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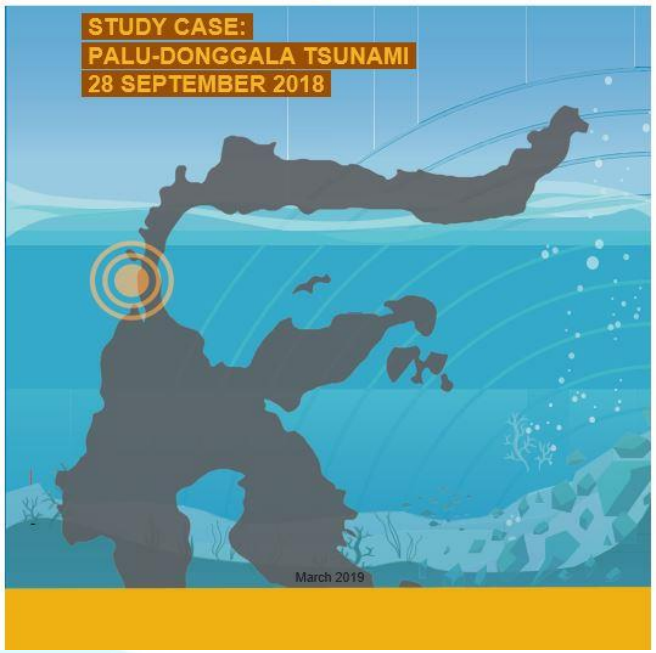
UNDRR

LIMITATIONS AND CHALLENGES OF WARNING SYSTEMS IN SAVING LIVES



Lessons Learnt from Near-field Tsunami Based on the Community Response Palu Tsunami

Task Team Tsunami Preparedness Near-Field Tsunami Hazard
22 – 23 August 2022

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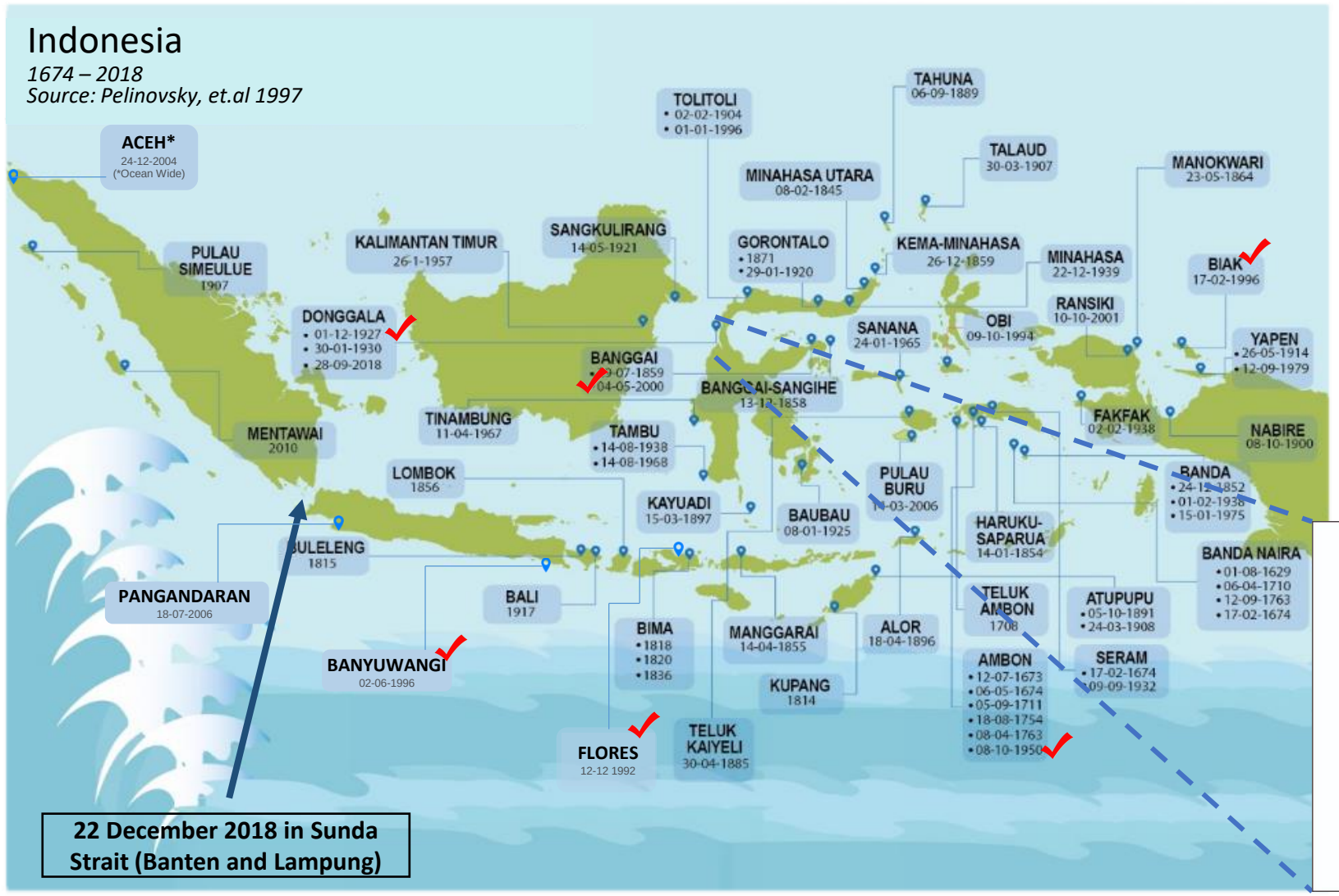
History of Near-field Tsunamis in Indian Ocean

