

Environmental Information System for Disaster Risk Management at Kota Surakarta

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ABSTRACT

Through this activity, disaster volunteers in Surakarta City can conduct disaster risk reduction (DRR) efforts based on ecosystem data and information management. Climate change has an increasing impact on ecosystems, resulting in environmental damage, thereby increasing the intensity of disaster events that need to be studied and monitored. Managing this disaster risk data and information requires using an environmental information system for ecosystem-based disaster risk reduction (ECO-DRR). The capacity of volunteers is vital in dealing with the risks of natural disasters and the impact of climate change by using SIL. Currently, volunteers manage using a form that has yet to accompany the presentation of information for decision-making and management of disaster risk knowledge. Requires remedial action by increasing the ability of volunteers to manage disaster risk data and information, report disaster events, and present them in dashboards. The method used is the parameters for development of SIL as a solution for ecosystem-based disaster risk reduction (ECO-PRB). The parameters were conducted on the topics of disaster risk, disaster incident reporting, and dashboard information management. The development of ECO-DRR SIL uses Quality Function Deployment (QFD) to obtain information on improvements in developing a user-based digital platform.

KEYWORDS

Ecosystem
Disaster risk reduction
Environmental
information system

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1. Introduction

A disaster is an event or series of events that threatens and disrupts people's lives and livelihoods caused by natural and non-natural factors and human factors resulting in human casualties, environmental damage, loss of property and psychological impacts (*Data Dan Informasi Bencana Indonesia (DIBI)*, 2022). In the first three months of 2018, Indonesia experienced at least 513 natural disasters. Two major disasters occurred in August and September 2018, with the earthquake in Lombok and the Tsunami in the Central Sulawesi region (Cos-Guerra et al., 2022).

Humanitarian organizations are at the forefront of the disaster management process, including the SAR Team, the Indonesian Red Cross, as well as various other humanitarian agencies from various foundations in Indonesia. All disaster management activities from each of these groups are coordinated by the National Disaster Management Agency (BNPB).

The Muhammadiyah for Resilience Institute, better known as the Muhammadiyah Disaster Management Center (MDMC), is one of the disaster social institutions under the Muhammadiyah Central Executive (Rachmawati et al., 2022). MDMC is engaged in disaster management activities, including mitigation and preparedness, emergency response and rehabilitation. In implementing disaster management, MDMC is assisted by various volunteers from the Muhammadiyah region.

MDMC Surakarta City, as one of the regions, also helps in all forms of disaster management in Indonesia. In sending aid, it is generally necessary to process accurate and fast data collection so that other policies can be implemented immediately.



Figure 1. Disaster risk reduction by MDMC

In the disaster management process, volunteers collect data on conditions and needs when a disaster occurs. The data collection process is still manual and needs fixing indicators, so coordination between volunteers is experiencing problems. The Surakarta City MDMC also requires daily reports on conditions and needs at the disaster site to be used as documentation and reference for the rehabilitation and reconstruction process.

The Surakarta City MDMC coordinates and communicates internally and externally through direct meetings and the WhatsApp Group social media. The information technology channel used to report and offer activities is the Surakarta City MDMC Facebook page https://www.facebook.com/people/lpb_mdmc-surakarta/100071309380193/, which 120 followers follow. Apart from that, there is also an account on Instagram with the address https://www.instagram.com/lpb_mdmc-surakarta/.

The existence of Whatsapp Groups and Facebook Groups has limitations where the information that appears is the latest. This makes presenting information or fixed links that can be controlled as in an information system challenging. Making an information system, making the data entry process, storage, analysis and display, and reporting more attractive and ergonomic to optimize the website's function.

Besides the Surakarta City MDMC, collaborative information system development also uses resources from the Urban Resilience Initiative and Collaboration (URIC). The URIC organization was established to increase city resilience and increase citizen participation with the support of local knowledge (Agustianingsih et al., 2023). In 2022, Dikti personnel assisted the MDMC Muhammadiyah Central Executive with an information system for handling disasters and Covid-19, namely the SAHABAT Program. This program is a strategy to deal with disasters and the Covid-19 pandemic through collecting data and information.

Homepage www.sahabatmdmc.online, which provides natural disaster reporting categories in the SAHABAT program. Through developing an information system with a platform, as in the SAHABAT Program, efforts to reduce disaster risk can be carried out. This impacts the participation of volunteers and the community to achieve sustainable development goals (SDGs), especially in the environment and adaptation to climate change mitigation.

