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Research Article

Implementation of Web GIS in Visualizing Certified Pharmacies Mapping by DPM PTSP in Kisaran Area

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ABSTRACT

The advancement of information technology has enabled the utilization of Geographic Information Systems (GIS) in various fields, including healthcare services. This study aims to implement Web GIS for visualizing the mapping of certified pharmacies in the Kisaran area to provide easy access to information for the public and relevant stakeholders. The system is developed using web-based technology with PHP and MySQL to manage spatial data and pharmacy attributes. The results show that the developed Web GIS system can display location information, certification status, and pharmacy details interactively through a digital map. With this system, the public can easily identify certified pharmacies, thereby enhancing the safety and quality of healthcare services. Additionally, the implementation of this Web GIS assists the Investment and One-Stop Integrated Service Agency (DPM PTSP) in monitoring and managing pharmacy data more efficiently and transparently. The system also features a user-friendly interface that supports search and filter functionalities to improve user interaction. Data presented in real-time further improves the reliability of information accessed by users. Furthermore, this Web GIS solution contributes to spatial-based decision making, enabling authorities to conduct targeted inspections, identify underserved areas, and plan the development of new pharmacies based on geographic distribution. The integration of spatial data with pharmacy certification records also supports transparency and accountability in public health service management. In conclusion, this research demonstrates the potential of Web GIS as an effective tool for improving access to reliable health service information and enhancing the operational performance of relevant governmental institutions.

Keywords: Geographic Information System; Certified Pharmacies; DPM PTSP; Mapping

1. INTRODUCTION

The Development of Information Technology and Its Impact on Public Services and Spatial Data Management. The advancement of information technology has brought significant changes in various aspects of life, including public services and spatial data management. With these developments, processes that previously took a long time can now be carried out more quickly, efficiently, and accurately. Information technology enables data processing into useful information. One of the rapidly growing technologies with an essential role in this regard is the Geographic Information System (GIS). GIS allows the visualization of spatial and non-spatial data on an integrated platform, which can be used to present information in the form of interactive digital maps (Pahlupi, 2024). This greatly helps government agencies, organizations, and the public in understanding and utilizing location-based information effectively. Kisaran, which includes Kota Kisaran Barat District and Kisaran Timur District, is a rapidly developing region in Asahan Regency, North Sumatr,a Province (Juwari, 2023).

This area serves as a center for economic, social, and healthcare activities for the local population. Along with population growth and increasing societal needs, access to adequate healthcare services becomes crucial. One of the essential healthcare facilities in this region is pharmacies. The presence of pharmacies not only ensures the availability of safe and high-quality medicines (rahman, 2023) but also plays a vital role in the overall healthcare system in these two districts. This research refers to previous studies on related topics, including a study titled "Utilization of Web GIS for Mapping the Distribution of Healthcare Services in Madiun City." This research discusses that GIS is a technology designed to manage, analyze, and visualize geographically referenced data. GIS enables the integration of location-related data, such as point locations, road lines, and area boundaries, with other information such as demographic or healthcare data (Rasyid, 2021), (Harahap, 2023). This allows GIS users to gain a more comprehensive understanding of a given region's conditions. GIS can support data-driven decision-making by presenting accurate and easily understood

information in a visual form (Effendi, 2023)]. The application of GIS is extensive, ranging from urban planning and environmental monitoring to managing healthcare facilities, such as mapping pharmacies in a particular region. A pharmacy is a business establishment that provides various types of medicines, both those requiring a doctor's prescription and over-the-counter drugs. The primary function of a pharmacy is to ensure the availability of safe [6], high-quality (Tuharyadi, 2021), medicines that comply with prevailing regulations. In Indonesia, these regulations include the Minister of Health Regulation No. 35 of 2014 concerning Pharmacy Service Standards, which mandates pharmacies to provide professional services that meet safety standards, as well as Law No. 36 of 2009 on Health, which emphasizes the importance of providing safe and high-quality healthcare services (Indah, 2021). Additionally, pharmacies must comply with licensing requirements (Wahono, 2021) under Government Regulation No. 51 of 2009 on Pharmaceutical Practices, which sets the legal framework (Yasir, 2020), for pharmaceutical operations. Certification and licensing serve as guarantees that pharmacies operate according to legal standards, providing a sense of security to the public (Arisanti, 2024).

