International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

WebGIS-Based Land Asset Visualization (Case Study: Pangkep Regency Government)

Muhammad Rizal H[1], * Ratnawati [2], Abd. Rahman [3], Mahfudz Masyhur [4], Elly Warni[5]

[1,2,3,4]Department of Informatics Engineering, Universitas Teknologi Akba Makassar, Makassar, Indonesia
[5]Department of Informatics Engineering, Universitas Hasanuddin, Gowa, Indonesia

Email address:
rizal@unitama.ac.id, ratnawati@unitama.ac.id, abdrahman@unitama.ac.id, mahfudz@gmail.com, elly@unhas.ac.id

*Corresponding author : rizal@unitama.ac.id

Received: January 30, 2022; **Accepted**: June 6,2024 ; **Published**: August 6,2024

Abstract: This study discusses the implementation of e-Government in Pangkep Regency with the aim of improving public services, especially in land asset management. This research responds to requests from the Department of Housing, Settlement Areas and Land (Disperkimtan) by addressing the challenges of complex administrative procedures and increasing public awareness of land asset management. The goal is to design a web-based Land Asset Mapping Information System using WebGIS to simplify administrative processes and increase transparency. This research applies the Rapid Application Development (RAD) method. The results show an effective user interface (UI) in land certificate creation as well as smooth functions in the login and land acquisition process. This system is able to handle user loads well, which is reflected in the user satisfaction rate of 76.4%.

Keywords: e-government, public services, land asset management, WebGIS

1. Introduction

WebGIS is a system that utilizes web technologies to share and analyze spatial data, making it easier for users to access and understand information related to geographic location [1]–[3]. It enables the integration of different types of spatial data, such as maps and sensor data, and provides tools for data manipulation and visualization. WebGIS has been implemented in many fields, including tourism, agriculture, and public health [4]–[6]. It allows users to collect, represent, and analyze spatial data, facilitating the application of spatial concepts in learning and research [7]. The system is relatively easy to use and can be accessed through a website, eliminating the need for complicated installation or configuration. WebGIS supports the

DOI: 10.52362/ijiems.v3i2.1412

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

development of spatial thinking skills and can be used for in-depth geographic analysis activities [8], [9].

The Pangkep Regency Government, like many other local governments, has a great responsibility in the management and management of its land assets. However, challenges arise in managing information relating to such land assets efficiently and effectively. The lack of an integrated and easily accessible system can complicate the decision-making process related to land asset management. Therefore, this study aims to develop a web-based geographic information system (GIS) that aims to visualize the land assets of the Pangkep Regency Government. Through a case study approach, this research will explore the potential of GIS technology in the context of regional land asset management.

The Pangkep Regency Government, like many other local governments, has a great responsibility in the management and management of its land assets. However, challenges arise in managing information relating to such land assets efficiently and effectively. The lack of an integrated and easily accessible system can complicate the decision-making process related to land asset management. Therefore, this study aims to develop a web-based geographic information system (GIS) that aims to visualize the land assets of the Pangkep Regency Government. Through a case study approach, this research will explore the potential of GIS technology in the context of regional land asset management [10], [11].

The methods used in this study include collecting spatial data on land assets, designing appropriate geographic databases, developing WebGIS applications using the latest technology, and implementing systems for field use. The case study was conducted using actual data on land assets of the Pangkep Regency Government to validate and test the developed system.

Previous research in this field has tended to focus on developing general-purpose geographic information systems, without considering the specific needs and local context of local government. In addition, most studies do not provide integrated and scalable solutions for land asset management at the local level. This research offers a solution in the form of a WebGIS system specifically designed to meet the land asset management needs of the Pangkep Regency Government. The system will allow users to access real-time land asset information, conduct spatial analysis, and make decisions based on accurate and up-to-date data. The research gap that is the main focus of this study is the lack of a specific and integrated geographic information system for land asset management of the Pangkep Regency Government. This study also attempts to fill gaps in the literature on geographic information technology applications in the context of land asset management at the local level.