The target of this research group serves to provide problem-solving (solutions) to problems that occur to partners, namely increasing the capacity of volunteers in the Muhammadiyah Disaster Management Center (MDMC) in Surakarta City in carrying out disaster risk reduction (DRR) efforts based on ecosystem data and information management. The Climate Change and Environment Research Group collaborated with URIC in this case.

2. Method

The method used by Research Group of Climate Change and Environment is discussion and participatory action research using the Quality Function Deployment (QFD) approach to build an information system for disaster risk reduction in Surakarta City (Mao et al., 2019). The development carried out is not only for campaigns or education but also as a means of data input, storage, analysis and presentation, as well as disaster data reporting. Parameters identification needs to be implemented to increase the capacity of volunteers in the following areas.

2.1. Disaster Management Parameters

Meetings with the parties were held to determine the need for a disaster incident reporting information system. This meeting agreed that there is no information system that can involve the community in reporting disaster events. In addition, an information system is needed that can be accessed by disaster volunteers. The data and information entered into the information system will assist in handling it. This functionality is provided by the system in the decision making module (Zar Chi Aye et al., 2015). In the product design process, volunteers are given the opportunity to use the initial version of the information system and record any comments or responses. For example, when volunteers had to enter disaggregated data, it turned out that the classification used had to be adjusted according to the oldest age level.

Discussion of process design is carried out through workshop activities. Together with stakeholders, several workshops have been held involving MDMC management and volunteers, health workers and paying attention to input from Muhammadiyah leaders. The result is expected to be an agreement on disaster management procedures or flow as the Guidelines for Disaster Response and Recovery MDMC Surakarta City. The agreed guidelines are also a disaster management system that must be able to adapt to other emergencies that accompany it, for example, such as a pandemic. These guidelines ensure that the information system fulfills the two main parts of the disaster management information system, namely the information management system and the disaster inventory system (Rafi et al., 2018).

2.2. Data Management Parameters

Based on monitoring and evaluation, it is known that one way to increase beneficiaries' skills and knowledge in using applications is to encourage them to use applications in their daily lives. By creating a simulation based on real-time earthquake events, this project forces volunteers to familiarize themselves with the various features and menus available in the application. The BMKG releases about 100 earthquake events every day, giving projects enough options to choose from a few to trigger simulations.

To better familiarize beneficiaries with the app's functionality and features, the project is conducting parameters discussion for volunteers. It is hoped that this skills in parameters application will be attended by participants from all regions in Surakarta City. During the discussion, the project simulates a disaster response using an Earthquake and tsunami scenario (Sakya et al., 2023). Human resources and networks have an important role in linking activities because some of the activities include capacity building programs in disaster-prone areas.

3. Results and Discussion

3.1. Environmental Information System from Disaster Management Discussion

Implement disaster management; is carried out through 3 (three) stages follows: the pre-disaster stage is implemented when there is no disaster and when under threat of potential disaster, the

emergency response stage is designed and implemented when a disaster is happening, and the post-disaster stage is the time after a disaster occurs (Modarresi & Maleki, 2023).

In the pre-disaster stage, they started with prevention and mitigation Stage. The disaster prevention and mitigation phase is carried out to reduce and overcome disaster risks. The series of efforts undertaken can be in the form of repairs and modifications to the physical environment as well as awareness and capacity building in dealing with disaster threats. Disaster prevention and mitigation stages can be carried out structurally and culturally (non-structural).

Structurally, the efforts to reduce disaster vulnerability are technical engineering of disaster-resistant buildings. Meanwhile, culturally, efforts to reduce vulnerability to disasters are by changing paradigms and increasing knowledge and attitudes to build a resilient society. Cultural mitigation includes making people care about their environment to minimize the occurrence of disasters (Wardekker et al., 2023). Activities that can generally be carried out at this stage are making a map or plan of areas very prone to disasters, disaster alarms, making buildings resistant to specific disasters, and providing counselling and in-depth education to people living in disaster-prone areas.

The level of readiness is the second stage in the pre-disaster stage. The preparedness stage is carried out before a disaster occurs. At this stage, nature shows signs or signals that a disaster will soon occur. So at this stage, all elements, especially the community, need to be prepared and always on standby to face the disaster. At this stage, a Renkon process stands for Contingency Plan. A contingency is a circumstance or situation which is expected to occur soon but which may not occur (Dou et al., 2014). A contingency Plan means identifying and preparing a plan based on such contingency or uncertain circumstances. A contingency plan may never be activated if the foreseeable circumstances do not occur.

