

# Lessons Learned from Palu Tsunami Assessment on the Last Mile's Response



**Ardito M. Kodijat**  
**UNESCO IOC IOTIC**



# UNESCO

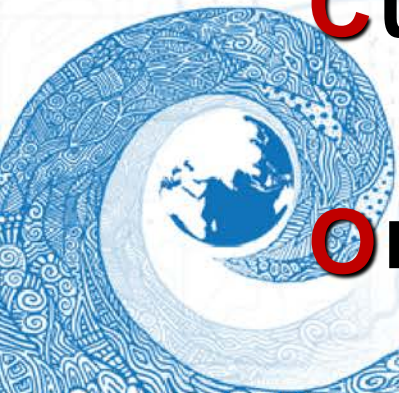
**U**nited  
**N**ation  
**E**ducation  
**S**cience  
**C**ulture  
and **C**ommunication  
**O**rganization



Building Peace in the  
Mind of Men and Women



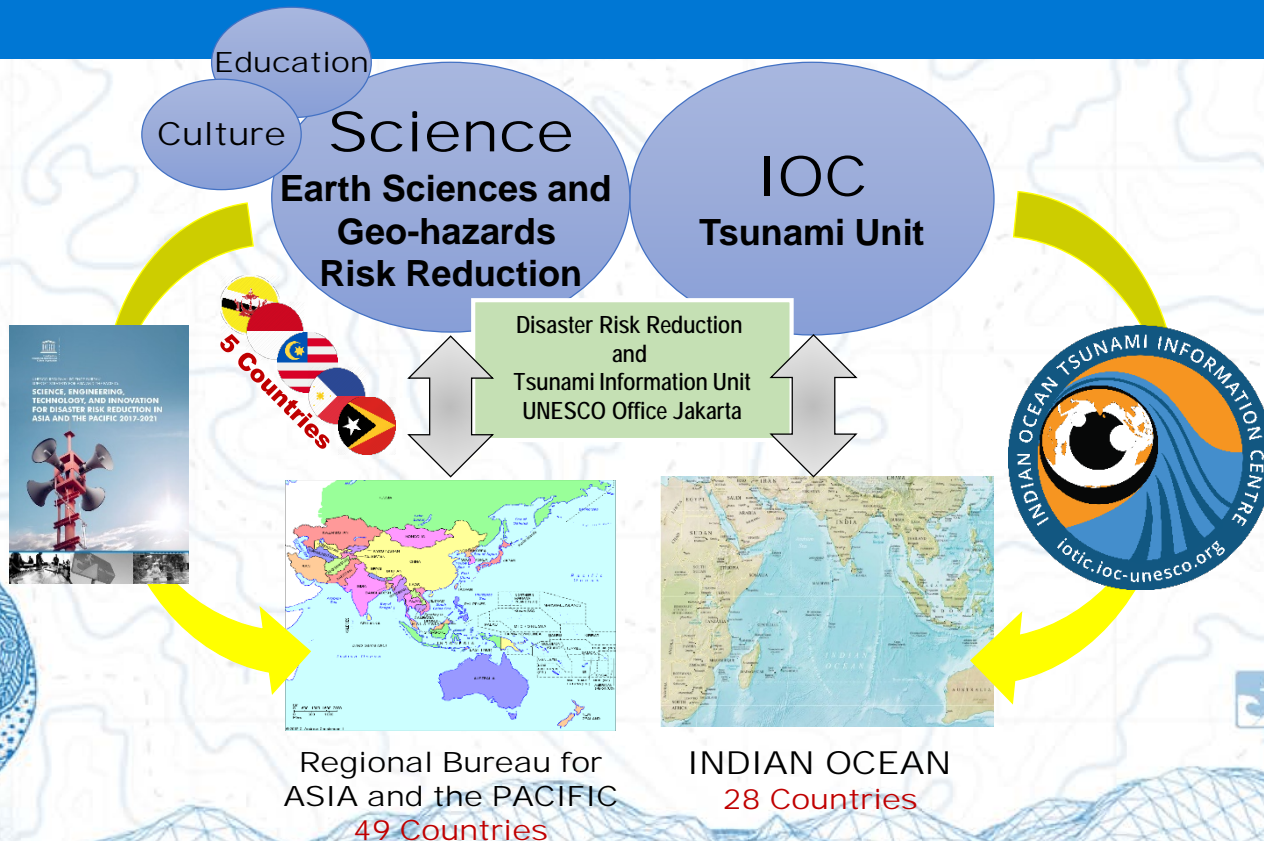
Contribute to  
peace and human  
development  
through education  
science, culture  
and  
Communication  
Information