2. Materials and Method

2.1 Data Collection

Spatial Data Collection involves the acquisition of spatial data relevant to the land assets of the Pangkep Regency Government, such as administrative maps, regional boundaries, and topographic data. The data source used must be verified for its accuracy and according to the

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

scale required for the analysis to be performed. Researchers, in the selection of data sources, must choose the most accurate and reliable data sources, involving consultation with related parties such as the Geospatial Information Agency (BIG) or the Spatial Planning and Land Assets Office of Pangkep Regency. In addition, researchers can utilize data that is already available in digital form, such as data provided by local governments or other related institutions. Once the spatial data has been collected, the next step is Initial Data Processing, which may involve converting data formats, cleaning invalid data, or deleting irrelevant data. This data processing process is important to ensure the accuracy and consistency of the data to be used in subsequent analysis. Before the data is used in the analysis, Data Verification is performed to ensure the accuracy and consistency of the data. This step may involve comparison of the data obtained with other independent data sources or field surveys to validate the spatial information collected. Data verification is a critical step in ensuring the validity of the results of the analysis to be carried out.

2.2 Geographic Database Design

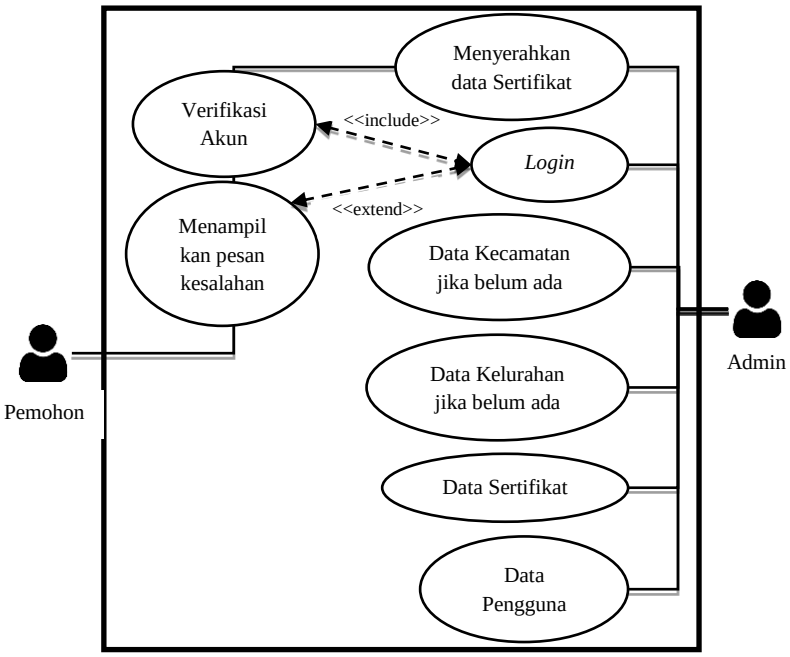
Geographic Database Design is an important stage in this research. This process includes designing a geographic database structure that fits the needs of the study, which involves mapping spatial data entities into databases. In addition, this stage also includes creating relationships between data entities to facilitate the integration of information needed in spatial analysis. Thus, the design of this geographic database aims to create a robust and structured framework for the storage and management of geographic data, thus enabling efficient and effective use of data in the development of WebGIS systems.

2.3 WebGIS Application Development

WebGIS Application Development is a very important next step in this research. This stage involves the use of the latest technology in the development of WebGIS applications, with the aim of creating a system that is able to provide an optimal user experience. In addition, in this stage, an intuitive and easy-to-use interface design will be carried out, making it easier for users to access and navigate using the application. In addition, special features will be implemented according to the needs of land asset management, such as the ability to visualize detailed land asset data, conduct spatial analysis, and generate informative reports. Thus, the development of this WebGIS application aims to provide an efficient and effective platform for related parties in land asset management of the Pangkep Regency Government. In the developed system, there are two actors, namely the applicant and the admin. The use case diagram can be seen in Figure 1.

