Early warning system model as a resilience of disaster-prone communities

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Abstract. Living in a watershed (DAS) means getting ready for the risk of flooding. The choice of relocation is often taken by the government to reduce these risks. But the attachment of citizens to the surrounding environment makes relocation not the best choice. This study seeks to reveal how the Garda Caah community as citizens in the Citarum River Basin is able to decide and be responsible for their ideas, decisions and actions in the face of flooding. This study uses qualitative methods with a case study approach. The data collection techniques are carried out by interviews, focus group discussions and observations. The findings resulted resilience the communities around the Citarum watershed are realized by forming the Garda Caah Community, which in their work projects seeks to minimize the effects of flooding by sharing information about possible flooding. The Garda Caah community created a flood early warning system so that residents and local governments prepared to face flooding. Dissemination of information about floods is carried out through various media commonly used by the public, both traditional and modern channels.

1. Introduction
The National Disaster Management Agency (BNPB) has signaled that hydro meteorological disasters which include floods and landslides are the most deadly disaster. Throughout 2014 nearly 2 million people were displaced by floods and landslides. The disaster not only caused casualties but also economic losses and infrastructure disruption. The high potential for danger is also exacerbated by the large number of settlements along the watershed (DAS), as well as changes in land use that are not in accordance with the spatial layout. Especially regarding flooding, the South Bandung region along the Citarum watershed is a flood-subscribed area. At the end of December 2014, floods that inundated the South Bandung region were fairly severe with the number of refugees reaching almost 12 thousand people. The flood of the overflow of the Citarum River seems to be a common occurrence. However, repeated incidents certainly raise questions about how the disaster management has been carried out so far, given the huge losses it has caused. This is exacerbated by the unpreparedness of citizens in facing floods. This unpreparedness is suspected by the slow information received by residents of the Citarum watershed and the low level of knowledge of citizens regarding disaster management. Therefore, standard mechanisms and procedures are needed in disaster management. Citizen participation is an absolute necessity in detecting possible disasters and handling post-disaster. Seeing this, the involvement of citizens in detecting and handling post-disaster is mandatory.
Communication becomes important when citizens will be actively involved in dealing with this flood problem, because only by communication, flood information can be disseminated to citizens. Myers and Myers argue, that communication is intended to share information and reduce rigidity in the organization [1]. Communication can create flexibility in carrying out organizational activities without having to deviate from existing regulations. In conventional thinking, communication is self-disclosure that runs in accordance with the rules or norms that apply as the rights and obligations of everyone involved in it [2]. Thus, communication can create flexibility in carrying out activities, but still rests on mutually agreed rules and norms. According to Bachtiar Chamsah in the implementation of disaster management, regional governments must prepare a Disaster Management Contingency Plan, which includes analysis of disaster-prone areas, identification of potential and source systems that can be mobilized, determine policies and strategic steps in the event of a disaster [3]. In this context, the community must be positioned as a subject, not as an object in disaster management, so that they know the threat in their area and are able to increase their capacity to face threats through the Community Based Disaster Management Program. Therefore, deregulation of the supervision and disaster control system is needed with special rules in an emergency, which can cut down the bureaucracy of assistance and streamline the tiered communication process into a pattern of integrative communication in a fast time.

The speed in communication for decision making and the communication system that is connected between agencies caring for disasters will minimize the victims. Reference to disaster management can run smoothly if disaster information management is managed interactively. Luckily, this made us all aware of the importance of a good disaster management process. At present there is Law No. 24 of 2007 concerning disaster management and there has also been a National Disaster Management Agency present at the central level and the Regional Disaster Management Agency in each province [4]. According to this law, disasters are defined as events or series of events that threaten and disrupt the lives and livelihoods of people caused by natural factors and / or non-natural factors, as well as human factors, resulting in human casualties, environmental damage, property losses and psychological impact. Based on this understanding, it is imperative for us to minimize the possibility and impact of disasters. One way that can be done is to have good communication between the parties concerned. Through good communication those affected by disasters can gain comprehension and understanding about disaster.

The Garda Caah Community is one of the community around the Citarum watershed, precisely in Kampung Kondang, Majalaya Village, Majalaya District, Bandung Regency. This community was born from the chat of a number of residents affected by floods who wished to be able to minimize the effects of flooding or even avoid flooding. One of these efforts was realized by conducting a survey on flood vulnerability in December 2008, which was followed up in 2009 in the form of self-normalization of rivers. In accordance with his motto, “always hoping for the best, preparing for the worst”, the continuity and complexity of community communication behavior in the face of flooding becomes interesting to study. This research refers to the Freedom of Information paradigm. The importance of information in dealing with disasters also relates to and influences decision making when the threat of flooding will hit an area. Decision-making in emergencies requires non-traditional approaches and devices that are characterized by non-hierarchical structures and have flexibility [5]. A dynamic environment in disasters makes imperative decision making by investigating inter-sectoral and inter-agency cooperation and coordination. Through testing the Emergency Management Assistance Compact (EMAC) in the hurricane Katrina and Rita in 2005, EMAC facilitated the resources needed during and after the disaster occurred. Overall EMAC’s performance is relatively satisfying, with investment in communication, building trust, and reducing differences in inter-agent values and making them imperative. In the Indonesian context, referring to Law Number 24 of 2007 concerning Disaster Management, disaster management consists of pre-disaster aspects, emergency response processes and post-disaster or reconstruction [4]. In the purpose of this research, the author also focuses on what is done by Komunitas Garda Caah in its preventive efforts as a pre-disaster aspect to minimize the impact of disasters. The preventive effort is manifested in a Flood Early Warning System model. The objectives are elaborated on the following problems,
"How does Komunitas Garda Caah make the flow of information on flood early warning in the Majalaya region and its surroundings”