Pharmacy activities involve various processes related to the procurement and distribution of medicines. Pharmacies process and dispense doctors' prescriptions, provide patients with information on the correct use of medicines, and closely monitor stock levels to ensure availability. Additionally, pharmacies play a role in public health education by offering essential information to ensure the proper and safe use of medications. These activities aim to support overall public health and prevent the misuse of medicines (Akbar, 2024). The issuance of business licenses, including pharmacy licenses, is one of the key responsibilities of the Investment and One-Stop Integrated Service Agency (DPM PTSP). The DPM PTSP of Asahan Regency manages licensing processes centrally and transparently (Dharmawan, 2023), allowing the public to access services more easily and efficiently. The DPM PTSP office is located on Jalan Jenderal Ahmad Yani, Kisaran, in the Kisaran Timur District, which serves as the administrative center of Asahan Regency. As a strategic institution, DPM PTSP continuously strives to improve the quality of public services, including monitoring and managing data on pharmacies operating within its jurisdiction, particularly in the Kisaran area (Dewantoro, 2024). Despite the critical role of pharmacies, there are several challenges in managing and disseminating information about certified pharmacies in Kisaran. The public often struggles to verify the certification status of pharmacies, leading many to purchase medicines from uncertified establishments (Nanda, 2024). This situation increases the risk of consumers obtaining unlicensed or unsafe medications, which may endanger their health. Furthermore, DPM PTSP has yet to implement an effective solution to address this issue. As a result, the public remains vulnerable to purchasing unregulated medicines, which can lead to adverse health effects and reduce public trust in DPM PTSP services (Rozak, 2021).

Previous studies have highlighted the potential of Geographic Information Systems (GIS) in the healthcare sector. For example, Sari (2022) developed a GIS-based application to map hospital locations in Central Java, which successfully improved public access to health facilities. Similarly, Anwar et al. (2023) applied GIS to monitor the distribution of community health centers (Puskesmas) in urban areas, allowing local governments to identify underserved regions. However, these studies focused primarily on large-scale health facilities and did not specifically address pharmaceutical services such as pharmacies. In addition, most existing GIS implementations in healthcare are limited to desktop-based systems, which are less accessible to the general public. The integration of Web GIS for mapping certified pharmacies remains underexplored, especially at the regional level, such as in Kisaran. This represents a significant research gap, particularly in optimizing public access to reliable and real-time information about certified pharmacies. Proposed Solution: Implementing Web GIS for Certified Pharmacy Mapping To address these challenges, the implementation of a Web GIS system presents an effective solution. Web GIS is a web-based system that enables interactive spatial data visualization, allowing users to easily access information on pharmacy locations and their certification status. With this system, DPM PTSP can more effectively and efficiently monitor certified pharmacies. Additionally, the public can quickly obtain trusted information through a digital map that is accessible anytime and anywhere (Hajar, 2021). By filling the research gap in the use of Web GIS for pharmacy certification, this study contributes to public health transparency and supports the digital transformation of regional licensing services.

The problem identified in this study includes the lack of access to information and the public's difficulty in determining the certification status of pharmacies in Kisaran. Additionally, DPM PTSP has yet to develop an effective solution to prevent the public from purchasing medicines from uncertified pharmacies. The agency has also not yet leveraged adequate technology for managing and disseminating certified pharmacy information. This study aims to develop a (Harianto, 2024) Geographic Information System (GIS) capable of displaying pharmacy location information, certification dates, certification status, pharmacy building photos, and operating hours in Kisaran in a clear and interactive manner (Munir, 2021). Specifically, the study seeks to develop a Web (Rasiman, 2020) GIS system that can assist in visualizing and mapping certified pharmacies in Kisaran using PHP programming language and a MySQL

database], (Putri, 2024). Provide a clearer and more comprehensive overview of certified pharmacy locations and certification statuses in the Kisaran area. Implement Web GIS as a tool to improve the management and dissemination of information related to certified pharmacies, ensuring easier access for the public (Santoso, 2021).

2. RESEARCH METHOD

A framework (Sulystio, 2021)] is a conceptual structure used as a guide in carrying out activities, developing plans, or building systems. This framework typically consists of principles, rules, and methods that help in systematically organizing work steps to achieve specific goals. In the context of research or projects, a framework serves as a guideline to ensure that each stage proceeds in the intended direction, making the results more focused, efficient, and effective. The research framework can be seen in **Figure 1**.

