

The 6.8 RS Earthquake south of Bali on the 13 October 2011

Institutional and community reaction in Bali to the earthquake and related messages from InaTEWS

A Case Study

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Capacity Development in Local Communities

Project for Training, Education and Consulting for Tsunami Early
Warning System (PROTECTS)

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1 Introduction

The island of Bali was hit by an earthquake on Thursday, October 13, 2011 at 11:16 am local time (WITA). At the time the earthquake occurred, most people were going about their normal daily activities. The initial earthquake was followed by several aftershocks, which continued until the afternoon. The earthquake's epicenter, which had a magnitude of 6.8 on the Richter scale (SR), was located 143 km off the coast from Nusa Dua at a depth of 10 km. The location of the quake's epicenter can be seen on the following map, which was issued by the Meteorology, Climatology and Geophysics Agency (BMKG):

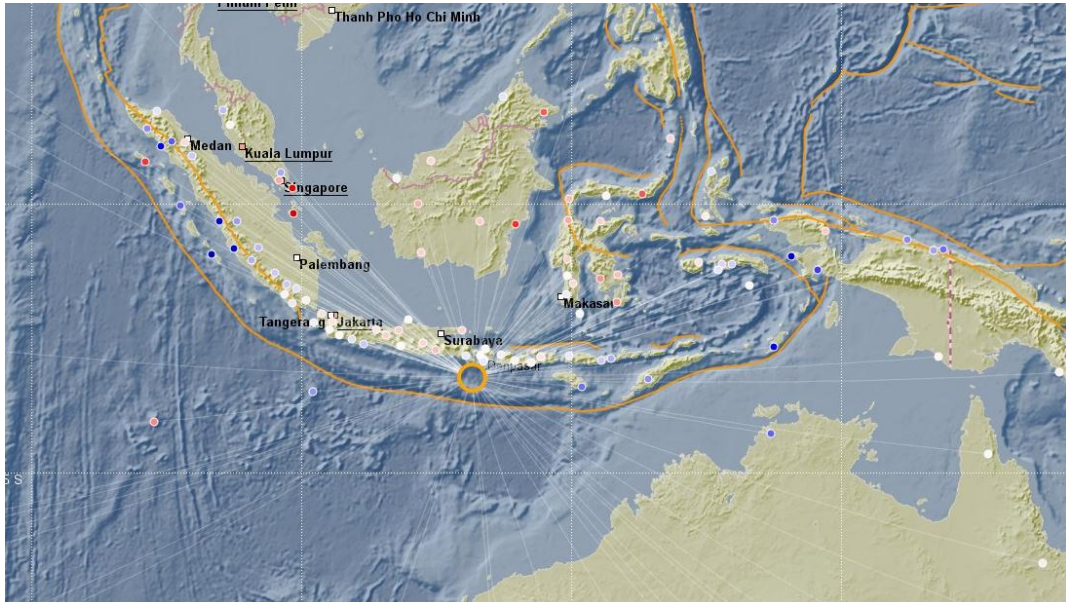


Figure 1: The statement letter from the BMKG

The initial quake was very powerful and lasted about one minute, while the aftershocks registered a magnitude of 5.8 SR. After the first quake, the BMKG issued a warning stating the earthquake did not have the potential to cause a tsunami. Five minutes later at 11:21:01 WITA (10:21:01 Western Indonesian Time – WIB), the Bali Province Operation and Controls Centre (PUSDALOPS) received this information via its DVB equipment. Due to the strength of the earthquake, it was also felt by people living outside of Bali, in areas including Mataram in West Nusa Tenggara, and several cities across East and Central Java, where it registered different strengths.

Although there was no potential for a tsunami, the earthquake did cause some people in Bali to panic; it also caused damage to several buildings in the Denpasar area, including Bangli and Gianyar. For some people, this was the first time they experienced an earthquake of this magnitude. Before this quake, they had only heard stories about a powerful earthquake that had occurred in December 1979 in Karangasem. The 1979 earthquake was described as being as strong as the earthquake they had just felt. Following the Japanese tsunami in March 2011, people who were at the beach at the time of the Bali earthquake in October 2011 were more aware of tsunami hazards and this may have been what triggered panic among some of them.

Local government agencies, in this case the Bali Province PUSDALOPS, are obliged to follow up on earthquake information and tsunami early warning information plus advice submitted by the BMKG. Local governments are the only party in the tsunami early warning communication chain that has the authority and responsibility to determine and announce

clear directions to local communities. Warnings and guidance issued by the local government assist local residents and visitors to react quickly and appropriately to tsunami threats.

Between 2006 and 2010 Bali was one of the pilot areas of the GITEWS project to develop procedures and mechanism for tsunami early warning and preparedness. During this period the Bali government and relevant local stakeholder were supported by GIZ IS to develop tsunami hazard maps, the local warning chain and related SOPs as well as a 24/7 service, evacuation plans for selected areas in Denpasar (Sanur) and Badung districts (Tanjung Bena, kuta). The project also provided trainings and educational materials to improve community preparedness increasing people's knowledge and raising their awareness about tsunami hazard and early warning. Cooperation was also established with the tourism sector, especially with the Bali Hotels Association (BHA).

This case study aims to record and document the reactions and responses by the institutions at province and district level as well as from three communities which whad been supported by the GITEWS project in Bali. It comprises the time from the earthquake's occurrence through until information about the earthquake was released on national and local television. The case study also includes issues surrounding the earthquake's aftershocks and information relating to tsunami early warning. The findings presented in this case study are derived from interviews with key actors who are directly involved in the Tsunami Early Warning System, representatives from other involved insitutions and the three communities mentioned above by Widi Artanti from GIZ-Protects.

Those interviewed included personnel from the Bali Province PUSDALOPS, relevant government agencies (the BMKG in Region III, Denpasar, the local Disaster Mitigation Agency (BPBD) in Badung district and the Civil Defence and Community Protection (Kesbangpol) in Bandung district and Community Protection (Linmas) office in Badung regency), the Indonesian Red Cross (PMI), Search and Rescue (SAR) teams, television and radio stations as well as facilitators of the Tsunami Early Warning System at village and urban levels, and community representatives, including those from schools.

It is hoped that this documentation will offer a valuable reflection and information for the Bali Province PUSDALOPS and its partners regarding the events that took place on that day.



