

Citizen-Centric Decision Support Systems for Housing Assistance: A Low-Barrier E-Government Approach

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Abstract

Digital public services often require account-based authentication that can create access barriers for citizens with limited digital literacy. In housing assistance services, such barriers may reduce the accessibility of systems intended to support vulnerable groups. This study aimed to develop and evaluate a low-barrier decision support system for housing assistance by integrating Guest Mode access with the Simple Additive Weighting (SAW) method. The study used a design-oriented development approach in collaboration with *Dinas Perkim Minahasa*. System requirements were identified through staff interviews, and the prototype was tested in the agency environment using real housing data. Validation was conducted by comparing system-generated SAW results with manual calculations performed by agency staff and by testing the main system functions operationally. The results showed that the system produced the same ranking results as the manual calculations in the tested cases, while staff evaluation indicated that the Guest Mode design simplified the submission process and reduced administrative barriers. This study contributes to inclusive e-government practice by proposing a citizen-centered, low-barrier architecture for housing assistance services that maintains decision support accuracy while improving service accessibility.

Keywords: decision support system; digital inclusion; e-government; guest mode; low-barrier architecture

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INTRODUCTION

The provision of adequate housing is an important public service issue because it is closely related to social welfare, public safety, and inclusive development. In *Indonesia*, efforts to improve public services are supported by the Electronic-Based Government System policy, which encourages government institutions to deliver services that are more effective, transparent, and responsive (Almulhim & Yigitcanlar, 2025; Aytakin et al., 2025; Ismail et al., 2025; Latupeirissa et al., 2024; Lubis et al., 2024). However, the implementation of digital public services is not always equally accessible to all citizens, as digital transformation in government often remains constrained by barriers related to access, inclusion, and service usability (Almulhim & Yigitcanlar, 2025; Aytakin et al., 2025; Peeters et al., 2025). In this context, accessible service design becomes especially important in social assistance services intended for vulnerable groups (Sala & Kochergina, 2025; Zhuang et al., 2025).



In the context of housing assistance, these challenges are particularly relevant to the management of uninhabitable house assistance proposals. At *Dinas Perumahan dan Kawasan Permukiman (Perkim) Minahasa*, the volume of requests increased sharply following flooding in villages around Lake *Tondano*. This condition created a substantial administrative burden because staff had to process a large number of proposals manually. The accumulation of paper-based records and manual recapitulation made the service process time-consuming and exhausting for staff, while also creating difficulties in maintaining orderly, timely, and accurate data processing. These practical conditions indicate that the problem is not only administrative efficiency, but also how digital services can be designed to remain accessible for citizens while reducing the operational burden on public agencies.

Decision Support Systems (DSS) have been widely used to support public decision making by reducing subjectivity and improving consistency in the evaluation of multiple criteria (Moradi et al., 2023). In this area, the Simple Additive Weighting (SAW) method is frequently used because it is transparent and suitable for ranking alternatives based on weighted criteria (Chen et al., 2025; Güler & Büyüközkan, 2023; Petrović et al., 2023). In housing assistance services, such an approach is relevant because the condition of a house must be assessed using several official criteria, such as foundation, structure, roof, wall, and floor conditions. In practice, these criteria are not uniform for all houses, since the assessment standards used by the agency distinguish among concrete, wood, and bamboo house types.

Although DSS studies have demonstrated the usefulness of methods such as SAW for ranking and prioritization, many digital service implementations still assume that users can complete standard account-registration procedures before accessing the system. In public service settings, this assumption can become a practical barrier, especially for citizens with limited digital literacy or those who only need occasional access to a service (Peeters et al., 2025; Sala & Kochergina, 2025). Research on digital inclusion has also shown that access to ICT-based public services remains uneven when service design does not adequately consider vulnerable users and real usage contexts (Moghayedi, 2025; Teixeira et al., 2024; Zhuang et al., 2025). In addition, text-based location entry may create difficulties in field verification when staff cannot easily identify the actual location of a house (Calzada & Eizaguirre, 2025). In the *Minahasa* context, this became an important issue because staff reported difficulty locating submitted houses when relying only on written address information.

The main issue handled in this study is not merely how to rank housing assistance recipients, but how to design a housing assistance service that remains accessible to citizens while preserving the reliability of decision support results. Previous studies have given substantial attention to decision accuracy and digital government in development, but less attention has been directed to the integration of low-barrier access, official housing criteria, and location-based input in a citizen-facing public service context (Janssen et al., 2025; Peeters et al., 2025). This study therefore focuses on the need for a service design that reduces entry barriers without removing the structured assessment required by government agencies (Suradi et al., 2026).

