EARLY WARNING SYSTEM (EWS) TO SUPPORT TOURISM IN BALI

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Abstract

The threat of a tsunami disaster for the people of Indonesia is enormous, especially people who live in the coastal areas of Bali. This study aims to find out information on how the involvement and coordination between the Regional Government or Institutions related to tsunami disaster management preparedness to several related stakeholders, including the Provincial Government of Bali, BPBD, and BMKG Region III Denpasar. Anticipation of the tsunami is expected to create a sense of security so that they can support the tourism sector. This research method uses qualitative. Data collection techniques are interviews and observation. Based on the results of the study, the Balinese and tourists have been provided with knowledge by local stakeholders, including the sign of tsunami siren activation as an early warning, knowing the evacuation route if a tsunami occurs, even the community has conducted several disaster management simulations. With the Early Warning System, a tsunami disaster can be anticipated so that it can support the tourism sector. Thus, the readiness of the Provincial Government of Bali in dealing with the tsunami disaster is part of the effort to develop tourism.

***Keywords**: EWS, Tsunami, tourism, Bali*

Introduction

Geographically, Bali is located at 8 ° 3'40 " - 8 ° 50'48 South Latitude and 114 ° 25'53 " - 115 ° 14'55 " East Longitude, which makes it tropical-like other parts of Indonesia. The Province of Bali is part of the Lesser Sunda Islands with an area of 5,636.66 km2, with a coastline length of 529 km. The Province of Bali consists of 8 Regencies and 1 City with a population of 4,2227,705 people or close to 4.3 million inhabitants. The Bali region consists of 6 mainland areas, namely the island of Bali, Menjangan Island, Ulau Serangan, Nusa Penida, Nusa Lembongan, and Nusa Ceningan. The physical limits are as follows: North: Bali Sea; East: Lombok Strait (West Nusa Tenggara Province); South: Indonesian Ocean; West: Bali Strait (East Java Province) Administratively, Bali Province is divided into 9 Regencies / Cities, 57 Districts and 716 Villages. Districts / Cities include Jembrana, Tabanan, Badung, Gianyar, Karangasem, Klungkung, Bangli, Buleleng, and Denpasar Cities.

The most significant source of regional income (PAD) in Bali Province is from the tourism sector. The results of the study stated that the growth in the number of tourist visits, the level of investment, the trade sector, and hotels had a positive effect on the Regional Original Income (PAD) of the Province of Bali. Therefore, the tourism industry

is the most critical sector and developed in the Province of Bali. Tourism, as the primary industry, is strongly influenced by various factors, one of which is safety. Disasters, as part of security, have a significant influence on the tourism sector. Humans are anxious and worried about visiting destinations that are prone to disasters. Visitors' security and safety are multidimensional ideas in various components such as political security, public safety, health and sanitation, personal data security, disaster protection, and guaranteed service quality. For that reason, the factor of tourist safety and security is the main thing that must be considered by the Bali Provincial Government in the development of its tourism sector.

The Mount Agung eruption disaster in 2017 that lasted until 2018 has had an impact on most Balinese people, especially those who work in the tourism sector. The impact of the eruption of Mount Agung is very influential on the income of local people from the accommodation business. The reduced number of tourist visits due to travel warnings and the closure of Ngurah Rai airport for several days due to the burst of volcanic ash had made the industry in the tourism sector experience a downturn. Media coverage related to the Mount Agung eruption also resulted in a decline in the number of tourists. The role of comprehensive media as a system of dissemination of early warnings to the community can minimize the loss of life and the amount of losses because the community can take attitudes and anticipatory actions. The involvement of the media in providing education and the system of dissemination of early warning to the community as part of disaster mitigation.