Photo 1: Interview with PUSDALOPS personnel in Bali Province

2 The sequence of the earthquake's events

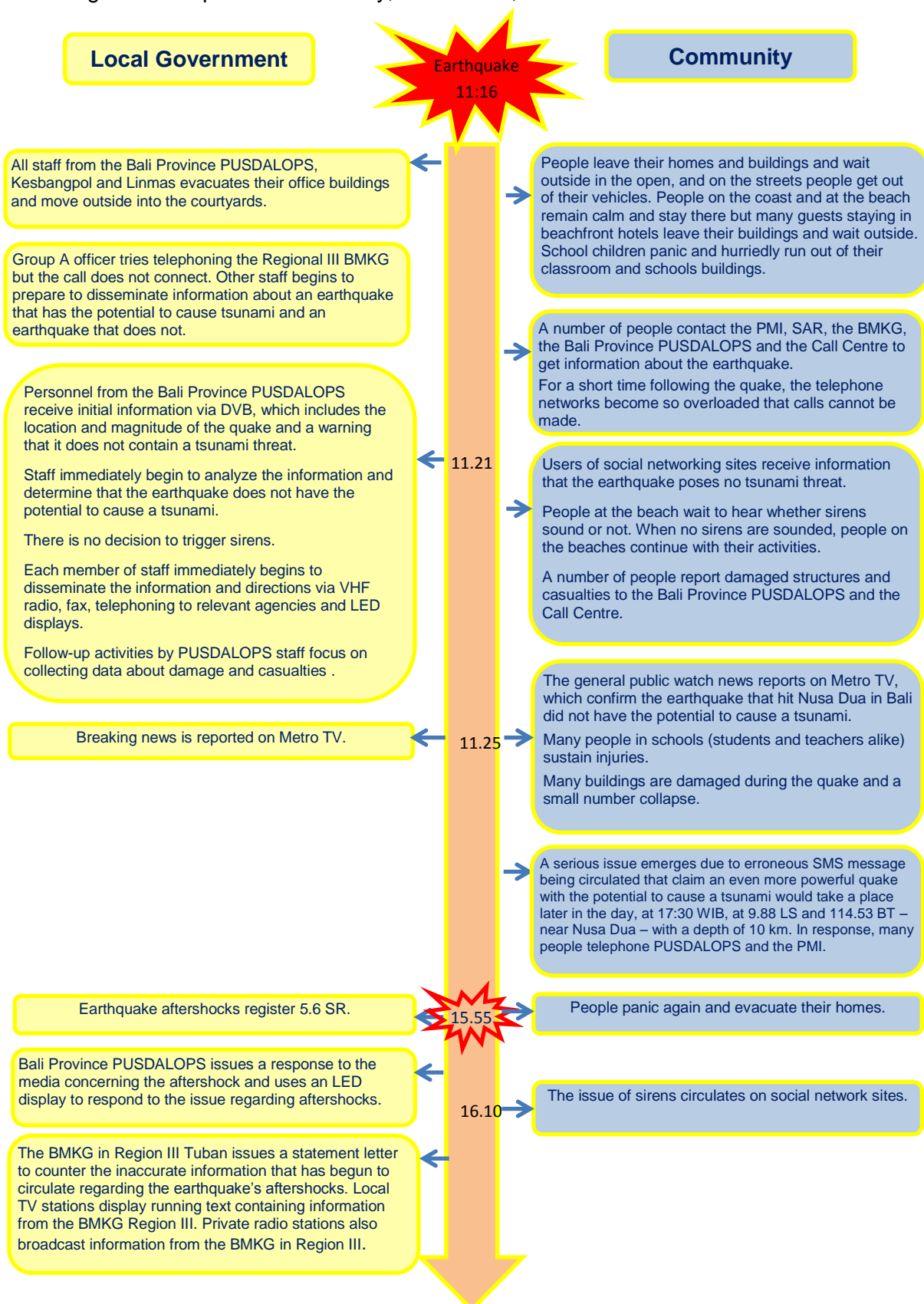
2.1 The sequence of events by the BMKG

The following table, provided by the BMKG in Jakarta, shows the sequence of events during and after the initial earthquake through until the release of information on national television:

Time (WIB)	Time Intervals (minutes)	The Earthquake's Time Line, Nusa Dua - Bali 13 October 2011
10:16:27	0:10:23	Earthquake strikes
10:17:00	0:00:33	<i>Live signal and Stasiun Status Blinking (IGBI,DNP, RTBI, SRBI)</i>
10:17:15	0:00:48	<i>Start Interactive Tool Seiscomp3</i>
10:17:56	0:01:29	Result of <i>first location</i> Seiscomp3: OT= 10:16:30 WIB, 9.66 LS – 114.58 BT Mag = 6.5 SR Kedlmn:10 km, followed by alarming sound
10:18:34	0:02:07	Update interactive by Seiscomp3: OT= 10:16:29 WIB, 9.72LS – 114.52 BT Mag = 6.7 SR Kedlmn:10 km
10:19:00	0:02:33	Initial indications from Bawil III: in Kuta IV-V MMI, Mataram IV-V MMI
10:19:34	0:03:07	Commit seiscomp3: OT= 10:16:27 WIB, 9.89 LS – 114.53 BT Mag = 6.8 SR Kedlmn:10 km
10:19:45	0:03:18	Result of <i>first location</i> CEA: OT= 10:16:31 WIB, 9.79 LS – 114.51 BT Mag = 6.7 SR Kedlmn:18 km
10:20:34	0:04:07	Decision of Seismic OT= 10:16:27 WIB, 9.89 LS – 114.53 BT Mag = 6.8 SR Kedlmn:10 km
10:20:50	0:04:23	Send data for dissemination
10:21:01	0:04:34	Decision to disseminate: OT= 10:16:27 WIB, 9.89 LS – 114.53 BT Mag = 6.8 SR Kedlmn:10 km
10:21:30	0:05:03	Check log status sent/received
10:21:50	0:05:23	Initial indications from the public: in Madura III-IV MMI
10:22:00	0:05:33	Web GEOFON OT:10:16:31 WIB 9.69 LS – 114.51 BT Mag = 6.3 SR Kedlm = 49 Km
10:22:45	0:06:18	Initial indications from Stage of Karangates: in Jember, Blitar, Surabaya, Malang, Karangates III-IV MMI, and Wonogiri II-III MMI.
19:23:40	0:07:00	Web USGS OT:10:16:32 WIB 9.35 LS – 114.64 BT Mag = 6.0 SR Kedlm = 61 Km
10:24:18	0:07:51	Interactive update by Seiscomp3: OT= 10:16:31 WIB, 9.74 LS – 114.49 BT Mag = 6.5 SR Kedlmn:63 km
10:25:00	0:08:33	Breaking News MetroTV
10:58:00	0:41:33	Breaking News TVOne

2.2 The sequence of events as observed in the community

The graph below shows the sequence of actions taken by the Bali Province PUSDALOPS following the earthquake on Thursday, October 13, 2011:



3 The reaction by coastal communities and representatives from government agencies during and after the earthquake

The earthquake, which had a magnitude of 6.8 SR, was felt strongly enough to cause most people – including school children and people at work – to hastily exit the buildings they were in at the time to avoid potential injury. At the Mandala Niti office in Renon, for example, most of the employees ran out of the building when the earthquake struck. Some school children in Denpasar sustained injuries due to the collapse of their school's roof and also in the scramble to get out of their classrooms. The quake also caused some damage to several other buildings in Denpasar.



Photo 2: The scene at the time of the earthquake in front of the Kasih Ibu Hospital, Teuku Umar

Meanwhile, the people who were on the beaches at Kuta, Sanur and Tanjung Bena remained more calm when the earthquake struck; they did not panic as they were already outside in the open but also they did not hear any warning siren and there was no visible change in the condition of the sea. Guests staying in beachfront hotels were aware of the earthquake and they immediately evacuated the buildings. They chose to go outside to avoid any potential damage that the earthquake may have caused to the hotels.



Photo 3: The situation in front of one of the hotels in Kuta

The earthquake also resulted in the telephone network and mobile phone lines becoming jammed because of a surge in phone usage when a large number of people all tried to make phone calls at the same time. In the short time immediately following the quake, communication via landline telephones and mobile phones throughout the Denpasar area was impossible. However, the earthquake did not cause power outages.