This study aims to mitigate the accessibility barriers inherent in digital public services by developing and evaluating a low-barrier decision support system for housing assistance in *Dinas Perkim Minahasa*. The development focuses on integrating Guest Mode access to eliminate account creation requirements for citizens, while utilizing the SAW method to rank housing assistance proposals based on official assessment criteria. The study also incorporates geospatial input to help staff identify house locations more accurately during verification. The novelty of this research lies in the integration of citizen-facing low-barrier access, criteria-based decision support using official agency standards, and location-based input within one service architecture. The contribution of this study is to provide a citizen-centered design model for housing assistance that supports inclusive e-government practice while maintaining the

consistency of decision support calculations, as confirmed through validation against manual agency results.

METHOD

This study used a design-oriented development approach with functional validation to develop a web-based decision support system for housing assistance at *Dinas Perumahan dan Kawasan Permukiman (Perkim)* Minahasa (Matta et al., 2025; Richardson et al., 2023). The system operates as a low-barrier digital service, allowing citizens to submit data without creating accounts while enabling structured ranking based on official standards. The research integrates the SAW method and system development to provide an inclusive e-government model. This framework effectively bridges digital literacy gaps for vulnerable populations in the *Minahasa* region while maintaining the technical rigor required for administrative oversight.

Data were collected through interviews with three staff members at *Dinas Perkim* Minahasa to identify workflows and administrative requirements. This information was combined with official regulations to determine housing assessment criteria and weights across various construction types. The application was developed using PHP, JavaScript, and CSS within a standard web environment. Two main flows were implemented, providing a guest submission route for public users and an administrative dashboard for staff verification. The development followed a design-oriented methodology, conducting iterations based on staff feedback to ensure the system reflected actual administrative needs.

The decision support component utilizes the SAW method following official standards for concrete, wood, and bamboo house types. In the first stage, the decision matrix is normalized using the benefit criterion in Equation (1) to ensure comparable scales across different criteria. After normalization, the final preference value is calculated by multiplying normalized values by criterion weights and summing the results, as shown in Equation (2). This process generates the final ranking score for each housing proposal, establishing a clear basis for determining submission priority within the agency's administrative environment.

$$r_{ij} = \frac{x_{ij}}{\max(x_{ij})} \quad (1)$$

$$V_i = \sum_j^n \omega_j \cdot r_{ij} \quad (2)$$

Where:

r_{ij} = Normalized performance rating.

x_{ij} = Decision matrix row and column values.

$\max(x_{ij})$ = Maximum value of each criterion (benefit).

$\min(x_{ij})$ = Minimum value of each criterion (cost).

V_i = Final preference value for alternative i .

ω_j = Predetermined weight for criterion j .

n = Number of criteria.

Validation consisted of calculation and functional testing to determine the feasibility of the proposed system in supporting regional housing services. Calculation validation was performed by comparing system-generated results with manual calculations from four real housing data samples provided by *Dinas Perkim* Minahasa. Functional validation involved direct testing by agency staff of guest access, data entry, location selection, and document

generation. Through these procedures, the study assessed whether the application was functionally usable and consistent with existing manual assessment procedures used by the agency.

RESULTS AND DISCUSSION

Results

The weighting structure used in the system followed the official standards applied by *Dinas Perkim* Minahasa for three different house construction types. The purpose of Tables 1, 2, and 3 is to detail the specific criteria and weights assigned to concrete, wood, and bamboo materials, respectively. These tables ensure the system adapts to the material characteristics of different dwellings, as structural components generally receive the highest weight across all types. This adjustment is significant because it reflects the actual evaluation standards used by agency staff in the field, ensuring that structural stability remains the primary consideration in the prioritization process.

Table 1. Weighting criteria for concrete construction (sentence case)

Code	Criterion	Weight
C1	Foundation / Sloof Condition	15%
C2	Column / Beam (Structure)	35%
C3	Roof Frame Condition	25%
C4	Wall Condition	15%
C5	Floor Condition	10%

Table 2. Weighting criteria for wood construction (sentence case)

Code	Criterion	Weight
C1	Wood Pillar / Column (Main Structure)	35%
C2	Roof Frame Condition	25%
C3	Pedestal Foundation Condition	15%
C4	Plank Wall Condition	15%
C5	Plank Floor Condition	10%

Table 3. Weighting criteria for bamboo construction (sentence case)