DOI: 10.52362/ijiems.v3i2.1412

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139



Gambar 1. Use Case Diagram

2.4. System Testing

After the development of the WebGIS application is complete, the next stage is to test the system in the appropriate test environment. Testing is carried out to ensure that the system is functioning properly and can be used as needed. Furthermore, a system performance evaluation is carried out to assess the extent to which this system meets the needs and research objectives that have been previously set. This evaluation involves testing various features and functionality of the system, as well as an assessment of the system's response to its use. After the evaluation is done, the final step is system optimization based on feedback from users and test results. This includes the improvements and adjustments needed to improve overall system performance and effectiveness. Thus, this stage is an integral part in the development of the WebGIS system which aims to provide optimal solutions in the land asset management of the Pangkep Regency Government.

3. Results and Discussion

3.1. System Requirements Analysis

This analysis aims to thoroughly understand how the running system works, and identify its advantages and disadvantages. In addition, it is also necessary to analyze the needs and objectives of the new system to be built. This involves gathering information about what is expected from the new system, the goals to be achieved, and the functional and non-functional needs to be met. By conducting a comprehensive analysis of existing systems and needs sistem

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

baru, diharapkan The developed system can run well and achieve the desired goals efficiently and effectively.

Based on the results of the researchers' analysis of the Geographic Information System for Land Asset Mapping of the Pangkep Regency Government that has been running, 2 systems are needed that are integrated into *the same database*, namely the Information System for Monitoring the Land Acquisition Process & Land Certificates of the Pangkajene and Islands Regency Government (SIPANTAS) and the Land Information System of the Pangkajene and Islands Regency Government (SITANPAN). Here are the system requirements that researchers formulate:

Land Information System of Pangkep Regency Government (Sitampan):

1. Reporting Facilities:
   The SITANPAN application is designed to provide convenience in reporting related to land security of local government assets, especially Pangkep Regency. With this application, it is hoped that the reporting process related to land assets can be carried out more efficiently and effectively, in accordance with the purpose of research to facilitate the process of making land certificates.
2. Digital Public Services:
   SITANPAN creates a digital picture in processing public services related to land data and land assets of the Pangkep Regency Government. This application contributes to digital transformation in the provision of public services, facilitating access and management of information regarding regional land assets.
3. Public Access:
   Sitampan is also designed to be accessible to the public. The information contained in the application includes data on assets of the Pangkep Regency Government, especially public facilities and social facilities.

Information System Monitor Land Procurement Process &; Land Certificate of Pangkep Regency Government (Sipantas):

1. Monitor the Land Preparation Process:
   The Sipantas application aims to monitor the process of land acquisition and issuance of land certificates by the local government of Pangkep Regency. This shows the focus of the application on the land acquisition and legality process involving local governments, which is in accordance with the research objectives to facilitate the process of making land certificates.
   Based on system needs, the design process of the Government Land Asset

Mapping Geographic Information System is carried out using software and hardware as follows:

Software

1. Using JavaScript as a programming language.
2. Use Node.js to build backend systems.

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

3. Use the Next.js framework to build system interfaces.
4. Using API technology as a communication path between backend and frontend systems.
5. Using MongoDB as a Database.
1. Use Visual Studio Code as an IDE (*Integrated Development Environment*) in writing and compiling system code.

3.2 Proposed System Analysis

Based on the needs that researchers found in the Geographic Information System for Land Asset Mapping of the Pangkep Regency Government, the system proposal that researchers can convey is to build an information system with web technology based on *microservice* architecture that researchers hope can be accessed and used easily & flexibly, can implement digitization of data recording, integrate data between services, and facilitate development and maintenance of information systems in the future. The proposed system would have functions and features that the researchers describe as follows:

1. The system is developed with web technology to facilitate access and use of services.
2. The system provides two client-side frontends , namely for Sitanpan and Sipantas.
3. The system has a server-side backend that functions as a logic processor and data transactions between the client-side frontend and the database via API communication.
4. The microservice architecture used on the server-side backend functions to make the system modularly manageable in the form of microservices based on the required business processes, reusable on diverse client-side frontends, can handle high spikes in user traffic, and facilitate the process of developing and maintaining systems in the size of a team of developers who small.

