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## **Bantul Integrated Sirine System (BISS) as a Bantul Regency Preparedness in Dealing with Tsunami Hazard**

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### **Abstract**

Bantul Regency is directly adjacent to the Indian Ocean and has a long coastline of 17 km (Marine and Fishery Service of Bantul Regency, 2017). There are at least 3 sub-districts with 11 coastal villages in Bantul Regency directly adjacent to the Indian Ocean. These sub-districts include Kretek, Sanden and Srandakan sub-districts. That is, there are 11 villages from 3 sub-districts in Bantul Regency directly exposed to tsunami threat from the Indian Ocean. There are the uncertainty of tsunami information in community. an Early Warning System (EWS) is needed to reduce the risk of a tsunami disaster and improve the existing evacuation system in the southern coastal area of Bantul District. With the information clarity of the tsunami disaster then the evacuation process will be more tersistem and neatly so that the panic of citizens will be reduced when the symptoms of a disaster occurred. this study has the objectives of (1) Identifying BISS as a means of disseminating tsunami early warning spreaders (2) Identifying the influence of BISS in improving community preparedness of Bantul Regency in facing the threat of tsunami disaster. The result show that Bantul Integrated Sirine System (BISS) is one form of tsunami early warning system built in Bantul Regency using sedrhana technology which is independently assembled by Bantul Regency and utilize the existence of community settlement location in tsunami early warning dissemination. The sustainability of tsunami early warning is certainly expected by all parties. Because the positive impact of this innovation is very important in reducing the risk of tsunami disaster. This early warning sustainability can be done because it is supported in a constitutional, and technological manner

**Keywords:** Early Warning System, Preparedness, Tsunami, Bantul

### **Introduction**

Geographically, Indonesia lies between three of the world's major tectonic plates that are becoming increasingly urgent. The three plates are the Eurasian plate, the Indian-Australian plate, and the Pacific Ocean plate. The two plate encounters will create an earthquake which will further trigger a tsunami due to the disruption of sea water (Meteorology Climatology and Geophysics Agency, 2010). The events of earthquake and tsunami that occurred in Indonesia has been proven to be sacrifice and resulted in material loss which is very big. Tsunami disaster in Indonesia occurred on December 26, 2004 with magnitude magnitude 9 Mw which resulted in hundreds of thousands of people in seven countries of the Indian Ocean region died and lost and suffered huge losses. (Ministry of Research and Technology, 2008). Furthermore, in 2006 the earthquake hit Yogyakarta Special Region and surrounding areas with a strength of 5.9 on the Richter Scale. The earthquake caused the deaths of 5773 people, 38,814 people were lightly injured, and there were 2,165,488 evacuees. The most severe disaster impacts occurred in Bantul and Klaten districts (National Disaster Management Agency, 2008).

Geographically, Bantul Regency is directly adjacent to the Indian Ocean and is in the zones of active collisions of Indo-Australian and Eurasian active plates that have a movement speed of approximately 7 cm



per year. These conditions place the coastal Bantul Regency has potential risks earthquake and earthquake and local or remote tsunami (Bantul Government, 2014). Although there has never been a tsunami in Bantul district, there is no possibility that a tsunami threat will come at any time. The density of the occurrence of disaster occurrence in Indonesia makes the entire population of Indonesia alert to the symptoms of disaster around them. Communities become more sensitive to the natural phenomena that occur in relation to disaster. Bantul District, which had the greatest impact of the 2006 earthquake, left a psychological trauma and fear of further disaster events for the people of Bantul. Disaster fears happen not only in earthquakes, but in the tsunami. This knowledge people get to see from the tsunami in Aceh in 2004 that was preceded by an earthquake. Thus, the inhabitants of Bantul now know that an earthquake can trigger a tsunami. This knowledge and experience make for a very quick emergency response. In the event of an earthquake, most people think that there will be a tsunami, and the coastal population will immediately save themselves and their families by running to the higher ground. This is indeed good, knowing that society has an attitude of emergency response. But the impact is the circulation of information / issues that have not been confirmed the truth related to the tsunami. So what happens is the panic and unanswered emergency response. There are no instructions regarding evacuation directives nor information on the characteristics of disaster threats.

