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RESEARCH ARTICLE

Development and Implementation of a Computer-Based Information System for Recording Damaged Houses in Tangse District

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Abstract

This study focuses on the development and implementation of a computer-based information system for recording house damage in Tangse District, an area frequently affected by natural disasters such as earthquakes, floods, and landslides. The system is designed to improve the efficiency and accuracy of managing damage data following disasters. The traditional manual data collection method has proven to be slow and prone to errors, slowing down response efforts. The research covers several stages, including needs analysis, system design, implementation, and evaluation. Microsoft Access 2007 was used for database management, and Microsoft Visual Basic 6.0 was utilized for the development of the user interface. Evaluation results confirm that the new system enhances data collection efficiency and accelerates the damage reporting process. It also improves coordination between agencies like the Regional Disaster Management Agency (BPBD), facilitating faster recovery efforts. The system developed can serve as a model for other regions with similar challenges in managing post-disaster data.

Keywords

Computer-Based Information System; Disaster Management; House Damage; Recovery Efforts; Information Technology.

1 | INTRODUCTION

Advancements in information technology have greatly impacted various fields, particularly in managing data related to natural disasters. Each year, many regions face significant infrastructure damage caused by disasters such as earthquakes, floods, and typhoons. In disaster-prone areas like Tangse District, managing data on damaged houses becomes a major challenge. The process of recording and monitoring damaged houses is often done manually, which can be time-consuming and prone to errors. This delay hampers the speed of response and affects the accuracy of determining the recovery actions needed. Local governments, particularly at the sub-district level, must provide accurate and timely information about damaged houses after a disaster, enabling immediate recovery efforts. Data shows that the number of natural disasters in Indonesia has been rising rapidly, with 3,239 incidents recorded in 2023 (Manurung *et al*., 2024). The development of computer-based information systems plays a crucial role in improving the efficiency and accuracy of managing disaster-related data. These systems serve as tools to speed up information collection, create more structured reports, and support well-informed decision-making. Studies have shown that a well-designed management information system enables effective handling of information resources and enhances rapid disaster responses (Sudjiman, 2020).

A key part of this information system involves the recording of data on damaged houses in Tangse District. With a digital approach, sub-district officers and village heads can input information about house owners and the extent of damage, making data collection faster and more integrated. Research indicates that using information technology in disaster management helps overcome common barriers found in manual data collection, such as inefficiency and the risk of errors (Sarjito, 2023). Moreover, features that automatically generate reports allow local governments to better prioritize response efforts. The use of such information systems also improves communication among various agencies, which is essential for optimizing disaster responses and ensuring aid reaches the communities most in need. Previous studies have shown that coordination between the Regional Disaster Management Agency (BPBD) and other stakeholders is vital for effective disaster management (Muzdalifah *et al*., 2023). With a centralized system storing all data related to damage, all involved parties can easily access the required information, promoting better collaboration in the recovery process. The development of computer-based information systems not only enhances the speed of data access and processing but also plays a significant role in improving coordination and resource allocation in disaster management. This is supported by research that indicates the use of technology in disaster management strengthens collaborative mechanisms among agencies (Syugiarto *et al*., 2022). During post-disaster recovery, it is important for local governments to utilize information technology to assist all parties involved, ensuring recovery efforts are carried out more effectively and in response to the needs on the ground (Perdana & Siregar, 2022). The creation of computer-based information systems for recording damaged houses in Tangse District can be an effective solution for improving the efficiency of disaster data management. By introducing technology that simplifies data collection and analysis, the recovery process can be quicker and more accurate. Implementing this system is expected to benefit not only Tangse District but also other regions facing similar challenges in managing disaster-related damage data.

With these systems in place, local governments can ensure resources are allocated more efficiently, and disaster responses are more coordinated. Real-time data access and automated report generation ensure no critical information is missed and that appropriate actions are taken without delay. This technology-driven approach provides a more organized and effective disaster response mechanism, which is vital for both immediate relief and long-term recovery. Additionally, computer-based systems enable local governments to monitor progress during recovery and provide timely updates to stakeholders. These systems are particularly valuable in countries like Indonesia, which experience frequent natural disasters. They support not only immediate recovery but also long-term resilience by helping communities prepare for future disasters. The adoption of computer-based systems for managing disaster-related data helps reduce human error, speed up recovery, and improve communication among local authorities and stakeholders. As more regions implement such technologies, the overall effectiveness of disaster response will improve, benefiting not only local communities but also national disaster management efforts. With continuous advancements in technology, the potential for more efficient, accurate, and coordinated disaster management systems is set to increase, helping protect lives and property when faced with natural disasters.