United Nations  
Educational, Scientific and  
Cultural Organization

# DRR in UNESCO Jakarta





United Nations  
Educational, Scientific and  
Cultural Organization

# DRRTIU and the Global Frameworks

## Sustainable Development Goals



## Sendai Framework for Disaster Risk Reduction

### 1 OUTCOME

The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

### 1 GOAL

Prevent and reduce loss-of-life disasters through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazardous exposures and vulnerability to disaster, increase preparedness for response and recovery, and foster stronger resilience.

### 4 PRIORITIES

Understanding disaster risk	Strengthening disaster risk governance to manage disaster risk
Investing in disaster risk reduction for resilience	Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction

**(i) Understanding disaster risk;** **(ii) Strengthening disaster risk governance to manage disaster risk;** **(iii) Investing in disaster reduction for resilience** and; **(iv) Enhancing disaster preparedness for effective response,** and to **"Build Back Better" in recovery, rehabilitation and reconstruction.**

### 7 TARGETS

- ↓ DISASTER MORTALITY BY 2030
- ↓ NUMBER OF AFFECTED PEOPLE BY 2030
- ↓ ECONOMIC LOSS BY 2030
- ↓ INFRASTRUCTURE DAMAGE BY 2030
- ↓ DR NATIONAL/LOCAL STRATEGIES BY 2030
- ↓ INTERNATIONAL COOPERATION BY 2030
- ↓ EWS AND DR INFORMATION BY 2030



## Comprehensive School Safety Framework



STEP - A

**UN Decade on Ocean Science 2021-2030**



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# Indian Ocean Tsunami Information Centre

## IOTIC of IOC – UNESCO / UNESCO Office Jakarta



United Nations  
Educational Scientific and  
Cultural Organization



Intergovernmental  
Oceanographic  
Commission



**BMKG**



**INDIAN OCEAN TSUNAMI  
INFORMATION CENTRE  
PROGRAMME OFFICE**

[iots-sec-unesco.org](http://iots-sec-unesco.org)  
[www.iotsunami.net](http://www.iotsunami.net)  
[www.iotsunami.info](http://www.iotsunami.info)  
[www.iotsunami.org](http://www.iotsunami.org)



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The IOTIC is an IOC UNESCO entity housed in UNESCO office Jakarta that serve to support the Indian Ocean member states in capacity building, education, awareness and preparedness for an effective tsunami warning and mitigation system in the region.



# TANTANGAN BAGI PERINGATAN DINI YANG MENYELAMATKAN JIWA

STUDI KASUS  
TSUNAMI PALU-DONGGALA,  
28 SEPTEMBER 2018



## UNISDR – IOTIC – LIPI – BNPB - BMKG Study on Assessment on the Last Mile's Response of Palu Tsunami 28 September 2018

### Team:

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- Irina Rafliana (ICIAR / PPO LIPI)
- Syarifah Dalimunthe (PPK LIPI / Nagoya University)

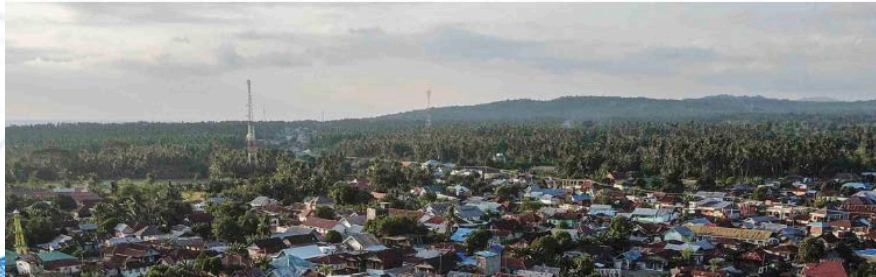


# Background

The New York Times

## What Went Wrong With Indonesia's Tsunami Early Warning System

By ANJALI SINGHVI, BEDEL SAGET and JASMINE C. LEE OCT. 2, 2018



## Indonesia's geophysics agency under fire for lifting tsunami warning

Warning lifted after 34 minutes, with agency saying it had no data  
at the town of Palu, where hundreds died



# Background

KOMPAS, SABTU, 13 OKTOBER 2018

## Peringatan Dini Tsunami Tidak Gagal

Daryono  
Kepala Bidang Informasi Geospasial dan Peringatan Dini Tsunami BMKG

Peristiwa gempa dahsyat berkekuatan M 7,4 yang mengguncang Pulau dan Donggala pada 28 September 2018, selain merusak ribuan rumah, juga memicu bencana kutan ("collateral hazard"), yaitu tsunami destruktif.

