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Digital Humanitarian Spaces In The Disaster Management Process: A Case Study of Indonesia

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Abstract:
Advanced information and communication technology have triggered an evolution in human activities in response to the threat of a disaster. Through appropriate disaster management, damage and loss can be anticipated. The research employed a qualitative descriptive technique to analyze humanitarian actors' roles in responding to the threat of natural or non-natural disasters by integrating technology. The information was gathered through library research and in-depth interviews with various stakeholders involved in disaster management in Indonesia. The results showed that innovation-based disaster management for three stages (pre, during, and post-disaster) has opened Indonesia's humanitarian spaces. First, the pre-disaster phase includes mitigation and preparedness. It emphasizes several elements, including preparedness data, citizen reporting, crisis mapping, the Internet of Things, Artificial Intelligence, and data visualization through video, virtual reality, and innovative financing. Second, during a disaster, the response focuses on utilizing humanitarian ID, biometrics, 3D printing, drones, cash transfer programming, monitoring, and evaluation. Third, post-disaster efforts include area reconstruction and risk reduction through the use of smart city and educational technologies.

Keywords: Disaster, disaster management, digital humanitarian, Indonesia.

1. Introduction

According to Richard Ullman, a threat to a country's national security is understood as a measure or a series of events that expose threats, either natural or non-natural disasters (Syamsuddin, 2019). Indonesia is one of the archipelagic countries prone to a natural disasters. World Risk Report (2016) mentioned that Indonesia is categorized as highly susceptible to disaster. In Indonesia, disasters can be divided into three: natural disasters, non-natural disasters, and social disasters. The trend was hydrometeorological, which reached 98%, and the rest was geological (2%) (Wibowo, 2020). Disaster often occurs slowly and unexpectedly. An earthquake, of which the time, location, and magnitude cannot be measured accurately. Meanwhile, floods, landslides, droughts, eruptions, tsunamis, and climate anomalies are the ones that can be forecasted. However, a disaster creates a shocking effect and causes a significant loss, either material or non-material (Fillah et al., 2016).

Referring to the data obtained from 1999 to 2019, natural disasters increased significantly. It claimed the life of 190.444 people during the decade, damaged 2.739.994 units of hoses, and moved 12.402.972 people from their dwellings (Wibowo, 2020). Natural disasters, such as earthquakes and tsunamis in Aceh-Nias (2004), earthquakes in Yogyakarta and Central Java (2006), floods in Jakarta (2007), the earthquake in Bengkulu (2007), the earthquake in Sumatra (2009), the tsunami in Mentawai (2010), the Merapi eruption (2010), Merapi cold lava (2011), floods in Jakarta (2012, 2013, 2014), and the Sinabung eruption (2013, 2014), have caused losses of as much as 420 trillion rupiahs (BNPB, 2014).

Further, disasters that occurred in 2018 also caused great losses. For example, floods in Brebes, Central Java (876.52 billion rupiahs); the earthquake in Lombok, West Nusa Tenggara (18.20 billion rupiahs); the earthquake; and the tsunami in Central Sulawesi (20.89 trillion rupiahs). In the year, the approximate loss reached 34 trillion rupiahs (Wibowo, 2020). Meanwhile, in 2020, other than natural disasters, a non-natural disaster also hit Indonesia and the whole world, which is COVID-19. Based on WHO's report on September 30, 2020, Indonesia ranked 23rd with the highest number of cases globally. The first was the United States (7.044.327), followed by India (6.145.291) (BNPB, 2020).

The primary factor that needs to be taken into account, given the state of Indonesia, which is facing several disaster threats, is how to meet the demands of the disaster-stricken community and the families of victims outside the affected area to receive quick information. The need for this information is crucial because it gives current knowledge on the environment damaged by a disaster, which influences community response and humanitarian efforts to solve the issue. For this reason, the researcher believes that it is crucial to understand how the digital humanitarian spaces in the disaster management process has significant role in Indonesia.

Considering the loss, help, and support for the victims are necessary. Indeed, it becomes a moral obligation that humanitarian actions are required to fulfill the victims' rights as human beings. Actions need to be taken before, during, and after disasters. Seeing the study's development of humanitarian actions, information, and communication technologies also facilitates activities.

The use of digital technology allows for two-way communication between humanitarian organizations, the government, the private sector, and the affected community. To date, partnerships between humanitarian organizations and technology laboratories have become common. It allows them to create innovations, such as feedback mechanisms through mobile phones, fundraising through social media, and delivery assistance using drones (Ong & Combinido, 2018). Most utilized technology is developed and produced by the central government and the private sectors. Organizations or other institutions do not have the capacity or resources to invest in research and development to create such innovation. Therefore, the increasing role of the private sector in humanity is inevitable (Picucci, 2017).

