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THE LESSON LEARNED FROM MENTAWAI TSUNAMI, OCTOBER 25th, 2010

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ABSTRACT *The Mentawai Tsunami, October 25th, 2010, was caused by collision between the Indian-Australian plate with the Eurasian plate that caused the fault in the Sunda subduction zone megathrust. Tsunami with magnitude 7.7 MW occurred at 21:42:22 pm which epicenter at 3.484oSL and 100.114oEL, 20.6 km depth in the Indian Ocean, 110 km from the North Pagai. Tsunami Mentawai, 2010 is started by an underwater earthquake and called as slow tsunami because the ground shaking is quite weak in long periods but produce great waves. Mentawai tsunami cesarean parameters are strike 325o, dip 11.62o and slip 101.4625o. This research aims to know the lesson learned of The Mentawai Tsunami. The impact is coastal degradation, i.e. loss of small islands, abrasion and mangrove degradation. The lessons learned are people should be aware of natural sign of tsunami, evacuate themselves to high places, avoid the inundation area, take the best decision based on situation. Tsunami mitigation must be implemented to save lives and minimize risks.*

Keywords: *Mentawai Tsunami, tsunami impact, lesson learned.*

INTRODUCTION

Indonesia is a vulnerable country because of the location is laid on active tectonic plate collision paths that cause earthquakes and trigger tsunamis. The Indian Ocean Tsunami (IOT), 2004 dan The Tohoku Earthquake and Tsunami (TET), 2011 are the most phenomenal tsunamis in these few decades that caused lots of casualties and losses. The IOT gave a good lesson learn of the great natural disaster and became the

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first reminder for some tsunamis after in Indonesia and one of them is Mentawai Tsunami, 2010. Mentawai Tsunami caused losses and severe trauma for those who live at Mentawai islands, West Sumatera.

Knowledge and awareness of tsunamis are very limited, so people did not prepare for tsunami. The West Sumatera Province is a very vulnerable area of earthquake and tsunami. It lays on the path of active tectonic plates of the Eurasian and Indian-Australian which are prone to friction and collisions. According to a former field survey, the range of run up height of Mentawai Tsunami at the North Pagai Island is about 4.0 to 5.6 meters (Satake et al., 2013). Most of earthquakes in West Sumatera are categorized as high scale because tectonic plate of the Hindia-Australia hit the Eurasia at west Sumatera at 12° to the east with average speed is 50-60 mm/year (Natawidjadja, 2007); (Prawirodirdjo, 2000).

Plate collisions in the subduction zone cause two-way pressure, perpendicular and parallel trough to the northwest, causing the Sumatran fault along the Barisan Hills (Sieh & Natawidjaja, 2000). The distance of tsunami reaches the land depends on the steepness or slope of the coast (Shuto, 1993). Coastal slope, earthquake magnitude and roughness of coastal impact the level of tsunami's disaster (Sieh & Natawidjaja, 2000).

The Mentawai Tsunami on Monday, 25th October 2010 started by earthquake 7.7 Mw beneath The Hindia Ocean that cause fault along 200 km at Sunda Megathrust zone (Setyonegoro et al., 2012). The earthquake occurred on 14:42:22 UTC or 21:42:22 Indonesia time with epicenter 3.484°SL and 100.114°EL, depth 20.6 km (USGS, 2010); 110 km southwest from the North Pagai Island, Mentawai Islands. Tsunami, 2010 caused 428 people died, 74 people missed and 498 people injured. 617 buildings were heavily damaged, and 204 houses destroyed. The losses are estimated at about 6,8 billion rupiahs (Pualligibuot, 2010). (EOS & LIPI, 2010) predicted that Mentawai still has a potency of 8.8 Mw earthquake and tsunamis around Siberut island and Pagai islands (Natawidjaja, 2011). The Mentawai earthquake, 2010 caused up cesar to ground surface at subduction border at Hindia-Australia plate and Sunda Megathrust in northeast direction (Yudhicara et al., 2010). This paper aims to describe the impact and lesson learn of the Mentawai Tsunami, 2010.

METHOD

The method of this research is using literature review and GIS based on former field survey by RICRV, 2016. Figure 1 shows the epicenter of Mentawai earthquake, 25th October 2010 and the location of Mentawai Islands with cesarean parameters (Table 1).