2 | BACKGROUND THEORY

In recent years, the role of information technology in managing data related to natural disasters has become increasingly significant. This is especially true in the context of efficiently collecting and managing infrastructure damage data caused by natural calamities like earthquakes, floods, and typhoons. Maini *et al*. (2017) highlight the importance of swift responses and proper resource allocation by authorities during such events. The advent of computer-based information systems has provided a robust solution for managing disaster-related information, as noted by Emami and

Marzban (2023), who emphasize the efficiency brought by software that automates data collection and verification processes. The reliance on manual data collection has been a major hindrance to achieving efficiency and accuracy in disaster management. Huang *et al*. (2018) discuss how traditional methods using forms or spreadsheets are not only slow but also prone to errors. This underscores the necessity for a new approach that reduces dependency on inefficient manual methods. By accelerating the data collection process, computer-based systems ensure that stored data is more structured, which allows authorities to access and manage information more effectively (Phengsuwan *et al*., 2021). Furthermore, Othman and Beydoun (2016) explain that through data normalization, redundancy is minimized, thereby enhancing the integrity of the information system.

Normalization is a critical component of database design in post-disaster information management. It organizes data into interrelated tables, facilitating quicker access without duplication (Bazyar *et al*., 2020). The development of a robust system, from needs analysis to user interface design, is crucial to ensure the system meets users' real-world needs (Usta & Onat, 2023). Thorough testing is essential to verify that all system functions operate smoothly and contribute positively to post-disaster recovery. Manaseer and Alawneh (2017) point out that such systems improve coordination between various agencies involved in emergency response, enhancing data access for stakeholders. The management of data is further simplified by these systems, opening the door for more detailed analysis, such as identifying the most affected areas or predicting future disaster impacts. This capability provides authorities with better tools for planning and managing long-term recovery efforts. Decision-makers can accurately assess damages, prioritize areas needing immediate attention, and ensure that recovery processes are systematic and timely. Effective communication and collaboration across different government levels and among various agencies involved in disaster relief are also enhanced by well-designed information systems. Real-time, accurate data sharing between stakeholders is crucial for effective response coordination. The integration of these systems into government operations ensures that every relevant agency has access to the same up-to-date information, facilitating quicker decision-making and a more synchronized effort during emergency situations.

The benefits of these systems extend beyond immediate relief efforts, providing the tools needed for long-term recovery and future disaster preparedness. The use of technology in managing disaster data also supports long-term urban planning, allowing for safer construction practices, improved infrastructure, and better public awareness programs to prepare for and reduce the impact of disasters. As technology continues to advance, its integration into disaster management practices will undoubtedly improve the effectiveness and efficiency of disaster response efforts globally. Alfaris *et al*. (2022) discuss the operational research aspects that can be applied to optimize disaster management systems, emphasizing the importance of integrating advanced algorithms and data processing techniques. Purbasari *et al*. (2024) further elaborate on the significance of programming algorithms in developing efficient disaster management applications, highlighting the role of robust software engineering practices in enhancing system reliability and performance. Wali (2017, 2018, 2020) provides insights into the development of applications using Visual Basic and the integration of Microsoft Office add-ins, which are instrumental in creating user-friendly interfaces and enhancing data processing capabilities in disaster management systems. In conclusion, the integration of computer-based information systems in disaster management is a transformative step towards improving data collection, analysis, and coordination. By automating processes, reducing errors, and enabling real-time data sharing, these systems contribute to more efficient and timely responses to disasters. The proactive approach facilitated by these technologies not only strengthens current disaster response efforts but also builds resilience in communities for future events. As emphasized by the various studies and research, the continuous evolution of technology offers numerous opportunities to refine and scale disaster management systems, ultimately improving response efficiency and enhancing the overall resilience of communities.