Code	Criterion	Weight
C1	Bamboo Pillar Condition (Structure)	35%
C2	Roof Frame Condition	25%
C3	Woven Bamboo Wall Condition	15%
C4	Floor Condition (Dirt / Plaster)	15%
C5	Construction Binding (Rope / Nails)	10%

The conformity test between manual and system calculations is presented in Table 4. The table shows that system-generated scores were consistent with manual calculations for the tested samples, with no difference shown between the results. This indicates that the SAW calculation implemented in the application was able to reproduce the ranking results used in manual assessment. Functional testing results in Table 5 show that the guest access, map-based input, and document generation features operated successfully. Overall, the results indicate that the developed system was able to combine accessible submission features and reliable decision support within one integrated service flow.

The developed application provides a no-login submission mechanism for citizens, which was intended to reduce entry barriers at the beginning of the service process. To support location accuracy, the system integrates digital map input so that users can mark house positions directly. The significance of the results shown in Figure 1 lies in the interface's ability to capture precise coordinate data, effectively eliminating the ambiguity often associated with written address information. After submission, the system connects citizen data with administrative verification, generating official PDF documentation. Figure 2 illustrates the result of this automated process, demonstrating the successful transformation of assessment data into a formatted administrative document for staff verification.

Table 4. Conformity test of manual and system calculations (sentence case)

Submission Code	Manual Score	System Score	Difference	Accuracy
U01	0,9120	0,9120	0,0000	Identical
U02	0,8160	0,8160	0,0000	Identical
U03	0,5680	0,5680	0,0000	Identical
U04	0,7450	0,7450	0,0000	Identical
Average			0,0000	100%

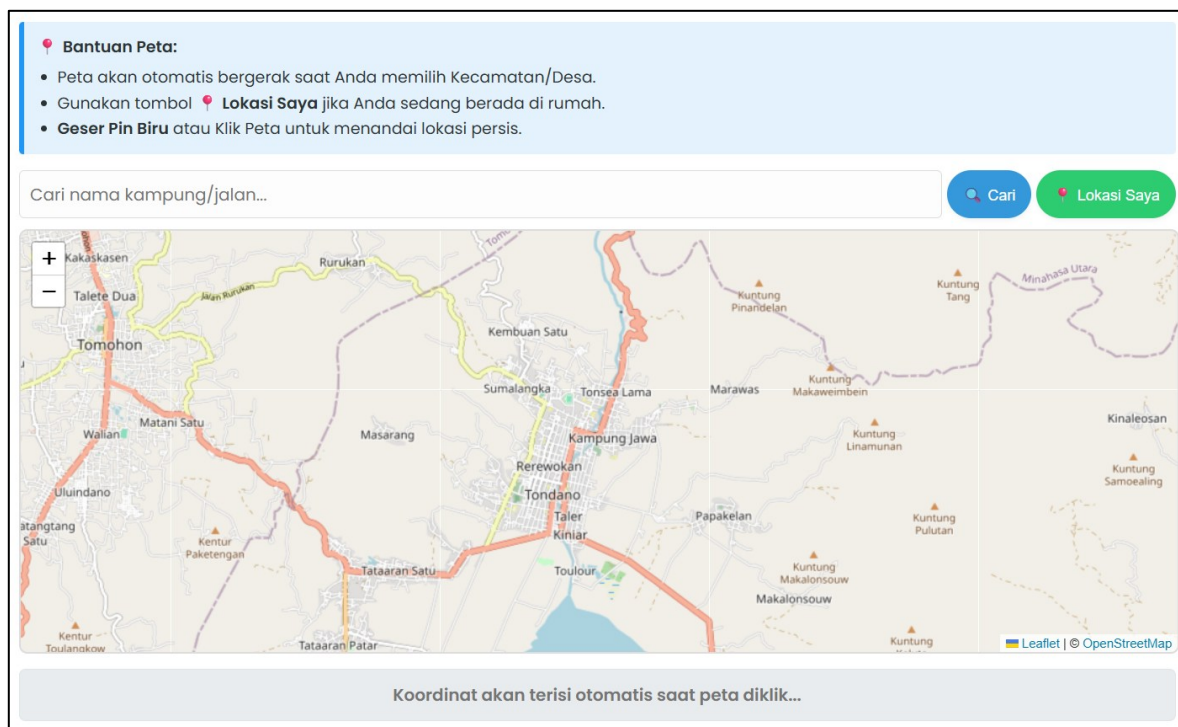


Figure 1. Interactive map interface for location determination (Sentence case)

The functional test results are summarized in Table 5. The tested functions included guest access, housing data entry, map-based location input, SAW processing, and document generation, and all were recorded as operating successfully in the staff trial. These results show that the application was functionally usable in supporting both submission and administrative review processes. Staff testing also indicated that removing account creation reduced the initial barrier to submission and made the application flow easier to follow. Although this observation was based on staff testing rather than direct public-user testing, it still shows that the low-barrier design was operationally feasible in the agency context. Overall, the results indicate

that the developed system was able to combine accessible submission features, location-based input, and decision support processing within one integrated service flow.