The following is an overview of the overall process of the proposed Pangkep Regency Government Land Asset Mapping Geographic Information System Design, with microservice architecture:

DOI: 10.52362/ijiems.v3i2.1412

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

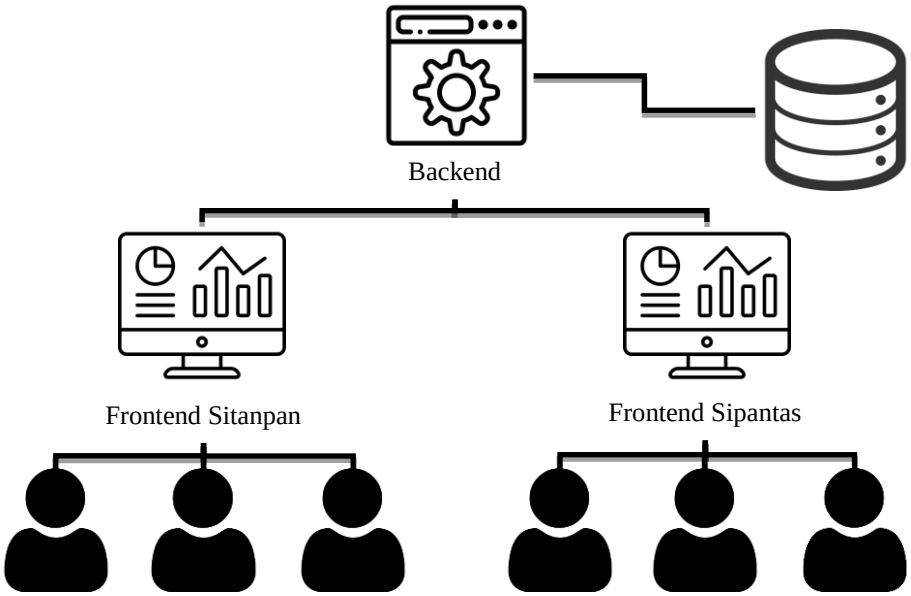


Figure 2. Proposed Geographic Information System for Land Asset Mapping of Pangkep Regency Government

Then, below are the features that will be provided on the library's proposed self-service information system:

Client-side Land Information System Frontend of Pangkajene and Islands Regency Government (SITANPAN)

1. District Page
   This feature allows admins to add, change and delete subdistrict data.
2. Village Page
   This feature allows admins to add, change and delete village data.
3. Certificate Page
   This feature allows admins to add, modify and delete Certificate data. This feature also displays a map visualization which then calculates the land area based on the coordinate points of the map visualization.
4. User Page
   This feature allows admins to add, change and delete admin data. This feature can also define the role of each admin such as (1) super admin, (2) editor, and (3) view only.
5. Halaman *File History*
   This feature allows admins to see every other user who has opened a *file* or *image* on each land title data.

Information System Monitor Land Procurement Process &; Land Certificate of Pangkajene and Islands Regency Government (SIPANTAS)

1. Procurement Page

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

This feature allows admins to add, modify and delete procurement data.

2. Land Acquisition Page
   This feature allows admins to add, modify and delete land acquisition data.
3. Conflict cases page
   This feature allows admins to add, modify and delete conflict case data.
4. Customary Land Page
   This feature allows admins to add, change and delete customary land data.
5. Financial Realization Page
   This feature allows admins to add, change and delete financial realization data.
6. User Page
   This feature allows admins to add, change and delete admin data. This feature can also define the role of each admin such as (1) super admin, (2) editor, and (3) view only.

3.3 System Implementation

3.3.1 Login Page

Figure 3 illustrates the user interface (UI) of the SITANPAN login page which consists of two main parts, namely the login form and the login button. This login form contains input for the username and password. The login button is used to transmit login data into the system.

Figure 3. Login Page

3.3.2 Dashboard Page

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

In figure 4 illustrates the UI of the SITANPAN dashboard page consists of three main parts, namely header, content, and footer. The content contains general information about the system, such as the number of registered land assets, the number of registered users, and other statistics.

