Utilization of Survey123 and WebGIS Platform for the Data Collection and Analysis System of Disaster Prepared School in Karo Regency

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Abstract. Indonesia is among the countries with the highest disaster risk due to its location at the convergence of four major tectonic plates in the Pacific Ring of Fire. Karo Regency, North Sumatra, is highly vulnerable to the eruption of Mount Sinabung, which has significantly affected the education sector. This study aims to develop a disaster preparedness information system for schools using Survey123 and WebGIS to support the School Disaster Preparedness (SSB) program. The research employed a quantitative descriptive method, collecting data through digital questionnaires with Survey123 linked to the spatial coordinates of each school. The data were analyzed descriptively and visualized in WebGIS using ArcGIS Online. Results show that most schools have clear evacuation routes (±82%) and preparedness improvement plans (±92%), but lack specific budgets (±7%), rescue facilities (±21%), and early warning systems (±14%). The integration of Survey123 and WebGIS effectively facilitates preparedness mapping, identifies vulnerabilities, and supports data-driven decision-making. This model has the potential to enhance disaster risk management in schools, though sustained funding, regular data updates, and human resource capacity building are still required.

Keywords: Disaster Preparedness Elementary School, Survey123, WebGIS, Spatial Analysis, Karo Regency.

1 Introduction

Indonesia is known as one of the most disaster-prone countries in the world. This is due to its geographical location at the convergence of four major tectonic plates in the Pacific Ring of Fire, namely the Indo-Australian Plate, the Eurasian Plate, the Pacific Plate, and the Philippine Sea Plate. Most of Indonesia's coastal areas are highly vulnerable to various natural hazards such as tsunamis, earthquakes, and volcanic activity [1]. Indonesia also has more than 500 volcanoes, around 128 of which are still active [2]. The country faces various types of disaster

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risks, each with its own characteristics (sudden or slow onset, purely natural or human-induced) and varying levels of affected areas [3].

Over the past four decades, Indonesia has experienced 22,441 disaster events occurring across different regions. On average, around 560 disasters occur annually, with the most dominant types being hydrometeorological disasters such as storms, floods, and landslides. The impact on human safety has been significant, as reflected in the total death toll of 367,840 lives, or about 8,758 lives per year. In addition, economic losses caused by disasters in Indonesia over the last 40 years reached approximately IDR 660 trillion, or equivalent to USD 44 billion, meaning an average annual loss of IDR 15.72 trillion. The disasters that caused the largest economic losses were earthquakes and tsunamis, followed by floods and forest and land fires [4].

One of the regions with a high level of disaster risk, particularly volcanic eruptions and earthquakes, is Karo Regency in North Sumatra Province. This area is located around Mount Sinabung, which in recent decades has shown significant volcanic activity, creating widespread socio-economic impacts, including on the education sector. Repeated eruptions of Mount Sinabung have not only disrupted teaching and learning processes but also caused trauma, damaged infrastructure, and posed safety threats to school communities.

Such vulnerabilities demand more targeted, systematic, and sustainable disaster mitigation and adaptation efforts. In the context of disaster risk reduction (DRR), the education sector plays a highly strategic role. Education is not only aimed at transferring knowledge but also at shaping character, raising awareness, and building a culture of disaster preparedness from an early age. One approach that has been implemented is the development of Disaster Preparedness Schools (Sekolah Siaga Bencana/SSB), which are schools equipped with preparedness systems through capacity building for school communities, DRR-based curriculum development, and strengthening disaster-safe school infrastructure [5].

Disaster Preparedness Schools are part of the national strategy to build community resilience against disasters, particularly through education. This program encompasses three main components: (1) enhancing the knowledge and capacity of school communities in disaster response, (2) constructing and improving school facilities to ensure disaster safety, and (3) developing an integrated disaster risk management system within the school environment [6]. However, the implementation of the SSB program still faces various challenges, especially in terms of collecting accurate, up-to-date, and comprehensive data on each school's level of preparedness.