Information and communication technology have generated digital humanitarianism and encouraged the emergence of non-traditional actors in humanity, such as Google, Facebook, telecommunication companies, software, and volunteer technical networks (Duffield, 2016). Besides, other actors also appeared after Haiti's earthquake in 2010: citizen journalism and digital volunteers. They serve as informal response communities that cover international online volunteers. They contribute to the emergency by monitoring and responding to social media messages, creating and renewing digital maps, and coordinating the help and post-disaster recovery (Chernobrov, 2018).

Considering the trend of digital humanitarianism development in many countries and the condition of Indonesia, which is highly vulnerable to natural disasters, the researcher must analyze the changes in humanitarian spaces in the digital era, particularly in their contribution to facing the threat of disasters to Indonesia's national security.

Society’s vulnerability to disasters becomes a concern of various parties regarding disaster management. Heijmans mentioned three perspectives to be used to analyze the vulnerability: 1) nature, 2) cost, and 3) social structure (Heijmans, 2004).

Nature as a cause presents knowledge and technology (IPTEK) to reduce society's vulnerability. It needs a beneficial system that is useful to predict the dangers and design and apply the technology that enables humans to overcome the negative impact of a disaster. The second is cost as a cause. It focuses on the economic and financial aspects of the solution. The development of knowledge and technology in the context of a disaster often requires a great number of funds. Therefore, the financial aspect becomes crucial. Third, the societal structure as a cause offers politics as the solution to the problems. The people were exposed to the hazard and

became more vulnerable due to the socio-economic and political conditions. It influences the people's ability or the government's capability in responding to the disaster situation, leading to slow recovery after destruction. The condition occurs before, during, and after the disaster (Oktaviani et al., 2019).

Referring to points one and two of the perspective mentioned by Heijman (2004), other parties need to be involved in providing knowledge and technology in disaster preparedness and financial aid for the victims.

The advanced technology supporting humanitarian activities is also employed in disaster mitigation. Disaster management consists of four components: mitigation, preparedness, response, and recovery. The mitigation process is an effort to reduce or remove the possibility or consequences of a potential disaster. Mitigation is intended to lessen the hazard, preventing it from harming the people or the environment. Preparedness refers to the efforts made to help potential victims by giving them knowledge or equipment (financial or infrastructure). Therefore, they can save themselves and minimize financial loss or other kinds of damage. Response means activities to reduce or remove the effects of natural disasters to prevent further damage. Meanwhile, recovery means the effort to return the affected people to their previous condition before the disaster occurred. Recovery takes several months or years after the response to a natural disaster (Pratama, 2010). In general, disaster management stages can be divided into three primary activities: pre-disaster, during the disaster, and post-disaster (Ulum, 2014).

The European Parliamentary Research Service (2019) mentioned that the categorization of technological innovation supporting the Humanitarian Program Cycle (HPC) is closely related to disaster management's four activities. Those are preparedness, response, recovery, reconstruction, and disaster risk reduction (see Figure 1).

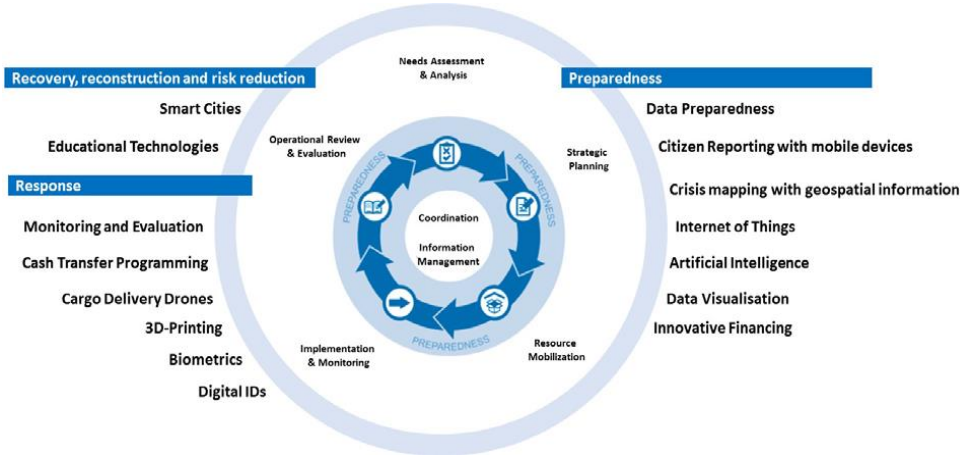

Figure 1. Disaster Management for Humanitarian Activities based on Technological Innovation

The Humanitarian Program Cycle is a series of coordinated activities conducted to prepare, manage, and implement emergency procedures and aims to fulfill the needs of the affected people. Besides, it is to facilitate the most vulnerable victims, increase the amount of financial support, and improve humanitarian activists' accountability.