3 | METHOD

This study adopts an applied research design aimed at developing and implementing a computer-based information system to record house damage in Tangse District. The primary goal is to enhance the efficiency and accuracy of managing data related to house damage after natural disasters. The research involves several stages: needs analysis, system design, implementation, and evaluation. These stages will be tested in the field to assess the system's effectiveness in improving disaster response. The research was conducted in Tangse District, Aceh Province, Indonesia, an area frequently affected by natural disasters such as earthquakes, floods, and landslides. The location was chosen due to its vulnerability to such events, which often result in significant damage to housing infrastructure. The participants in the study include sub-district officers, village heads, and members of the Regional Disaster Management Agency (BPBD), who are directly involved in managing and recording house damage data after disasters, making them ideal subjects for evaluating the computer-based system's implementation in disaster data management. The research was carried out in several key stages. Initially, a feasibility study was conducted to gather data about the existing manual system used for recording house damage. A feasibility analysis followed, assessing whether a computer-based system could be effectively developed. This study considered the technical, economic, and operational aspects to ensure that the proposed system would meet the research objectives. The preliminary planning phase involved defining the project's scope, identifying the system requirements, and understanding the project's needs. During this phase, estimations of resources such as budget and timeframe were made for system development. Preliminary specifications were outlined based on the needs identified in the feasibility study. The system analysis phase focused on determining the functional and non-functional requirements of the proposed system. Data Flow Diagrams (DFD) were employed to illustrate the processes involved in recording house damage, showing how information is passed from house owners to sub-district officers who process and report it. The analysis aimed to improve the flow of data, reduce redundancy, and optimize data processing for better efficiency.

In the system design phase, the system's architecture, database structure, user interface, and overall process flow were planned. The computer-based system was designed to streamline the data collection process, making it easier for sub-district officers to work. Tools such as Microsoft Access 2007 and Microsoft Visual Basic 6.0 were used to build the database and develop the application interface. Normalization techniques were applied to ensure data consistency and reduce redundancy, which are crucial for maintaining data integrity and optimal system performance. During the system implementation phase, the design was translated into a functioning system. The manual system previously used for recording house damage was replaced with the newly developed computer-based system. This system was built using Microsoft Visual Basic 6.0 for the user interface and Microsoft Access for database management. The implementation also involved replacing paper-based records with electronic entries, speeding up data processing and minimizing human error. After implementation, the system underwent comprehensive testing to ensure that it worked as expected. Two types of testing were conducted: functional testing, which assessed whether all system features operated correctly, and non-functional testing, which measured the system's performance, such as speed and responsiveness. Additionally, User Acceptance Testing (UAT) was performed to ensure the system met the users' needs and was user-friendly.

Following testing, an evaluation and refinement phase was carried out. This phase assessed the system's effectiveness in improving the efficiency and accuracy of recording house damage data. Feedback from users, including sub-district officers and village heads, was gathered regarding the system's performance and ease of use. Based on the evaluation results, refinements were made to improve the system's functionality for future use. Data were collected through various methods to assess the system's impact. These methods included semi-structured interviews with sub-district officers, village heads, and BPBD members to gain insights into the challenges faced with the manual system and their expectations for the computer-based solution. Direct observations were made of the current manual process to identify limitations and areas where the new system could improve. Surveys were distributed to system users (officers and village heads) to assess their satisfaction with the newly implemented system, and documentation reviews of disaster-related data and reports from Tangse District were conducted to inform the system's design and evaluate its impact on data collection and reporting. The collected data were analyzed using both descriptive and comparative analysis techniques. Descriptive analysis was used to interpret the data from interviews and surveys, focusing on user satisfaction and the system's usability. Comparative analysis was used to compare the performance of the computer-based system with the previous manual method, evaluating improvements in terms of data accuracy, processing time, and user satisfaction. The success of the research was measured by several indicators: improved efficiency in data collection and processing compared to the manual system, increased data accuracy measured by the reduction in errors and inconsistencies, user satisfaction gathered through surveys and interviews, and improved coordination among involved parties, evaluated by the speed and accuracy of information sharing between various disaster response agencies.