In July 2006, Indonesia was again hit by a tsunami disaster in Pangandaran, West Java. The Tsunami disaster was preceded by an earthquake measuring 6.8 on the Richter Scale. The incident of the tsunami disaster in Pangandaran also resulted in casualties and losses. A total of 620 people died, 33 people lost, and 520 souls lost due to the disaster (National Disaster Management Agency, 2008). Indonesian citizens' anxieties about the upcoming disaster are getting bigger as more and more disasters happen in Indonesia. Bantul residents also experience panic because they also feel the vibration of the earthquake from Pangandaran. Bantul residents who in the previous two months experienced a major disaster that earthquakes have high awareness of the symptoms of natural disasters. During the earthquake in Pangandaran and surrounding areas, the coastal residents of Bantul also experienced the same panic and tried to rescue themselves respectively or so-called independent evacuation. This they do randomly and unystemally in the position there is no confirmation of potential tsunami disaster. As a result, issues that are not true are widely spread by word of mouth about the tsunami and the anxiety among the people is growing so that people are confused about which information is clear.

The concept of disaster management in the world has experienced a very dynamic paradigm shift. The paradigm shift must be lowered in real disaster management practices. Some of the paradigm shifts are outlined in Hyogo Framework for Action (2005) and Sendai Framework for Action (2015) (UNISDR, 2005; United Nation, 2015): (1) Reactive to Responsive Disaster Risk Reduction, (2) Emergency to Disaster Risk Reduction, (3) Government Based to Community Based Disaster Risk Reduction, and (4) Engineering based to People-centered Disaster Risk Reduction. Preparedness is a series of activities undertaken to anticipate disasters through organizing as well as through appropriate and efficient measures (RI Law No.24 Year 2007). Preparedness as intended by RI Law no. 24 of 2007 shall be conducted through: preparation and piloting of disaster emergency response plans; organizing, installing and testing early warning systems; provision and preparation of basic needs supply goods; organizing, counseling, training, and rehearsals on emergency response mechanisms; preparation of evacuation sites; preparation of accurate data, information, and updating of disaster response emergency procedures; and the supply and preparation of materials, goods and equipment for the recovery of infrastructure and facilities. Individual and household preparedness has four parameters: knowledge and attitude, emergency planning, warning system, and resource mobilization (Nugroho, 2007). The knowledge dictated is to measure basic knowledge of natural disasters such as traits, symptoms and causes. Emergency planning to know the actions that have been prepared in the face of natural disasters. An early warning system is an existing effort within the community to prevent disaster-induced disaster by warning signs. While resource mobiliation is the potential and improvement of community



resources such as through the skills followed, funds, and others (Nugroho, 2007). Bantul regency to date has made various efforts to increase preparedness among others (Daryanto, 2017): (1) Tsunami Drill involves Government, Society and Early Warning System, (2) All Villages in Zone 1 Tsunami Prone have formed "Desa Tangguh Bencana" and FPRB, (3) Compiled Tsunami Contingency Plan at village, sub-district and district levels, (4) Tsunami Testing Early Warning System and Bantul Integrated Sirine System on the 26th of each month, special on the 27th of May, (5) Preparation of participatory Evacuation Procedures, and (6) Evacuation signs to the Temporary Evacuation Site and Final Evacuation Site.