Hazard and Risk Knowledge

Indonesia

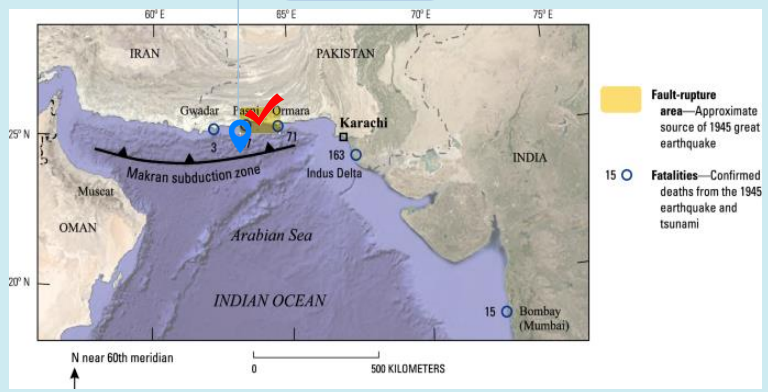
1674 – 2018
Source: Pelinovsky, et.al 1997

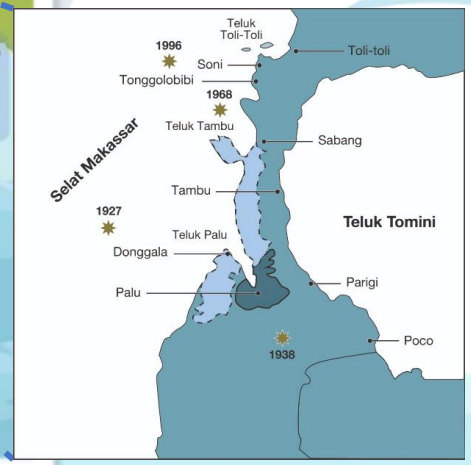


22 December 2018 in Sunda Strait (Banten and Lampung)

Northwestern Indian Ocean

MAKRAN
28-11-1945





28 September 2018 in Palu and Donggala

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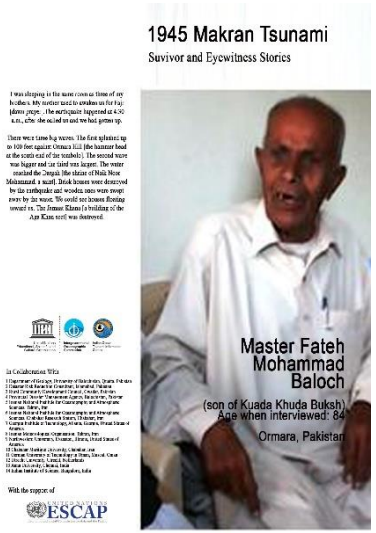
History of Near-field Tsunami Sources in Indian Ocean