2. Research method
This study used qualitative research methods. Qualitative research is examining things that are in their natural environment trying to understand, or interpret phenomena based on the meanings that people give to these things. Conventionally qualitative methodologies tend to be associated with the desires of researchers to examine the meaning, context, and a holistic approach to phenomena.

2.1. Case study approach
Case studies are one type of qualitative research. Unlike the other types, case studies intensively analyze and describe a single unit or a system based on space and time. The topics normally examined in case studies are individuals, events, or groups. Through case studies, researchers are also expected to be able to gain an in-depth understanding of the situation and meaning that surrounds it.

The case study design that the researcher applied in this study was a single case design because it only examined the communication of peripheral communities in alleviating natural disaster problems.

2.2. Data collection technique

2.2.1. Deep interview. In order to get accurate data, the researchers conducted interviews with informants namely Riki Waskita as the Garda Caah coordinator and Rahmat as the Jaga Balai coordinator and representatives of related institutions.

2.2.2. Observation. Observations were made to better understand and provide certainty about the information provided by informants relating to the management of community disaster communication in Bandung Regency, especially the Garda Caah community which covers an area of around 4 sub-districts in Bandung Regency.

2.2.3. Focus Group Discussion (FGD). The FGD was conducted with stakeholders involved in the community in overcoming disasters in their area. The parties were the government leaders of Sukamaju Village, residents of the flood affected community, the Garda Caah community and the Jaga Balai community. The FGD was held on May 26, 2017 at Balai RW 20 Sukamaju Village, Majalaya District.

2.2.4. Literature study. Data collection is obtained by examining various sources of written information, both in the form of books, journals, and articles in the media including the internet.

3. Discussion
Referring to the focus of research that led to this study, the analysis refers to the question the researcher aims.

3.1. Resilience of the Garda Caah community
Majalaya is a sub-district located in Bandung Regency. This area is well-known as an industrial center in West Java. The number of factories has had a follow-up effect in the form of damage to river habitats that make watery as an annual "ritual". This flood routine in the Majalaya area is what makes some young people who are members of a group of nature lovers try to find a solution. "The initial history of flood victims around Majalaya already felt embarrassed and annoyed because every year floods, the losses of material, psychological and even mental. With that background, we were moved to find a solution so that Kampung Kondang, Majalaya District, Bandung Regency is not flooded," explained Riki.

In an interview opportunity, Riki as the initiator and Garda Caah coordinator said, "even though we, the people around the river are victims of floods, but we want to benefit others". This attitude was then
realized by several community colleagues who were initiated by creating a Flood Early Warning System (SPDB) and disaster education for the community. The Majalaya Flood Early Warning System (SPDB) exists not because of institutions that build community self-reliance, but communities that are self-reliant to meet upstream rain and water level information needs as flood early warning information, so that it is accommodated in an institution.

In the perspective of resilience, this community of citizens who are members of the Garda Caah community have demonstrated their adaptive abilities which are as high as residents affected by floods who have tried to adapt to the cycle of flood disasters which always bring loss and misery to their lives. Klohnen refers to it as ego-resilience, which is an ability that involves high and flexible self-adjustment abilities when faced with internal and external pressure [6]. This was also confirmed by Jansen who called it social resilience, namely the ability of groups or communities to deal with external pressures and disturbances as a result of social, political and environmental changes [7]. In this case, the community groups joined in Garda Caah have managed to overcome the pressure due to environmental changes in the form of floods. Not only that, the Garda Caah community has also transformed itself from disaster victims to become agents of change in tackling disasters by making a fixed procedure (Flood Protection System) (SPDB) and conducting disaster education for disaster-affected communities around it.

3.2. Information on flood early warning in Majalaya and surrounding areas

Early warning systems are an important part of the community preparedness mechanism because early warning is an important key factor that connects the preparedness stage with the emergency response phase. How much warning can reduce the impact of a disaster event will depend on many factors, for example: the accuracy of the warning, the time available between the issuance of warnings to the arrival of events that can cause a disaster, and how prepared pre-disaster planning and community preparedness, including the community's ability to respond to these warnings and take anticipatory actions appropriately. Philosophical fixed procedures are guidelines for work steps that are mutually agreed upon by the institutions involved in disaster management that are used in the implementation of disaster response in a coordinated, integrated and structured manner.