## Method

This research is a qualitative research applying pragmatic approach of disaster management practice in terms of preparedness of Bantul Regency in facing the threat of tsunami disaster especially using Bantul Integrated Siren System. BISS. Methods in this study by using qualitative descriptive analysis by collecting information about the existence of BISS in the community. The data collected by mechanism are observation, interview, and documentation study related to tsunami preparedness development in Bantul District. Observation (observation) is data collection activities conducted by observing directly the object of research in the field. This observation activity aims to explore the possibility of information passed by the researcher and enrich the observation dimension of the phenomenon which is the topic of research (Marpaung, 2011). Observations were conducted around the southern coast of Bantul District to document and see the state of tsunami early warning dissemination tools. Interview is one way to get information by asking directly (Singarimbum and Effendi, 1995). Interviews were conducted to the parties who undertook efforts to increase preparedness against tsunami threats in Bantul District, among others, Aka Luk-Luk Fitriansyah as Pusdalops Manager in Disaster Management Agency of Bantul and Mohamad Ayub as a technician for making BISS, and other parties such as FPRB, and others. The advantage of the interview is that it allows researchers to obtain large amounts of data and information. Conversely, the weakness is because the interview involves the emotional aspect, then the good cooperation between the informant and the interviewer is needed (Sarwono, 2006). Document review or document review is one of the data collection methods used to extract secondary data related to the problem under study (Marpaung, 2011). The document review was conducted by reviewing documents related to tsunami preparedness in tsunami prevention in Bantul Regency such as contingency plan, disaster management disaster relief village disaster planning document in south coast of Bantul Regency.

## Results and Discussion

Bantul Regency is directly adjacent to the Indian Ocean and has a long coastline of 17 km (Marine and Fishery Service of Bantul Regency, 2017). There are at least 3 sub-districts with 11 coastal villages in Bantul Regency directly adjacent to the Indian Ocean. These sub-districts include Kretek, Sanden and Srandakan sub-districts. That is, there are 11 villages from 3 sub-districts in Bantul Regency directly exposed to tsunami threat from the Indian Ocean. Based on previous conditions about the uncertainty of tsunami information, an Early Warning System (EWS) is needed to reduce the risk of a tsunami disaster and improve the existing evacuation system in the southern coastal area of Bantul District. With the information clarity of the tsunami disaster then the evacuation process will be more tersistem and neatly so that the panic of citizens will be reduced when the symptoms of a disaster occurred. In 2007 POKJA (work group) supported by Gesellschaft für Internationale Zusammenarbeit (GIZ) proposed a tsunami early warning system to improve tsunami preparedness in Bantul District. The target group for tsunami early warning that will be made is the entire population, both tourists and local residents who are in the area of tsunami hazard in Bantul Regency and surrounding areas. With the Early Warning System (EWS) is expected preparedness of the population of



Bantul District tsunami hazard increases. The Early Warning System (EWS) is considered to solve the problems previously discussed because the planned tsunami early warning dissemination can broadcast a message of siren as well as voice.

One of the early warning services intensively developed by BPBD Bantul Regency is the tsunami early warning system. In the case of early warning against tsunami hazard, PB PUSDALOPS as in the regional preparedness and early warning, have the authority to process data and disseminate early warning information submitted by BMKG as National Tsunami Early Warning Service Center, as well as to carry out evacuation orders to tsunami affected communities if needed. Bantul Integrated Sirene System (BISS) is a medium of dissemination of tsunami information obtained from BMKG to the public. BISS is part of the Early Warning System (EWS) run by PUSDALOPS PB of Bantul Regency

The innovation model of tsunami early warning tool developed by Bantul District Government in developing tsunami early warning service is classified into two categories: (1) TEWS Tower Model (Tsunami Early Warning System). This tsunami early warning tool was developed specifically by building independently building tsunami early warning towers with a typical building that is relatively affordable and affordable by the local budget. Figure 6 is a TEWS Tower photo developed independently by Bantul District Government; (2) Model of Public Infrastructure Cooperation. The cooperation here is the concept of information dissemination equipment deployment by utilizing existing information gear in tsunami-prone areas, one of which is a broadcasting tower owned by mosques. BPBD cooperates with mosques to place information receivers connected to the mosque's loudspeaker equipment to be relayed in parallel between BMKG Tower, TEWS Tower and Mosque Tower. Figure 6 is a photo of a mosque sound detector used as a means of dissemination of tsunami early warning information