Tsunami melanda hampir seluruh wilayah Tana Toraja. Tsunami tsunami ini diwarnai perusakannya perusak, tingkat juga merusak korban jiwa. Signa adalah perusakan tsunami terbeli, berteknologi canggih.

Ada indikator bahwa Indonesia berada di zona gempa tektonik dan vulkanik. Indonesia berada di zona gempa tektonik dan vulkanik. Indonesia berada di zona gempa tektonik dan vulkanik.

Peringatan dini tsunami adalah informasi yang disampaikan kepada masyarakat tentang ancaman tsunami yang akan datang.

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Opini | 7



SRI

TheJakartaPost THURSDAY October 4, 2018

## InaTEWS: About more than technology

Harald Spahn and Jim Luterjerg  
SPECIAL OPINION



Harald Spahn and Jim Luterjerg  
SPECIAL OPINION

Harald Spahn and Jim Luterjerg  
SPECIAL OPINION

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SPECIAL OPINION

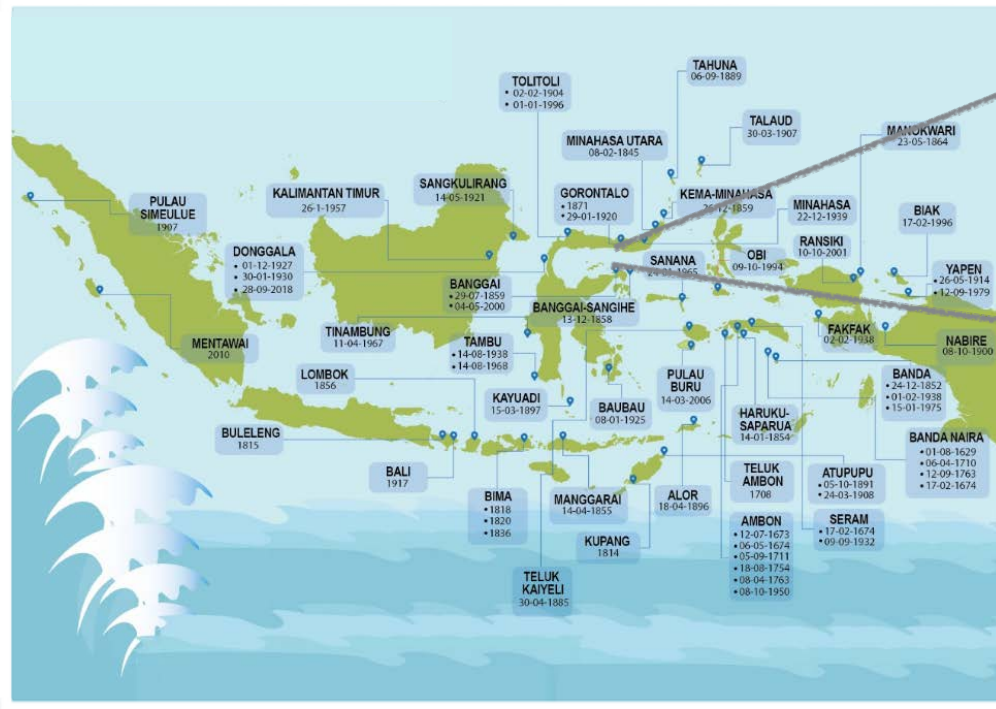
• the Warning is according to the agreed SOP  
• here is no Human Error nor Instrument Error  
(Upstream)