At the same time, in the offices of the Bali Province PUSDALOPS and the BPBD in Badung district and Denpasar city, all personnel and duty officers evacuated their buildings when the earthquake took place.

3.1 Badung District

3.1.1 Badung District BPBD

The receiving of earthquake information that did not have the potential to cause a tsunami:

Round-the-clock operations (24/7) in Badung regency are based in the Kesbangpol and Linmas office and are run by the Rapid Response Team (*Tim Reaksi Cepat* - TRC) within the Badung regency BPBD. At the time of the earthquake, there were four personnel on duty, namely Nyoman Saputra, I Gede Anom, Andiawan and Ngurah Dedy. When the earthquake occurred, all four personnel inside the three-story building made their way downstairs and out into the open courtyard. When they felt safe enough, the TRC officers sought information by trying to telephone the BMKG, but the telephone network at the time was overloaded and could not be accessed. They then listened to a VHF radio broadcast issued by the Bali Province PUSDALOPS and from that obtained the information that the earthquake did not have the potential to cause a tsunami.

As there was no risk of a tsunami the TRC personnel, in accordance with Head of BPBD's directives, immediately proceeded to forward the information to other agencies while they continued to seek data on damage and casualties caused by the earthquake. At the same time, many phone calls came in on the TRC phone number (2120057) with reports of damage and casualties from the field.

Decision making:

When the head of the Badung BPBD, who was at home when the earthquake occurred, had been notified that there was no tsunami risk, he instructed the TRC officials to travel out into the field so as to be ready to respond to cases of damage and personal injury in the area as well as to monitor ongoing data developments regarding damage and casualties.

The dissemination of warnings that the earthquake had no tsunami potential and guidance:

Warning information that the earthquake did not have the potential to cause a tsunami was widely disseminated by telephone and VHF radio to relevant agencies.

3.1.2 Tanjung Bena Village

The receiving of earthquake information that did not have the potential to cause a tsunami:

At the time of the earthquake, the Tanjung Bena head of village, I Wayan Kembar, was in the village's office, while one of the early warning system facilitators, Mrs. Nengah Sutarni, was out of the office. At the precise moment the earthquake occurred, all the village office staff left the building and so, too, did members of the Tanjung Bena community, who evacuated their homes and work places. They did not panic; they instead prepared themselves to evacuate the area if a warning siren sounded. When no siren was sounded and as the news spread that the quake had no tsunami risk, people began to return to their respective activities.

Tanjung Benoa village is connected by VHF radio communication with the Bali Province PUSDALOPS via HT radio, but at the time of the earthquake, the HT radio was not activated, and there was a lack of clarity about who should take charge and be responsible for receiving information and directions from PUSDALOPS.

Decision Making:

Given the fact that no siren was sounded during the five minutes following the quake, the village head did not disseminate this information. Some people had already obtained information from the national television station Metro TV that the quake did not have the potential to cause a tsunami.

The dissemination of warnings that the earthquake had no tsunami potential and related guidance:

Almost all the residents living in Tanjung Benoa knows well of facilitators of the early warning system in the community; people like Nengah Sutarini who, after receiving information about the earthquake from the PMI via her mobile phone, actively disseminated the information and provided guidance to community members regarding the earthquake and the fact that it posed no tsunami threat.

Schools in Tanjung Benoa

Primary schools (SD 1 and SD 2) in Tanjung Benoa, together with Secondary School (SMP 3 Kuta Selatan) in South Kuta, had already undergone simulation exercises in how to react to earthquakes and tsunamis. At the time the earthquake occurred, many of the elementary students panicked and cried a great deal, especially children in grade 1. The teachers had also forgotten much of what needed to be done. This resulted in the students leaving their school buildings on their own initiative without receiving any formal guidance from their teachers.

The information that the earthquake carried no risk of a tsunami was communicated to SD 1 by the local facilitator, Mrs. Nengah Sutarini. At SD 2, the communications coordinator Mrs. Eka, who was not in Denpasar at the time, telephoned PUSDALOPS and obtained the information that the earthquake did not carry a tsunami potential approximately eight minutes after the earthquake had occurred. She then forwarded this information to the school's coordinator, Mr Komang. Meanwhile, at SMP 3 in Kuta, the coordinator Mr. Yudha listened out for the sound of sirens and also sought information from the television, which eventually provided confirmation that the earthquake did not have the potential to cause a tsunami.

All the three schools in Tanjung Benoa village already have reaction procedures in place if faced with an earthquake or tsunami. However, these procedures did not work despite the fact that they had on one occasion carried out simulation exercises.

Because the earthquake had no potential to cause a tsunami, the schools' principals or their deputies immediately made the decision to send their students home early. There were also a number of parents who collected their children from the schools.

3.1.3 Kuta Village

The receiving of warning information about the earthquake that did not have the potential to cause a tsunami:

One of the villages in Badung regency's pilot areas was the urban village of Kuta. At the time the earthquake occurred, none of the village's early warning staff were on duty and the head of village, Mr. I Wayan Dariyana, was attending a competition at the Denpasar Arts Centre. Members of the local community and some hotel guests began to panic, moving outside of their houses and hotels when they felt the strong earthquake. This was in contrast to the people on the beach, who carried on with their activities as normal because they had not seen any natural signs to suggest a tsunami was approaching, such as ocean tides receding.

According to one vendor at Kuta Beach, Mr. Mujiyo, the socialization of tsunami early warning information the previous year had been very beneficial. Due to the knowledge that he had acquired, he remembered what to do in the event of a potential tsunami.

The information that the earthquake had no tsunami risk was obtained from PUSDALOPS, television broadcasts and VHF radio communications, which were coordinated by local facilitator Mr. Made Dana. At the time of the earthquake, the head of village directly sought information from the local facilitator concerning the earthquake's developments.

Decision Making:

As there was no potential tsunami risk, the village head directed Linmas and the SPDT's facilitator to help provide information regarding damage caused and casualties, which needed to be collected quickly and forwarded to the Bali Province PUSDALOPS.

The dissemination of warnings that the earthquake had no tsunami potential and related guidances:

The head of the Kuta village ordered Linmas to check the latest situation on and around Kuta Beach. In this case, Mr. Made Dana, who was a member of Linmas as well as a member of the Kuta working group, immediately began to monitor the latest situation in the vicinity of the beach.

Schools in Kuta

In general, schools in Badung district, especially those in Kuta, which are in the red and yellow zones in relation to tsunami hazards, had already received socialization in tsunami early warning systems by Badung's Kesbangpol and Linmas. However, because many schools did not have evacuation plans or procedures in facing earthquakes and tsunamis, many students panicked. The same was true for the schools' teachers. A lack of knowledge about where to obtain information about whether or not there was the potential for a tsunami was also the case in many schools in Kuta.

3.2 Denpasar City

3.2.1 Denpasar City BPBD

The receiving of warning information about the earthquake that did not have the potential to cause a tsunami:

The Denpasar Call Centre in the city of Denpasar, being the technical implementation unit of the Denpasar BPBD, operates 24 hours per day and is located in the Mayor's office. At the time of the earthquake, the head of the Regional Implementation Unit (Unit Pelaksana Teknis Daerah - UPTD) was not at the office but there were four officers on duty at the time: Surata, Agus Sanjaya, Dewa Suri and Wira Sanjaya. At the moment when the earthquake's powerful tremors were felt, all the staff in the Mayor's office complex left their offices except for Dewa Suri, who stayed on inside the Call Centre. After the shaking stopped, Dewa tried to telephone the BMKG but the call would not connect. He then activated the DVB instrument that had previously been deactivated by the quake. The information obtained from the DVB included the strength and location of the earthquake and the warning that there was no tsunami risk. This information was immediately disseminated via VHF radio communication to the Denpasar BPBD network, which included the aid post on Jalan Juanda covering disaster management in South and East Denpasar; the aid post on Jalan Tjokroaminoto covering areas in North Denpasar; the aid post on Jalan Merpati covering West Denpasar; and village security agencies (Badan Keamanan Desa - Bakamdes) throughout the city of Denpasar.