Documentation of Eyewitness and Survivors of Near-field Tsunamis

2015

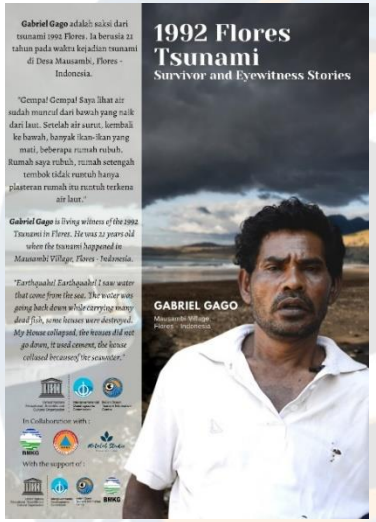


1945 Makran Tsunami
38 videos

2016

1950 Ambon Tsunami
28 videos

2018

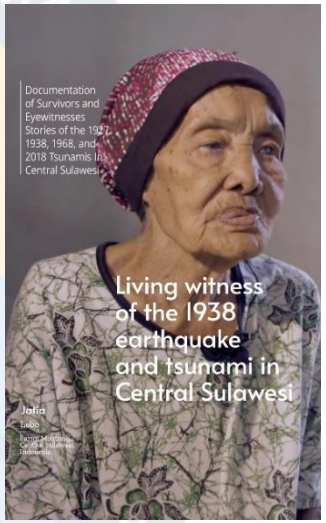


1992 Flores Tsunami
45 videos

2019

1994 Banyuwangi Tsunami
46 videos

2020



Central Sulawesi Tsunamis (1927, 1938, 1968, 1996, 2018)
30 videos

2021

1996 Biak Tsunami
60 Videos

2022

2000 Banggai Tsunami
72 Videos

319 of Past Tsunamis Eyewitness Stories

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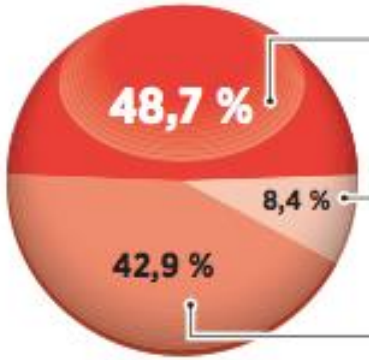
BENCANA MASIH DIPANDANG SEBAGAI TAKDIR

Cara Pandang Responden terhadap Bencana Alam



- **Cenderung Tradisional** (berpandangan bencana semata-mata takdir yang tak terhindarkan)
- **Cenderung Rasional** (berpandangan risiko bencana bisa diminimalisasi jika ada kewaspadaan dan persiapan)
- **Antara Tradisional dan Rasional**

Kesadaran Publik Hidup di Daerah Rawan Bencana

(dalam persen)

	Sadar hidup di daerah rawan bencana	Tidak sadar hidup di daerah rawan bencana
1. Banda Aceh 1*	60	40
2. Banda Aceh 2*	34	66
3. Kota Yogyakarta	26	74
4. Sleman	62	38
5. Padang	80	20
6. Palu	35,5	64,7
7. Bengkulu	80,2	19,8
8. Karangasem (Bali)	38,4	61,6

*) Keterangan:
Banda Aceh 1= daerah yang terkena tsunami
Banda Aceh 2= daerah yang tidak terkena tsunami

Sumber: Litbang Kompas

Kompas Research 2011

communities' awareness and acceptance on **risk**

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Areas hits by Tsunami

Bappeda Palu (Urban): Death in Palu (death and missing) 3.679 persons, ±**1.252 caused by tsunami** the remaining due to EQ and liquefaction.

BPBD Donggala (Rural): Death in Donggala (death and missing) 212 person, **48 caused by tsunami**

Images Source:
Hamzah Latief

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Chronology Upstream and Downstream

28 September 2018

Earthquake of 5.9 Mw — **15:00 WITA**

15:00 WITA — Earthquake felt by people in Donggala and Palu

Many received SMS blast of BMKG EQ Information (Ministry of Communication and Information)

Communities in Labean villages evacuated to the hills

Earthquake of 7.7 Mw — **18:02 WITA**

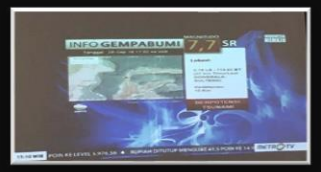
18:02 WITA — Strong shaking and difficult to stand still

18:04 WITA — Electricity and Communication cut off in Donggala and Palu

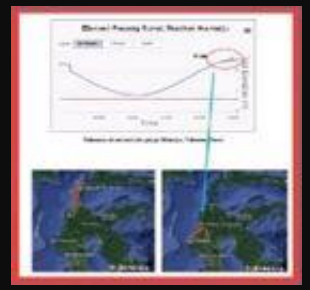
BMKG Bulletin 1
Advisory in Palu and Warning in Donggala — **18:07 WITA**

18:06 WITA — Tsunami Arrives in Wani (based on CCTV of Mr. Andi)
➔ 3 min 46 sec after the EQ