Two models of tsunami early warning dissemination tool developed by Bantul Regency Government are optimally developed to replicate the warning function of BMKG in order to reach all areas affected by the tsunami in Bantul District. BMKG Tower, Tower TEWS, and Mosque Speakers connected in parallel with the early warning control center are in the Early Warning Room of PUSDALOPS PB BPBD Bantul District. Early tsunami warning dissemination must meet the following concepts: (1) functioning when power outages, (2) earthquake resistance, (3) has time range in seconds. References used in the manufacture of tsunami early warning dissemination tool is the concept of Public Address System and Two Way Radio System. At the beginning of the proposal, eight dots of early warning were distributed. Referring to the objectives, the ways and strategies used are as follows:

In 2012 BMKG provides assistance to Bantul Regency in the form of InaTEWS (Indonesia Tsunami Early Warning System). InaTEWS is a tsunami early warning system provided by BMKG to reduce tsunami risk. This certainly helps Bantul Regency in its effort to reduce the risk of tsunami disaster. The concept of BISS functionally similar to InaTEWS is to disseminate tsunami early warning to the target group that is coastal resident south of Bantul regency. But technically, BISS is very different and completely new. BISS can disseminate early warning for many points in Bantul District. To date there are 29 early warning points on the south coast in Bantul District. The added value again, BISS can spread the information in the form of voice and siren. The idea to use voice engineering in the EWS is to provide clarity about the truth of potential tsunami information as well as to provide guidance for evacuation and soothing residents in the event of a tsunami early warning. Economically, BISS is very cheap compared to other early warning dissemination tools.

The creative and innovative approach that makes this innovation successful is in its implementation involving the community. Sirens used as a medium of dissemination of early warning information placed in places of worship. The place of worship is used as the location of the installation of tsunami early warning dissemination tools with the assumption that the place of worship is in the middle of residential groups. That



way, when BISS is turned on for both test and tsunami early warning the population can hear it clearly. To achieve the objectives of BISS embodied from there are several points that indeed become a unitary system with BISS in order to become an effective early warning system. First, the development of Early Warning System (EWS) tsunami in the coastal district of Bantul from the media, to SOP evacuation. It needs to be straightened out here that BISS is not an Early Warning System (EWS). However BISS is one of the potential information dissemination media of tsunami disaster and is one part in Early Warning System (EWS). In other words the Early Warning System (EWS) is not a tool but a system used to reduce disaster risk with early warning to vulnerable and vulnerable areas. Thus, the action plan created is not only limited to the creation of BISS, but the system surrounding the acceptance of information, the dissemination of early warning information, to the evacuation.

PUSDALOPS PB as disaster information center in Bantul District is very careful in making decisions about potential tsunami hazard. The decision is based on earthquake info informed by BMKG. If earthquake is felt in Bantul and potentially tsunami then communication between stake holder must be implemented immediately. Dissemination of tsunami early warning information is carried out within seconds of voice and then siren. The different BISS concepts from other TEWS are voicemail or siren information about the truth of tsunami potential as well as evacuation directions using BISS after the earthquake. This is done to make effective early warning system as reliable information source media related to tsunami potential to coastal people in Bantul Regency as well as to empower the community in the operation of tsunami early warning system. Voice is a warning by using vocals through siren as the medium. The concept of this voice is different from the previous concept of EWS concept that only uses siren only. Conducted a way of voice in tsunami early warning because not all people understand the meaning of siren. So, by using the voice way that the source of information directly from humans, then the public will quickly understand, clarity about emergency punada, and have clear evacuation direction, panic of disaster in the community subsided.