Receiving facsimiles from the Bali Province PUSDALOPS containing warnings and directions proved difficult because the fax machine was located in the Santel office in the Mayor's office complex and the machine is only switched on during office hours. Information regarding warnings and guidance issued by the Call Centre are usually obtained by calling the Bali Province PUSDALOPS. Meanwhile, the Call Centre (telephone number 223333) received many calls both from people requesting information on whether or not the earthquake might cause a tsunami and those reporting damage and casualties from the field.

Decision Making:

Based on the information that the earthquake had no tsunami potential, the head of the BPBD directed personnel in the Call Centre and the four auxiliary aid posts to immediately forward the information to the Babinsa (non-commissioned military officer) in Denpasar and follow up with collating data concerning casualties and damage requiring further attention.

The dissemination of warnings that the earthquake had no tsunami potential and related directives:

The information that the earthquake posed no tsunami risk was disseminated via VHF radio and forwarded to other frequencies including the Denpasar city government's radio (91.45 MHz).

3.2.2 The Villages of Sanur, Sanur Kaja and Sanur Kauh

The receiving of warning information about the earthquake that did not have the potential to cause a tsunami:

The community in Sanur obtained the information that the earthquake would not cause a tsunami from the UHF radio communications that are connected with the BPBD in Denpasar city. From there, the SPDT facilitator and Bakamdes quickly channelled this information to the public.

Decision Making:

Because the earthquake contained no tsunami risk, the village head directed Linmas and the facilitator to help provide information about the data on damages and casualties that required urgent action. This information and data was then forwarded to the Bali Province PUSDALOPS.

The dissemination of warnings that the earthquake had no tsunami potential and related guidances:

The dissemination of information about the earthquake was carried out via UHF and VHF radio communications to the Bali Province PUSDALOPS and from there was forwarded to the radio frequencies run by the Babinsa and Bakamdes by the local facilitators.

Schools in Sanur

The 6.8 SR earthquake caused panic at a number of schools located in the Sanur area. Some schools, such as SD 3 and SD 12 in Sanur, SMP Wisata and two kindergartens that had received awareness raising exercise on earthquakes and tsunamis still panicked when the earthquake occurred. Panic also occurred in other schools in Sanur, which had not received the socialization programme.

3.3 Other institutions

3.3.1 Media

Penguin Radio 103.6 MHz

Broadcast hours: 05.00 – 24.00 WITA

Telephone: (0361) 429853 hunting (office), (0361) 429852 (studio)

info@radiopinguinfm.com

www.radiopinguinfm.com

Penguin Radio station has 15 crew members. At the time of the earthquake on October 13, 2011 all the crew frantically ran out of the building due to fears that the radio tower, which stood next to the building, would collapse as a result of the tremors. After the initial tremors had stopped and the radio tower was found to be secure, one of the crew members, Dedy Suryana, tried to obtain information about the location and magnitude of the quake from the BMKG website. It was difficult to access the website, however, because the internet connection had become very slow. A few minutes after that at 11:24 WITA, information about the earthquake's location and strength was uploaded onto the social networking site Facebook, just a few minutes after receiving a fax from the Bali Province PUSDALOPS at 11:21 WITA. The on-duty broadcaster at the time, Salty Ardiani, immediately broadcast the

information to listeners that the earthquake contained no tsunami risk together with the guidance from PUSDALOPS that had been included in the fax.

Generally speaking, if information comes in to the radio station from a clear source about important issues, such as disaster information, any crew member on duty at the time is authorised to interrupt scheduled programmes to air the news. According to one of the radio's crew members, David, it is often the case that data provided by the local government takes too long to access, as happened during this latest earthquake when the PUSDALOPS website, www.pusdalops.baliprov.go.id, could not be accessed. The crew had not tried to obtain information by telephoning PUSDALOPS directly; remembering that at the time the telephone network was not functioning.

Phoenix Radio 91.00 FM

Broadcast hours: 05.00 – 24.00 WITA

Telephone: (0361) 223199; Fax: (0361) 223393

info@phoenixradiobali.com

www.phoenixradiobali.com

At the Phoenix Radio station, there were only six crew members in the office when the earthquake occurred, while the remaining staff members were out in the field. Everyone in the office at the moment the quake hit panicked and ran out of the two-story building. According to one of the crew, Yoga Perdana, the earthquake felt very powerful with the result that they were all afraid. In seeking information about the source of the earthquake, Yoga Perdana tried to open the BMKG website but it was very hard to access.

Just after the earthquake's tremors had stopped, BMKG information regarding the location and size of the quake appeared on Twitter. None of the crew was aware at the time whether or not there was a tsunami risk and where to find information remained unclear. Only after receiving a fax from PUSDALOPS at 11:24 WITA, which contained an alert that the earthquake did not have the potential to cause a tsunami along with guidance, did the crew broadcast the information to listeners as "hottest news ". Radio Phoenix also had a number of reporters offering "live reports" so that news and events could be broadcast live along with the updated situation from the field, which could then be collated for information dissemination. For the most part, the crew members at Phoenix Radio did not have a good understanding of the tsunami early warning communication chain or the information dissemination mechanisms, starting with the BMKG, then on to PUSDALOPS and then to the public.



Photo 4: Social networking communities access info from the BMKG's Twitter account

Menara Radio 102.8 FM

Broadcast hours: 05.00 -24.00 WITA

Telephone: (0361) 410101, 414666; Fax: (0361) 411139

contact@menara-fm.com

<http://menara-fm.com>

FBI Radio 91.8 FM

Broadcast hours: Monday - Friday 09.00-17.00 WITA, Saturday 09.00-14.00 WITA

Telephone: (0361) 410101, 414777; Fax: (0361) 411 139

contact@fbifm.com , marketing@fbifm.com

<http://fbifm.com>

Menara FM and FBI radio stations share the same building. Menara FM received earthquake information via a fax from the Bali Province PUSDALOPS at 11:26 WITA, ten minutes after the quake had struck. However, almost all the crew members at Menara Radio were members of the social networking site Twitter where, five minutes after the quake, earthquake-related information was made available. According to the station's programme director, Deny, emergency information could be broadcast directly to listeners from these information sources as they were known to be accurate and reliable. In addition, members of the public and the local government could ring in to Menara Radio on 414666 to offer updates on the latest situation in the field.

At the time of the earthquake on October 13, 2011, all Menara and FBI radio staff evacuated the building as there was a radio transmitter tower on the roof of their office building.