4 | RESULTS AND DISCUSSION

4.1 Reults

4.1.1 System Development

System development refers to the process of modifying, replacing, or reorganizing an existing system, either partially or entirely, to improve the performance of the current system. In a dynamic company, system development is an essential step to undertake. The goal is to enhance the mechanisms or workflows within the company to make them more efficient and integrated into a unified system or set of regulations. The primary focus of this development is to replace the old (conventional) system with a new, modern system that is more integrated and leverages computer technology to facilitate data processing. This aims to produce high-quality information that will support effective decision-making, particularly at the managerial or leadership level within a company. After data is collected and facts are documented, the system analyst evaluates the current system to understand how it operates. The next step is to conduct a feasibility study, which assesses whether the organization or institution that is developing the system can proceed to the next stage in the system development process. This feasibility study focuses on the key factors that may affect the system's ability to achieve the desired objectives. The first step in system analysis is a preliminary study, which includes assessing the type, scope, and initial understanding of the information technology system project to be developed. This study aims to provide an initial overview of the system to be built, along with estimates for the required costs and timeline for project completion. The diagram clearly shows that the damaged house data includes information regarding the owner of the damaged house. Following this, the sub-district head reviews and approves this data as part of the damaged house evaluation process. The process associated with damaged houses can be observed in the subsequent visuals.

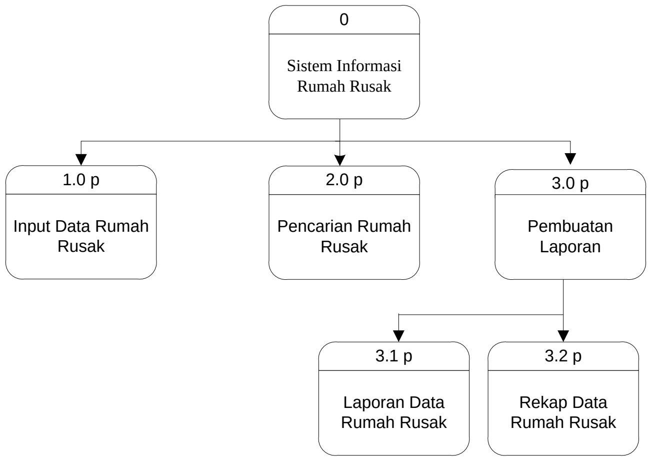

Diagram 1. Hierarchical Diagram

Based on the illustration in the previous section, it is clear that the process of handling each damaged house involves three main steps: inputting data for the damaged house, searching for damaged houses, and generating a report. To provide further clarity, the transitions between these processes can be observed in the next section on page 32. The process begins when the owner of a damaged house provides their personal data, which is recorded in the system. The final step in this process is generating a report, which will then be forwarded to the sub-district head. Additionally, the next level of the data flow process, which involves creating a table based on the available data, is also demonstrated. From this explanation, it is evident that each data archive supplies information to the corresponding data input process. For instance, the damaged house data is provided to the damaged house input process. Once inputted, this data is stored in its respective data file. The structure of the damaged house information system consists of several components: the login structure, the main menu structure, and the exit menu structure. The system implementation phase involves preparing the system for operation. This phase also entails replacing the old system with the new one. To ensure a smooth transition from the old system to the new one, a well-defined approach or strategy is necessary.

4.1.2 System Design

The designed information system enables fast data entry, which significantly improves the work efficiency of the Sub-district Head of Tangse. The system design is aimed at two main objectives: first, to improve the information system in the procedures involved in data processing, and second, to develop an information system for users using computer tools such as Microsoft Access 2007 and Microsoft Visual Basic 6.0, replacing the previous use of Microsoft Excel 2007. The first step in building the database involves designing the data structures properly. Well-designed structures not only enhance the complexity of the application but also increase its flexibility. A good data structure is critical to the success of the application. To ensure raw data reaches the relational database model, a process called normalization is required. Normalization is a technique used to create data structures that minimize duplication and prevent inconsistent data, especially during data additions or deletions. The normalization process includes several stages. The first stage, known as Unnormalized Form (UNF), occurs when data is entered exactly as it is, without any reorganization. This results in redundancy within the data. The next stage, known as the Normalized Form, ensures that each data item in a given row and column has only a single value, eliminating repetition and ensuring each data item is atomic, meaning it holds a single, meaningful value.