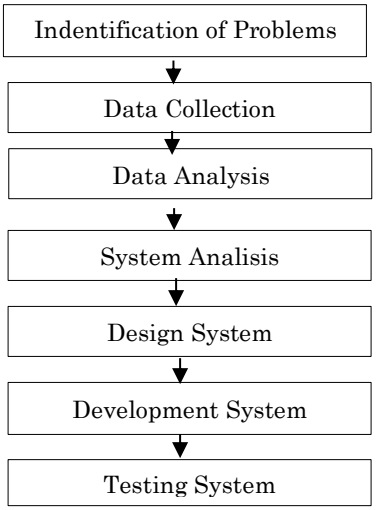

Figure 1. Research Framework

2.1 Research Methods

Based on the research framework that has been developed, as shown in the previous image, the discussion of each stage in this research is as follows (Fitriana, 2021):

1. Problem Identification

   The problem identified in this research is the challenge in managing and delivering information regarding the certification status of pharmacies in the Kisaran area. The public often struggles to determine whether a pharmacy is certified, leading them to purchase medicine from uncertified pharmacies. This poses the risk of buying medicine without distribution permits, which could endanger public health. The Investment and One-Stop Integrated Services Office (DPM PTSP) has yet to implement an effective solution to address this issue, resulting in suboptimal public oversight. Additionally, DPM PTSP has not fully utilized technology such as Web [24] GIS to disseminate information about certified pharmacies, limiting public access to this crucial information.

2. Data Collection

   Data collection is conducted by gathering information about pharmacies in the Kisaran area through available records from the DPM PTSP of Asahan Regency.

3. Data Analysis

   Data processing process to obtain useful information and can be used to make decisions. Data analysis is also called data processing or data interpretation.

4. System Analysis

   This stage involves analyzing the current conditions related to mapping certified pharmacies in the Kisaran area. The analysis aims to identify obstacles and challenges faced in managing and distributing information about certified pharmacies by DPM PTSP. By understanding these issues, researchers can design an appropriate solution for developing a more effective Web GIS-based pharmacy mapping system.

5. System Design

   During the design phase, several diagrams are created, including use case diagrams, class diagrams, activity diagrams, and sequence diagrams. These diagrams illustrate how users interact with the system, the required data structure, and the processes involved in the Web GIS-based certified pharmacy mapping system. Additionally, a flowchart is developed to clearly depict the step-by-step process from input to output, facilitating system implementation and testing.

6. System Development

   In this stage, the system is built using PHP as the programming language for web application development and MySQL as the database for storing certified pharmacy data. XAMPP is used as a local server to test and run the application. Furthermore, Leaflet is chosen as the JavaScript library for map visualization, allowing pharmacy locations to be displayed interactively within the system. ArcGIS is also used to define the boundaries of the researched area.

7. System Testing

   At this stage, system testing is carried out to ensure that the developed application functions according to the specified objectives and requirements. The testing includes verifying each feature, such as input and processing of pharmacy data, interactions with the MySQL database, and the map display generated by Leaflet. All tests are conducted using XAMPP as a local server to ensure the system is ready for deployment in a broader environment. The test results are used to evaluate whether the system operates as expected.

2.2 Data Collection Techniques

The data collection techniques used in this research are as follows:

1. Interviews
   This technique gathers data through direct conversations between the researcher and respondents. Interviews can be structured, with pre-prepared questions, or unstructured, allowing for flexible discussions. This method is effective for exploring respondents' views or experiences in depth.
2. Observation
   This technique involves direct observation of the object or phenomenon being studied. The researcher closely examines the situation or conditions in the field to obtain accurate data.
3. Documentation
   This technique collects data from various documents or records relevant to the research topic. These documents may include reports, notes, books, or digital recordings that provide valuable information.
4. Literature Study

   This technique reviews literature, theories, and previous research related to the topic. A literature study is essential for establishing a theoretical foundation, identifying research gaps, and understanding recent developments in the relevant field.

2.3 Time and Place of Research

This research was conducted at the Office of the Investment and One-Stop Integrated Service Agency (DPM PTSP) of Asahan Regency, located at Jalan Jenderal Sudirman No. 123, Kisaran, Asahan Regency, North Sumatra. This location was chosen because DPM PTSP holds essential data and plays a crucial role in the certification of pharmacies in the region. The geographical coordinates of the DPM PTSP Office of Asahan Regency are 2.9693903, 99.617943.

3. RESULTS AND DISCUSSION

3.1 System Analysis

In this study, an analysis was conducted on a Web GIS-based mapping system to visualize the locations of pharmacies certified by DPM PTSP in the Kisaran area. The data used were obtained from interviews regarding pharmacies that meet certification standards. Web GIS is implemented to present information interactively, making it easier for the public to identify certified pharmacies.