Radio Republik Indonesia (RRI), 88.6 MHz

Telephone: (0361) 222161; Fax: (0361) 227129

RRI received the information that the earthquake posed no tsunami risk via an SMS from the chairman of Indonesian Journalist Association (Persatuan Wartawan Indonesia – PWI), Mr Bagus Ngurah Rai, who was registered with the BMKG as one of their recipients for SMS information. A fax received from PUSDALOPS was received at 11:32 WITA, 17 minutes after the earthquake occurred. The fax machine was located in the secretariat's office but at that time no personnel worked on 24/7 standby. However, the emergency information that was received by Bagus Ngurah Rai was forwarded to the radio station's announcer and all section heads at RRI.

At the time of the earthquake on October 13, 2011, information about the quake was received faster by SMS than fax. The announcer on duty immediately broadcast the information to RRI listeners.

DEWATA TV

Dewata TV is one of the local television stations in Bali. The station's crew members, such as their reporters, already had access to earthquake information via staff at the BMKG in Denpasar. At that time, the Dewata TV office received a fax from PUSDALOPS at 11:30 WITA. The fax was received by Mrs. Ayu Dewi who, at the time, was in the secretariat office. After receiving the fax, she immediately released the information on television via running text. The procedure of delivering emergency information from accountable, reliable sources involves immediately broadcasting it on Dewata's programmes or in news flashes. Obstacles faced in the event of an emergency situation are related to the time needed to disseminate information using running text, Dewata programmes or news flashes. Conveying information via running text requires personnel who are capable of editing the text to be displayed but in

such situations, the personnel needed are not always on standby. Similarly, for Dewata's programme information or news flashes, the programme to be broadcast live requires both presenters who are ready (with costume and make up) and material that can be prepared to be read within a short period of time. In an emergency situation where time is of the essence this is often difficult to achieve.

In addition to the above, broadcasters and television crew at the station did not fully understand PUSDALOPS' earthquake and tsunami dissemination format with the result that they could not comprehend all the earthquake information or the directions that accompanied the statement.

BALI TV

Bali TV is a local television station, which has easy access to the BMKG in Region III, Denpasar. At 11:30 WITA, after the initial earthquake had stopped, Bali TV carried out a televised interview with the BMKG about the earthquake that had just taken place. Also every hour, Bali TV broadcast news updates that provided up to the minute developments that were taking place in affected areas. Bali TV also employs field personnel. At the time of the earthquake, there were four journalists who continued to monitor developments in and around Denpasar, namely at the Kasih Ibu Hospital, Simpang Siur, Sun Set Road and the Nikko Hotel. These live updates provided information directly to the broadcasters who were on duty. Mrs. Puspa, a Bali TV news editor, instructed personnel to broadcast breaking news and running text as soon as she received updates from the field.

As part of its efforts to help spread the latest information, both from the public and from relevant institutions, Bali TV has its own standby mobile telephone service with the number 2074888, which can be used for emergencies and live "on air" updates from the field. This was used shortly after the earthquake, when Bali TV conducted an interview with Mr. I Wayan Suardana, SE, MM, from the BMKG in Region III, Denpasar.

3.3.2 The Indonesian Red Cross in Bali Province

The receiving of warning information about the earthquake that did not have the potential to cause a tsunami:

The Indonesian Red Cross (PMI) has a standby post in operation around the clock, with two shifts per day. The Monday to Friday morning shift (08.00 to 18.00 WITA) is carried out by one member of staff while the night shift and Saturday and Sunday shifts are manned by two personnel on each shift. The PMI post has the function of providing shelter and sharing information, both vertically (the provincial PMI forwards information to the central PMI headquarters in Jakarta) and horizontally (with relevant agencies), regarding activities conducted at the district and city levels among cross-sectoral agencies, as well as opening access to communications and information sharing among cross-sectoral agencies at the regency and city levels.

The PMI post's duty officer received information about this latest earthquake from the Bali Province PUSDALOPS via VHF radio having already tried to access the BMKG website, but to no avail. According to Diah, one of the officers at the PMI post, the BMKG website could only be accessed approximately ten minutes after the quake had occurred. Shortly after the earthquake, many people contacted the PMI for information about the quake and also to provide information about casualties and damage from the field.

Decision Making:

Mr. Winata, who at the time of the earthquake was on duty as the acting chief at PMI headquarters, ordered his staff to forward information about the quake to the other PMI offices in the regencies and cities via UHF radio on frequency 433.500. In addition to forwarding the earthquake information, Mr. Winata also sought updates on the latest developments in each regency and city.

The dissemination of warnings that the earthquake had no tsunami potential and related directives:

The dissemination of earthquake information from the Bali Province PUSDALOPS was carried out using radio communication on the 433.500 frequency.

3.3.3 Search and Rescue

The Search and Rescue (SAR) office occupies two floors in a building located on Jalan Uluwatu in Jimbaran. At the time of the earthquake, all the staff made their way out of the building and into the courtyards in front and to the side of the building. Once there, all the staff members listened to the verbal directions given to them by SAR's chief officer. The two standby communications officers on duty at the time were Dewa Made Supartha and Putu Purna Wijaya.

Information regarding the location and magnitude of the earthquake was obtained five minutes after the quake had struck via SMS from one of Dewa Made Supartha's friends, who were a staff member at the BMKG. According to procedure, this information should have been obtained from the BMKG via fax, but the BMKG fax only arrived at the SAR office at 11:27 WITA, 11 minutes after the earthquake had occurred. Efforts were made to proactively telephone the BMKG but the phone lines were busy. Immediately after the quake had stopped, the standby communications officers continued to monitor the situation via radio frequency 147.47. Using this channel, information was already being broadcast about the location and magnitude of the earthquake together with a warning that the quake did not have the potential to cause a tsunami.

Because there was no tsunami risk, the communications officers proceeded to collect data about casualties and damage to buildings and other structures. Meanwhile, phone calls came in to the SAR office on telephone number 703300 from members of the public enquiring about the possibility of a tsunami and the possibility of aftershocks. The standby communications officers informed callers that their SAR office was not responsible for providing this information and they continued to await further information from the BMKG.

In the case of an emergency situation, the chief standby communications officer should send a report to the National Search and Rescue Agency (Badan SAR Nasional – BASARNAS) and disseminate information about the situation via radio, to include the water police, the Tourist Rescue Agency (Balawista) and the SAR posts in Karangesem and Jembrana, as well as telephoning relevant agencies, as described below.

3.3.4 The BMKG in Region III in Denpasar

The BMKG in Jakarta provides earthquake and tsunami information and communicates it to local governments and the media to be followed up by local communities. The BMKG in Region III, Denpasar supports BMKG headquarters by undertaking quality control activities

in determining the earthquake's parameters and analysing a number of preliminary data. Simultaneous earthquake information is also received from the BMKG's headquarters.

The BMKG issues earthquake information and tsunami warnings from its headquarters in Jakarta to its interface institutions (the media, local governments, the BNPB, the police, SAR posts and other institutions at both national and regional levels) through a communications network called the "five-in-one". The BMKG in Region III, Denpasar, then disseminates this information to the relevant institutions in Bali that are not registered with BMKG headquarters. This information can also be accessed by the public through mass media sources, such as radio and television, the BMKG website or social networking sites including Facebook and Twitter.