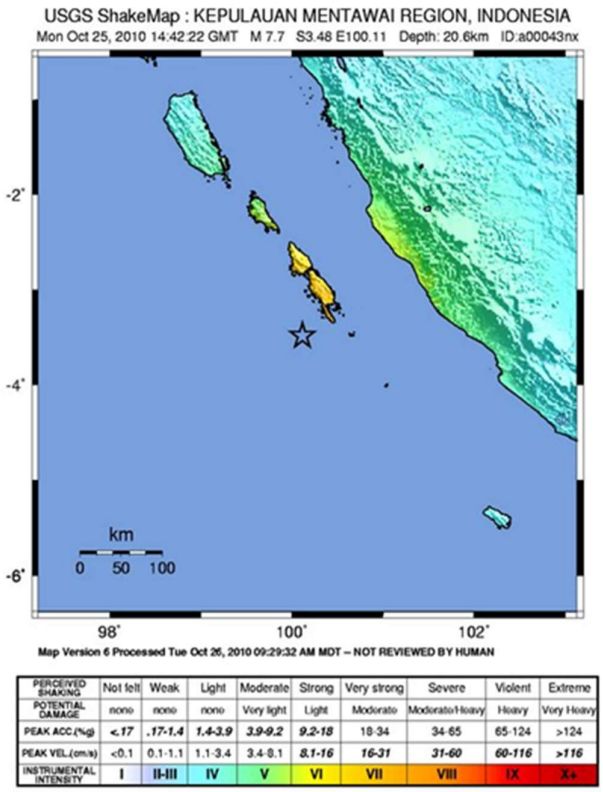

Figure 1. The epicenter of Mentawai earthquake and location of Mentawai Islands (USGS, 2010)

Table 1. The cesarean parameters of Mentawai tsunami

Epicenter		*Focal depth (km)*	*Length (km)*	*Width (km)*	*Disloc ation (m)*	*Strike (°)*	*Dip (°)*	*Slip (°)*	*Total runtime (s)*	*Dt (s)*	*Dx (menit)*
Lat. (° S)	*Lon (° E)*										
3.464	100.11	20.6	190	70	12.088	325	11.62°	101.4625°	1800	1	0.5

RESULT AND DISCUSSION

Mentawai earthquake, 2010 is called as slow earthquake. Even the ground shaking is low, and the period is long (> 1 minute) but it creates high waves. Some ground shakes after primary earthquake occurred before tsunami. People didn't realize it because it occurred at night when most of them were sleeping. The highest wave came after several waves. The height wave can reach until 17 m at The Sibigue Island, west of The South Pagai Island.

Mentawai earthquake, 2010 is categorized as III-VI MMI. The wave coverage is wide and lasts up to 12 hours (Figure 2a). Figure 2b shows the bathymetry around Mentawai Island. The tsunami occurred at minute 30-45 followed by several high waves after 2 hours and more (Figure 3).

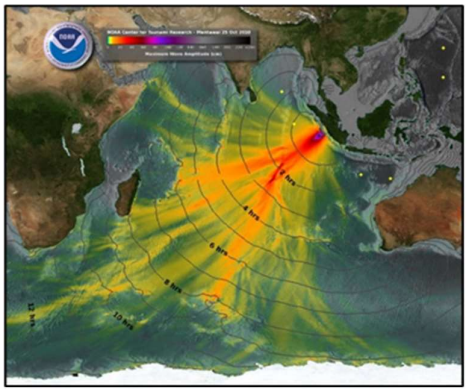

Figure 2a. Wave coverage of Mentawai tsunami (NOAA, 2010)

