Literature Study of Tsunami Waves in the Study of Science and the Al-Qur'an

Welly Anggraini, Yuberti Yuberti, Ria Santika, Trimo Saputro, Muhammad Ridho Syarlisjiswan

Abstract. This research aims to determine the movement of waves that cause tsunamis based on tsunami intensity values by connecting science and the Koran. The method used in this research is a literature study with a descriptive analysis approach. Data collection uses interview observation techniques, documentation, and relevant literature. Based on the results of interview observations and BMKG documentation data, tsunami waves have different characteristics based on the modeling and movement of each cause, including landslides, subduction of the Indo-Australian Plate under the Eurasian Plate, volcanoes, and more influential causes of earthquakes. The scientific view is that tsunamis occur like earthquakes due to plate movements that occur, allowing friction or collisions between plates to occur. The result of this collision will cause one plate to rise and the other plate to subduct, this is often called subduction. This event will cause an earthquake. The earthquake that occurred is very likely to cause a tsunami. The explanation outlined in the Book of Allah has a broad dimension of knowledge and insight, especially discussing science and nature. The Qur'an's view of tsunamis is that they are a disaster or calamity that occurs according to His will, tsunamis are absolutely due to the laws and provisions of Allah SWT for nature. These things are one of the signs of a small apocalypse.

1 Introduction

Indonesia is a country that is very rich in natural resources, but on the other hand it is also very prone to natural disasters. Statistical data even records that there are many incidents and fatalities caused by disasters that come. Indonesia has fertile land, abundant agricultural products and marine resources. However, Indonesia is also not free from the risk of natural disasters, which are a series of events that disrupt and threaten life safety and cause material and non-material losses. Indonesia is said to be a country that is rich in disasters such as earthquakes, tsunamis and volcanic eruptions, and based on its geographical position and location, Indonesia is located in the Indonesian archipelago which is in a very active tectonic and volcanic zone caused by a very vulnerable to the dangers of earthquakes, movements, faults, volcanic eruptions and tsunamis. With such...
geographical conditions and when three tectonic plates collide with each other, Indonesia is very vulnerable to natural disasters such as volcanic eruptions, earthquakes, tsunamis, liquefaction and landslides. And during the rainy season with high intensity, Indonesia is very vulnerable to floods and landslides.

Disasters that occur and tsunami events from various regions can be studied carefully, using data that is used to reconstruct events in order to know and predict disaster events that will occur in the future. However, from the Tsunami disaster which was based on an earthquake, it caused serious damage to populated areas and coastal areas, especially areas close to the epicenter of the earthquake, such as the West Coast area of Lampung, which is an area directly bordering the Eurasian plate, this is one of the possibilities for tsunami waves to occur on the coast.

Plates that have high seismic activity have the potential to cause many natural disasters, one of which is earthquakes which are the main impact of seismicity. Tsunami is one of the most dangerous natural disasters in areas around the coast, the cause of tsunamis arises as a result of the movement of water in quite large quantities caused by earthquakes, underwater volcanic eruptions, landslides and other causes that occur below or at the bottom of the sea.

According to the Volcanological Survey of Indonesia (VSO), a natural disaster called a tsunami is defined as a series of sea waves capable of spreading at a speed of 900 km per hour, which are mainly caused by earthquakes that occur on the seabed, in sea waves which can be tsunami waves moving up to 900 km/hour, but when it reaches shallow sea near land the wave will slow down at a depth of 15 meters the speed can be 45 km/hour, this speed is still too difficult for people on the beach to be able to run to save themselves.

These natural law phenomena certainly influence each other and the damage that occurs in nature is also the will of Allah and with Allah's permission because Allah has given warnings to humans with signs, so that humans return to the right path and do not cause damage to the earth and in the natural environment.

Meaning: "And when the sea becomes overflowing" (Q.S. Al-Infitar: 3).
Meaning: "And whatever misfortune befalls you is caused by the actions of your own hands, and Allah forgives many (of your mistakes)". (Q.S. Asy-Syura: 30)

In the Qur'an, disasters are closely related, including 'mushibah, bala, iqab, slander, adzab, sayyiat, ba's, and dharra'. Disasters are the basis or essence of faith, where everything that happens is with Allah's permission. With this research, in the world of education and in environments where disasters are discussed, the values of the Al-Qur'an can be integrated in order to instill an attitude of awareness, alertness and response to disasters.