Humanitarian disasters due to war or conflict have decreased, especially after the Second World War. On the other hand, the disaster was caused by the increasing number of natural disasters, particularly after the 1990s. Aid in the form of the humanitarian concept proposed in the Geneva convention emphasized efforts to alleviate human suffering caused by a crisis or disaster. The principle becomes the primary commitment of humanitarian actors (Sinulingga, 2016).

Hilhorst suggested a humanitarian aid concept dominated by a paradigm of ethics and humanitarian principles based on the international humanitarian agencies under the United Nations and NGOs. The classic humanitarianism paradigm is based on the basic principles of humanity, injustice, neutrality, and independence.

They are intended to ensure the pure intention of assisting regardless of political motifs or any form of discrimination (Hilhorst, 2018).

Similar ideas were proposed by Hehir (in Rosyidin, 2016), mentioning that humanitarianism and humanitarian procedures are the terms used by humanitarian actors and non-government organizations. It is considered altruistic and non-political. It is a concern for the benefit of many people. The actors include non-government organizations and international institutions, such as the United Nations in charge of refugees (UNHCR), the International Red Cross (ICRC), and others. However, Rosyidin also mentioned that health, food distribution, infrastructure reconstruction, education, and others also involve the government (Rosyidin, 2016).

Aids have undergone an evolution. Humanitarian actions are not limited to donor institutions or big NGOs but also common people, called "citizen aid." They come from the countries on the North and South poles. Citizen aid refers to the altruistic action carried out by individuals using their own money to help the needy (Fechter & Schwittay, 2019).

Burns (2018) and Akhmatova & Akhmatova (2020) described an evolution in humanitarian actions related to digital technology utilization. The practices have transformed following the digitalization trend. The trend has developed in the southern countries as well as the affected countries. It leads to fundamental changes in the context, procedures, and distribution of aid. Akhmatova and Akhmatova explained that the use of messaging applications, social networks, platform media, and electronic money for the victims is being introduced (Akhmatova & Akhmatova, 2020). Meanwhile, Burns revealed the current condition as digital humanitarianism, which covers crowdsourcing, crisis mapping, social media, and virtual operations (Burns, 2018). At technology suppliers, humanitarian institutions often collaborate with academics or the private sector (The European Union, 2019).

It was different from Madianou, explaining that the digital humanitarianism concept's development includes five approaches. First is the logic of humanitarian accountability. It refers to the response to reformation demands and humanitarian accountability by utilizing digital innovation. Second is the logic of audit, which is the use of technology and data as the metrics for the audit activities following the donor's needs. The third is capitalism's logic, which refers to the private sector's ways of expanding its authority over the existing social order. The Fourth is the logic of solutionism, which refers to the human desire to find a solution to complex social problems by utilizing technology. The last is the logic of securitization, which involves the government's role in humanitarian operations (e.g., donors). Besides, it provides the technology to secure the country from the hazard of disaster. (Madianou, 2019).

Referring to the previous studies, humanitarian actions have undergone an evolution from the aspects of the actors' development or the parties involved. The evolution also occurred in the way humanitarian operations are conducted. First, humanitarian operations involve actors from the organization or non-government organizations, international institutions (e.g., the UN), and humanitarian organizations. Instead, it also engages the government, the private sector, and the common people. Second, humanitarian operations can be carried out in two ways. First is directly entering the areas under crisis or affected by disasters. The second is indirect, utilizing technology and digital platforms to distribute the aid. Therefore, the present study answers the research question about how humanitarian spaces gain a place in responding to disasters in the digital era.

2. Methods

The research employed a qualitative descriptive approach to finding the answers from individuals or groups in a particular social setting (Lune & Berg, 2017). The social setting refers to humanitarian activities based on technology to respond to disasters in Indonesia. The information was gathered through in-depth interviews with two main informants, namely officers from Muhammadiyah Disaster Management Center (MDMC) and Sleman Disaster Mitigation Agency (Badan Penanggulangan Bencana Daerah/BPBD Sleman). While a study of previous literature relevant to the research topics was conducted to answer the research problem.

3. Results and Discussion

When the news or information about natural disasters spreads, humanitarian help comes in a vast amount from various private companies, NGOs, and the affected country. Indeed, other countries also show their solidarity. Humanitarian actions are mobilized in many affected areas to help people living in crisis (Hedman, 2005).

The humanitarian actors discussed in the present study included the state as part of the manifestation of responsibility to protect citizens vulnerable to disaster. The country acts as the main actor in providing the facilities and infrastructures during the pre-, while, and post-disasters. The actors include the ministry, non-ministerial government agencies, and central and local government. The country must protect and serve the people before, during, and after the disaster.

3.1 Pre-Disaster stage: Mitigation and Preparedness

The pre-disaster step consists of disaster mitigation and preparedness. Both need ready-to-use data and information that helps to arrange the plan to avoid and prevent a disaster. Data preparedness refers to the ability and capacity of an organization to distribute and gather data and analyze them before the disaster occurs. Data can be used in many ways, such as gathering real-time information about the people's needs, connecting with communities, and creating situational awareness through, e.g., mapping (AIDF, 2016 in The European Union, 2019).

