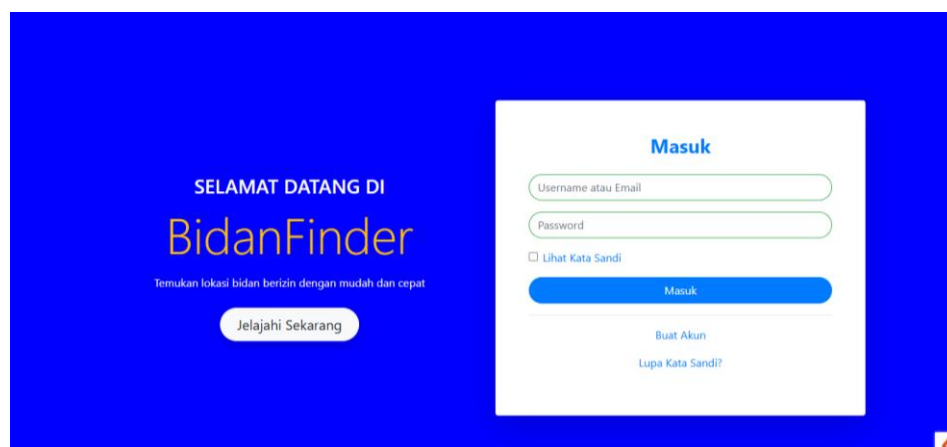

Figure 1. Login

3.1.2 Admin Home Page

The dashboard provides the admin with a concise overview of the number of midwife practices, sub-districts, feedback, and services. Admins can manage data related to midwife practices, licensing, sub-districts, services, feedback, and reports through the menu available on the left side. The simple design makes it easy to manage information in the system.
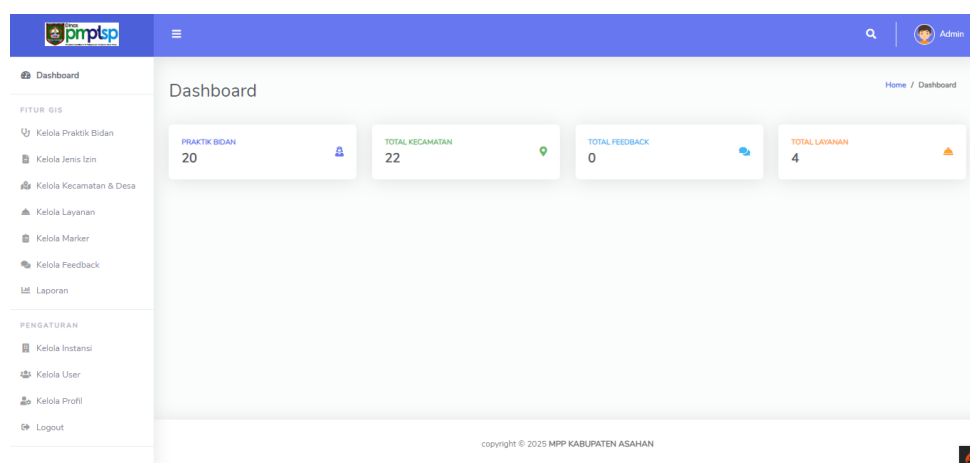
Figure 2. Admin Main Page

3.1.3 User Home Page

The main page of the Asahan Licensed Midwife Practitioner WebGIS welcomes users with a clean and informative design. At the top, users can find contact information and the location of the Asahan Regency Investment and One-Stop Integrated Service (DPMPTSP). Users can access various features such as the agency's profile, map, midwife practice data, and login options to manage or search for more detailed information about licensed midwife practices in Asahan Regency. A simple layout ensures easy navigation for site visitors.

Figure 3. User Home Page

3.1.4 Map Page

The map view displays the location of licensed midwife practices in Asahan Regency with markers indicating each practice point. Users can choose various map views, such as satellite, outdoor, or other modes to make it easier to find the location of midwife practices in the region. This map is designed to provide a clear and interactive visualization experience for users.
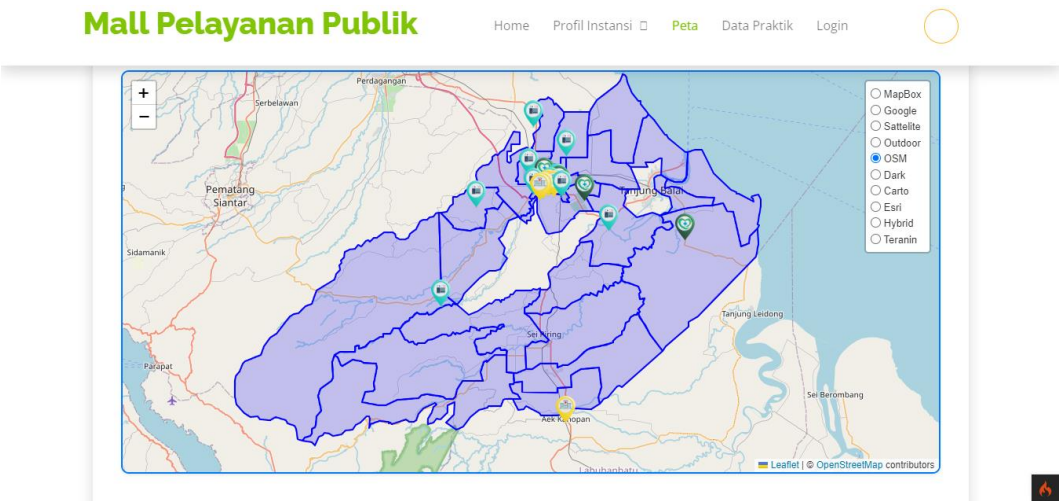
Figure 4. Map Page