In general, activities at the preparedness stage include developing plans for developing warning systems, maintaining supplies and inter personnel discussion, developing search and rescue measures and evacuation plans for areas that may be at risk from recurring disasters and carrying out these preparedness steps before a disaster occurs and are aimed at minimizing loss of life, service disruption, and damage when a disaster occurs.

When emergency happen, we need emergency response stage. The emergency response phase is carried out when a disaster occurs. Activities during the emergency response stage that generally apply to all types of disasters include save yourself and loved ones, don't panic, to be able to save others, you must be in a safe condition, running or staying away from the epicenter of the disaster doesn't need to take any belongings with you, then protect yourself from things that may hurt yourself.

Post action after emergency responses, we should prepare for rehabilitation and reconstruction stage. Rehabilitation and reconstruction stages are usually carried out after a disaster occurs. The core activities at this stage are be emergency assistance, established a relief command post, coordinate with the Coordinating Unit for Disaster Management and other aid providers, established shelter tents, public kitchens, health posts and coordination posts, distributing medicines, groceries and clothing, finding and placing the victims in tents or evacuation posts, helping medical staff for treatment and grouping victims, and search, evacuate, and bury the dead.

Next phases in post action we need damage inventory, damage evaluation, recovery, and rehabilitation. Damage inventory consist of data collection is carried out on the various damages that have occurred, both buildings, public facilities, agricultural land, and so on. Damage evaluation, At this stage, a discussion is carried out regarding the advantages and disadvantages of disaster management that has been carried out. Improvements in disaster management are expected to be achieved at this stage. Recovery (Recovery), At this stage, restoration or restoration of damaged or chaotic environmental conditions due to the disaster is carried out as at the beginning. This recovery is not only carried out in the physical environment, but victims affected by the disaster are also given recovery both physically and mentally (Paudel et al., 2023).

Rehabilitation, starting to design regional spatial planning (master plan) ideally by giving trust and involving all components of society, especially disaster victims. Included in this activity is the mapping of disaster areas (Valaei Sharif et al., 2023).



Figure 2. Disaster Management Discussion



Figure 3. Data Management Invention

Final stages are reconstruction and continue monitoring. Reconstruction activities are carried out with medium and long term programs for physical, social and economic improvements to return people's lives to better conditions than before. Continue monitoring, Areas that have experienced a disaster have a high probability of experiencing the same event again. Therefore it is necessary to carry out continuous monitoring to minimize the impact of the disaster.

3.2. Environmental Information System based on Data Management Parameters

In meetings to discuss about disaster management what groups can do in volunteer group where it is necessary to understand whether there is a system that will collect reports or not data on disaster events and their handling. This matter need exists information system that will record all records data and information that has been input into the system then data and information is not just silent. In an environmental information system, incoming data and information must be manageable, at least it can be presented according to its needs or designation.

In this case the management of data and information relating to the group of volunteers who will provide comments or responses and follow-up of the data and information. For example when there is data then this data turns out to have to be compiled with other data of course the group of volunteers who receive it must be able to act as reviewer and provide data compilation. It will be even more different if it turns out that the group of volunteers who receive data and information from the system must do something so that what is done needs to be recorded and known by the other volunteers so that there is no double action or the same response from the other party.

Similarities or differences from responses to information systems that want to accumulate input from events and volunteers need to be agreed in advance how this needs to be followed up. For example, when there is incident data or disaster data, it turns out that what is needed is only to be presented first, while the decision process will go through a meeting, in this case, then we see that there are two parts of an information system that require different containers and actions. The first is an information system that will collect all data, both data with high validation and data with low validation, but then it will be discussed in the meeting forum in this case, anyone who will attend the meeting must be related to other sub information systems (Wang et al., 2021). When a decision appears from the meeting following up on the information above, it needs to be accommodated by another information system.

Responding to current situation, the handling of disaster events can be followed up from two sides, namely the first side follow up with activities on the report or the report submitted is a container for input in decision making from the volunteer group. considering this, as the first information subsystem will be separated from the second information subsystem. As for disaster management it is necessary that there is a typical response that will be carried out whether this response is based on incoming data and information or is the response based on the results of a meeting or agreement between parties. The disaster volunteers involved in today's activities or this time it is more appropriate to recognize in the form of an information system which is two things, namely the existence of an information system for reporting disaster events and an information system based on the results of meetings or decision making of parties involved related (Nissen et al., 2021).