To overcome these challenges, the use of information and communication technology has become highly relevant and necessary. One technological innovation that can be applied is Survey123, a mobile-based data collection application developed by ESRI. This application enables real-time data collection with geographic coordinate (GPS) support and reporting features directly connected to a Geographic Information System (GIS) [7]. Survey123 can be used to gather important information related to school preparedness, such as building conditions, evacuation routes, emergency assembly points, and the implementation of disaster education programs.

Furthermore, survey data collected with Survey123 can be integrated into the WebGIS platform, a web-based geographic information system that allows users to visualize and conduct spatial analysis interactively. WebGIS helps stakeholders understand spatial patterns of school

preparedness, identify areas with high vulnerability, and formulate more targeted policy interventions based on field evidence[7]. This technological combination is expected to improve efficiency, transparency, and effectiveness in decision-making for disaster risk management in the primary education sector.

Based on this background, this study aims to develop and implement a data collection and analysis system for school preparedness using Survey123 and WebGIS in Karo Regency. The primary focus of this research is on elementary schools designated as Disaster Preparedness Schools, with the expectation of producing a comprehensive overview of school preparedness in facing disasters. This system is intended not only as a technical tool but also as a foundation for planning, monitoring, evaluation, and policymaking based on evidence and accurate spatial data.

With the adoption of a system based on Survey123 and WebGIS, stakeholders at both regional and national levels can access valid and easily interpretable data. This will greatly assist in designing various capacity-building programs, developing safer school infrastructure, and integrating disaster education into the school curriculum. Moreover, this model also has the potential to be replicated in other disaster-prone regions of Indonesia, thereby strengthening a resilient and adaptive national education system in the face of future disaster risks.

2 Methods

This study employs a quantitative descriptive approach with the aim of developing a disaster preparedness information system based on WebGIS for elementary schools. The research location is set in Karo Regency, North Sumatra Province, an area known for its high disaster vulnerability, particularly the eruption of Mount Sinabung [8]. This region has a long history of volcanic activity that has significantly impacted the socio-economic life of the surrounding communities [9].

The primary data source of this study was obtained through a digital survey using the Survey123 application. The survey instrument consisted of a digital questionnaire designed in accordance with the indicators of disaster-prepared school preparedness, covering aspects such as infrastructure, evacuation routes, supporting facilities, disaster education programs, and human resource readiness in schools. The questionnaire was independently filled out by school representatives, including principals and teachers appointed as respondents.

Each entry in the Survey123 application is automatically linked to the school's geographic coordinates, thereby producing spatial data that can be further analyzed [7]. The collected data were then processed and visualized through a WebGIS platform based on ArcGIS Online [10], enabling interactive, thematic, and spatial presentation of school preparedness information.

Data analysis was carried out using a quantitative descriptive method, by tabulating and graphing the survey results, as well as mapping the distribution of school preparedness based on predetermined indicators. The resulting maps are expected to provide a comprehensive overview of the preparedness level of elementary schools in Karo Regency, while also serving as a foundation for developing strategies to enhance school capacity in facing disasters.

3 Results and Discussion

3.1 Overview of the Research Location and Sample School Characteristics

This study was conducted in Karo Regency, North Sumatra, a disaster-prone area. The survey covered 197 schools (public elementary, private elementary, public junior high, and private junior high) with an average of 205 students per school. Most school buildings are more than four decades old. Supporting preparedness facilities such as first aid rooms (68%) and sports fields/playgrounds (95%) are relatively available, although there are variations in accessibility to public roads and health facilities. This information is essential for WebGIS visualization in planning evacuation routes and aid distribution.