Not only that, in the world of education, scientific knowledge about tsunamis has its own characteristics and is related to wave length, wave amplitude, wave propagation speed, and wave period, so according to research conducted by Amira Tiara Wulandari, it is said that based on research that has been carried out in relation to disasters In science, tsunamis have an important role because tsunami material is one of the local content materials in the form of regional potential that can be integrated into integrated subjects, especially physics subjects.

2 Methods

This research uses a Literary Study research type method using a descriptive approach. The data analysis used is data triangulation. The data analysis used uses interview observations, documentation and relevant literature. Literature or library research is a theoretical activity related to studies and references that will be researched, research carried out using information and data collection techniques with the contribution of various supporting tools found in libraries such as reference books, results of similar research that has been carried out, 04015 (2024)E3S Web of Conferences https://doi.org/10.1051/e3sconf/202448204015 YSSSEE 2023
3 Results and Discussion

3.1 BMKG data results

Table 1. Tsunami 2018-2021

<table>
<thead>
<tr>
<th>No</th>
<th>Date</th>
<th>Region</th>
<th>Reason</th>
<th>Magnitude</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>05/08/2018</td>
<td>Lombok Utara, NTB</td>
<td>A tsunami caused by an earthquake</td>
<td>6.9</td>
<td>32 km</td>
</tr>
<tr>
<td>2</td>
<td>28/09/2018</td>
<td>Donggala, Palu, Sulawesi Tengah</td>
<td>Tsunami caused by sediment sliding in the sea.</td>
<td>7.4</td>
<td>11 Km</td>
</tr>
<tr>
<td>3</td>
<td>22/12/2018</td>
<td>Gunung Anak Krakatau</td>
<td>Tsunamis caused by volcanoes</td>
<td>4.7</td>
<td>30 Km</td>
</tr>
<tr>
<td>4</td>
<td>14/11/2019</td>
<td>Barat Laut, Jailolo, Maluku Utara</td>
<td>A tsunami caused by an earthquake</td>
<td>7.1</td>
<td>73 Km</td>
</tr>
<tr>
<td>5</td>
<td>02/08/2019</td>
<td>Sumatera</td>
<td>A tsunami caused by the subduction of the Indo-Australian Plate under the Eurasian Plate</td>
<td>7.54</td>
<td>10 Km</td>
</tr>
<tr>
<td>6</td>
<td>14/12/2021</td>
<td>Marokot, Barat Laut, Larantuka, NTT</td>
<td>A tsunami caused by an earthquake</td>
<td>7.4</td>
<td>10 Km</td>
</tr>
</tbody>
</table>

Based on the tsunami intensity in the table above, it can be seen that the tsunami in 2018 in Indonesia experienced 3 violent movements resulting from earthquakes, landslides and Mount Krakatoa, in 2019 experienced 2 events, which in August and December were caused by earthquakes and subduction of the Indo-Australian Plate under the Eurasian Plate, while in 2021 Indonesia only experienced a tsunami in December. The tsunami that occurred in Indonesia was caused because Indonesia has complex tectonics, so that Indonesia is a vulnerable region. And it has different characteristics based on modeling of each cause, including the result of landslides, subduction of the Indo-Australian Plate under the Eurasian Plate, volcanoes, and many more which have the influence of causing earthquakes which occur due to shifts in the earth's plates which trigger rolling waves called a tsunami.

The movement of tsunami waves is usually called a series wave or line of waves which will not happen once, for example, like playing on the beach with waves crashing repeatedly, so when the tsunami occurs, large energy will come and sweep the land and carry ships. Therefore, before the tsunami comes, the device installed on the beach will sound to give a warning, namely the INA-TEWS system (Indonesian Tsunami Early Warning System) which is a tsunami early warning system because usually most tsunamis cause and result from earthquakes, so when a tsunami comes with the potential for great power so it has the characteristics of being shallow in the sea. BMKG has a tsunami modeling system when an earthquake comes and has a large magnitude, it can be seen from the tsunami modeling system and will match it with an earthquake that has a large magnitude and has a vulnerability that is very at risk of a tsunami with the location where it is likely to occur. The BUOY system will function when there is an early warning of a potential earthquake that has great potential, the earthquake in question is an earthquake that has a scale above 5 by looking at the characteristics of the causes and symptoms that have potential. If there is a potential for a tsunami, then BMKG has a model of the areas that will be affected by a tsunami with height with the results of calculation analysis which will be the basis for issuing information to the public or it can also be called a Warning to immediately stay away from the coast, then residents are given 15 to 30 minutes from BMKG from the time of termination after the tsunami warning was stopped, meanwhile BMKG has a tool called observation modeling to see the true height of sea waves using the BUOY and Tide Gauge tools at the docks, the BUOY tool is installed in the middle of the sea as a tsunami early warning system have a system of cooperation between institutions.