TEWS Breaking News in Metro TV — **18:10 WITA**



Tsunami hits Palu coast
Estimated 18:10 – 18:13



6 cm Tsunami observed in Mamuju tide gauge (±300km South) — **18:27 WITA**

BMKG Bulletin 4
End of Warning for the 7.7 EQ in Donggala — **18:36 WITA**

Tsunami hits Palu coast videos went viral in Social Media

BMKG

Main findings

Early Warning System

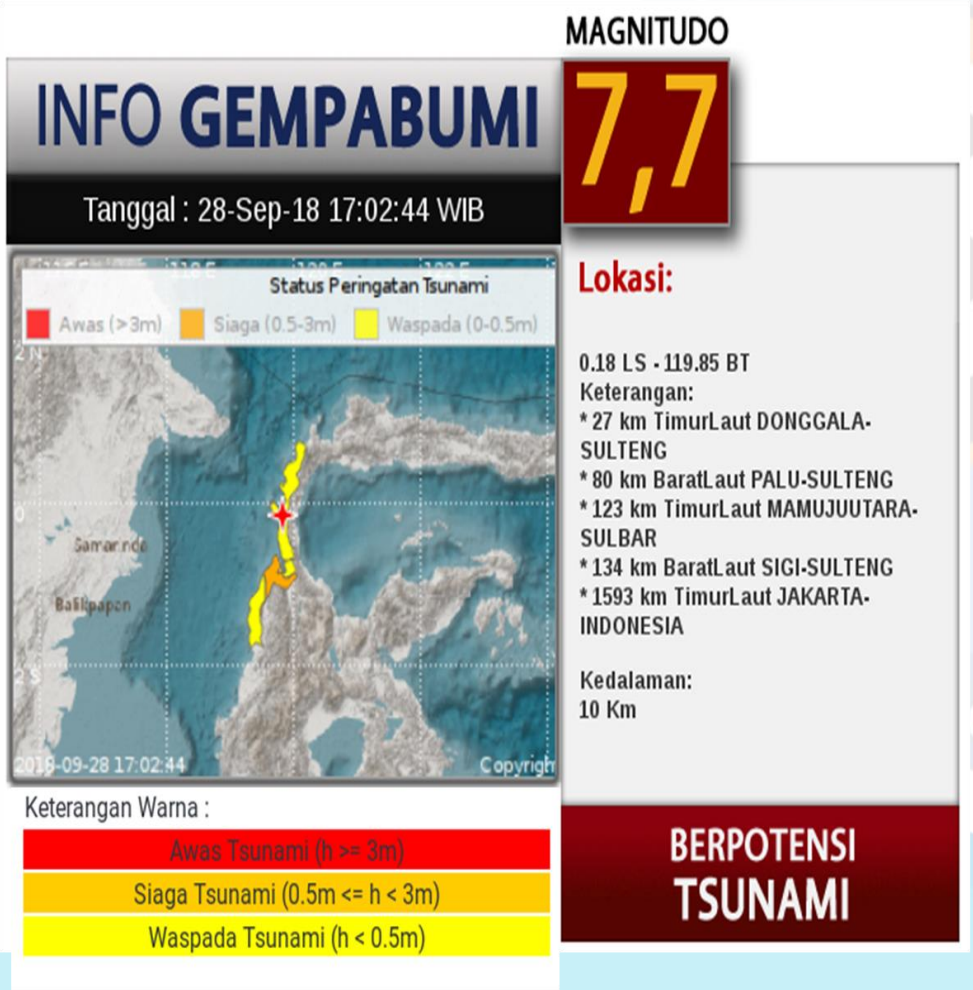
- Limitations of the Existing Tsunami Early Warning System
- Tsunami Early Warning Chain Failure
- False Sense of Security - TEWS

Risk knowledge and education

- Self-Evacuation is the Key to Safety
- The Importance of Internalizing Experience and Local Knowledge
- Preparedness, Awareness, and Education Must Be Based on the Characteristics of Local Threats
- Importance of Evacuation Plans and Routes

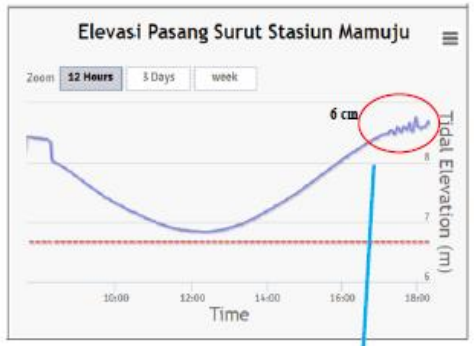
Limitations of Existing Tsunami Early Warning System