The current system operates as follows:

a. Admin/staff record certified pharmacies.
b. Admin/staff create reports on certified pharmacies, which are then printed in two copies.

c. Admin/staff submit the report to the Head of DPM PTSP for review and signature. One report is archived, while the other is returned to the admin/staff.
d. The public receives information about certified pharmacies.

The new information system flow enhances the management and monitoring of pharmacy data more effectively, as outlined below:

a. Admin/staff access the pharmacy mapping website.
b. Admin/staff log in to the system.
c. Admin/staff manage certified and uncertified pharmacy data, which is stored in the database.
d. DPM PTSP officials can view the certified and uncertified pharmacy data along with their mapped locations.
e. The public can access information on certified pharmacies and their mapped locations.

3.2 Process Analysis

Process analysis is conducted to identify the steps in a process, evaluate its efficiency and effectiveness, and explore opportunities for improvement or enhancement. The processes that the system must perform are as follows:

a. Data Input by Admin

The admin first logs into the admin/pharmacy management dashboard. The system starts with the admin entering data of certified pharmacies, including the pharmacy name, certification date, certification status, address, and building photo. This data is stored in the system as a well-organized digital archive that is easily accessible.

b. Data Editing by Admin

The admin has access to edit pharmacy data stored in the system. If there are any updates, the admin can modify the information via the admin dashboard. Any changes made will be automatically updated in the system and visible to users.

c. Data Deletion by Admin

The admin also has the authority to delete pharmacy data from the system. If a pharmacy ceases operations, the admin can remove the data. Deleting the data will remove the pharmacy information from the list and the digital map, preventing public access to outdated records.

d. Comparison of Certified and Non-Certified Pharmacies

DPMPTSP can monitor the comparison between certified and non-certified pharmacies. The system provides data visualization in the form of charts or tables that display the number of pharmacies based on their certification status. This feature allows DPMPTSP to evaluate the distribution of non-certified pharmacies and implement strategic measures to increase the number of certified pharmacies.

e. Landing Page for the Public

On the landing page, the public can access information about the institution's profile, vision, and mission, as well as an interactive digital map visualizing the locations of certified pharmacies. The map displays pharmacy locations along with essential details, such as the pharmacy name, address, and certification status.

Table 1. Input Data

No.	Pharmacy Name	Address	Certification Status
1	Apotek Budi Ataral Prima	Jl. Sisingamangaraja No. 297, Lk. IV Kelurahan Tegal sari, Kota Kisaran Barat.	Certified
2	Apotik Alfikri	Jl. Budi Utomo, Siumbut Baru, Kec. Kota Kisaran Timur	Certified
3	Apotek Harnaz Medical Grup	JL Imam Bonjol No. 285 Teladan, Kota Kisaran Timur.	Certified
4	Apotek Saudara Farma	Jalan Cokroaminoto, No. 200 Lk. I Mekar Baru, Kota Kisaran Barat.	Certified
5	Apotek Matahari Farma	Jalan Doktor Sutomo No. 110 Kisaran Kota, Kota Kisaran Barat.	Certified
6	Apotek Beta Farma Jaya Asahan	JL. Jend Gatot Subroto LK. III Kedai Ledang, Kota Kisaran Timur.	Certified
7	Apotek Hari Patent	Jl. Imam Bonjol No.14, Desa/Kel Kisaran Kota, Kec. Kota Kisaran Barat	Certified
8	Apotek Maharaja Mitra Sejahtera	Jalan Sisingamangaraja No.249E Kisaran Kota, Kota Kisaran Barat.	Certified

Based on the **Table 1**, shows the location of each certified pharmacy in the Kisaran city area, positioned through a map processed using a GIS application.