3.2 System Testing and Evaluation

System testing and evaluation is carried out to ensure that the WebGIS of Licensed Midwife Practices in Asahan Regency functions as expected. Functional testing is carried out to verify that key features such as location search and data management are running properly. Evaluation is done through feedback from users to assess the ease of use and accuracy of the system. The results of this test are used to improve and enhance the system to make it more efficient in accessing information and managing midwife practice data.

3.2.1 Testing Results

System testing is a process used to verify and evaluate a system to ensure that the system operates in accordance with predetermined specifications. This process includes various forms of testing aimed at detecting flaws, bugs, or potential weaknesses in the system (Hajizah, 2024)(Ramadhani et al., 2024). The main purpose of system testing is to ensure that the developed system is safe, reliable, and works as it should before being implemented in a real environment (Vetdri et al., 2023). The results of system testing show that the main features, such as location search for midwife practices, interactive map visualization, and data management by the admin, function well and as expected. The system also successfully passed the security test, which ensured the protection of the stored data. Overall, testing proved that the system runs effectively and can be used to facilitate access to information and data management of licensed midwife practices in Asahan Regency.

Table 2. Testing Results

No.	Test	Objective	Result
1.	Login Testing	Ensure users can login with a valid username and password.	The system successfully verifies the username and password, and users can access the main page after login.
2.	Testing Input, Edit and Delete Midwife Practice Data	Ensure that the admin can enter data, edit data and delete midwife practice data into the system.	Admins successfully input midwife practice data, edit midwife practice data, delete midwife practice data and the system saves and displays data correctly.
3.	Testing Input, Edit and Delete Permit Types	Ensuring the admin can input, edit and delete valid types of midwife practice licenses.	The type of license entered, edited and deleted can be stored correctly in the database and displayed accurately.
4.	Input, Edit and Delete Sub-district and Village Data Testing	Ensure the admin can input, edit and delete sub-district and village data correctly.	Sub-district and village data entered, edited and deleted are successfully saved and displayed correctly on the map.
5.	Input, Edit and Delete Service Testing	Ensure that the admin can input, edit and delete the types of services provided by midwife practices.	Services entered, edited and deleted are successfully saved and displayed on the midwife practice location details page.
6.	Input, Edit and Delete Marker Testing	Ensure that the admin can add, edit and delete markers on the map to mark the location of midwife practices.	Markers are successfully added, edited and deleted on the map and the location of the midwife practice can be seen visually accurately.
7.	Testing Replying to Feedback	Ensuring the admin can reply to reviews or feedback from users	Admin successfully replies to user reviews and replies are displayed on the relevant page.
8.	Print Report Testing	Ensure the system can print reports on licensed midwife practice data.	Reports are successfully printed in the desired format, including complete midwife practice data.
9.	Testing Edit Agency Data	Ensure the admin can edit agency data.	Agency data is successfully edited and the results can be displayed by the system.
10.	User Delete Testing	Ensure the admin can delete user accounts.	The system successfully deletes user data.

11.	Testing the Location Search for Licensed Midwife Practices	Ensure users can search for licensed midwife practice locations based on certain criteria.	The system successfully displays search results according to the criteria entered by the user.
12.	Reviewing Testing	Ensuring users can provide reviews of midwife practice locations.	Users can provide reviews, and reviews are successfully saved and displayed on the location page.

2 CONCLUSION

This research successfully developed a Web GIS system specifically aimed at mapping the location of licensed midwife practices in Asahan Regency. The system not only functions as a spatial mapping tool, but also as a medium for providing information on practice legality, available services, as well as allowing community participation through a review feature. All core features of the system have been tested and proven to work well, supporting the initial goal of improving access to information and transparency of midwifery services. The novelty aspect of this research lies in the integration of midwife practice legality data into a web-based geographic information system designed to be directly accessible to the public. Previously, information related to the legality and location of midwife practices was only available in the form of static documents and was not easily accessible to the public. This research fills this gap by providing a spatial technology-based solution that is interactive, structured, and user-friendly, which has never been specifically applied to the context of midwifery services in Indonesia. In addition, the system offers a new approach to health service monitoring by combining spatial visualization, intelligent search features, and user engagement. This innovation has the potential to be replicated in other regions and further developed, such as real-time data integration or connectivity with other healthcare systems. Thus, this research makes a real contribution to the application of GIS in the health sector, while opening up opportunities for the development of information systems that are more inclusive and based on community needs.

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