Disaster mitigation needs accurate data and information. The data available in Indonesian ministries, local governments, and other organizations are not integrated. In other words, the data and information formats are varied. The National Disaster Mitigation Agency (BNPB) has provided a facility for data and information stored in software applications. Indonesian Disaster Information Data (DIBI) can be used as the analysis tool for disaster occurrences and effects. DIBI can be accessed through dibi.bnpb.go.id. Besides, people can also access the data about the disaster in Indonesia through data.go.id, developed by the Ministry of National Development Planning through Satu Data (One Data) Indonesia.

One of the technological innovations developed in 2015 in Indonesia under the Vulcanology and Geological Disaster Mitigation Center (PVMBG) to improve disaster mitigation is the application "Magma" (Multiplatform Application for Geohazard Mitigation and Assessment) Indonesia. Magma is a multiplatform application (web and mobile) that presents integrated information and recommendations about a geological disaster (volcano, earthquake, tsunami, and ground motion). They can be accessed in quasi-real-time and interactive through the website magma.vsi.esdm.go.id.

Figure 2. Magma Indonesia Application

Other than developing Magma, Indonesia also established an application to support the humanitarian sectors. It is about the disaster information that includes the pre-disaster, during the disaster, and post-disaster phases through the InaRisk application. The Indonesian government attempts to increase society's understanding and capacity to anticipate disaster autonomously. The application provides a disaster management class that contains information and recommendations about the necessary actions to take during the three phases of a disaster. InaRisk is an online information system based on GIS services that display a disaster risk study (dangers, capacities, vulnerabilities, and risks) in real-time. Besides, it also monitors the decrease of the disaster risk index in Indonesia. InaRisk was developed by BNPB by collaborating with the relevant ministries and institutions. The data presented here are officially published by the relevant ministry and institutions through a "Server to server" mechanism. The portal is dynamic in that other institutions are allowed to join in the collaboration. In this case, InaRisk becomes the reference for the local plan and projection of the loss. InaRisk contains disaster risk information systems and risk-mapping in web or mobile applications (Wibowo, 2020).

Furthermore, data preparedness can be obtained through the Humanitarian Data Exchange, a humanitarian website serving to share any necessary data. The purpose is to assist with information tracking and data utilization as necessary. HDX can be accessed publicly through data.humdata.org.

The utilization of technology and communication in disaster mitigation and preparedness can be carried out in several ways.

3.1.1 Citizen reporting

Crowdsourcing can consist of information intentionally sent by an individual, such as via Short Message Services (SMS) or social media. Essentially, social media platforms such as Twitter, Facebook, Youtube, and Instagram can provide real-time information about disasters. This has been done not only by government actors, but also by non-governmental organizations, one of which is MDMC Indonesia, which is using the platform to disseminate disaster information and as a platform for education, awareness raising, and training (Interview with Rahmawati Husein, MDMC, August 29, 2020).

Even though the Indonesian government has been disseminating disaster information, community members have also been involved in disseminating real-time information about disasters in their area. When COVID-19 became a pandemic in Indonesia, one of the Indonesian Humanity Committee (Komite Kemanusiaan Indonesia/KKI) volunteers gathered the data from social media. Through Facebook, Instagram, and websites, information about COVID-19 has become intensive since March 2020. The messages delivered through social media are mostly in the form of articles about the pandemic. They also contained photographs of the volunteers distributing aid, referral hospitals for COVID-19, doctors who passed away during the pandemic, the prevention and treatment of COVID-19, a donation invitation, and a live streaming video. The messages delivered to social media are an invitation to give some donations that will be distributed to society, especially to those who suffered economically due to the pandemic. The donation is also distributed to the hospitals, particularly for the provision of APD. Besides, messages also include posts about the symptoms and prevention of the coronavirus, according to the Ministry of Health. The prevention includes keeping the hands clean, avoiding direct contact with anyone showing the infection, taking balanced nutrients, exercising and taking enough rest, avoiding direct contact with an animal, and covering the nose and mouth while sneezing or coughing (Avila & Herlina, 2020).

Meanwhile, natural disasters that occurred in Indonesia, such as in the Special Region of Yogyakarta, can be seen through BPBD services at the provincial and district/city levels, which open cross-agency collaboration, such as the tweet from the Center for Research and Development of Geological Disaster Technology (BPPTKG) regarding reports on Mt. Merapi, which was retweeted by BPBD DIY. Apart from social media, efforts to accommodate public complaints are also made through two channels: Lapor Sleman and Lapor Bencana Sleman. In Lapor Sleman, public complaints are handled by BPBD DIY employees, who will then follow up on the complaints. BPBD Sleman created the Lapor Bencana Sleman application, which performs a similar function to Lapor Sleman but is focused on disaster issues. It is available for free download from the Google Play Store (Interview with Asih Kushartati, BPBD Sleman, August 29, 2020).