Bearing in mind this, the management of disaster events requires a layer that will respond. There may be sectoral responses or individual responses that have not gone through the meeting and this is categorized as an initial response or a special response that is not part of the report from the meeting. If then a report is made to a meeting or there is a discussion between the authorities or those who have an interest, then actions which are a response to the disaster incident will be conveyed through a decision which will then be conveyed by acclamation to the parties, in this case besides the volunteer leaders as well as organizational leaders who have power over the volunteers.

We can take the example of the first two things, for example, is an incident the handling of the flood disaster that was directly faced by volunteers in locations where apart from being reported as a disaster incident there were also special actions or pre-meeting actions that were carried out and these were also conveyed at the meeting or we can also raise other big examples such as for example the earthquake in Cianjur (Fakhriati et al., 2023). At Cianjur, we no volunteers were directly at the location or dealing with the disaster but then all referred to the rules set by the volunteer organizations and volunteer leaders that mobilization would take place on specific hour date by using that resource collected first through other mechanisms. The disaster management discussion was attended by parties from MDMC Indonesia volunteers as well as UNS students and Bakorlak UNS disaster management who have experience and also manage disaster events but need an information system to safeguard and follow up on events and action taken.

3.3. Environmental Information System Required

The development of an environmental information system needed for disaster risk reduction is built through the ESRI platform starting from the cover page which ensures that access is carried out by disaster volunteers (Vishwanath et al., 2023). Furthermore, it is necessary to prepare who is the reporter of the disaster incident who must be validated or contacted next.

The certainty of the data in it is built by relying on an environmental information system for disasters which includes aspects before the disaster, during the disaster, and post-disaster funds. In general, the model is as follows.

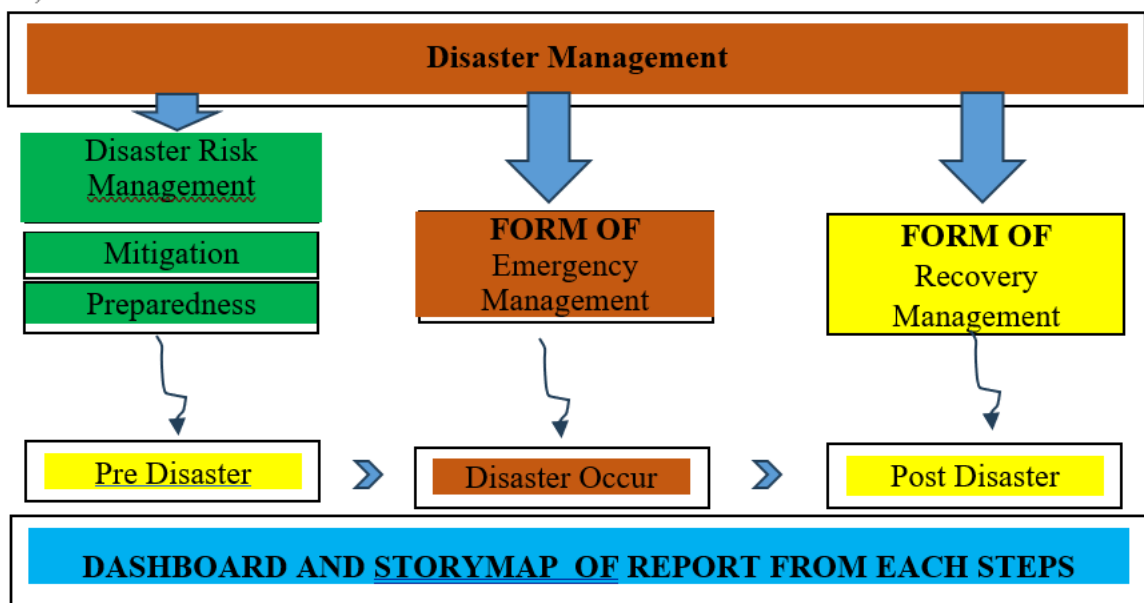


Figure 4. Model of Data Flow in Disaster Management

4. Conclusion

This activity was found some basic parameters from disaster management and data management to conduct environmental information system. Every step as the follow up from system are need to be define the form of information system and parameters from it surround environment. Steps of everything in pre disaster will affect the pattern in disaster occur and post disaster. Model of data

flow for Environmental Information System is the platform to define the result of volunteer to response disaster management.

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