![Diagram of flood early warning system](image)

**Figure 1.** Information on the flood early warning system.

Volunteers who are members of Garda Caah have their respective duties. Those who are in charge of monitoring the weather usually do it in two ways, that is by direct observation of clouds that have the potential to rain in the upstream area and monitor them by using the Automatic Weather System (AWS) weather monitor provided by Maipark, LAPAN and Meteorology ITB which are placed at several points monitoring, especially in the upstream area which includes the districts of Ibun, Paseh and Kertasari. Volunteers who monitor visually are usually informant partners in the upstream area. They will provide
the report to the Garda Caah data processing team. In practice reports from visual observations are often accompanied by terminology in regional languages with the aim of facilitating communication channels such as Sayang Hileud (Indonesian language, means caterpillar nests) to refer to clouds that have the potential to rain or hileud orok (Indonesian language, means baby caterpillars) which means heavy intensity rain. The Garda Caah analysis team will analyze it and then deliver the results of the analysis first to the Muspika, district BPBD, village officials, and volunteer partners for later Garda Caah and Jaga Balai will inform the public.

"The manual weather monitoring occurs when entering the rainy season from October to May. In fact there are often jokes from the public, are there semar and cepot (Sunda puppet figures) calling to convey weather conditions in the upper reaches of the Citarum River.

"By chance, the Citarum River upstream in the Gunung Wayang area was identical to the name Semar and Cepot," said Riki. He said, manual weather monitoring also followed the frequent occurrence of major flooding in the Majalaya region, which resulted in the destruction of residential settlements. So, at the initiative of the volunteers to advocate for flood prevention in Majalaya through bureaucratic channels. "We formed an emergency response with the code name of the Garda Caah operation," he said. According to him, with the formation of the emergency response, starting in 2008 it began to inform about the weather conditions to the public. But at that time it was still limited to the community. In 2010 and 2011, major flooding began in the Majalaya region.

"On the basis of the incident, we are trying to predict local weather which includes Majalaya, Ibin, Paseh, Pacet and Kertasari. Local weather monitoring is to find out weather conditions that have the potential to cause overflow or flooding, "Riki explained further. Weather monitoring is also done by going to the field and seeing the rainfall and river flow conditions. When you see the weather conditions have the potential for flooding, then spread to the public through short messages.

3.3. Media dissemination of flood early warning information

Information and communication systems will be effective if using the right media in accordance with the characteristics of its users. This information dissemination is done with several media so that information reaches citizens who are at the point of disaster-prone (TRB). This includes using:

3.3.1. SMS group. Cell phone numbers are made in groups or groups based on the TRB. These numbers get an SMS containing early warning information in one shipment without the development of information on the renewal of the situation and conditions of the flood.

3.3.2. WA Group. Early warning information is delivered through WA under the name Citizens' Alert group. In contrast to the SMS group, the WA group each member who is joined receives updated information regarding the development of the flood situation.

3.3.3. Facebook. Early warning information is disseminated through Facebook social media accounts with the Jaga Balai account name by mentioning it to the Garda Caah Sukarelawan account.

3.3.4. Telephone. Calling can be done if needed in an urgent situation for the immediate and very prompt delivery of information to certain numbers according to their duties and authority both to affected residents, internal teams, community partners, and related agencies or policy makers such as muspika.

3.3.5. HT. Information is communicated by the internal team and several parties from outside the team in terms of coordination and control of the field situation is limited to weather monitoring groups, communication networks and emergency response during disasters.

If we look at the information dissemination media used by Garda Caah in delivering flood early warnings to the community, the Garda Caah has used communication media so that information is quickly spread out and known by residents who have the potential to be hit by floods. The use of
communication media, including communication and information technology devices is indeed important to be used in the face of flood disasters that, "communication is seen as a place of relations between four elements of disaster management, namely: mitigation, preparedness, response and recovery "[8]. Even further said that in the modern era like today, the evolution and progress of communication and information technology increases the opportunities and efficiency of disaster management, especially in the scope of prevention and mitigation.

Resilience by the Garda Caah community by modeling the flood early warning system is an effort to make the community more independent in the face of disasters. The concept of resilience as a form of resilience of citizens is not new. The concept of resilience goes to sociology and human geography [9], in the sense of a resilient society, this is characterized by human need to adapt to extreme environments. In this case, the definition of resilience is used to express resilience and adaptation capacity of social networks as one of the most promising developments for disaster risk reduction. Klein et al. go further by stating that maintaining and increasing adaptive capacity must be the overall goal of resilience [10]. However, instead of adaptation being a property of resilience, Klein et al. see resilience as part of the capacity to adapt that every community needs during times of high danger and climate change [10]. Another part is exposure management and re-resistance [11].

4. Conclusion
Based on the results of the research that has been carried out, there are several conclusions, including: Resilience the communities around the Citarum watershed are realized by forming the Garda Caah Community, which in their work projects seeks to minimize the effects of flooding by sharing information about possible flooding. The Garda Caah community created a flood early warning system so that residents and local governments prepared to face flooding. Dissemination of information about floods is carried out through various media commonly used by the public, both traditional and modern channels.

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