In the system development process, several steps are taken. First, the program folder is created by navigating to Drive "D" and creating a new folder named "Damaged House Application." Next, the project is created by opening Microsoft Visual Basic 6.0, selecting the "Standard Exe" option, and opening the project. After that, the database is created by selecting "Visual Data Manager" from the menu, choosing Microsoft Access Version 7.0 MDB, and naming the database "Data.mdb." The structure for storing the data is then defined, adding the necessary fields, and once all required fields are included, the data structure is built. This system uses one database that includes two sets of data and five form objects. The data structure for the admin includes fields such as "Kode_Admin," "Username," and "Password," while the damaged house data includes fields such as "Nomor," "Nama," "Umur," and "Pekerjaan," among others. These elements organize and store the information needed for the system's functionality. The form design process begins with creating a login form that serves as protection for the program users. When the correct username and password are entered, the main menu opens, allowing users to access various menu options. The design of this form includes components such as labels for "Username" and "Password," along with buttons for "Login" and "Exit," which manage user interaction with the system. This structured approach to system design ensures that all processes, from data entry to user access, are efficient and secure, allowing the system to enhance the functionality and performance of the Sub-district Head's operations.

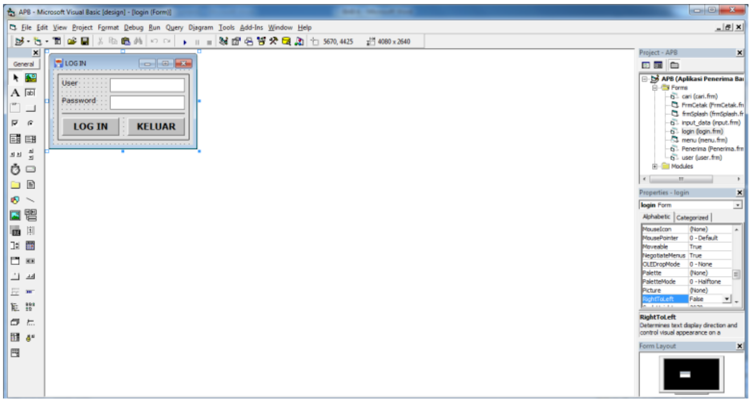

Figure 2. Login Form

The main menu form is designed to provide access to all the submenus available within the program. It includes several menu options that facilitate user interaction with the system. To provide more clarity, the details of the form objects are as follows: The "MDIForm" object is used for the main menu and is captioned as "Main Menu Form." The "ImageList1" object is used for displaying images, while the "Toolbar1" object handles the toolbar functionality, and "StatusBar1" is used for the status bar. These components are organized within the main menu form to ensure ease of use and efficient navigation for the user.

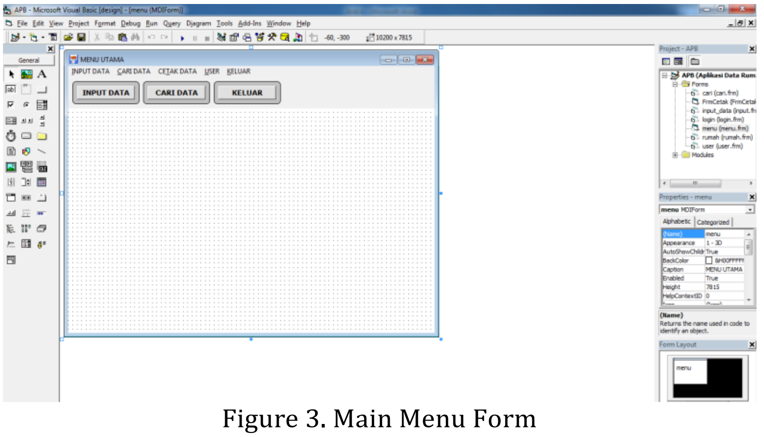

Figure 3. Main Menu Form

The process of creating the user form is intended to input data for the users of the application system. This form gathers user information, such as name and password. The list of objects for the user form is outlined in Table 9 below. It includes labels and textboxes for entering data, as well as command buttons for actions such as creating a new user, saving, deleting, and exiting the form. Based on this table, the form's layout is shown in the following section. The Recipient Form is designed to collect data related to damaged houses. It gathers various details such as the house number, the owner's name, age, occupation, number of dependents, type of damage, and the condition of the damage. The form includes labels for each field and textboxes for data input. Additionally, it features several command buttons for actions like creating new entries, saving data, editing, deleting, printing reports, and exiting. Table 10 presents the objects in the form, while the layout is provided in the next section. The Search Form allows users to search for data related to damaged houses. It offers fields for searching by house number or name. The form includes textboxes for entering search criteria and buttons to clear the search fields, display results, or exit. The details of the objects in this form are listed in Table 11, with the corresponding layout provided in the following section. The report output for damaged houses uses twelve text objects to display the relevant information. The layout and design of the report are presented in the following section, showing how the data will be organized and displayed.