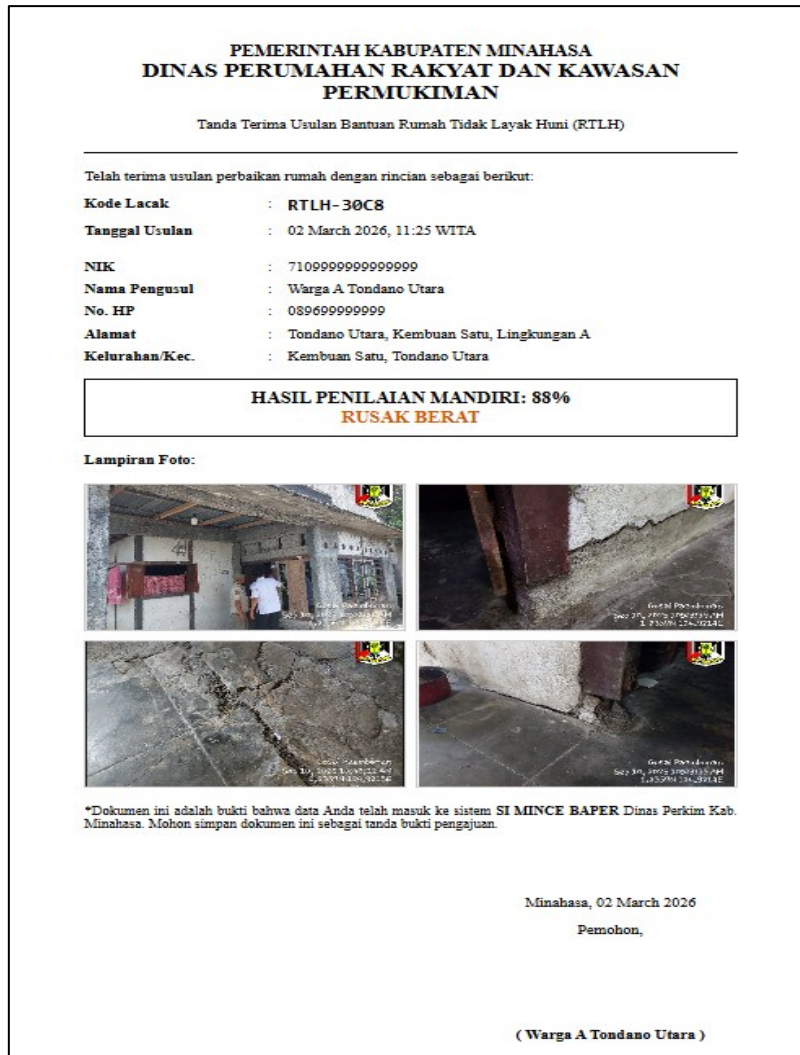


Figure 2. Automatically generated registration proof document output (sentence case)

Table 5. Summary of Black box testing results (sentence case)

Functional Category	Testing Scenario	Expected Outcome	Status
Authentication	Guest access via NIK validation	Access without registration	Success
Data Input	Multivariate housing criteria entry	Data saved to database	Success
Decision Engine	SAW algorithm calculation	Ranking score generation	Success
Spacial Data	Geospatial tagging via Leaflet	Coordinate data capture	Success

Discussion

The results show that the developed system was able to integrate low-barrier access, administrative review, and decision support processing within one service flow (Djatkiko et al., 2025). The most important finding is that account-free submission can be combined with structured assessment without changing the agency's official evaluation logic. This is reflected

in the conformity between the system-generated SAW results and the manual calculations conducted by agency staff. In addition, the implementation of map-based location input and document-based review indicates that the system was not limited to calculation automation, but also supported the practical verification needs of housing assistance services. Taken together, these findings suggest that a citizen-facing service can be simplified at the point of entry while maintaining the procedural structure required for administrative assessment.