3.3 System Implementation

System implementation is a procedure that must be carried out to complete the system design outlined in the approved system design document, as well as to test, install, and initiate the use of the new system. In general, the purpose of this implementation is to conduct a trial of the system development concept that has been formulated. This phase focuses on investigating whether the proposed concept can be correctly implemented or not. The outcome of this stage is a trial recommendation based on the research conducted during the trial period. Based on the completed design, this section discusses the implementation of Web GIS in visualizing the mapping of certified pharmacies by DPM PTSP in the Kisaran area. System requirements analysis is the process of identifying, recording, and understanding user needs and specifications that must be met in system development. The primary objective is to ensure that the developed system can optimally and efficiently meet user requirements. This system will enable DPM PTSP Kabupaten Asahan to input pharmacy data, including location, certification status, operating hours, and other supporting information while generating an output in the form of a map visualization displaying certified pharmacies in Kisaran. This process can be explained through a new information system flow that supports the management and monitoring of pharmacy data effectively;

1. The admin/staff visits the pharmacy mapping website.
2. The admin/staff logs in.
3. The admin/staff manages data on certified and uncertified pharmacies, which will be stored in the database.
4. DPM PTSP can view data on certified and uncertified pharmacies along with their mapping.
5. The public can view data on certified pharmacies and their mapping.

3.4 Pharmacy List Display

The list of pharmacies in the implementation of Web GIS for visualizing the mapping of certified pharmacies by DPM PTSP in Kisaran includes four buttons: Add, Print Report, Edit, and Delete. Below is the display of the pharmacy list in the Web GIS implementation for visualizing the mapping of certified pharmacies by DPM PTSP in Kisaran.

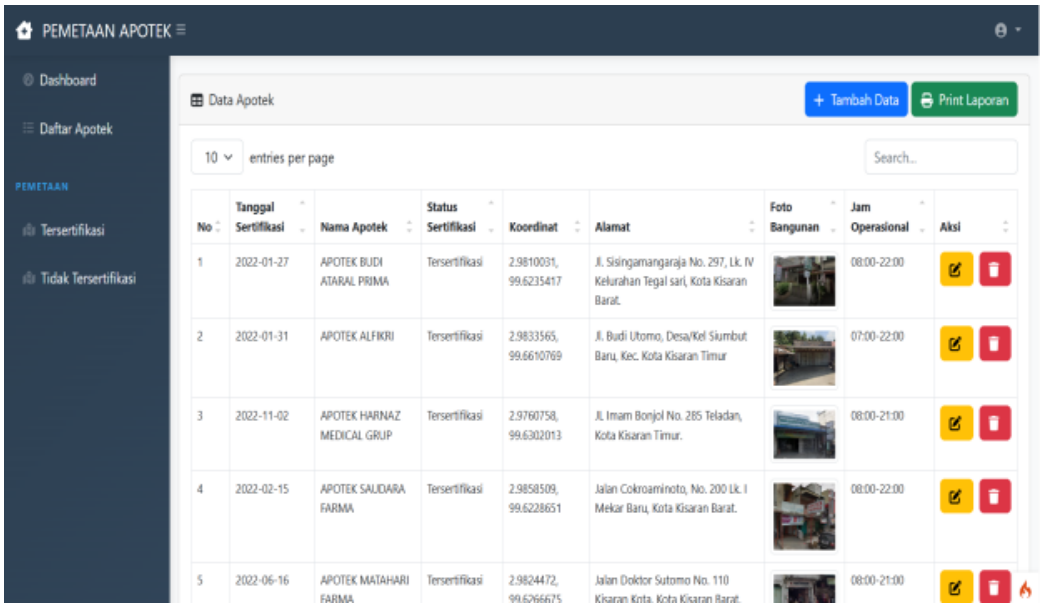

Figure 2. Pharmacy List Display

3.5 Pharmacy Data Addition Form Display

The add pharmacy data form in the implementation of Web GIS for visualizing the mapping of certified pharmacies by DPM PTSP in Kisaran contains nine text fields that must be filled in, along with two buttons: Reset and Save. Below is the display of the add pharmacy data form in the Web GIS implementation for visualizing the mapping of certified pharmacies by DPM PTSP in Kisaran.