3.1.2 Crisis mapping with geospatial information

According to the World Bank, crisis mapping is the act of gathering, displaying, and analyzing real-time data during a crisis. The activity enables many people and actors to provide information when they are in disasters or remote areas. The implementation of crisis mapping is supported by innovation from the Geographical Information System (GIS), a computerized system used to gather, manage, analyze, and display various kinds of data, including geospatial information. The application is beneficial for humanitarian actors to coordinate the responses by creating situational awareness or acquiring insight into the affected people (The European Union, 2019).

One example of implementing crisis mapping in humanitarian activities is the utilization of the Seismo Sense, developed in Indonesia to coordinate community reports more quickly and accurately. The application also enables people to send photographs of the damage, which are displayed on a map. The map in the application will show a red color in areas with a greater number of reports. The redder color means more victims and worse damage. Based on the map, the disaster mitigation board can take appropriate and efficient actions (Riyandi, 2016).

Meanwhile, BNPB has cooperated with the Urban Risk Lab at the Massachusetts Institute of Technology (MIT), The United States of America, to develop a mapping system on social media to reduce the effect and quicken the response. It is conducted through PetaBencana.id. Besides integrating the application with social media, the map is also integrated with WhatsApp's instant message service. The integration allows people to exchange information with each other and with the government efficiently and effectively. PetaBencana.id is established in three cities; those are Jakarta, Surabaya, and Bandung. The cities were selected because they are metropolitan cities in Indonesia with the highest population and the most vulnerable to disasters (Tiba, 2016).

Besides, through an application designed by the Management Unit of Jakarta Smart City, Jakarta's government has provided information about Jakarta Capital City's water condition. The application displays Jakarta's map with the colored zones for disasters such as floods, water levels, and emergency status. The application also has a report menu that presents reports about floods hitting the city. The other menu displayed by the application includes the water level information in each floodgate and the observation post of the water flow in Jakarta. Through the Jakarta application, people are expected to anticipate potential floods. Besides, the officers can take immediate action to handle the problem (smartcity.Jakarta.go.id, 2016).

3.1.3 Internet of Things

The Internet of Things (IoT) refers to a connected device system that allows smart technology to learn and adapt to the data related to disasters. The device is not limited to telephones and computers; it covers all kinds of "objects", such as a thermostat, cars, and medical trackers (European Union, 2019). The Meteorology, Climatology, and Geography Agency has developed an IoT system to monitor the potential earthquake since 2008. It is to monitor the earthquake with sensors installed in all areas in Indonesia, especially those with major faults. BMKG requires five minutes to notify the public of a potential tsunami following an earthquake via early warning. The information is automatically sent to the National Disaster Mitigation Agency (BNPB), television, and Indonesian Army (TNI) headquarters in Jakarta (Bahfein, 2020). This is consistent with the findings of interviews with BPBD Sleman, who stated:

"...The physical mitigation is like building an evacuation road; then there is the installation of evacuation signs; then there is the construction of refugee barracks, and then there is the Early Warning System. Yes, the EWS is a series. There is a hot cloud EWS, there is a lava flood EWS, and there is a landslide EWS. So indeed, EWS is a system starting from sensors, then CCTV, then there are sirens, so that it becomes a single unit." (Interview with Asih Kushartati, BPBD Sleman, August 29, 2020)

For landslides, the Indonesian Scientific Knowledge Agency (LIPI) has developed a system called the LIPI Wireless Sensor Network for Landslide Monitoring (WISELAND). It monitors ground motion (LIPI, 2019).

Meanwhile, one IoT application is also being developed for disaster mitigation, called IoT Smart City. It is an Android-based Smart City application for flood and earthquake mitigation. The application was created by Laurensius Dede Suhardiman from Kuningan Regency, West Java. The features include the water level (dam or river), earthquake shaking, temperature, and humidity conditions where the sensors are located. The IoT Smart City – Disaster Mitigation is connected to an IoT service named Antares or antares.id. The application received the data from the Antares server regularly.

3.1.4. Artificial intelligence

Artificial intelligence (AI) is a theory and development of computer systems that perform tasks previously requiring human intelligence, such as visual perception, speech recognition, decision-making, and language translation. AI machines can learn from experience and adjust to new inputs. In many cases, AI is used concerning big data (European Union, 2019).

One of the ways AI is utilized is the use of chatbots. It was used as a response to a disaster in Indonesia in the massive digitalization era. For example, Covid 19 Chatbot's electronic chat facility is to educate society to prevent coronavirus. The Chatbot Covid19.go.id appeared as a collaboration between the Ministry of Communication and Information with several parties joined in a task force and other stakeholders, such as the Ministry of Health, BNPB, KSP, BUMN, Telkom Group, and WhatsApp Inc (Arifin, 2020).