Table 1. General School Statistics

General Characteristics	Information
Total Schools Surveyed	197
Number of Public Elementary Schools	130
Number of Private Elementary Schools	15
Number of Public Junior High Schools	36
Number of Private Junior High Schools	16

Table 2. General School Characteristics Based on School Population

No	General Characteristics	Range	Total	Average
1	Students	19 – 1,016	40,235	± 205
2	Civil Servant Teachers	0 – 44	2,002	± 10
3	Non-Civil Servant Teachers	0 – 31	796	± 4
4	Administrative Staff	0 – 12	390	± 2

Table 3. Distribution of Preparedness Support Facilities

No	Support Facilities	Percentage of Schools Equipped	Average Quantity (if available)	Quantity Range (if available)
1	First Aid Room (UKS)	± 68%	1 room	0 – 1 room
2	Sports Field/Playground (assembly point)	± 95%	± 1,500 m²	50 – 48,000 m²
3	Electricity Supply	100%	± 2,500 Watt	450 – 23,000 Watt
4	Distance to Nearest Public Road	100%	± 200 m	0 – 15 km
5	Distance to Nearest Hospital/Clinic	100%	± 1.5 km	50 m – 25 km

3.2 Analysis of School Disaster Preparedness

The analysis indicates that evacuation routes are relatively clear (±82%), and there is a strong intention for future preparedness improvement (±92%). However, critical aspects such as dedicated budgets (±7%), early warning systems (±14%), rescue facilities (±21%), and trained preparedness teams (±19%) remain very limited. Most preparedness training is irregular (86.7%), reflecting a lack of consistency. School community preparedness perception and knowledge are generally moderate (average 3.3 out of 5), but require deeper content and more intensive drills.

Table 4. Availability of Disaster Preparedness Systems and Procedures

No	Key Preparedness Aspect	Percentage of Schools Responding "Yes"
1	Effective monitoring and supervision system	± 22%
2	Clear contingency and evacuation plan	± 38%
3	Strong earthquake-resistant school buildings (perceived)	± 54%
4	Clear and safe evacuation routes	± 82%
5	Rescue facilities (stairs/emergency exits)	± 21%
6	Community involvement	± 46%
7	Collaboration with relevant agencies	± 41%
8	Preparedness education and training	± 33%
9	Detailed evacuation plan	± 37%
10	Trained disaster preparedness team	± 19%
11	Effective early warning system	± 14%
12	Dedicated budget for disaster preparedness	± 7%
13	Future preparedness improvement plan	± 92%

Table 5. Frequency of Disaster Preparedness Training per Year

Training Frequency	Number of Schools	Percentage (%)
None	2	1.0%
Irregular	170	86.7%
Once	12	6.1%
Twice	8	4.1%
More than twice	4	2.0%

Table 6. Average Level of Preparedness and Knowledge of School Communities

Aspect of Preparedness/Knowledge	Average Likert Scale (1–5)
Overall preparedness	3.3
Effectiveness of monitoring systems	3.2
Clarity of contingency & evacuation plans	3.5
Strength of school buildings	3.6
Clarity of evacuation routes	3.7
Availability of rescue facilities	3.3
Community involvement	3.4

Collaboration with relevant agencies	3.4
Education & training implementation	3.4
Detailed evacuation plans	3.4
Trained disaster preparedness team	3.4
Effective early warning system	3.3
Dedicated budget	3.2
Future preparedness improvement plans	3.5
Knowledge of volcanic eruptions	3.5
Knowledge of earthquakes	3.5
Knowledge of landslides	3.5
Knowledge of floods	3.5
Knowledge of fire hazards	3.5