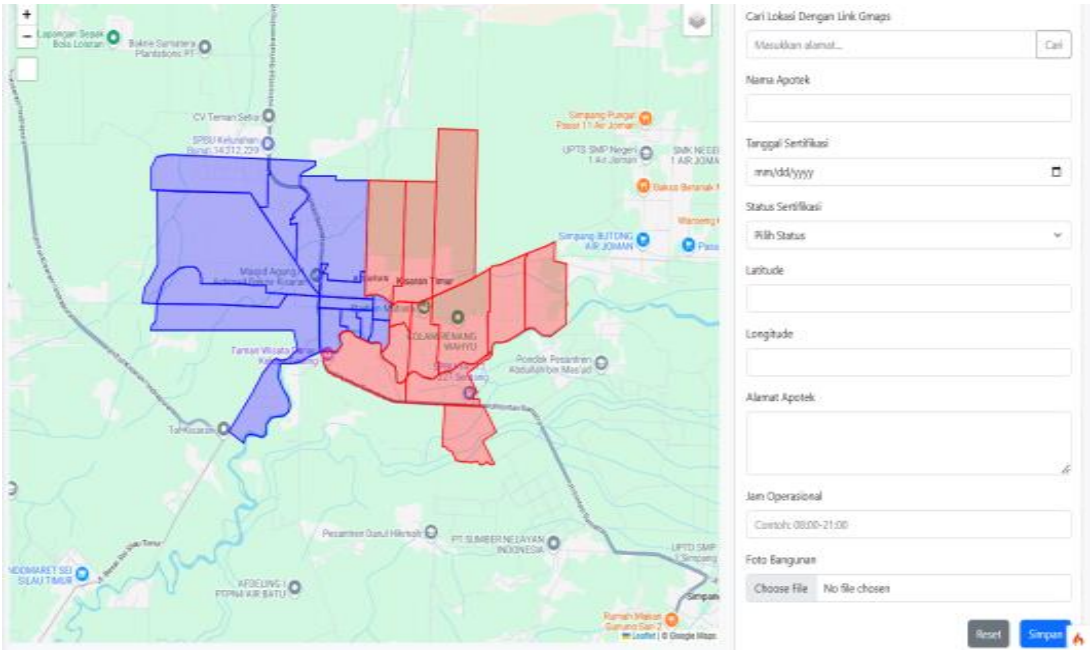

Figure 3. Pharmacy Data Addition Form Display

3.6 Pharmacy Data Edit Display

The edit pharmacy data form in the implementation of Web GIS for visualizing the mapping of certified pharmacies by DPM PTSP in Kisaran contains eight text fields that must be filled in, along with two buttons: Back and Update. Below is the display of the edit pharmacy data form in the Web GIS implementation for visualizing the mapping of certified pharmacies by DPM PTSP in Kisaran.

3.7 System Testing

The implementation of the Web GIS system for certified pharmacy mapping in Kisaran has successfully produced an interactive platform that enables users to view pharmacy locations, certification statuses, and detailed information regarding each pharmacy. The system utilizes PHP and MySQL to manage spatial and attribute data, and presents this information through a user-friendly web interface. Users can search for specific pharmacies, filter based on certification status, and access relevant data quickly and efficiently. These features significantly improve the accessibility and transparency of pharmacy-related information for both the public and DPM PTSP. This study supports the findings of Sari (2022), who demonstrated that GIS-based applications could improve public access to health services by visualizing spatial data in a clear and interactive manner. Likewise, Anwar et al. (2023) highlighted the importance of spatial mapping in identifying service distribution gaps, which aligns with the goals of this study in visualizing certified pharmacy coverage. However, while their research focused on hospitals and community health centers, this study extends the application to pharmaceutical services, which remain relatively underexplored in the context of Web GIS. Furthermore, the results of this study align with Hajar (2021), who emphasized that Web GIS can enhance the efficiency of government service monitoring. This research confirms that integrating Web GIS not only facilitates data management within DPM PTSP but also serves as a public information tool that promotes transparency and safety in pharmaceutical services. In contrast to Dharmawan (2023), who pointed out the lack of digital solutions in licensing services, this study offers a concrete example of how Web GIS can bridge the gap between public needs and administrative service delivery. Thus, this research contributes by demonstrating a practical and scalable solution that addresses a specific problem faced by both service providers and users. In summary, the results of this study are consistent with previous research while also contributing a novel application area. The implementation of Web GIS for certified pharmacy mapping not only enhances public access to reliable healthcare information but also supports regional government efforts in digital transformation and public service innovation.

4. CONCLUSION

The implementation of Web GIS for mapping certified pharmacies in Kisaran provides significant benefits for both the public and the DPM PTSP. The system features a user-friendly interface with clear navigation, making it accessible to both the general public and DPM PTSP staff. It presents real-time, accurate information on pharmacy certification status,

including geographical location, operating hours, address, and building images. Additionally, the system enhances data management and monitoring by allowing DPM PTSP to systematically oversee pharmacy certification. It also increases transparency and public awareness, enabling people to easily identify certified pharmacies and make informed choices when purchasing medications. By encouraging pharmacies to meet certification standards, this system contributes to improving the quality of healthcare services in Kisaran, creating a more reliable and well-regulated pharmaceutical environment.

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