A chatbot should be a strategic tool to distribute information during a natural disaster. The utilization of chatbots in the sector can be a medium diversification effort of natural disaster information distribution implemented in other media kinds.

Regarding the Indonesian city of Jakarta's flood, the most trending topics on Twitter Indonesia on February 20, 2021, were #banjir and #JakartaBanjir as the nation's capital city experienced flooding for the third time following especially heavy rainfall. "Disaster Bot," an automated chatbot that monitors social platforms for posts on disasters and prompts users to make more thorough disaster reports, greeted Jakarta residents who went to social media to give flood updates. On the free and open-source website PetaBencana.id, disasters are mapped using these reports from the general public (Petabencana, 2021).

3.1.5. Data visualization

Data can support situational awareness and decision-making processes. However, visual insights sometimes reach people more effectively. There are different ways to visualize data, e.g., through photos, videos, infographics, or even Virtual Reality (VR) (European Union, 2019). For example, BPPTKG (Badan Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi) produced such videos through the YouTube BPPTKG Channel about Merapi activity by live streaming.

3.1.6. Innovative financing

This system fills gaps in the humanitarian system by using the science of weather and climate to anticipate possible impacts in risk-prone areas and mobilize resources automatically before an event (European Union, 2019). Forecast-based-Financing (FbF) is a funding mechanism for disaster preparedness actions that depend on accurate estimation methods or predictions and is financially supported and implemented before a disaster hits, which can be done by building a funding system based on weather, climate, and hydrological information for the area concerned (Wijaya & Susandi, 2018).

In Indonesia, for example, the Disaster Risk Management Agency (BNPB) developed the InaSAFE platform with technical assistance from Kartoza and financing from the Australian Government and GFDRR. This technology is being used for contingency planning and emergency response. The InaSAFE-FbA project was created by Kartoza and the Red Cross Red Crescent Climate Centre to investigate how a risk information management platform can be used as a pilot for impact-based forecasting, which can then be used as a trigger for Forecast-based Financing systems (Kartoza & Climate Centre, 2020).

In terms of application, the Indonesia Red Cross (or other actors) can use this tool to utilize their Early Action Protocols (plans that allow the organization to implement early actions in the window of time between the forecast and the shock). For instance, once PMI determines which districts, sub-districts, and villages are more likely to get affected by the flood, they can prioritize which ones they can deploy groups to undertake Early Actions with the respective local authorities and communities. One requirement to be qualified to access automatic funds to carry out the pre-agreed early action in the Red Cross Red Crescent case is to have this decision-making system to determine when and where to activate early action (Kartoza & Climate Centre, 2020).

3.2 During the disaster: Response to Disaster

Immediately after the disaster occurs, the emergency response begins. There will be several activities during the stage, such as searching, rescuing, and identifying the victims, followed by aiding. Humanitarian actors have benefited from advanced information and communication technology by registering and identifying affected people using digital ID.

3.2.1 Digital ID

A digital identity is defined as "a set of digital form collected and saved attributes and personal data which can uniquely identify people" (Casswell, 2019: 64). It can serve as a legal or personal identity, such as a birth certificate or passport, or it can serve as a functional identity like a library card (Holloway et al., 2021).

One example of a Digital ID in responding to a disaster is the Humanitarian ID, an online device to manage the contact list during an emergency. First responders will apply for the Humanitarian ID and register for an emergency. They will find contact with an emergency in a particular country. Humanitarian ID is provided at humanitarian.id and other mobile applications based on Android and iOS. Some humanitarian organisations are expanding their digital services, initiating to discover digital identification as a way to improve existing services for donors and provide new ones (Slavin et al., 2021).

3.2.2 Biometrics

The term "biometrics" refers to biological or physical features (fingerprints, facial structures, iris or retinal patterns, voice recognition, gait, etc.) that are measured and evaluated for either the identification of a person about an individual by comparing with a database of already samples taken. In order to support digital identity for service delivery, biometrics are occasionally used. However, this use increases significantly with cash and voucher assistance (CVA), that has grown to be a crucial part of humanitarian responses due to the higher level of assurance needed by donors when giving money (Holloway et al., 2021).

In Indonesia, biometrics such as the e-KTP (electronic id card) can be developed to identify fingerprints, faces, iris, retina, DNA, voice, and signature. Another option is PT Aplikasi Karya Anak Bangsa (Gojek Indonesia) electronic money. It has encouraged users to activate the biometric features to support the safety of doing transactions outside the Gojek application. Gojek provides the menu to transfer humanitarian donations, including those for disasters, either natural or non-natural, through a third party, such as Kitabisa.com.