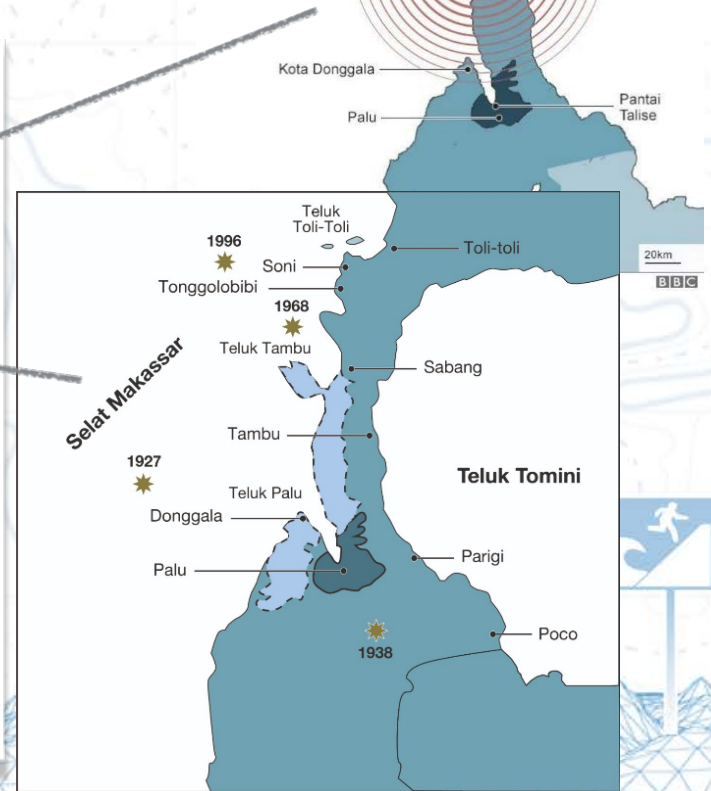
Mardi Spahn is a geologist who worked in Indonesia in 2006-2007



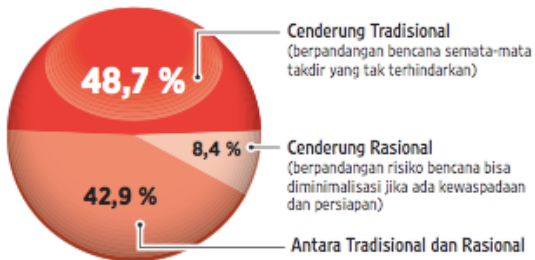
# History of nearshore tsunami sources in Indonesia



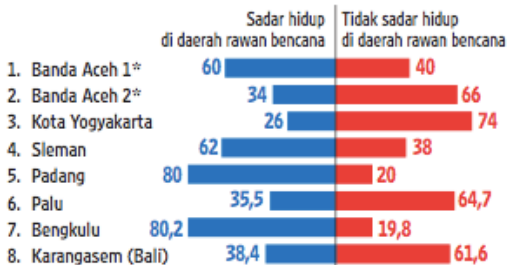
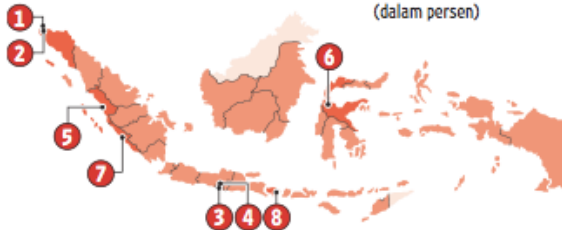
## 28 September 2018 earthquake, tsunami & Liquefaction event Pein Palu and Donggala



## Cara Pandang Responden terhadap Bencana Alam



## Kesadaran Publik Hidup di Daerah Rawan Bencana (dalam persen)



\*) 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**

# Background

Key Question: What happened at the downstream

- How did the community responded to the event.
- How did the Tsunami Early Warning affected / influenced their response.
- How could the Tsunami Early warning system work better (considering the complexity of the local tsunami threat).



# 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

Electricity and Communication cut off in Donggala and Palu

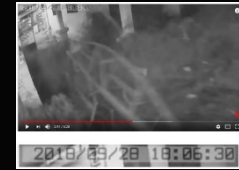
BMKG Bulletin 1  
Advisory in Palu and Warning in Donggala

18:07  
WITA



18:06  
WITA

Tsunami Arrives in Wani  
(based on CCTV of Mr. Andi)  
→ 3 min 30 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 ( $\pm 300$ km South)

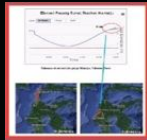
18:27  
WITA



18:36  
WITA



Tsunami hits Palu coast videos went  
viral in Social Media



# Areas hits by Tsunami

Donggala rumah loncor



Donggala, bahu Jalan tergerus tsunami



Lolipesual

Buluri



Pantai Datokarama



Mesjid depan SPBU



Jembatan Kuning



Pohon Kayu dan mobil terbawa tsunami

## SURVEI TSUNAMI PALU

© PUSGEN 2018



Pelabuhan Wani 2



Tondo Maboro



Citra land



Pantai Longsor Talise

## Bappeda Palu:

Casualties in Palu

3.679 persons, **±1.252**

**caused by tsunami**

the remaining due to EQ and liquefaction.