In general, coastal areas in Indonesia are prone to tsunami disasters, including coastal areas in Bali. The western region of Sumatra, Sunda Strait, South Java Island, and East Nusa Tenggara are tsunami hazard zones. The four points of the seismic gap area (earthquake zone has never been shaken by a massive earthquake between 50 - 100 years) in Indonesia are in the Sunda Strait, the southern coast of Java, the Bali Strait, and the area near Alor Island has the potential to cause a tsunami. The coastal area of Bali is one of the coastal areas that are on a seismic gap, so it is very vulnerable to the threat of a tsunami disaster. The cause of the tsunami is due primarily to the tectonic earthquake, which is usually shallow, large magnitude, and has a rising or falling fault. Table 1. is the data of the 2018 disaster events in Bali Province.

Table 1 Disaster events in Bali Province in 2018

No.	DISASTER EVENT	NUMBERS OF EVENT
1	Earthquake	902
2	Tsunami	0
3	Fire	442
4	Flood	151
5	Landslide	250
6	Tornado	23
7	Volcanic Eruption	3
8	Drought	11

Based on the data in Table 1. it can be concluded that an earthquake is a disaster with the highest incidence of disasters throughout the year. In fact, in the previous explanation, tectonic earthquakes were the cause of most tsunamis. Therefore, it is necessary to pursue disaster mitigation activities to reduce the impact caused in the

event of a tsunami. One of the disaster mitigation activities that can be carried out is the existence of a tsunami early warning system.

The early warning system, according to UN-ISDR (United Nations - International Strategy for Disaster Reduction), is the provision of timely and practical information through identified institutions, which enables people exposed to hazards to take action to avoid or reduce their risk and prepare for an effective response. A practical and complete early warning system consists of four interacting elements namely risk knowledge, monitoring and warning services, dissemination and communication, and response capabilities. An effective early warning system is not only concerned with technical matters but also focuses on people who are exposed to risks, both arising from natural hazards or social vulnerabilities. The system approach that combines all relevant factors in risk is needed to realize an effective early warning system.

With the description above, the researcher takes the theme of the Preparedness of the Early Warning System (Early Warning System) of the Bali Provincial Government in facing the Tsunami Disaster, because it knows the ability and readiness of Bali in maintaining safe and comfortable tourism conditions in order to find out how the government local and officeholders and the role of the community in creating Bali security and comfort as one of Indonesia's mainstay tourist attractions. Readiness is key to dealing with tsunamis; developing local preparedness strategies is critical. The development of preparedness strategies requires a good understanding of the hazards.

Methods

The research method was used as a qualitative research method that applies a pragmatic approach in the practice of disaster management in terms of readiness to face the threat of tsunami disasters in coastal areas of Bali. Data collection was carried out through interviews and documentation studies related to the development of preparedness for the tsunami Tsunami disaster in Bali. Interviews are one way to get information by asking directly. Interviews were conducted with those who made efforts to increase readiness to face the threat of a tsunami in Bali, among others, the Provincial Government of Bali, BPBD Bali, and BMKG region III Denpasar. Documentation study is one method of collecting qualitative data by looking at or analyzing documents made by the subject itself or by others about the subject of study documentation such as notes, photos, video recordings, or sounds [8]. Documentation studies were carried out by reviewing documents related to tsunami preparedness in tsunami prevention in Bali, such as contingency plans and disaster management planning documents.

Result and Discussion

BPBD / Pusdalops Readiness of the Bali Provincial Government

The early warning system is only useful when the arrival (intensity, time) of an event in a place can be predicted in advance. Therefore information or tools are needed to detect the occurrence of an event. The release of information about hazard conditions is the estuary of a process of analyzing data about disaster sources and synthesis of various considerations. The accuracy of the information can only be achieved if the quality of analysis and synthesis that triggers the release of information has high accuracy. Thus there are two main parts of the early warning system, namely the

upstream part in the form of efforts to package the data into the right information and the downstream in the form of efforts so that information quickly reaches the community.

The existence of the BPBD (Regional Disaster Management Agency) / Pusdalops (Government of Bali Province aims to integrate disaster management in the regions, which has four functions, namely: disaster data and information center, early warning system, emergency response control operations, emergency services. Pusdalops functions include a) providing early warning to the community to avoid any disaster/security threats; b) centers controlling people's mobility to avoid disasters; c) monitoring disaster-prone points. Early warning system (BPBD Early Warning System) / Bali Provincial Emergency Center has supporting facilities and human resources (HR), among others: BMKG / INA TEWS and CCTV servers, monitoring towers, CCTV cameras, BMKG workstations, and tsunami siren activation, early warning sirens, CCTV & LCD TV projector screens, digital information terminals, radio communications, tel/facsimile/internet, CCTV workstations, SOPs and HR (D3 IT).