3.3 Visualization of Survey123 Analysis Results in WebGIS

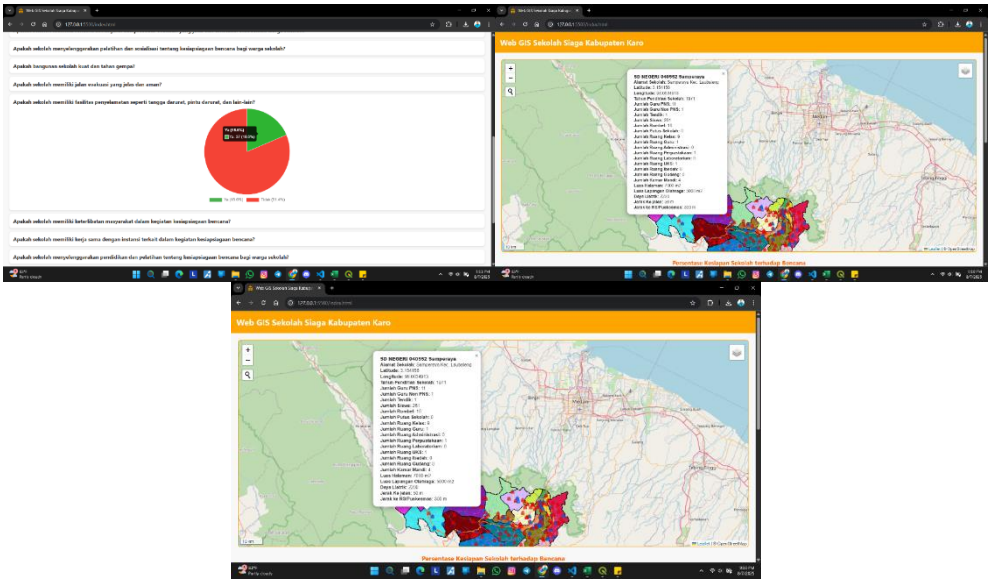

Fig. 1. WebGIS Analysis on Desktop

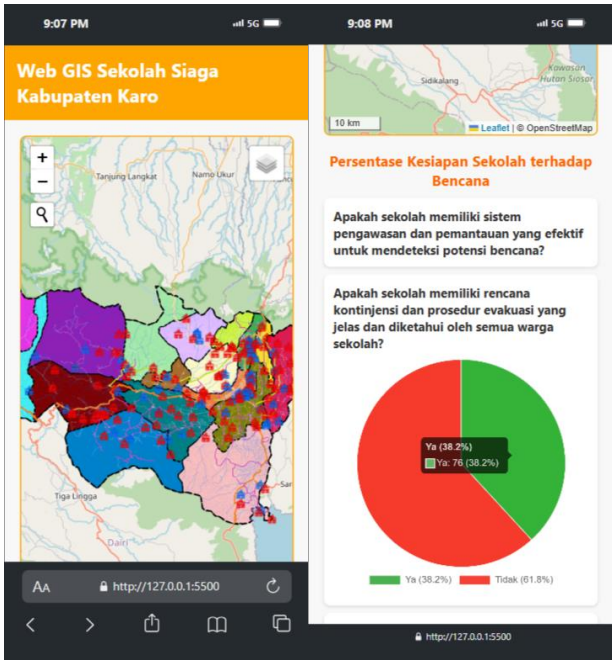

Fig. 2. WebGIS Analysis on Android

3.4 Identification of Geospatial Data Needs for Disaster-Prepared Schools

The survey identified essential geospatial data such as school coordinates, addresses, and distances to public roads and health facilities. For WebGIS integration, additional datasets are needed, including hazard zone maps, evacuation routes, locations of emergency facilities, assembly points, and school infrastructure data. WebGIS has the potential to bridge information gaps, accelerate coordination, and improve preparedness strategies by providing access to digital training materials and synchronized data across stakeholders.

Table 7. Identification of Geospatial Data Requirements for Disaster-Prepared Schools

Data Category	Specific Data	Primary Source
Survey Data	School Coordinates (X, Y)	Respondents
	School Address	Respondents
	Distance to Nearest Public Road	Respondents
	Distance to Nearest Hospital/Clinic	Respondents
Data for WebGIS Integration	Hazard Zone Maps (Volcano, Earthquake, Landslide, Flood, Fire)	Relevant agencies (BPBD, BMKG, PVMBG)
	Primary & Secondary Evacuation Routes	Local Government, BPBD