## BPBD Donggala:

Casualties in Donggala

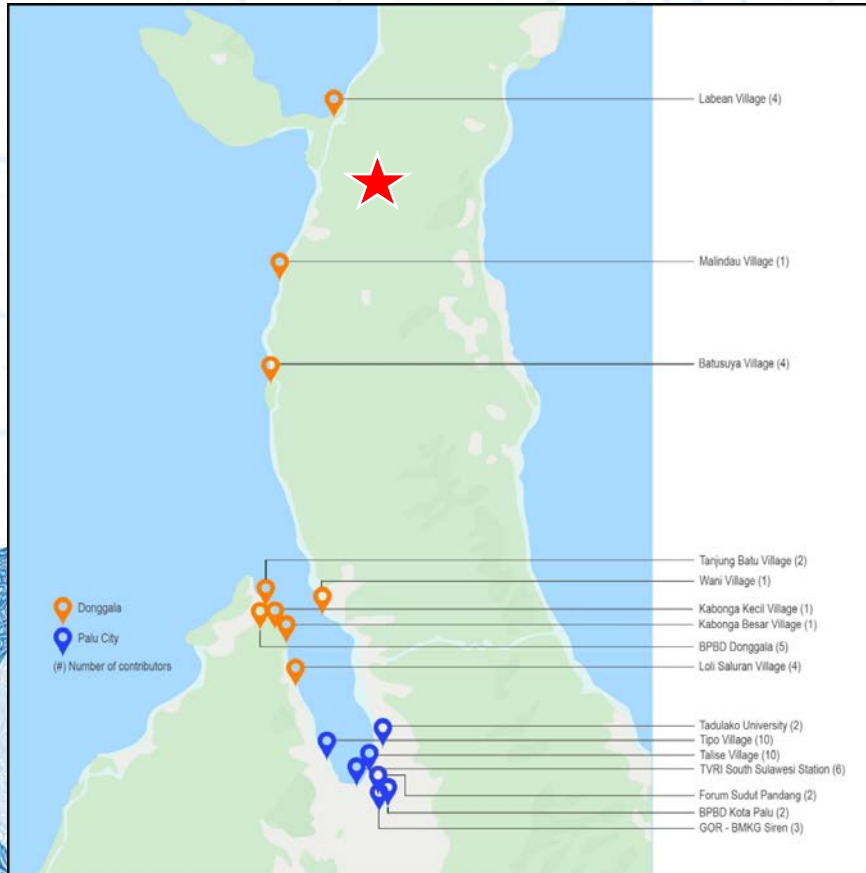
(death and missing)

212 person, **48 caused**

**by tsunami**



# Eyewitness Interviews



In-depth interviews with eyewitness and survivors:

1. Perception, knowledge, and understanding on Tsunami Early Warning System.
2. Reaction, action, and response of the community during the event.

70 eyewitnesses and survivors interviewed in Palu and Donggala

Focus Group Discussion and meeting with BMKG, BPBD, Local Electronic Media, Local academician, and Civil societies working on DRR