The readiness of the Bali Provincial Government in facing the threat of a tsunami from the southern coastal region of Bali Province, namely:

- Collaborating with the French Red Cross to establish the Crisis Center
- Establish cooperation with the German Indonesia Tsunami Early Warning System (GITEWS)
- Installing early warning sirens at nine points throughout the Province of Bali
- Establish cooperation with the regency/city government to install evacuation signs
- Disseminating tsunami hazards

Readiness made by the Bali Provincial Government is appropriate in realizing a capable tsunami early warning system. Government cooperation with the French Red Cross and the German Indonesia Tsunami Early Warning System (GITEWS) is a commitment made by the government to produce disaster risk observation and analysis as a component of the early warning system. The government has also socialized tsunami hazards to the community through disaster resilient village programs, socialization of tsunami siren activation, and disaster safe schools. Making evacuation routes throughout Bali is also carried out in order to facilitate the evacuation process if necessary.

The activation of tsunami sirens in Bali is carried out on the 26th of every month in order to check the sirens that are available throughout the Bali Province. The placement of siren distribution in Bali Province is shown in Figure 1.

Figure . Placement of Sirens in the Province of Bali

The placement of sirens in Bali Province, as shown in Figure 1. It has not yet reached all of the coastal areas in Bali, so that it requires an additional ten tsunami sirens to be able to reach all coastal areas in Bali. The tsunami siren activation activity, besides being used for checking tsunami early warning tools, is also used as a means of socialization to the community regarding tsunami disaster mitigation efforts.

Besides, the Pusdalops has a fleet and devices that support it with roles and functions including:

a. Radio Communication Systems,
b. KOMODO (Multi Moda Operation Control Communication),
c. Car Communication, DVB (Digital Video Broadcasting),
d. Disaster Information System, Monitoring CCTV, and LED Display, and other communication devices. And PB BPBG Pusdalops Device Desimination
e. DVB (Digital Video Broadcasting) with the function of Digital Video Broadcasting (DVB) to receive and disseminate information on earthquakes and potential tsunamis. PB Pusdalops provide tsunami early warning to registered cellphones in the form of SMS.

The use of the radio communication system as a supporting tool in the implementation of disaster management in Bali works if in the event of an internet network system suddenly down. Bali Province BPBD conducted a round table using radio communication three times a day with BMKG (Meteorology, Climatology, and Geophysics Agency) to update information related to the disaster.

Readiness of BMKG Region III Denpasar

The Center for Meteorology, Climatology, and Geophysics in Region III Denpasar has the task of carrying out an observation, data management, forecasting, research, collaboration, calibration, and meteorological, climatology, air quality, and geophysical services in the Bali Province. Regulation of the Head of BMKG Kep. 2015 of 2014 states that the Center for Meteorology, Climatology, and Geophysics has the task of carrying out observations, data management, forecasts, research, cooperation, calibration, and services for meteorology, climatology, air quality, and geophysics. Based on these regulations, the mitigation and preparedness efforts carried out by BMKG are to provide early warning.

Following the mandate of Law 31/2009 concerning Meteorology, Climatology, and Geofiika, BMKG conducts tsunami early warning services. Therefore, Indonesia, through the BMKG and related institutions under the coordination of the Ministry of Research and Technology, has developed tsunami early warning technology, equipment, systems, and governance since 2005, called the Indonesian Tsunami Early Warning System abbreviated as InaTEWS.

InaTEWS was built by implementing several integrated systems such as secure and sensitive seismograph networks, the construction of a Deep-ocean Assessment and Reporting of Tsunamis system along with devices such as buoys, satellite systems, tide gauges placed in ports to observe wave characters, and cameras by visually monitoring places with a certain height. Another device used by InaTEWS is DSS (Decision Support System). The DSS collects all information from the sensor group to decide whether a tsunami has occurred or not.