In the implementation of this tsunami early warning system certainly involves many parties. However, among those who have the most important roles related to BISS are PUSDALOPS PB BPBD staff of Bantul Regency and community members represented by the board of worship where the BISS sirens are located. PUSDALOPS PB Bantul staff has a role in receiving earthquake information and tsunami potency from BMKG, decision making, until the operator of this BISS. While the citizens represented by the board of worship places (mosques) play a role in monitoring the readiness of tools in transmitting information. Further copies of information to various parties as an effort to anticipate disaster risk reduction. An innovation that aims to increase disaster preparedness of society is supported by many parties. The expected result of this tsunami early warning system is the reduction of tsunami risk in coastal areas of Bantul Regency, one of which is caused by the tsunami warning service. Governments, implementers and communities have supported the innovation of this tsunami early warning service by: (1) Made Regional Regulation No. 1 of 2013 on Preparedness and Early Warning in Disaster Management Implementation. As a geographical area including areas prone to natural disasters, this Regional Regulation is an anticipative step that has become a necessity and is also intended as a concrete step to mendinamisasi or mobilize public awareness of the threat of disaster that at times come to hit residential areas; (2) Tsunami Drill Preparedness Exercise. In order for the community, local government officials and relevant stakeholders to be ready and responsive in facing the threat of tsunami disaster, a routine drill or simulation is needed in the face of tsunami disaster through Tsunami Drill. Tsunami Drill is an evacuation drill that involves 3 main unsur namely community, government, and early warning system. Tsunami Drill is conducted by Bantul Regency once a year.

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## Conclusion

Bantul Integrated Sirene System (BISS) is one form of tsunami early warning system built in Bantul Regency using sedrhana technology which is independently assembled by Bantul Regency and utilize the existence of community settlement location in tsunami early warning dissemination. The sustainability of tsunami early warning is certainly expected by all parties. Because the positive impact of this innovation is very important in reducing the risk of tsunami disaster. This early warning sustainability can be done because it is supported in a constitutional, and technological manner. Bylaw No. 1 of 2013 on Preparedness and Early Warning in Disaster Management Implementation is a manifestation of the commitment of local government in improving the community capacity of Bantul Regency. With the making of the local regulation, it is guaranteed the existence and maintenance of early warning tools.

## References

- Badan Meteorologi Klimatologi dan Geofisika. (2010). *Pedoman Pelayanan Peringatan Dini Tsunami*. Jakarta: Badan Meteorologi Klimatologi dan Geofisika.
- Badan Nasional Penanggulangan Bencana. (2008). *Data Bencana Indonesia tahun 2006-2007*. Jakarta: Badan Nasional Penanggulangan Bencana
- Bantul Regency Government. (2014). *Rencana Kontijensi Tsunami Bantul Regency*. Bantul: Pemkab Bantul
- Daryanto, Dwi. (2017). *Community Tsunami Preparedness In Bantul District, Special Region of Yogyakarta, Indonesia*. IOTIC-BMKG Regional Workshop Indian Ocean Tsunami ready. BMKG, Jakarta 6-8 September 2017 Indonesia
- Dinas Kelautan dan Perikanan Bantul Regency. (2014). *Data Kelautan, Pesisir, dan Pulau-Pulau Kecil*. Retrieved Juni 17, 2017, from <http://dkp.Bantulkab.go.id/filestorage/dokumen/2014/07/Data%20Kelautan,%20Pesisir,%20dan%20Pulau-Pulau%20Kecil%202013.pdf>
- Hall, R., (1995). *Plate Tectonic Reconstructions of the Indonesian Region*, Proceedings Indonesian Petroleum Association vol. 1, 1995, IPA, p. 70-84
- Hardjono, I. (2006). *Hirarki Gempa Bumi dan Tsunami (Aceh, Nias, Bantul, Pangandaran, dan Selat Sunda)*. Forum Geografi, 135-141
- Nugroho, Cahyo. (2007). *Kajian Kesiapsiagaan Masyarakat dalam Mengantisipasi Bencana Gempa Bumi dan Tsunami*. MBPI-UNESCO



UNISDR. (2005). Hyogo Framework for Action 2005-2015. World Conference on Disaster Risk Reduction , UNISDR. Kobe: United Nation.

Undang-Undang Republik Indonesia No. 24 Tahun 2007 tentang Penanggulangan Bencana

Zakaria Zulfialdi. (2007). Aplikasi Tektonik Lempeng dalam Sumberdaya Mineral, Energi an Kewilayahan. Buletin of Scientific Contribution 5(2):123-13