At the time of the earthquake on October 13, 2011, the people who used Facebook and Twitter managed to obtain information about the earthquake relatively easily from these sites, while gaining access to the BMKG website proved more difficult. However, the existence of social networking sites and the relative ease of sending SMS messages provided the perfect opportunity for some people to circulate messages with erroneous information among Bali's residents. One such message read: *"This is to inform you there will be a third aftershock at 17:30 WIB (18:30 WITA) with a magnitude of 7.9 SR. Epicenter at 9.88 LS, 114.53 BT. Strength estimated at 7.9 SR, epicenter at a depth of 10 km off Nusa Dua, Bali, with the potential to cause a tsunami."* This message and others like it were circulated by irresponsible people.

With the emergence of these SMS messages, the BMKG office in Region III, Denpasar issued a statement (see scanned statement letter below – in Bahasa Indonesia) to counter the information that had been circulated purportedly on behalf of the BMKG.

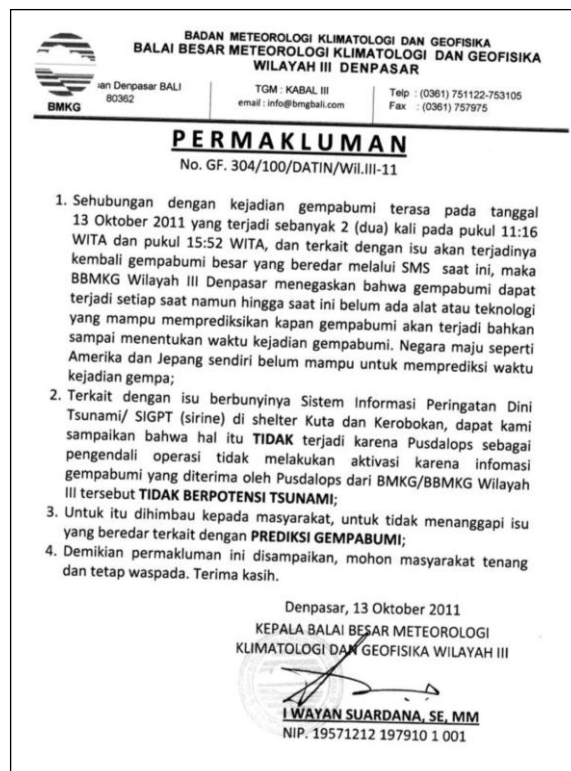


Figure 1: The statement letter from the BMKG

3.3.5 Bali Hotels Association

Earthquake and tsunami preparedness for hotels in Bali had already been introduced with the "Hotel Tsunami-Ready" scheme, which was initiated by the Bali Hotels Association (BHA). The association consists of more than 100 starred hotels across the island. The respective security and safety managers in each hotel belonging to the BHA received information by an SMS that was sent automatically a few minutes after the earthquake occurred. At the same time, the security and safety managers received a telephone call from the BHA's tsunami early warning operator, who was based in the Hard Rock Hotel in Kuta, informing them that no tsunami siren had been sounded. The BHA immediately responded by sending information to all of its member hotels. The first information release, which was sent eight minutes after the quake, stated that the earthquake had a magnitude of 6.8 SR, while the second information release put the earthquake's magnitude at 6 SR. A BHA email was then sent out to inform its members about the magnitude, depth and location of the earthquake as well as the fact that it did not have the potential to cause a tsunami. The BHA instructed its members to continue seeking update information on developments from accountable sources and to listen out for sirens. The association also instructed its members to immediately evacuate guests from their hotels should a siren be sounded.

On the whole, information about the earthquake and its associated tsunami potential was communicated smoothly within the BHA and the early warning system operator in the Hard Rock Hotel, who had the function of making available information to all the association's members, also performed well. As there was no tsunami risk, the early warning operator opted to provide this information via email to BHA members.

At the moment when the earthquake occurred, there was some panic and a few people were injured. At the same time, many of the BHA's member hotels, as well as foreign tourists and foreign governments contacted the association by telephone to enquire about the earthquake; all these enquiries were handled well.

After the BHA received the first lot of information, the association was appointed to hold an immediate press conference and issue a press release containing details about the earthquake and the current situation for both local and international media. These were implemented several hours after the quake occurred. Policies concerning the dissemination of information form an important control element, considering the BHA's entire member hotel staff had been trained in dealing with earthquakes and tsunamis.

The BHA is one collective of star-rated hotels, which has among its membership managers from 100 hotels and resorts in Bali, which together account for 15,000 rooms and almost 30,000 employees working in the tourism industry.

For further information regarding BHA security and safety initiatives, please contact:

Alexander Kesper

BHA Security & Safety Executive

alex.kesper@gmail.com

www.balihotelsassociation.com

3.3.6 Tourist Rescue Agency (Balawista)

Balawista is a rescue organisation that was formed by the regional government in Badung district. Its main task is to supervise coastal areas in order to provide (i) assistance to tourists who risk being drowned or swept away in the sea, (ii) information regarding safe areas for swimming and water sports and (iii) first aid, when necessary. Currently, the

Balawista in Kuta comprises 147 people who man 18 guard posts, the main post of which is located at Kuta Beach near the warning siren. The duty locations are situated along 63 km of coastline in Badung district.

At the time of the earthquake on October 13, 2011, the Balawista officers were dispersed to cover all 18 guard posts but there were only two personnel manning the main post. At the time the quake hit, the organisation's coordinator, Mr. I Made Suoarka, was not there. The Balawista officers were equipped with radio communication equipment used for internal communication between Balawista staff. When the earthquake was felt, officers ran out of their respective posts and saw the tourists who were on the beaches all stand up in response to the powerful groundshaking. However, people who were swimming in the sea continued to do so, as they had not felt the earthquake. Balawista officers, like Putu, saw many people who were staying in beach-front hotels come running outside when the earthquake struck but when no information about the quake was forthcoming and no sirens were sounded, most people proceeded to resume their respective activities.

The sending of earthquake information and tsunami early warnings by the BMKG or the Bali Province PUSDALOPS to Balawista is currently only transmitted via television and radio broadcasts. For radio communication, the frequency used by Balawista is not yet connected with PUSDALOPS, while the fax machine that is located in Balawista's main post no longer works. However, one of the agency's administrators, Mr. Wayan Somer, has registered his mobile telephone number to receive earthquake information and tsunami early warnings from PUSDALOPS. At this moment in time, Balawista has to rely solely on sirens and national television to obtain information regarding earthquakes that have the potential to cause tsunamis. A major concern, however, is that not all Balawista guard posts have tsunami warning sirens. Moreover, some coastal locations that are quite a distance from the main guard post do not yet have mobile phone coverage. Therefore, a radio communication device, which would connect Balawista staff with the PUSDALOPS office, is greatly needed, considering that Balawista officers are the early warning personnel closest to members of the public when they spend time at the beach.