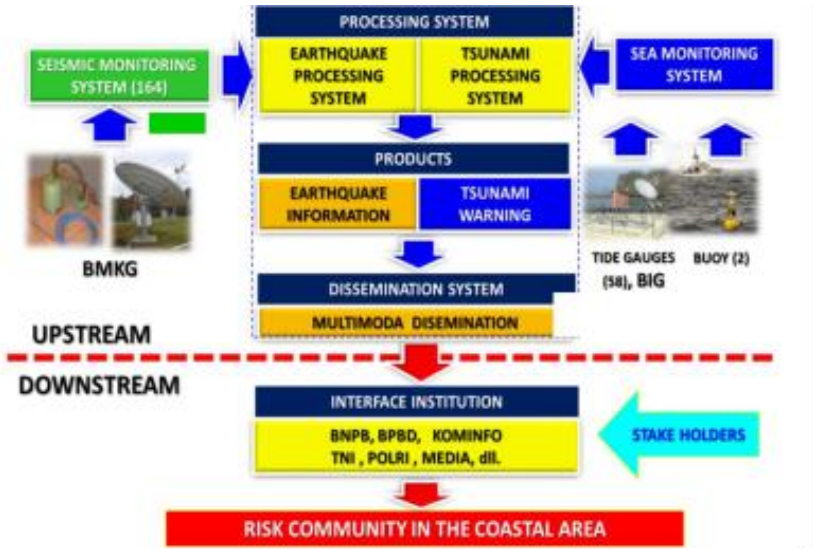

Figure 2. InaTEWS Design

InaTEWS design produces products in the form of earthquake information and tsunami early warning, as in Figure 2. Inatews uses a land monitoring system and a marine monitoring system. A land monitoring system consisting of a network of broadband and GPS seismometers. Sea monitoring system consists of tide gauges, buoys, and CCTV. Observational data is sent to BMKG to be processed and analyzed to produce tsunami early warning information related to areas that may be affected, warning levels, and tsunami arrival times.

The BMKG's work area in the tsunami early warning system is in the upstream domain, which means that the BMKG carries out its function as an institution that provides information services through the analysis of monitoring data related to tsunami early warning. Whereas downstream institutions or stakeholders function to disseminate information (function of dissemination) early warning to the public such as BPBD, TNI, Media, KOMINFO to the public exposed to coastal areas. The readiness of BMKG region III Denpasar Bali includes the readiness of personnel by collaborating with universities both at home and abroad in developing Ina TEWS. BMKG personnel were also given training at the BMKG Training Center, and there was also an internal assessment (certification) for each personnel. The readiness of facilities and infrastructure in the face of the tsunami disaster is quite reasonable according to the SOP (Standard Operating Procedure) in Inatews. Maintenance activities of facilities, and infrastructure include several activities, namely preventive (tool checking), corrective (damaged tool correction), tool calibration, replacement of equipment that is not feasible.

Conclusion And Recommendation

Readiness of the tsunami early warning system in Bali involves various sectors, such as BPBD, the Government of Bali, and BMKG. The role of BPBD is as a disaster data and information center, early warning system, controlling emergency response operations and emergency services, the role of the Bali Provincial Government includes cooperation with various international disaster agencies, installing sirens in Bali in collaboration with the district government, and conducting socialization disaster

mitigation to the community. The role of the BMKG concerning the threat of a Tsunami is to produce information related to seismic and Tsunami early warning. The three institutions have had basic tasks, functions, and good synergy in the face of the tsunami threat in Bali.

BPBD has plans for the addition of Tsunami sirens in coastal areas that are still unreached by existing sirens. Recommendations for the BMKG are to increase cooperation in the development of tsunami early warning detection sensors in order to produce faster and more accurate tsunami early warning information. With the existence of concrete efforts and actions before, when and after a disaster, it is expected to be able to create a positive image of Bali so that sustainable tourism can be created without concern for natural disasters.

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