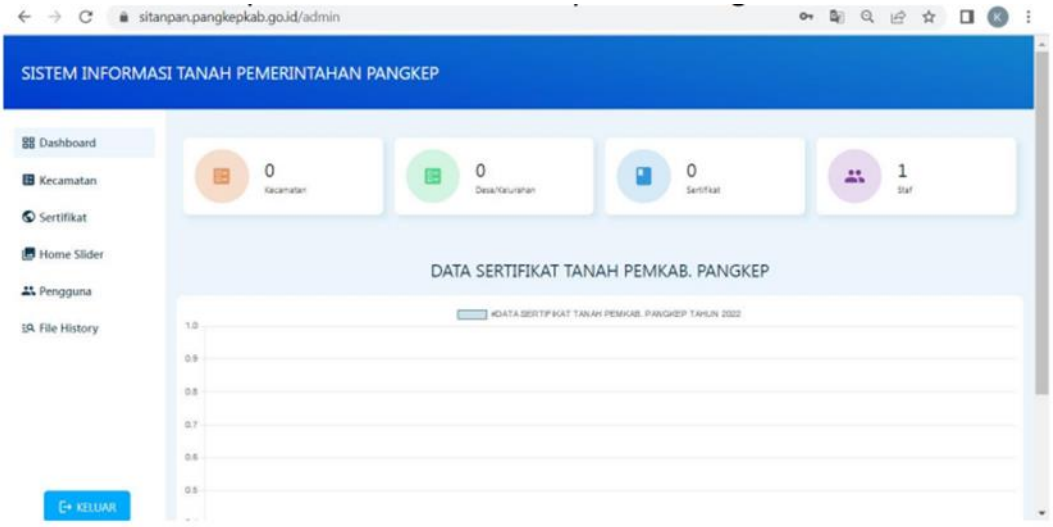


Figure 4. Dashboard Page

3.3.3 Certificate Page

In figure 5. describe the UI of the SITANPAN certificate recap page consists of three main parts, namely header, content, and footer. The content contains a certificate recap table consisting of information about SHP number, designation, village/kelurahan, sub-district name, area, issue date, coordinate points, and actions. The add button takes you to the add or edit certificate page. And the download button will open a dialog to download the certificate recap.