1. The Cause of the Tsunami can not be Detected by the Current System*

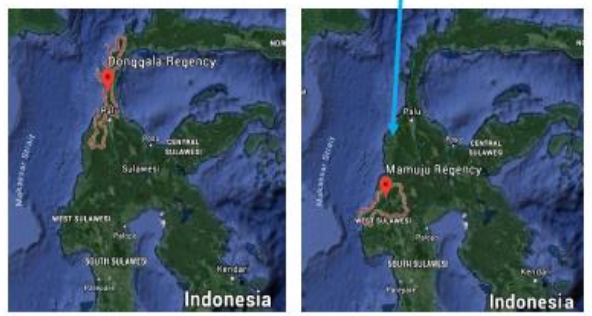


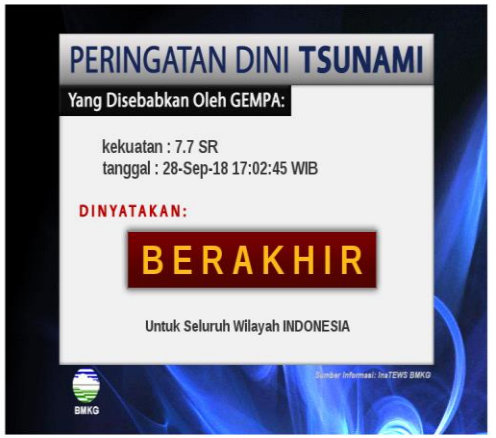
Monitor and detect tsunamis caused by the tectonic EQ events

** Experts reported / suspected the tsunami source was several submarine landslides very close to the coast which caused a very local tsunamis and the first tsunami arrives in very short time*



Rekaman observasi tide gauge Mamuju, Sulawesi Barat





Images courtesy of BMKG

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Limitations of Existing Tsunami Early Warning System

2. The first wave arrives in minutes, earlier than the warning*

The 7.7 Mw EQ
18:02:44 WITA

~ 3' 46"

CCTV of Mr. Andi's House in Wani

Images Source:
Hamzah Latief

* *Experts reported / suspected the tsunami source was several submarine landslides very close to the coast which caused a very local tsunamis and the first arrives in very short time*

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Limitations of Existing Tsunami Early Warning System

3. The first wave arrives in minutes, earlier than the warning

- The land collapsed to the sea
  In the coast of Palu (Pantai Talise) and Tanjung, Donggala, the land collapsed to the sea as the earthquake happened and the water came immediately

"… I was on the quay in Talise Beach, preparing my vendor stall for the Festival, I felt the afternoon EQ (15:00) and I had bad feeling about it, but I decided to stay. As the evening EQ (18:00) happened the quay where I was on collapsed, I fell into the sea. I struggled to stay afloat but the wave kept on pulling me down, I felt like I am inside a blender being spin around under water. Suddenly I was pushed up to the surface and able to hold on to a plank around my neck. I was then drifted to a fallen tree where I can climb. I hold on there until somebody helped me…."
Tsunami Survivor, Kelurahan Tipo, Kecamatan Ulujadi

"…there was no sea water receded, in this area, all the houses just collapsed, sunk into the sea and the water came at the same time…"
Tanjung Batu Village, Donggala

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Tsunami Early Warning Chain Failure

4. Lack of capacity at the local disaster management office on Tsunami Early Warning System

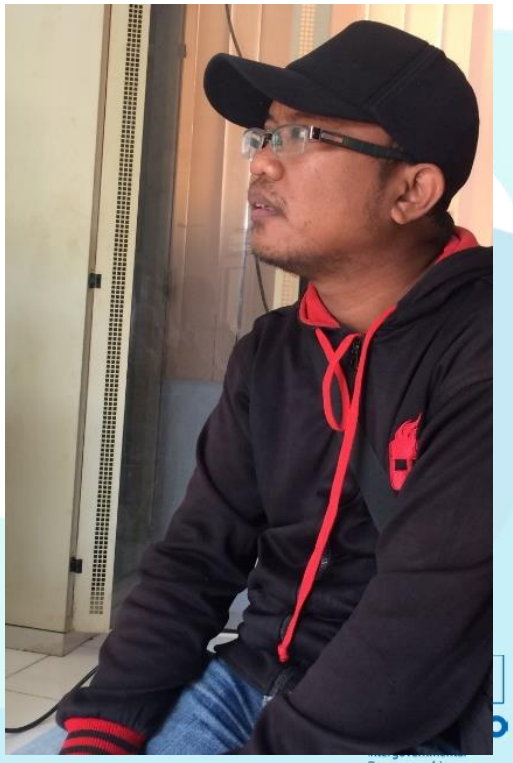
- Dissemination of warning from Upstream to Downstream failed
- There is no local SOP for TEWS ➔ no decision-making procedures
- Lack of knowledge of TEWS products
- The agreed Palu City Contingency Plan (2012) was not implemented (might be due to change of government)
  - Lack of DMO human resource capacity (focus only on respond)
  - Government Regulation no 21 (2008) constructed a longer warning chain for decision making that caused “golden time lost” for evacuating people at risk.