	Emergency Facility Locations (Hospitals, Clinics, Police Stations, Fire Departments, BPBD Offices)	Local Government, Related Agencies
	Designated Assembly Points/Safe Zones	Local Government, Schools
	School Infrastructure Data (building footprint, internal road network, utilities)	Field Survey, Education Office

3.5 Discussion: Potential and Implementation of WebGIS in Enhancing Preparedness

WebGIS is highly strategic for disaster information management in schools, particularly within the Disaster Preparedness School (SSB) framework. Its spatial visualization features present interactive maps of school locations, hazard zones, evacuation routes, and emergency facilities, allowing for rapid and accurate risk understanding. WebGIS also provides school profile dashboards, spatial analysis tools (proximity and buffer analysis), real-time reporting modules linked to disaster management agencies, emergency resource mapping, and interactive training modules. This transforms WebGIS into both a collaborative platform and a decision-support system.

However, WebGIS implementation faces challenges, such as limited dedicated budgets (only ±7% of schools have them) and varying technical capacities and digital literacy among school staff. To overcome these barriers, sustainable funding, tiered training programs, technical assistance, and regular data update protocols are necessary. Without these measures, WebGIS risks becoming outdated and unreliable.

Table 8. Conceptual Framework of WebGIS Features for Disaster-Prepared Schools

Feature Category	Main Features	Description
Spatial Visualization	Interactive Maps	Displays school locations, hazard zones, evacuation routes, and emergency facilities
	Spatial Data Display	Interactive map navigation with zoom, pan, and object identification
School Information Management	School Profile Dashboard	Presents tabular data on school characteristics, preparedness status, and contact information
	Search & Filter Functions	Enables filtering schools by name, type, preparedness level, or hazard exposure
Spatial Analysis	Proximity Analysis Tools	Calculates school distances to emergency facilities or hazard zones
	Buffer Zone Analysis	Identifies schools within a certain radius of a hazard or facility
Communication & Reporting	Real-time Reporting Module	Allows schools to update status (e.g., evacuation, safe, in need of assistance) during emergencies

	Early Warning & Notification System	Integrates early warning alerts from disaster agencies and sends notifications to schools
Resource Management	Emergency Resource Mapping	Displays locations of emergency supplies, trained personnel, and other critical assets
Education & Training	Interactive Training Module	Provides disaster preparedness materials, evacuation guidelines, and interactive quizzes

3.6 Synthesis of Findings and Research Implications

Karo Regency faces a high disaster risk, but school preparedness remains fragmented, with limited budgets and irregular training. WebGIS offers a solution to address data and coordination gaps by centralizing information on school locations, hazard exposure, evacuation routes, and preparedness status through interactive spatial visualization. This can improve risk awareness, accelerate decision-making, and support coordinated responses.

The effectiveness and sustainability of WebGIS largely depend on policy support, sustainable budgeting, and stakeholder engagement. This study recommends the formal integration of WebGIS into the SSB program, supported by dedicated funding, data update protocols, and systematic training programs. Such measures will ensure WebGIS becomes part of a sustainable proactive preparedness culture, delivering both social and practical benefits in strengthening SSB.

4 Conclusion

This study demonstrates that the use of Survey123 and WebGIS offers a strategic innovation for collecting, managing, and analyzing school preparedness data in disaster-prone areas such as Karo Regency. While most schools have established evacuation routes and future preparedness plans, critical aspects such as funding, rescue facilities, early warning systems, and consistent training remain limited.

The integration of Survey123 with WebGIS proved effective in visualizing spatial data, simplifying vulnerability identification, and providing a strong basis for evidence-based decision-making. Beyond mapping, the platform serves as an interactive, collaborative decision-support system accessible to stakeholders.

However, the sustainability and effectiveness of WebGIS rely heavily on budget support, regular data updates, digital literacy improvements, and stakeholder engagement. With strengthened policies, sustainable funding, and systematic training, this model can be replicated in other disaster-prone regions of Indonesia, contributing to stronger educational sector resilience against disasters.

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