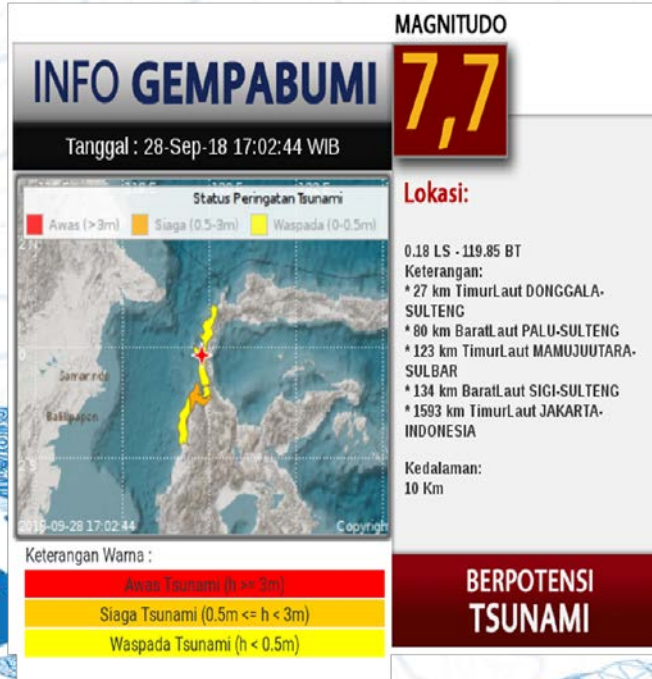
# Main findings

- **Limitations of the Existing Tsunami Early Warning System**
- **Tsunami Early Warning Chain Failure**
- **False Sense of Security**
- **Self-Evacuation is the Key to Safety**
- **Importance of Evacuation Plans and Routes**
- **The Importance of Internalizing Experience and Local Knowledge**
- **Preparedness, Awareness, and Education Must Be Based on the Characteristics of Local Threats**

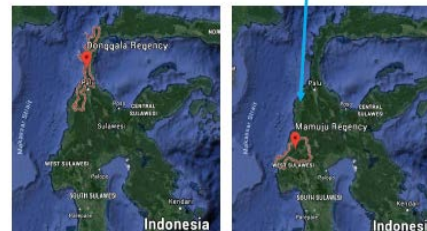
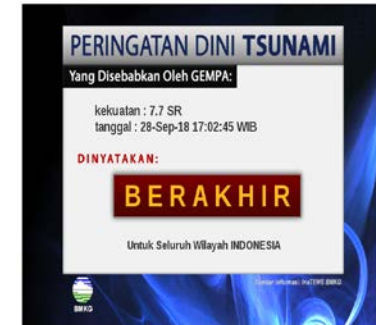
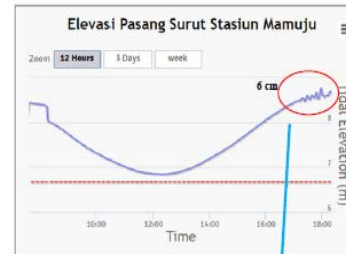


# Limitations of Existing Tsunami Early Warning System

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



Monitor and detect tsunamis caused by the tectonic EQ events



Images courtesy of BMKG





# Limitations of Existing Tsunami Early Warning System

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



CCTV of Mr. Andi's House in Wani



The 7.7 Mw EQ  
18:02:44 WITA  
~ 3' 46"

\* Experts reported that 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



# Limitations of Existing Tsunami Early Warning System

## 3. Electricity and communication were cut off in 2 minutes after EQ

Communities and Disaster Management Offices (Palu and Donggala) did not receive Tsunami Warning Information.



### **BMKG Palu Station Office**

Communication and connection were cut off after the 7.7 Mw 18:02 EQ. BMKG Palu Station staff was still responding to the 5.9 Mw 15:00 EQ



### **BPBD Palu (Local DMO)**

BPBD Palu has Warning Receiver System (WRS) and Siren. However, due to electricity cut of and the generator has been broken for a while therefore the system does not work and did not received any tsunami warning information from BMKG



### **BPBD Donggala (Local DMO)**

Do not have WRS nor Siren. They rely information from SMS or WhatsApp messages. Due to communication cut off, they did not receive any tsunami warning information from BMKG



# Tsunami Early Warning Chain Failure

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

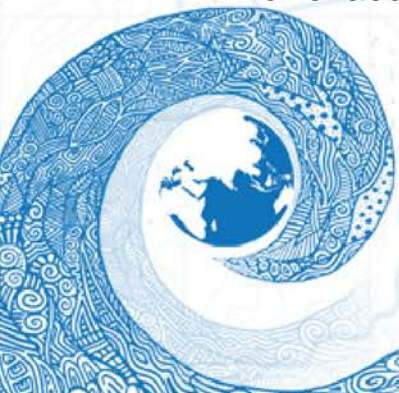
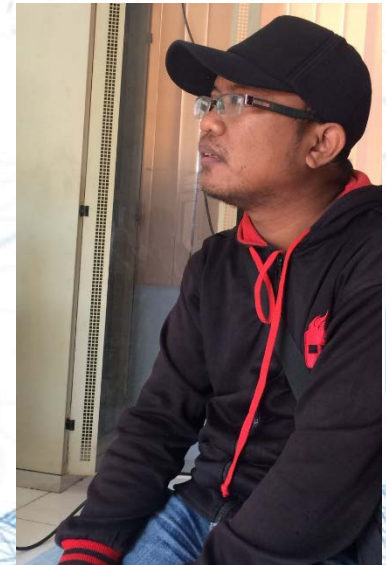
- Dissemination of warning from Upstream to Downstream failed
- There is no local SOP for TEWS → no decision making procedures
- Lack of knowledge of TEWS products
- The agreed Palu City Contingency Plan (2012) was not implemented (might be due to change of government)
  - Lack of DMO human resource 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 26<sup>th</sup> 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...”*