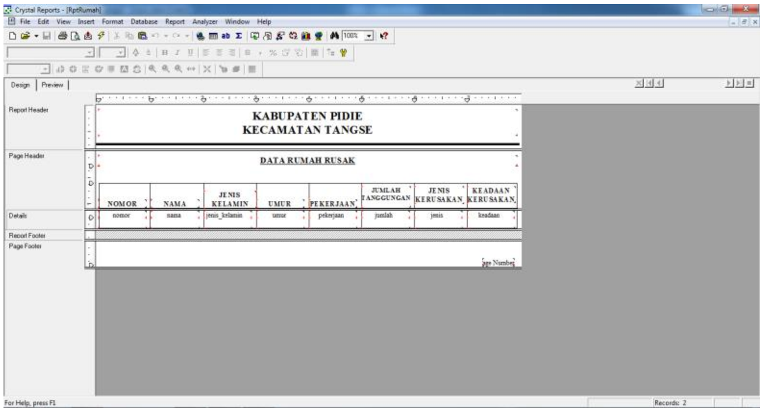

Figure 4. Damaged House Data Report

The image above shows the layout of the Damaged House Data Report. This report is designed to present information related to damaged houses in the Pidie Regency, Tangse District. The header displays the title of the report, which is "Damaged House Data," and includes the region's name, "Kabupaten Pidie, Kecamatan Tangse." The report's layout is structured with columns for various details, including the house number, name, gender, age, occupation, number of dependents, type of damage, and the condition of the damage. Each column is labeled for easy identification and provides a systematic way of organizing the data.

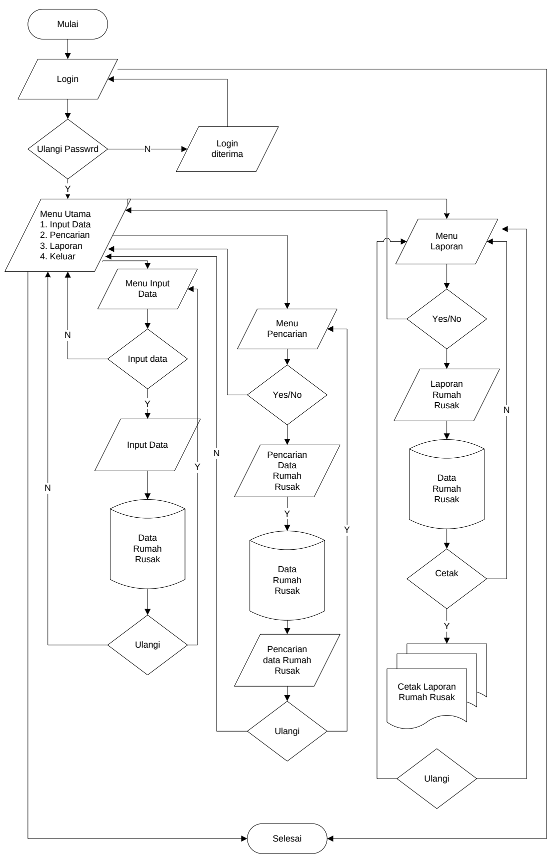

Figure 5. Flowchart

The flowchart above outlines the system's process flow for managing data related to damaged houses. It begins with the login procedure, where the user must enter their credentials. After logging in, the system presents several options in the main menu, such as data input, processing, and report generation. The flowchart shows that after selecting the "Input Data" menu, the user is prompted to input the relevant information, such as house number, name, and other details. Once the data is entered, the system checks whether the user wants to proceed with saving or editing the data. If the user confirms, the data is processed and saved in the system. Subsequently, the flowchart guides the user to the "Menu Processing" where data can be processed further or checked for errors. It includes conditional decision steps, such as whether to create or edit records. If the user opts to generate reports, the flowchart leads to the creation of the data report for damaged houses. At the end of the process, the user is given the option to exit the system or perform additional actions. This flowchart helps visualize the sequence of steps and decision points for handling damaged house data in the system.