3.2.3. 3D printing

3D is a form of additive manufacturing (AM) in which spare-parts or a set of a product can be 'printed' following a prototype created in a computer-aided design and drafting (CADD) program. In the humanitarian sector, 3D printing can produce needed goods for, e.g., a variety of activities, including health, sanitation, and shelter (European Union, 2019).

One example of 3D technology utilization in Indonesia was the three-dimensional modeling to obtain a general picture of a landslide. The technology serves to know the chronology of the landslide and to estimate the material volume. It helped the process of post-disaster recovery, especially in investigating the victims buried under the material. Besides, it becomes policy reasoning for land conservation. The modeling data was obtained from unmanned aerial photography with high temporal resolution. This way, it produces two main spatial

datasets: high-resolution aerial imagery and a data evaluation model (DEM). One of the modeling examples is the landslide that occurred in Loano, Purworejo, Central Java, on Saturday, June 18, 2016 (Parangtritis Geomaritime Science Park, 2016).

Furthermore, 3D is also utilized for a smart city, where Dassault Systèmes offers a three-dimensional application for the smart city that includes integrated information about disaster mitigation. The solution was created using the 3DExperience platform, owned by a French company (tempo.co, 2019).

3.2.4. Utilization of drones

A drone can be utilized to map activities, search and rescue, and light cargo delivery (European Union, 2019). Aerial robotics, or drones, have a high potential to be used during a disaster. It can identify the affected areas more effectively, estimate the loss in real-time, and deliver many kinds of help quickly, cheaply, and efficiently. One example of drone utilization in Indonesia was in mapping the forest fire in Papandayan Mountain in September 2015. The mapping was a collaboration between PT Aero Terra Indonesia and an NGO named Alam Kita. The results underlay the fundraising for the natural disaster (Prasetiyo & Suroso, 2018).

3.2.5. Cash transfer programming

Cash transfer programming (CTP) refers to the transferring model for support in ready money. It replaces the traditional form of aid in the form of goods delivered to the victims. The transfer can be performed using cards, e-transfer, or mobile payment (European Union, 2019). Frequently, several parties deliver their donations in the form of goods to the victims. Unfortunately, they are less useful for the victims in the affected area. Therefore, the cash transfer program (BLT) through transfer or mobile payment becomes the most appropriate.

3.2.6. The importance of data for monitoring and evaluation

Data availability helps the stakeholders monitor and evaluate the disasters, allowing them to face the challenges and identify the obstacles. The activity is crucial in maintaining accountability and transparency for the donor or the local people in financial management for humanitarian purposes.

A disaster monitoring and detection system called InAWARE already exists in Indonesia. This system is a form of disaster monitoring technology developed and funded by USAID. When dealing with natural disasters like earthquakes, volcanoes, fires, landslides, tornadoes, hurricanes, and tsunamis, analysts can use InAWARE to help them decide what to do. In this situation, InAWARE can offer details on the locations that fall within the evacuation area (Center for Digital Society (CfDS) UGM, 2020).

3.3 Recovery, reconstruction, and disaster risk reduction

In the reconstruction phase, an innovative solution after the disaster was to rebuild the area and improve society to reduce the risk and improve the people's resilience. It is carried out by implementing the smart cities model as well as educational technologies.

3.3.1 Smart cities

Some areas in Indonesia have given a positive response to the smart city concept being utilized to face disaster. The areas include West Sumatra, West Kalimantan, Makassar, and Kupang. A smart city is not only about internet access or integration of devices but also about evacuation that is based on simulation technology and modeling (Rosyadi, 2019). Aside from the cities mentioned, other disaster-prone areas can also benefit from the smart city concept. For example, Padang, supported by the Coordinating Ministry of the Economic Affairs of the Republic of Indonesia, is ready to be a Smart City to face any disaster (Harianhaluan.com, n.d.).

The program is also supported by PT Telekomunikasi Indonesia Tbk (Telkom), which offers the Smart City concept based on disaster mitigation for areas vulnerable to natural disasters. The program's name was Smart City Nusantara. In this case, the local government can start and develop the Smart City solution, which is called Living Lab Smart City Nusantara (IndoTelko, 2018).

3.3.2. Educational technologies

One critical issue in the social development process after the disaster was the empowerment of society, particularly the victims. Society empowerment refers to developing the active participation of the people, limiting the intervention of external parties. The activities included identifying the needs, strategic options, decisions, or actions; transporting the resources; and realizing the action to achieve the desired goals (Badri, 2018).

Disaster risk reduction should be understood and implemented by all parties to create a comprehensive framework, including technology, disaster preparedness education, and policy. Disaster preparedness education should be made relevant to the local characteristics and renewed based on the number of disaster occurrences (Biro Kerja Sama, Hukum dan Humas LIPI, 2019). One of Indonesia's educational efforts was through a disaster preparedness school in the Special Region of Yogyakarta. Under the Meteorology, Climatology, and Geophysics Agency (BMKG), a disaster mitigation school (SLG-Sekolah Lapang Gempa) was established with the Regional Disaster Mitigation Agency of Yogyakarta Special Region in 2017. The activities were conducted in the earthquake-prone area, inviting all elements of society and government.