BPBD Kota Palu, 24/7 EOC on duty personnel

“…. I have worked in BPBD for 10 years but I have not received any training on the Warning Receiver System (WRS)…”

“… we have siren, but do not test this anymore (the 26th every month), we also turned the volume down to avoid panic…”

“… I did not think of sounding the siren, the electricity was cut off and I ran after the earthquake…”



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False Sense of Security

5. Siren that will not safe people at risk

There is only 1 Siren installed in Palu,

Photo Yusuf Radja Muda, November 2018

Photo Neni Murdani Oct 2018

- Some believes having this siren protected them from the tsunami.
- The coverage will not reach people at risk in the coastal area of Palu City
- It has not been used for several months and the volume was turned down
- No activation protocol / procedure during emergency
- People do not understand what is the siren for

"… I use to hear the sound every month but I did not pay attention and do not know what it is for, I do not think I heard it in these last few months"

"… I have been here for almost a year but I never heard the sound of siren, I did not know there is a siren here"

False Sense of Security

6. Tower that is not a Siren

- Lack of knowledge on tsunami siren (a telecommunication tower believed as tsunami siren)
- People believe having this siren they are safer from tsunami
- People waited for the siren to take action ➔ local tsunami

"…we were told that this is a tsunami detection tower by the people who constructed this tower. All of us (people in the village) knew this as tsunami siren tower. On that day we waited for the siren but there was no sound. A few days after the tsunami, the maintenance person came and said the siren does not triggered because BMKG already lifted up the warning…."

Self evacuation is the key to safety

7. Early Self Evacuation (Labean, Sirenja, Batusuya)

Many of the rural communities evacuated after the 5.9 Mw Earthquake at 15:00

- Knowledge about past tsunami (1968)
- Previous intervention

Eyewitness of 1968 tsunami
"…after that (earthquake felt at 15:00) we evacuated to the hill with the children."

Designated village disaster management personnel
"…after the shakking (EQ at 15:00), I told everybody to run, many evacuated to the mountain (hill). Even my children and grand children went to climb the mountain. I told them to bring few clothes, food, and the (already) ripped tent..."

The Importance of Internalizing Experience and Local Knowledge

8. Local Knowledge that save lives, (and not…)

Many of the rural communities (Donggala) know about past tsunami events (1938 and 1968)

➔ there are still eyewitnesses of the 1968 tsunami in Donggala.

Local languages for tsunami from past events:

Kaeli tribe:

- **bulumba bose (Big waves)**
- **bulumba latollu (Three waves)**

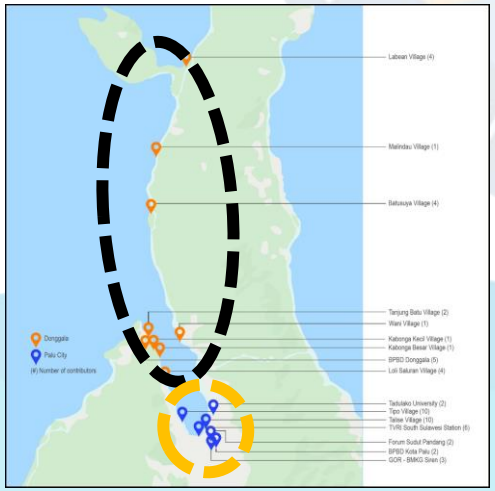
Mandar tribe:

- **lembo talu (Three waves)**

Bugis tribe:

- **bomba tellu (Three waves)**

- Although most of the eyewitness in Palu have heard of past tsunamis (1938 and 1968), many of them considered this as story from the past that will not happened again.
- Many believe with all the advancement of technology, tsunami will not happen in Palu
- Experience of the 6.8 Mw 2005 EQ, where there was no tsunami, they considered that Palu Bay is safe from Tsunami