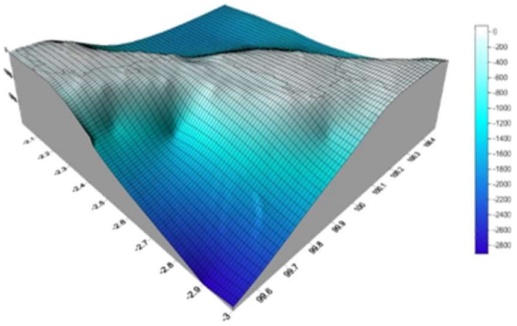

Figure 2b. Bathymetry around The Mentawai Island (

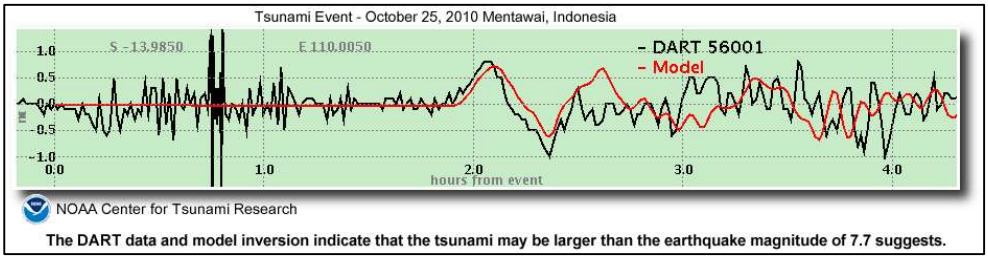

Figure 3. The tidal at the event of Mentawai tsunami (NOAA, 2010)

Figure 4 shows the propagation of Mentawai tsunami (Yue et al., 2014). The tsunami reaches the land 20-30 minutes. Figure 5 shows the tsunami run up at Mentawai Islands: Siberut, Sipora, North Pagai and South Pagai Island (Griffin et al., 2017).

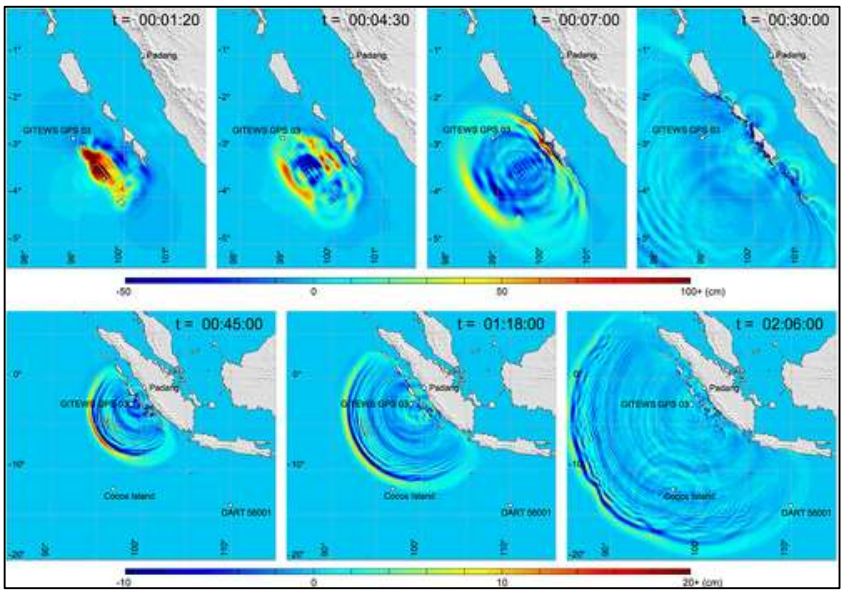

Figure 4. Mentawai tsunami propagation, 2020 (Yue et al., 2014)