These findings indicate that service accessibility should not be treated only as a front-end design issue, but as part of the overall service architecture. In many digital public services, access still begins with account registration, credential management, and repeated administrative input, which can become barriers for citizens with limited digital experience or occasional service needs (Peeters et al., 2025; Sala & Kochergina, 2025). The Guest Mode mechanism developed in this study responds to this issue by removing account creation from the submission stage. Although this study did not involve direct testing with public users, the staff trial showed that the simplified flow was operationally feasible and could reduce unnecessary barriers at the beginning of the service process. This interpretation is consistent with studies that emphasize the importance of reducing access friction and aligning digital service design with the actual conditions of vulnerable users (Djatkiko et al., 2025; Moghayedi, 2025; Teixeira et al., 2024; Zhuang et al., 2025).

The results also extend the practical application of decision support systems in public service settings. Previous work has often emphasized the use of methods such as SAW for ranking alternatives accurately and consistently in multi-criteria decision contexts (Chen et al., 2025; Güler & Büyüközkan, 2023; Petrović et al., 2023). The present study confirms that this calculation logic can still be applied reliably when it is embedded in a public-facing system designed for easier access. In this case, the system did not replace agency standards, but implemented the official criteria and weights already used by *Dinas Perkim Minahasa* for concrete, wood, and bamboo houses. This is important because it shows that low-barrier interaction does not have to weaken the consistency of the decision process. Instead, accessibility at the submission stage and rigor in the ranking stage can coexist within the same application (Chen et al., 2025).

Another relevant finding concerns the use of map-based input for house location. In the existing service context, written address information alone was not always sufficient for verification because staff experienced difficulty locating submitted houses in the field. By allowing applicants to mark the house location directly on a digital map, the system added a more practical form of spatial input to the submission process (Moradi et al., 2023). This feature is important not only for convenience, but also for administrative accuracy, because location information is part of the verification process in housing assistance services. The inclusion of map-based input therefore complements the decision support component by improving the quality of supporting information submitted to the agency. In this sense, the contribution of the system lies not only in ranking proposals, but also in strengthening the link between citizen submission and field verification, which is an important concern in citizen-centered digital service design (Calzada & Eizaguirre, 2025; Janssen et al., 2025; Peeters et al., 2025).

The study contributes to inclusive e-government practice by showing how a housing assistance service can be organized around low-barrier access without removing the structured criteria needed for public decision making. The contribution is both practical and conceptual. Practically, the system provides a more structured workflow for proposal submission, administrative checking, and document generation in an agency that previously depended heavily on manual recapitulation. Conceptually, the study shows that a citizen-centered service model can combine three important elements in one design, namely simplified access, criteria-based decision support, and location-based verification. For local governments, this implies that one-time or incident-based social assistance services may benefit more from reducing

access friction than from requiring persistent user accounts (Aytekin et al., 2025) from the beginning of the process (Kumar et al., 2025; Peeters et al., 2025; Suradi et al., 2026; Zhuang et al., 2025).

The study has several limitations. First, the system was developed and tested in only one agency context, so the findings cannot yet be generalized to other regional service environments without further evaluation. Second, system testing was conducted by agency staff rather than by actual public users, which means that the accessibility of the interface for citizens has not been examined directly (Fischer et al., 2025; Harari et al., 2025). Third, the conformity test of system and manual calculations was conducted using four real housing samples, so further testing with a larger number of cases is still needed. In addition, the system has not yet been implemented in a live public service environment. Future studies can therefore extend this work by involving real users, applying the model in other local governments, and examining whether low-barrier service design improves the accessibility and efficiency of social assistance administration in broader practice.

CONCLUSION

This study succeeded in developing and evaluating a low-barrier decision support system for housing assistance at *Dinas Perumahan dan Kawasan Permukiman* Minahasa by integrating account-free submission, map-based location input, and SAW-based ranking within a unified service flow. Verification results confirmed that the digital implementation remains consistent with established agency assessment procedures, as system-generated scores matched manual calculations with absolute accuracy while functional tests proved the system's operational readiness for both public users and administrators. These findings demonstrate that housing assistance services can be effectively redesigned to minimize access barriers for vulnerable groups without eroding the structured criteria necessary for government decision-making. By providing a practical model for inclusive e-government that maintains rigorous decision-support standards, this research offers a pathway for local governments to transition from manual recapitulation to citizen-centered digital services. Although the current evaluation is limited by its single-agency scope and a small number of calculation samples, the study establishes a viable architecture for broader digital inclusion efforts, suggesting that future research should involve direct public testing and cross-regional implementations to further refine the low-barrier design model.

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