Experienced 3 tsunamis in a lifetime 1938 (he was 8 years old), 1968 and 2018

The Importance of Internalizing Experience and Local Knowledge

9. Natural signs that trigger actions

- Many people on the coast saw strange phenomenon at the sea that trigger them to evacuate from the beach
- Strange behavior of animals (Cows, Goats, and Cats) direct the people to evacuate

"… I was working on my boat when the earth shook when I looked at the sea I saw bubbles on the surface looks like the water is boiling. Short after, I ran and telling people to also run, then the wave came, I continued to tell people to run as I remembered about the three waves. The tsunami destroyed my children's house"

Nurdin (46)
Loli Saluran Village, Banawa Sub district, Donggala

"…I was doing my ablution, preparing for the Maghreb prayer, when I felt the earth shook. I ran outside to the street, then I saw all the goats running across the street to the hills, also all the birds fly away from the mangrove trees behind my house. The goats ran while the earth was still shaking, after the shaking stops I heard people running from the coast yelling the sea water is rising !!"

Suhardin (37)
Kabonga Kecil Village, Banawa Sub district, Donggala

"…while it (the earth) was shaking I tried to go out from the house. I can barely stand, then I saw the cows running away from the coast along the street in front of my house. I started to run along with them and was almost stamped down by these cows!"

Eli (63)
Labean Village
Sub district, Donggala

Preparedness, Awareness, and Education Must Be Based on the Characteristics of Local Threats

10. Education versus Reality

- Most people in Palu city were convinced that Palu bay is not facing tsunami threat
- Education materials was based on 2004 Aceh Tsunami does not correspond to local threat
- Tsunami started with the sea water receded
- In Exercises the lead time for tsunami to arrive in Palu is around 20-30 minutes *
- No public knowledge of other potential source of tsunamis
- Tsunami Drills always started with siren
- Siren will be activated when tsunami occurs

* This was based on tsunami drill exercise where the scenarios is based on tectonic EQ outside the Palu bay. This scenario is adopted in the Palu City Contingency plan

"…there was no sea water receded, in this area, all the houses just collapsed, sunk into the sea and the water came at the same time…"
Tanjung Batu Village, Donggala

"…. this must be a false tsunami. There's no siren. No water receding. We thought this is just a hoax… what happened was different than what we learned 6 years ago…"
A youth group for disaster preparedness that was trained in 2012

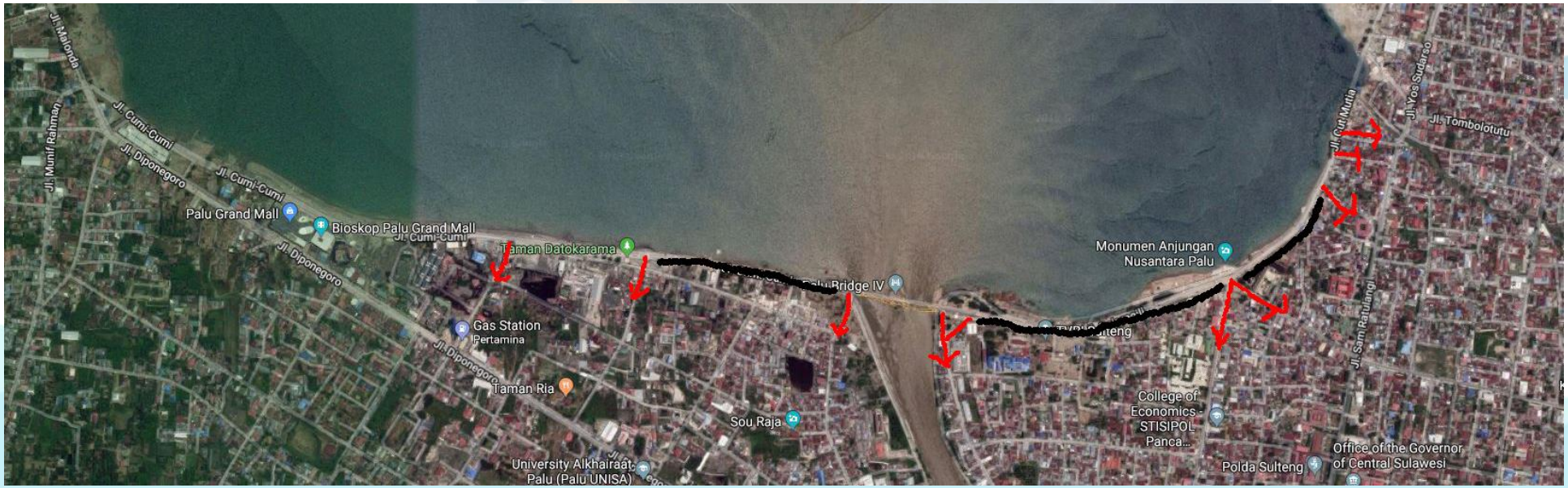
Importance of Evacuation Plans and Routes