4 Reaction towards the quake's aftershock (5.6 SR at 15.15 WITA) and the circulation of hoax SMS messages regarding a 7.9-magnitude earthquake

The public began to panic again when, five hours after the initial earthquake, aftershocks with a magnitude of 5.6 SR occurred. The panic was exacerbated by the circulation of erroneous information via SMS that many powerful aftershocks would take place. One such message read as follows:

"There is a possibility of aftershocks occurring on 13 oct 11, at 14:00 WITA, with the epicenter 9.88 LS - 114.53 BT, an estimated 7.9-magnitude quake, with a depth of 10 km, 143 km South West of Nusa Dua, Bali. There is no tsunami potential. All Bali residents are expected to remain alert. Info from the BMKG Bali! "

This message was responded to by PUSDALOPS with directions via radio and television:

"This information about aftershocks is not true and has the potential to troubles the community. Information from the BMKG states that aftershocks have already occurred several times; indeed, up to as many as six aftershocks have taken place since the initial quake through until 14:00 WITA but with magnitudes that were very low and could not be physically felt. It is not possible that aftershocks would be of greater strength than the original quake; for that reason, it can be ascertained that the information circulated was misleading. "

Shortly after the SMS was circulated, at 15:15 WITA, a second aftershock did occur with a magnitude of 5.6 SR. After the initial earthquake, some irresponsible individuals spread messages via social networking sites, SMS and BlackBerry Messaging (BBM) predicting a 7.9-magnitude earthquake in Nusa Dua, Bali, and a giant tsunami:

"This is to inform you there will be a third aftershock at 17:30 WIB (18:30 WITA) with a magnitude of 7.9 SR. The quake's epicentre will be at 9.88 LS and 114.53 BT. The strength of the quake is estimated at 7.9 SR with its epicentre at a depth of 10 km in Nusa Dua, Bali and there is the potential for a tsunami."

In response to this issue, the BMKG in Region III, Denpasar, issued a statement that was sent to the Bali Province PUSDALOPS, which in turn forwarded it to media personnel at radio and television stations.



Photo 5: Bali Province PUSDALOPS explains the issue of aftershocks

5 The Reaction after Receiving Information from the BMKG

5.1 The institutional reaction after receiving earthquake information from the BMKG along with the warning that the quake did not have the potential to cause a tsunami

Bali Province PUSDALOPS

Five minutes after the 6.8-magnitude earthquake took place on October 13, 2011, Bali Province PUSDALOPS received an official warning from the BMKG via its DVB tool, which read as follows:



Figure 2: BMKG information sent via DVB

Although the earthquake that occurred did not have the potential to cause a tsunami, this information had to be distributed according to standard operating procedures (SOPs). Personnel who were tasked with VHF radio communication immediately released the information via radio (Obed, ESR), after which I Wayan Suki and I Wayan Suparma sent faxes to private radio and television stations together with a broadcastable LED display.



Figure 3: The appearance of the LED from the location of Simpang Siur

Procedures concerning the tsunami early warning system had already been set up in cooperation between the Bali Province PUSDALOPS with the districts and cities in Bali. In this case, the dissemination of the information that the 6.8-magnitude earthquake did not have the potential to cause a tsunami and follow-up directions were circulated by PUSDALOPS via VHF radio, telephone, fax, SMS, radio and television broadcasts, and on websites and LED displays.

5.2 Public reaction after receiving earthquake information from the BMKG

Local communities received information about the earthquake from various sources: from national television media, SMS, social networking sites Facebook and Twitter, BBM, local radio and local village facilitators. Knowing that the quake did not have the potential to cause a tsunami, people calmed down and focused their attention on the possibility of aftershocks. Some hotel guests who were staying in multistory hotels chose to move to hotels that felt sturdier or that only had one floor, and were located further inland away from beaches. Meanwhile, some companies, schools, and government officials chose to send employees, students and staff home early in case there were any aftershocks.

6 Tsunami Early Warning Chain

6.1 Access to BMKG information by 24/7 services (PUSDALOPS) from local government

The challenge regarding the tsunami early warning chain is to ensure that communities in tsunami-prone areas receive official warnings and directions in a timely manner. As we already know, the earthquake that occurred on October 13, 2011, caused the mobile phone network to crash and an exponential increase in landline telephone usage in affected areas. In spite of such challenges, a warning dissemination system must remain functional.

In preparing for tsunami early warning dissemination in Bali, six sirens were installed - five in Badung district and one in the city of Denpasar. These sirens can be activated remotely by the Bali Province PUSDALOPS. Moreover, the sirens can emit sounds and/or verbal announcements or directions regarding whether there is a threat of a tsunami or not. In addition, PUSDALOPS also has an LED information system.

The Bali Province PUSDALOPS already operates around the clock. In Badung district, the Rapid Response Team (TRC) that operates 24/7, and the BPBD in the city of Denpasar and its Call Centre also operate 24/7. All personnel that have been assigned to work in shifts to cover a 24-hour period must, according to their procedures, take prompt and proactive action in seeking warning information from the BMKG, including via the internet, phone, SMS, radio broadcasts, HT, television, DVB, amateur radio, Facebook and Twitter. The TRC in Badung district, however, does not yet have earthquake and tsunami SOPs in place.

6.2 Decision making at the local level

The Bali Province PUSDALOPS is already well-established as part of the tsunami early warning system. In taking decisions, all personnel followed procedural steps in reacting to earthquake information. Before disseminating the information, all personnel followed the existing procedures, as too did the BPBD in Denpasar, which in this case was operated by the Call Centre. The exception was the BPBD in Badung district that does not yet have SOPs, so there is as yet no definite procedure on how to receive and distribute earthquake and tsunami information to the general public.

This was the first time that Badung district and Denpasar city had faced a powerful earthquake. Also, in the past there was an early warning system network from the Bali Province PUSDALOPS, which was very different in terms of coordination compared with what is now in place. Now, information is channelled directly from PUSDALOPS as the central controller, along with procedures and measures that are consistent in reacting to earthquakes, but all of these methods are still being tested.

In Badung district, for example, this 6.8-magnitude earthquake caused panic among rapid response staff as to what needed to be done. The regency's BPBD office had only recently been established and its personnel were still in the process of becoming familiar with their respective tasks, duties and functions. At the time the earthquake occurred, the TRC focused more on gathering data about the number of casualties and damage caused by the quake rather than on disseminating information, which was not prioritised; although it was the case that the earthquake did not have the potential to cause a tsunami.

6.3 Directions from regional government to communities at risk in the tsunami early warning system along with procedures for the general public

When people felt the strength of the earthquake, they were asked to immediately evacuate to safe places while waiting for directions from the local government. The authority of the governor in the tsunami early warning system was delegated to staff at the Bali Province PUSDALOPS, who set about analysing information based on their SOPs and a map of reference, after which they proceeded to disseminate the information. Based on information from the BMKG, the quake contained no risk of a tsunami; the PUSDALOPS duty officers immediately disseminated this information in accordance with their SOPs.

It should be noted that during the occurrence of this earthquake, the most effective means of dissemination was via VHF radio communication and electronic media outlets, such as television and radio. Phone lines and mobile phones could not be used because of overload, while dissemination via fax was not effective due to technical issues on the part of recipients and difficulties for PUSDALOPS staff, who had to enter individual pieces of information about the earthquake and then send them to various destination numbers.

In terms of local communities safeguarding themselves when faced with an earthquake, they need to be directed by the local government after the latter has received information from the BMKG. The Bali Province PUSDALOPS already possesses communication tools to widely disseminate earthquake and early warning information and to direct people to evacuate, if necessary. This is also the case with communities at risk: they should have a communication device or devices that can receive warning information from PUSDALOPS. Public safety depends on the preparedness both of regional work units (SKPD) and the communities themselves, so that reaction to earthquakes and tsunamis in the region can be improved.

A tsunami early warning system relies on local authorities assuming their responsibilities as decision makers in order to evacuate people as and when necessary and to guide local communities in their respective regions when faced with natural disaster threats. In the long run, therefore, it is crucially important that BPDB staff in Badung district and in Denpasar thoroughly understand the SOPs and be able to make appropriate decisions in order to determine whether to call for an evacuation or not. Information derived from different sources is an indication that people do not have direct access to the early warning system information as issued by the government.