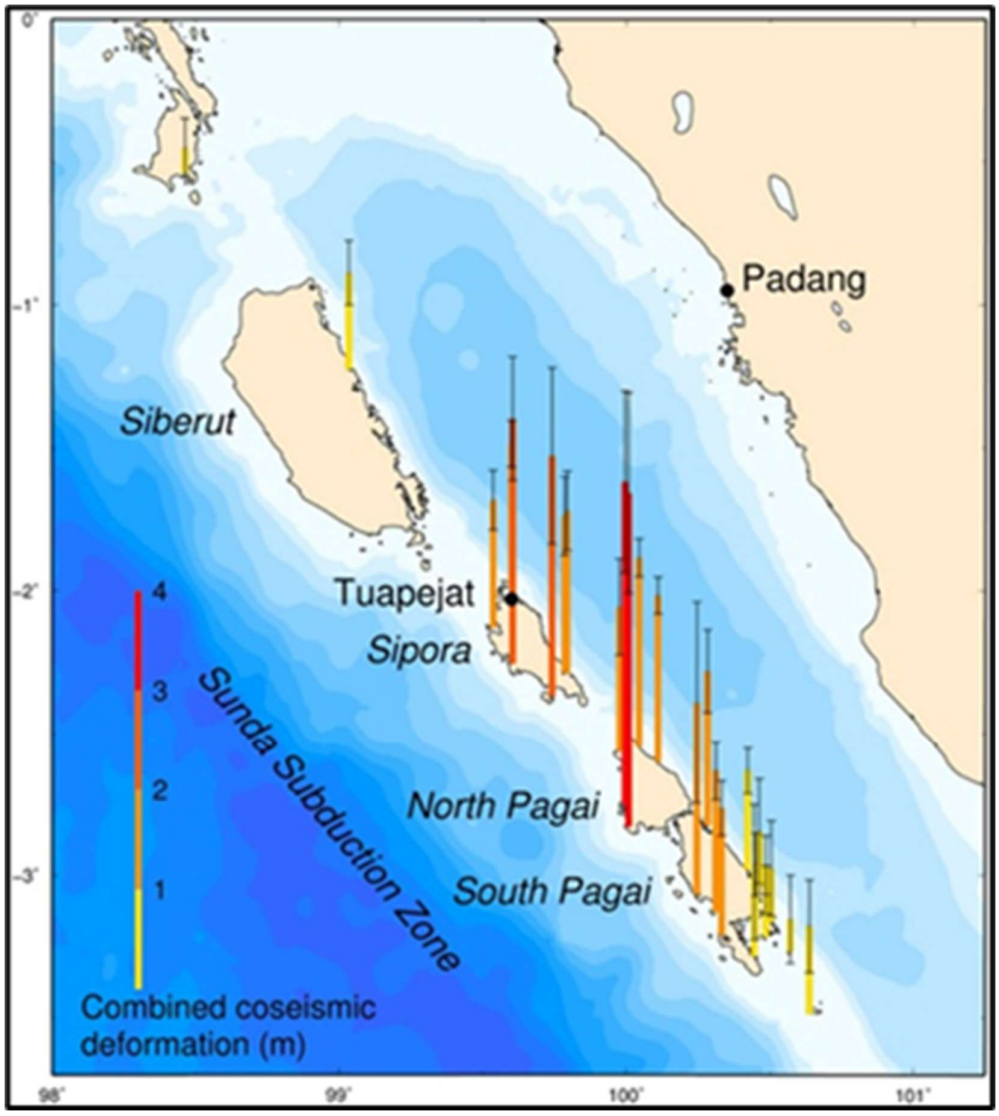

Figure 5. Tsunami run up at Mentawai Islands (Griffin J.D. et al., 2017)

There are several impacts of Mentawai tsunami at Mentawai islands for eq. The loss of The Sibigue Island at west of South Pagai Island (Natawidjaja, 2011). At the North Pagai Island, Muntei and Sabeugunggung are categorized as the highest destruction and moderate to high inundation, while Macaronies is moderate destruction with high inundation and Tumelei is low destruction with high inundation (Putra & Mutmainah, 2016). Figure 6 shows the inundation of Mentawai Island.

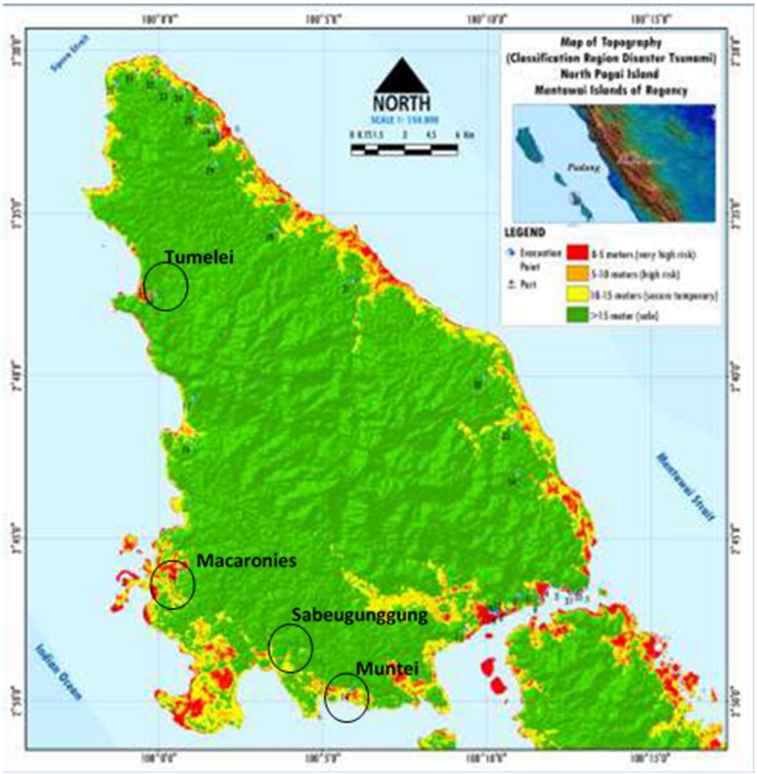

Figure 6. Inundation at the North Pagai Island (Putra & Mutmainah, 2016)