11. Access for evacuation

Palu:
Death caused by tsunami ± 1.252 lives.
Urban area, access inward from the coast was obstructed by buildings, walls, and fences

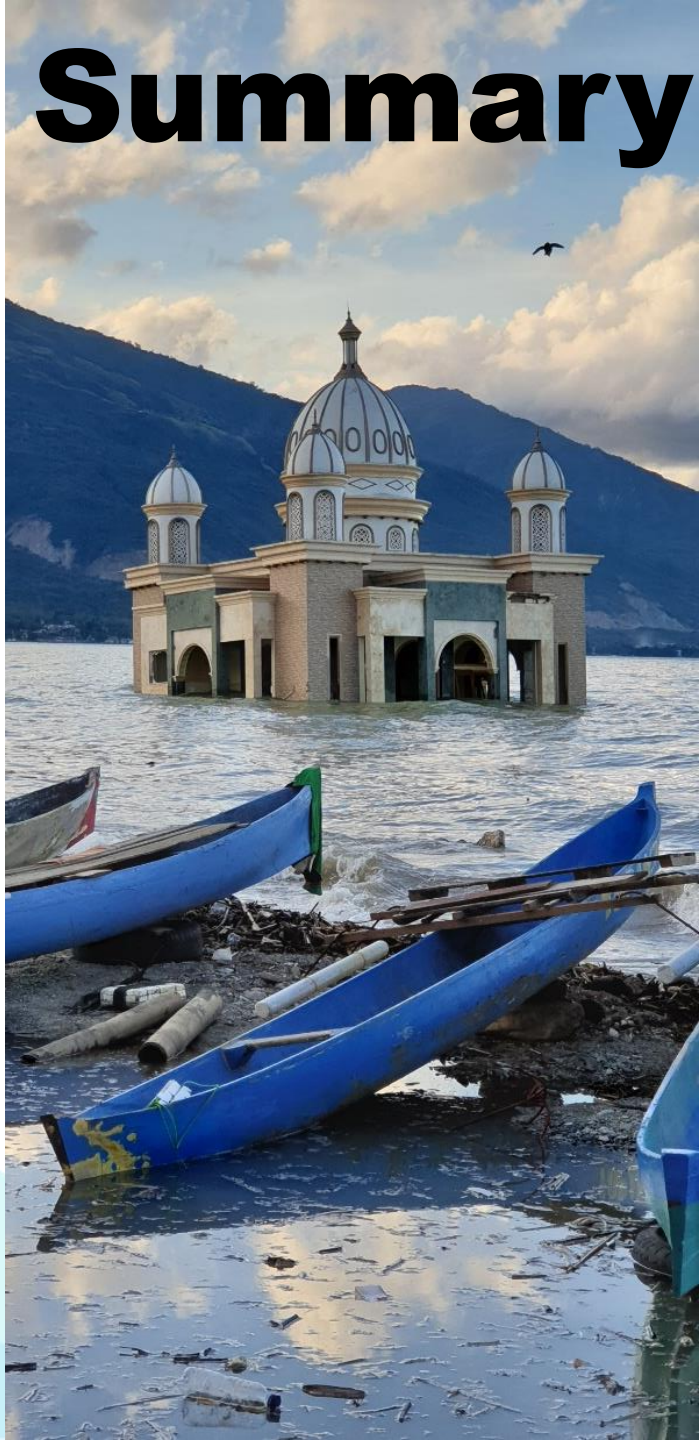
"…there was the 2018 Palu Nomoni Festival, people already gathered in Palu coast preparing for the festival, after the earthquake and the water came people ran but could not go inward, they have to run along the coast, or, they have to climb the fence and walls, I managed to jump over the wall as the water arrives, but many could not, mostly women and children…."

TVRI Employee, Palu



Summary

- Hazard knowledge and risk understanding need to be understood by all people living in tsunami risk area.
- Local knowledge need to be capitalized to educate local community on tsunami hazard, risk understanding, early warning, as well as action for response/ to save live.
- Education, awareness, and preparedness need to be prioritized given as a high urgency (all over the country, especially areas with high tsunami threat).
- Self Evacuation Protocol is the key to survive local tsunami, especially with a very short lead time.
- End to End Tsunami Early Warning System need to starting from and focusing on the downstream part.
- Simplify the Warning Chain and decision making process



Thank you

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