# 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...."*



# Importance of Evacuation Plans and Routes

## 7. Access for evacuation

**Donggala:**

**Death caused by tsunami 48 lives**

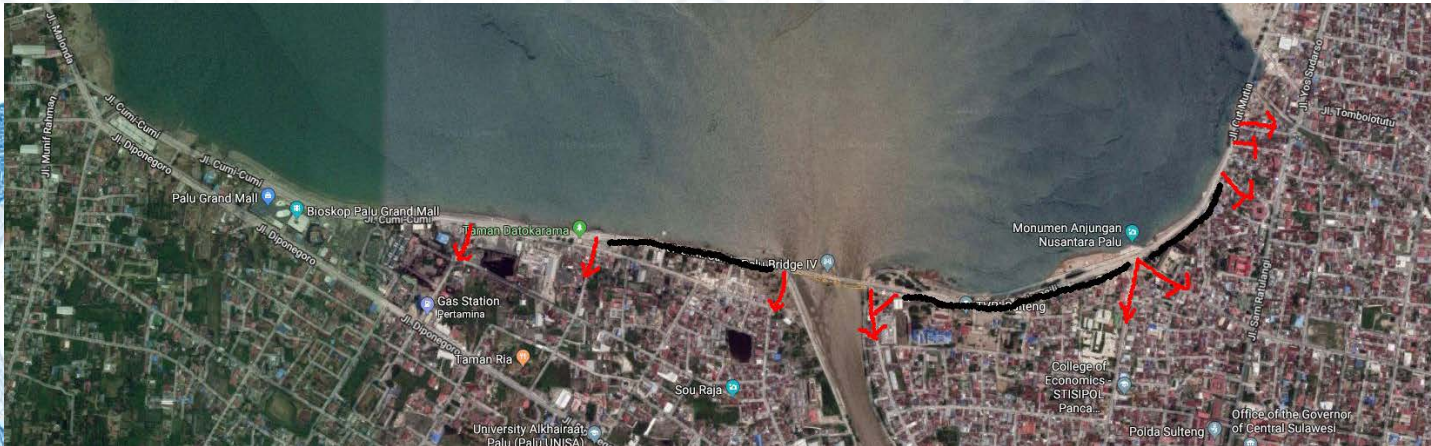
**Rural area where the hills are very close to the coast, there is no barricade going to the hill from the coast**

**Palu:**

**Death caused by tsunami  $\pm$  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



# The Importance of Internalizing Experience and Local Knowledge

## 8. 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

## 9. 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)**

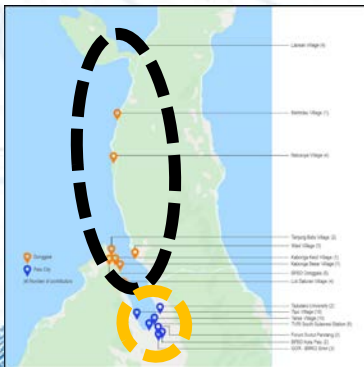
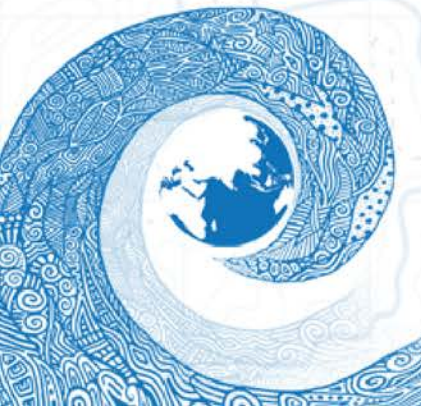
Mandar tribe:

- **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 happened 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 life time 1938 (he was 8 years old), 1968 and 2018*





# The Importance of Internalizing Experience and Local Knowledge

## 10. 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

## 11. Education versus Reality

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



- Most people in Palu (even the intellectuals) were convinced that Palu bay is not facing tsunami threat

*".... 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

- \* 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



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

## 11. Education versus Reality

- 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 Tipu, Kecamatan Ulujadi**



**DONGGALA AREA:**

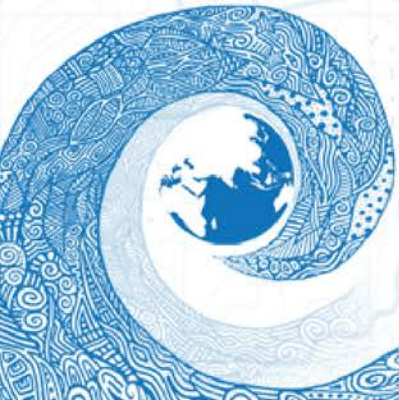


*"...there was no sea water receded, in this area, all the houses just collapsed, sunk into the sea and the water came at the same time..."*

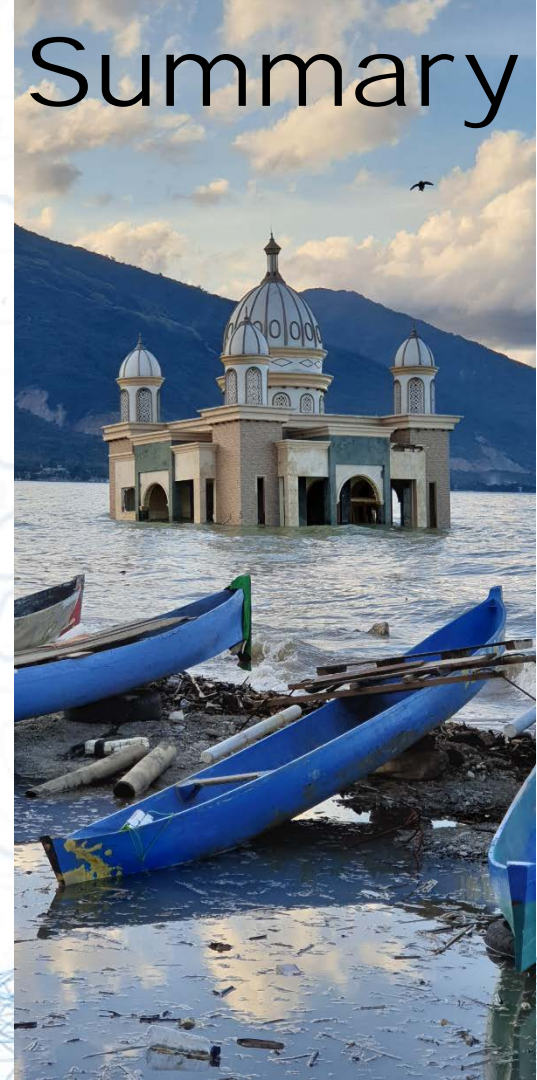
**Tanjung Batu Village, Donggala**



- Self Evacuation Protocol is the key to survive local tsunami, especially with a very short lead time.
- Risk understanding and knowledge need to be understood by all people in the tsunami risk area.
- Local knowledge need to be capitalized to educate local community on risk understanding, tsunami hazard, 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).
- End to End Tsunami Early Warning System need to be revitalized, starting from and focusing on the downstream part.
- Simplify the Warning Chain and decision making process (re-evaluate the PP 21 - 2008)



# Summary



# Follow up:

- Findings from **this scientific social study was exposed to national policy makers** in the InaTEWS: Coordinating Ministry for Human Development and Cultural Affairs, BMKG & BNPB
- This study is one of the rare reference from the downstream component/last mile that contributes to the improvement of the currently drafted **Presidential Regulation on Multi-hazard Warning System**
- There are already shifting paradigms in BMKG for the warning system: **prioritise self-evacuation as the main strategy to reduce loss of lives**
- **Reassessment of education materials and intervention approaches** relevant to tsunami risk reduction had took place and shared to other tsunami prone areas with short lead time.



Exposing assessment results to BMKG and BNPB & Kemenko PMK



# Palu's Urban Legend



# Thank you

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