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

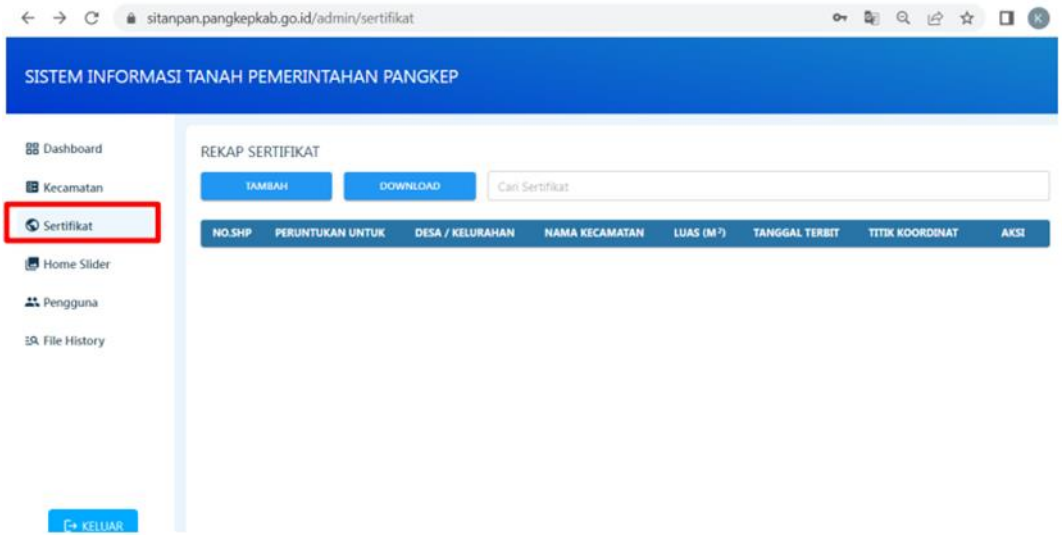


Figure 5. Certificate Page

3.4 User Acceptence Testing

The results of the tests that have been carried out, show that the application built already meets the functional requirements. However, in the process it is still possible for errors to occur. Functionally, the system that has been built can already produce the expected output. Then the data that has been obtained from the results of the questionnaire is then sorted based on the answers and then sums the data into a percentage by means of the total answers from each question item multiplied by 100 and then divided by the number of respondents. Based on the data from the questionnaire, the percentage of each answer can be found using the following formula:

$$P = \frac{f}{n} \times 100\%$$

Information:
P = percentage
f = Frequency of answers
n = Number of respondents

The following are the results of the questionnaire data after being added according to each answer, the data is as follows:

Table 1. Questionnaire results

No.	Variables	Question	Value				
			SS	S	KS	TS	STS
1.	Design	P1	3	4	3	-	-
2.		P2	1	4	4	1	-

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

3.		P3	2	6	2	-	-
4.	Facilities	P4	3	7	-	-	-
5.		P5	-	3	5	2	-
6.		P6	2	3	3	2	-
7.		P7	5	3	2	-	-
8.	Efficient	P8	4	4	1	1	-
9.		P9	3	2	5	-	-
10.		P10	-	6	4	-	-
TOTAL			23	42	29	6	0

From the questionnaire data obtained, it is then analyzed by calculating the average answer based on the score obtained from each respondent's answer. Based on the score that has been set, it can be calculated as follows:

From the results of the questionnaire data obtained, it is then analyzed by calculating the average answer based on the score obtained from each respondent's answer. Based on the score that has been set, it can be calculated as follows:

Table 2. Respondent score

Number of respondent scores	SS	23 x 5	155
Number of respondent scores	S	42 x 4	168
Number of respondent scores	C	29 x 3	87
Number of respondent scores	KS	46x 2	12
Number of respondent scores	STS	0 x 1	0
Total Number of Scores			382

Based on calculations that state the highest value is 500, percentages can be found as follows:

$$\frac{382}{500} \times 100\% = 76.4\%$$

Table 3. Score Interpretation Criteria

0% - 20%	Very weak
21% - 40%	Weak
41% - 60%	Enough
61% - 80%	Strong
81% - 100%	Very Powerful

The results of the system implementation show a percentage result of 76.4%, if converted with table 4.2 then the resulting system is suitable for use. These results are in accordance with

DOI: 10.52362/ijiems.v3i2.1412

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

the theory proposed by Riduwan (2008), if the percentage results obtained reach 61% - 80% then the test results can be said to be strong

4. Conclusion

Based on the results of the Geographic Information System for Land Asset Mapping of the Pangkep Regency Government, it can be concluded that:

1. The land certification information system is designed and built to facilitate the process of making land certificates at the Pangkep Regency Disperkimtan Office. The land certification information system consists of several features that are distinguished according to access rights, namely users and administrators. The features intended for users contain information about the requirements to the flow of the process of making land certificates. Users or applicants can directly access online and can check the field map after measurement. While features for administrators are features used to manage the web and process data of applicants who have registered.
2. Overall Client-Side Testing (SITANPAN and SIPANTAS), client-side testing shows that the login functionality, subdistrict data input, kelurahan, certificates, users, and other features run as expected. User interaction with the interface is well underway, and data validation provides appropriate responses. Load testing on SIPANTAS also shows that the application is able to handle user loads of 20 simultaneous users responsively and without operation failures. Likewise, backend load testing on certificate input features and financial realization reports showed good performance. The system is able to handle realistic user loads with responsiveness and 100% operation success. A relatively low average response time indicates adequate scalability of the system.
3. Based on the results of the questionnaire distributed to users showed a score of 76.4%, so that the land certification information system has good system functionality with accurate, relevant and timely information. With this land certification information system, it is expected to minimize costs because it can be accessed anytime and anywhere.