Disaster management, mitigation, and prevention are significantly aided by information and communication technologies (ICTs). ICTs can be used as tools for early warning information distribution, tracking, and communication during emergencies and in the aftermath of disasters. According to Berawi (2018), governmental agencies and stakeholders involved in rescue operations and decision-making processes need timely, predictable, and effective information. The development of models to predict damages and fatalities as well as the identification of areas that can flourish from city redevelopment has been made possible by technological advancement that employs urban development datasets.

For example, developing robust urban areas and infrastructure is necessary for countries like Indonesia, which are also vulnerable to earthquakes, floods, and tsunamis. The disastrous 7.5 magnitude earthquake and tsunami that struck Sulawesi Island in Indonesia is evidence that prompt responses from the government, disaster relief agencies, and the local and international community of Indonesia have improved stakeholder collaboration about reducing the event's impact. Utilizing various information and communication tools, such as social media, radio, television, mobile networks, drones, the internet, and geographic information systems (GIS), can increase capacity and decrease vulnerability (Berawi, 2018).

Previously, according to the results of an interview with BPBD Sleman, the communication tools used before the 2010 Merapi eruption only relied on word of mouth and used traditional kentongan tools and sirens. Now, based on interviews with representatives of the Muhammadiyah Disaster Management Center (MDMC) and the Sleman Disaster Mitigation Agency (BPBD Sleman), the use of digital technology, particularly to respond to disasters in Yogyakarta and other parts of Indonesia, has been put to good use. Social media platforms has also been used as a means to help the public get real-time information.

Despite Indonesia being a disaster-prone country and its existing technological advancement, the digital humanitarian spaces grow limitedly in the country. Disaster management cannot be solved by humanitarian actors alone, so involvement and support from the private sector are needed not only in the form of finance but also in providing services to disaster victims or those who are threatened by disasters. On the other hand, many parties think that the involvement of the private sector in disaster management is often inserted by a hidden agenda, especially related to profit-oriented aspects, so it is often considered inappropriate. In this case, the private sector usually wants to build a positive image through donations carried out for humanitarian activities.

However, it is undeniable that the private sector needs to be involved in various humanitarian actions because the responsibility for human safety is in the hands of all parties. As previously mentioned, the private sector's engagement in the digital humanitarian space not only just provides the funding, but also includes managing particular tasks like providing affected populations or vulnerable groups with security by training or providing

services like supply chain management, transport, and communication, information technology, infrastructure, and the delivery of cash transfers or the use of new technologies for assessment and data collection.

It is crucial to involve the private sector in that task because they are skilled in shipping, construction, food service, and first aid, which can enable them to offer the earliest response. The private sector can also encourage preparedness, reaction, and recovery actions among their staff and clients by using bulletin boards, websites, and other channels (Ryan et al., 2018). Although the private sector has a hidden motive to invest in disaster risk reduction, its fundamental purpose is not only to maintain the viability of its own business but also to have the benefit of protecting society by preserving the revenue and employment that depend on them.

Besides the private sector, other important actors which must be considered to support digital humanitarian activities are citizens and local communities. Often, information about an ongoing disaster is conveyed more quickly by citizen journalism through social media such as Twitter, Facebook, or Instagram than by the government. Meanwhile, local communities, as the actors in disaster-prone areas or surrounding areas, play a critical role in the success of prevention, preparedness, response, and recovery.

Moreover, implementing digital humanitarianism in the disaster management process in Indonesia has some challenges. The capability of vulnerable groups to access adequate information about disasters is limited. It could also be due to information or media content and delivery formats that do not take the user experience into account (Pujiono et al., 2021). Furthermore, an existing technological advancement (such as telecommunications, electricity infrastructure, and so on) in disaster management is usually the first to fail when disasters strike.

4. Conclusion

Humanitarian space in Indonesia provides opportunities for the state to fulfill the needs of the people, the disaster victims, and other parties to collaborate in solving the problems encountered by the people in the country. These actors are from NGOs, the educational sector, private sectors, ordinary people, or donating institutions.

Indonesia prone to disasters has attempted various innovations to protect its citizens. Through information communication and technology, the state provided humanitarian spaces as its responsibility to fulfill the people's needs. The state needs to collaborate with several parties including with private sector to meet the people's needs before, during, and after the disaster by implementing digital humanitarianism.

By innovation in the digital humanitarian space that is already provided by the private sector, it fosters innovation and advances catastrophe preparedness, mitigation, and prevention in communities. The impacted towns will benefit from private sector enterprises' history and experience in the afflicted areas, because of their understanding of supply chains, and their extensive network.

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