The tsunami triggered massive abrasion at small islands especially The Ragi Island that lies between North and South Pagai Island. Almost 50% of the area of The Ragi Island is lost due to the Tsunami Mentawai and till 2016 the abrasion rate is 1,075 m2/year. The Tsunami Mentawai, 2010 also destroyed some mangroves in Macaronies about 12,030 m^2. There are only 2 (two) types of Mangroves left, that is Rhizopora Apiculata and Bruguiera Gymnorrhiza, which density about 50-70% in medium cover (Figure 7).

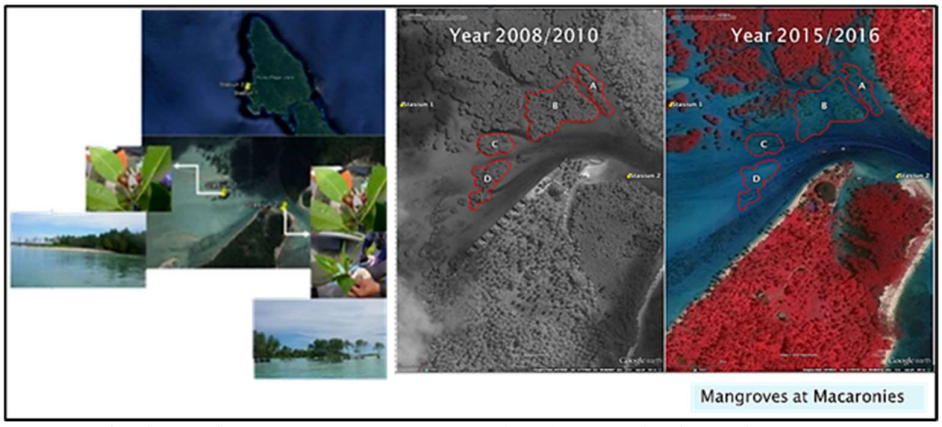

Figure 7. The lost of mangroves at Macaronies (Mutmainah et al., 2016).

Tsunamis are a very destructive natural disaster that people must be aware of. The tsunami took so many lives and caused infrastructure damage. It needs a long time (>10 years) for people and nature to recover. The lessons learned from Mentawai tsunami, 2010 is people should be aware of natural signs, save their lives by running to high places, and stay away from inundation area. As lessons learned from Alaska,1964 and Japanese tsunami,2011 in California coast, especially for the sailor, they must decide whether come back to the port or sail far away from tsunami if they have enough fuel and food. For boat owners, they must remove their boats to save area and evacuate themself to high area (Emergency Management Division, 2021). Based on that, tsunami mitigation is very needed. The scheme, i.e. hybrid coastal protection, tsunami early warning system, tsunami readiness, disaster management area and building codes can be considered as counter measures for tsunami mitigation.

After Tohoku tsunami, 2011 Japan government promotes tsunami coastal mitigation such as structure/non structure coastal protection, land use regulation and emergency management (Correia, 2017); green infrastructure model (Chang & Mori, 2021); hard and soft measure for mitigation (Oetjen et al., 2022). While the mitigation for the port at least covers warning management and response, adequate infrastructures, and zoning for management disaster area (Emergency Management Division, 2021). Since the tsunami became a big issue, UNESCO IOC determines some indicators to assess the tsunami readiness, i.e tsunami emergency operation and respond plans. Even when tsunami rarely happen, people should not forget and always be ready for tsunami.

CONCLUSION

The Mentawai tsunami, 2010 caused a lot of damage and losses. The impact not only to the infrastructure but also to the environment and coastal ecosystem i.e. the loss of small islands, coastal destruction, abrasion and mangrove degradation. The lesson learn from the Tsunami Mentawai is that people must be ready, and it needs mitigation scheme to anticipate tsunami and minimize the risks.

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