Acknowledgements

We would like to express our deepest gratitude to all those who have contributed, supported, and assisted in the completion of this research. Without cooperation and support from various parties. We would like to thank LP3M Universitas Teknologi Akba Makassar, for all the assistance, input, and support that has been given in completing this research.

References

[1] R. Han, “Web GIS in Development: From Research and Teaching Perspectives,” *GIScience Teach. Learn. Perspect.*, 2019, [Online]. Available:

DOI: 10.52362/ijiems.v3i2.1412

International Journal of Informatics, Economics, Management and Science
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i2.1412
Volume 3, Issue 2, August 2024, pp. 127-139

https://api.semanticscholar.org/CorpusID:86406615

[2] E. Warni, C. Yohanes, Z. Zainuddin, T. P. M. Wardhani, A. Rusmiati, and M. R. H, "WebGIS Visualization of Infectious Disease Clustering with a Hybrid Sequential Approach BT - Methods and Applications for Modeling and Simulation of Complex Systems," F. Hassan, N. Sunar, M. A. Mohd Basri, M. S. A. Mahmud, M. H. I. Ishak, and M. S. Mohamed Ali, Eds., Singapore: Springer Nature Singapore, 2024, pp. 377–389.

[3] W. Yin *et al.*, "An Interactive Data Visualization Design Based On WebGIS," *2019 IEEE 3rd Inf. Technol. Networking, Electron. Autom. Control Conf.*, pp. 2462–2465, 2019, [Online]. Available: https://api.semanticscholar.org/CorpusID:174819288

[4] S. Yasobant, K. S. Vora, and A. Upadhyay, "Geographic Information System Applications in Public Health," *Healthc. Policy Reform*, 2019, [Online]. Available: https://api.semanticscholar.org/CorpusID:264214040

[5] D. Kurniawan, D. Indah, P. Sari, and R. A. Akbari, "Geo-Informatics for the Future: A Systematic Literature Review on the Role of WebGIS in Infrastructure Planning and Development," *Indones. J. Comput. Sci.*, 2023, [Online]. Available: https://api.semanticscholar.org/CorpusID:260294460

[6] C. Fauzi, S. Novianti, and C. B. Septyandi, "Combating Overtourism: The Use of Web-GIS in Visualizing Tourist Distribution and Travel Patterns," *J. Tour. Sustain.*, 2022, [Online]. Available: https://api.semanticscholar.org/CorpusID:251241344

[7] A. C. Robinson, C. Anderson, and S. D. Quinn, "Evaluating geovisualization for spatial learning analytics," *Int. J. Cartogr.*, vol. 6, pp. 331–349, 2020, [Online]. Available: https://api.semanticscholar.org/CorpusID:219494256

[8] A. B. Santoso *et al.*, "The Utilization of Technology-Based Webgis as an Effort to Establish the Spatial Thinking Ability of Geographic Students In High School," *Proc. 6th Int. Conf. Educ. Soc. Sci. (ICESS 2021)*, 2021, [Online]. Available: https://api.semanticscholar.org/CorpusID:244177038

[9] A. M. Bodzin, D. Anastasio, R. Sharif, and S. Rutzmoser, "Using a Web GIS Plate Tectonics Simulation to Promote Geospatial Thinking," *J. Geosci. Educ.*, vol. 64, pp. 279–291, 2016, [Online]. Available: https://api.semanticscholar.org/CorpusID:63586128

[10] F. Febriyanto *et al.*, "PELATIHAN PEMANFAATAN SISTEM INFORMASI GEOGRAFIS ASET PADA DINAS PERHUBUNGAN DAN LINGKUNGAN HIDUP KABUPATEN MEMPAWAH," *Kumawula J. Pengabdi. Kpd. Masy.*, 2023, [Online]. Available: https://api.semanticscholar.org/CorpusID:258405839

[11] N. D. Raharjo, "Pemetaan Daerah Rawan Banjir di Kabupaten Bondowoso dengan Pemanfaatan Sistem Informasi Geografis," 2021. [Online]. Available: https://api.semanticscholar.org/CorpusID:233653146