4.2 Discussion

The development of a computer-based information system for managing damaged house data, as described in the study, offers a substantial advancement over manual data management methods. This transition is critical, as it addresses the inefficiencies and potential errors inherent in traditional data entry systems (Sarjito, 2023). The system development process, which involves modifying and upgrading existing frameworks, seeks to optimize workflows and leverage modern technology for more efficient data processing and reporting. In line with existing studies, such as those by Manurung *et al*. (2024) and Sudjiman and Sudjiman (2020), this development aligns with the strategic goals of disaster management systems: improving decision-making through timely and accurate information. By replacing the old manual system with a more integrated computer-based solution, the system not only enhances the speed and accuracy of data input but also facilitates better coordination between relevant stakeholders (Muzdalifah *et al*., 2023). The introduction of features such as automatic report generation and real-time data access ensures that disaster responses are more effective and that resources are allocated where they are most needed (Syugiarto *et al*., 2022).

The system's design, employing tools like Microsoft Access and Visual Basic 6.0, demonstrates a commitment to creating an adaptable and robust framework for data management. As emphasized by Othman and Beydoun (2016), database normalization is a key factor in ensuring data consistency and minimizing redundancy, which enhances the system's performance during periods of high demand, such as after a natural disaster. These methods support the long-term sustainability of the system, enabling it to scale as needed without compromising data integrity (Bazyar *et al*., 2020). The focus on improving user experience is evident in the design of the user interface and interaction models. As suggested by Phengsuwan *et al*. (2021), clear and intuitive system interfaces are crucial for ensuring that users, including local government staff and disaster response teams, can navigate the system with ease and efficiency. The use of forms for data entry, report generation, and user authentication ensures a smooth workflow, reducing the potential for operational bottlenecks.

Incorporating feedback from users during testing phases is another crucial aspect of this system's design, as noted by Perdana and Siregar (2022). Their research underscores the importance of involving end-users in the evaluation of disaster management systems to ensure that the tools developed meet their needs and provide tangible improvements in efficiency. The iterative refinement process, based on real-world feedback, enhances the system's adaptability and responsiveness to the dynamic demands of disaster recovery. The development and design of this computer-based information system for managing damaged house data in Tangse District exemplifies the positive impact of technology on disaster management. It addresses the core challenges of data accuracy, processing speed, and inter-agency coordination, ultimately contributing to more effective disaster recovery operations. The successful implementation of this system could serve as a model for other regions, providing insights into the integration of technology in public sector disaster response systems (Manaseer & Alawneh, 2017).

5 | CONCLUSIONS AND FUTURE WORK

The development and implementation of a computer-based information system for recording house damage in Tangse District has shown clear improvements in the efficiency and accuracy of disaster data management. By replacing the traditional manual method with an automated system, key challenges such as slow data processing and human errors have been addressed. The system has streamlined data entry and reporting processes, enabling faster, more reliable information sharing among stakeholders involved in disaster recovery efforts. Additionally, it has enhanced coordination between local authorities and disaster management agencies, leading to better alignment in resource distribution and recovery actions. The evaluation has confirmed that the system speeds up data entry, reduces the likelihood of errors, and supports the generation of real-time reports, all of which are essential for quick and informed decision-making during post-disaster recovery. Furthermore, the system has improved communication among various agencies, facilitating better collaboration and response times. Future development could focus on expanding the system's capabilities by incorporating more advanced data analysis tools. This would enable authorities to identify trends, anticipate future risks, and make more proactive decisions regarding disaster preparedness. Integrating geographic information systems (GIS) could add valuable spatial data, helping officials better understand the impact of disasters and optimize resource distribution. Another area for future work includes developing mobile versions of the system to enable field officers to directly input data from affected areas. This would ensure more accurate, real-time updates, even in remote locations. As technology evolves, there are numerous opportunities to refine and scale disaster management systems, improving response efficiency and enhancing the overall resilience of communities.

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