Photo 6: A teacher checks her hand phone for earthquake information via SMS



Photo 7: Students still in shock following the earthquake

7 Lessons Learned

The earthquake that occurred on Bali in October 2011 provided a valuable opportunity for all parties involved to gauge people's capacity in terms of their levels of preparedness in general and, in particular, to evaluate how they reacted to the threat of a potential tsunami. Here are some important points related to the earthquake:

NO.	INSTITUTION	LESSONS LEARNED	NOTES & RECOMMENDATIONS
1	Communities	<ul style="list-style-type: none"> • Those who had already received some awareness raising exercises about earthquakes and tsunamis were able to react appropriately when the earthquake occurred and they knew where to seek further information. • VHF and HF radio were more effective means of communication for receiving accurate information about the earthquake and whether or not it contained a tsunami risk. • Community social networking sites, such as BBM, Facebook and Twitter were utilised by many people to obtain information about the earthquake and potential tsunami threat. There were virtually no hindrances in circulating messages. • Communication instruments in villages were useless unless equipped with personnel on a 24/7 basis. 	<ul style="list-style-type: none"> • There is a need to increase public awareness activities related to earthquake and tsunami hazards. • Communities are not yet proactive in seeking earthquake information - most people tend only to wait for information. If these activities are implemented, they will enable people to obtain information in a timely fashion so that they can make their own decisions as to whether to stay or evacuate. • Telephone lines became overloaded shortly after the quake occurred. • Information about aftershocks and a potential tsunami – much of it inaccurate - that circulated quickly via social networks, such as BBM, Facebook, and Twitter, caused unnecessary panic among the public. • In some cases, communication tools were not active during the quake as they tended to be used only on an occasional basis.
2	Media (television and radio)	<ul style="list-style-type: none"> • National television was an effective means of providing information, not only for people in Bali but also across Indonesia. • Almost all radio and television crews did not know the dissemination format used by PUSDALOPS and they forgot the steps that should be carried out when they received warning information about the earthquake and tsunami risk. 	<ul style="list-style-type: none"> • Local television media experienced difficulties in preparing breaking news stories and displaying running text. • Bali Province PUSDALOPS should ensure there is greater communication of the tsunami early warning system among media personnel and a better understanding among them of the various dissemination formats. • There are no local radio stations that broadcast around the clock.

NO.	INSTITUTION	LESSONS LEARNED	NOTES & RECOMMENDATIONS
		<ul style="list-style-type: none"> • Some radio and TV stations received earthquake information via fax from the Bali Province PUSDALOPS 10 minutes after the quake had occurred. • Some crews, reporters and journalists from radio and television do not understand the processes involved in a tsunami early warning system. Shortly after the earthquake struck, many journalists and reporters descended upon PUSDALOPS, which caused a disruption to service personnel, who ended up trying to answer reporters' questions rather than being left to focus on their work. 	<ul style="list-style-type: none"> • The fax machine used by several radio and television stations is located in the secretariat office and is not operational on a 24/7 basis. • There is a need for disaster training for media personnel as well as regulations in governing access to disaster information at PUSDALOPS. • The PUSDALOPS and local government websites, www.pusdalops.go.id and www.balisafety.baliprov.go.id, which can be accessed to obtain disaster information, need to be widely disseminated. • Radio and television broadcasters and staff are not familiar with the dissemination format used by PUSDALOPS; in one case, even mistakenly thinking a fax from PUSDALOPS had been sent by the BMKG.
3	Schools	<ul style="list-style-type: none"> • Almost all students and teachers at schools in affected areas panicked and forgot what to do when the earthquake occurred. • Designated teachers in schools that had already been familiarised in earthquake and tsunami procedures did not all perform the necessary tasks when the earthquake struck. • A number of injuries were sustained by school children in several schools: State Vocational School (SMKN 2) in Denpasar (17 students and 2 teachers); SD 8 in Dauh Puri; SD 24 in Dauh Puri; and SMP 1 in Ubud. 	<ul style="list-style-type: none"> • Awareness raising exercises and simulations need to be carried out on a regular basis so that the entire school community can react appropriately to earthquake and tsunami information.
4	BPBD and PUSDALOPS	<ul style="list-style-type: none"> • Bali Province PUSDALOPS is already able to receive warnings from the BMKG five minutes after an earthquake occurs. Its various communication tools are fully 	<ul style="list-style-type: none"> • The need to prioritise the delivery of earthquake information to the media and relevant institutions is not yet clearly understood.

NO.	INSTITUTION	LESSONS LEARNED	NOTES & RECOMMENDATIONS
		<p>functional and its personnel are well-trained in managing earthquake information dissemination procedures.</p> <ul style="list-style-type: none"> • The Badung district BPBD does not yet have procedures in place when dealing with earthquakes. When this earthquake struck, all its employees panicked and hastily exited the three-story building, including members of the TRC, which is located on the first floor. • The Badung BPBD does not yet have SOPs concerning earthquakes and tsunamis. • TRC personnel, who are relatively new to their jobs, have not been fully trained in receiving earthquake information from PUSDALOPS and knowing how to deal with it in accordance with procedures. • The TRC received earthquake information from PUSDALOPS via VHF radio. • The Call Centre at the BPBD in Denpasar is connected with Bakamdes and the Babinsa in Denpasar via UHF Radio. 	<ul style="list-style-type: none"> • Constraints were experienced using the fax machine due to the length of time taken to enter each piece of information separately and then sending to various recipients on different numbers. • Obstacles were also faced when ringing telephone numbers with answering machines or operators. In these cases, disseminating information took a long time. • PUSDALOPS was not able to handle the volume of telephone enquiries to its office for a short while following the earthquake. • There is a need for training and simulations among TRC members of earthquake- and tsunami-related SOPs. • Radio RPKD is not on air around the clock. Its broadcasts end at 23:00 WITA each evening.

8 Conclusion

The 6.8 RS earthquake that occurred in the south of Bali on October 13, 2011, provided valuable lessons to all levels of civil society and relevant agencies in facing an earthquake that may have the potential to cause a tsunami. This earthquake made people aware of the crucial importance of possessing knowledge about earthquakes and tsunamis, especially for those people who live in coastal areas. Knowledge alone, however, is not enough; regular exercises and simulations regarding agreed procedures are also important, given the fact that this earthquake made a number of people panic and caused some of them to forget what they needed to do to increase their safety. Regular exercises and drills would help to ensure that people would remember the necessary steps to take in such circumstances.

So, too, with the relevant agencies; there are still many things that need to be re-evaluated, as several agencies lack a thorough understanding or, in some cases, SOPs governing reaction and response to earthquakes and tsunamis. Moreover, some agencies and institutions do not yet know how to accurately read earthquake information or how to disseminate it to the general public. This means that an understanding of community preparedness when faced with early warning processes is not fully comprehended by many involved in disaster risk reduction; whether from the designers of early warning dissemination mechanisms to those formulating warning messages and the information necessary to meet the needs of the system's end-users, namely those communities at risk.

Early warning in Bali is not fully effective because individual agencies and institutions lack the necessary knowledge and/or fail in carrying out their responsibilities. Added to which, they are often unaware of the roles played by other actors associated with local agencies that are assigned as regional earthquake and tsunami early warning centres.

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