3.2 Relevant literature results

Several journals show that there are different results in tsunami wave research. Therefore, the researcher selected several journals that suited the researcher's objectives in discussing Tsunami Waves.

<table>
<thead>
<tr>
<th>No</th>
<th>Writer</th>
<th>Research Title</th>
<th>Research design</th>
<th>Research result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Masih Honarmand</td>
<td>3D Numerical Simulation of Tsunami Generation and Propagation, Case study: Generation and Penetration of the Makran Tsunami in Chabahar Bay.</td>
<td>Qualitative Descriptive</td>
<td>From the research results, historically tsunami events that occurred in the world were caused by the movement of earthquakes, so penetration was carried out for Chabahar Bay.</td>
</tr>
<tr>
<td>2</td>
<td>Roifatu Diana Zain</td>
<td>Mechanics of Tsunami Wave Propagation: Case Study of the 2018 Palu Bay and Sunda Strait Tsunami.</td>
<td>Qualitative Descriptive</td>
<td>The kinematics and dynamics of tsunami wave propagation from the open sea to coastal areas are still valid for tsunamis triggered by non-seismic sources.</td>
</tr>
<tr>
<td>3</td>
<td>Stefaphant T</td>
<td>Modelling of the tsunami from the December 22, 2018 lateral collapse of Anak Krakatau volcano in the</td>
<td>Qualitative Descriptive</td>
<td>The observations made were the results of a significant tsunami caused by a volcano.</td>
</tr>
</tbody>
</table>
3.3 Discussion

Tsunamis are related to earthquakes because tsunami literally means big rolling waves that occur at seaside ports. Big waves at these ports are called Japanese, because this event occurs mostly in Indonesia and foreign countries. A tsunami is a displacement of a body of water caused by a sudden vertical change in sea level. The size and magnitude of an earthquake has an influence and is related to the natural disaster phenomenon of earthquakes and tsunamis. Tsunamis occur as a result of the breaking of the earth's plates at the bottom of the sea which causes earthquakes and disrupts the water balance, resulting in large waves. The size of a tsunami can not only be seen in terms of the strength generated by an earthquake but seen from the location of the source of the epicenter, its magnitude, the depth that has the potential for a shallow tsunami, namely under 6 KM from the position of the rising fault and descending fault or shifting, if the fault rises or falls. This will result in the sea volume being disturbed by the fault. Australian geologists try to explain scientifically some of the processes that cause disasters. He explained that a chain of events had occurred, namely a large-scale earthquake that liquefied loose soil and possibly caused underwater landslides. Then, the landslide triggered a tsunami wave with high intensity because it occurred in bay-shaped waters.

Sonny Robert Dirgantoro et al said that in general the closer an area is to the coastline, the higher the level of vulnerability to tsunami waves, and the risk is greater and conversely the farther an area is from the coastline, the higher the level of vulnerability to tsunami waves. The closer an area is to the coastline and the large number of people living near the land, the potential for a tsunami to pose a very dangerous risk of vulnerability for the population. However, if the position is in the middle of the Indian Ocean, the energy propagating by tsunami waves will decrease and become smaller because it is a long distance from the epicenter, it is possible that the potential for a small tsunami will run out of energy, therefore the closer it is, the more dangerous it is. In studies, science is very important for education. Science is a science that studies knowledge and natural phenomena in life which are closely related to phenomena that occur naturally. The knowledge gained can provide knowledge and insight to find out the symptoms that cause environmental damage on earth. As described in the Al-Qur'an which is the book of Allah SWT. The explanations outlined in the Book of Allah have a broad dimension of knowledge and insight, especially discussing scientific matters.

It can be interpreted that humans can understand and know the universe by increasing their belief in the existence of God's decrees. Related to symptoms that cause environmental damage, such as tsunami disasters which occur due to the movement of waves that hit and hit land. Tsunami is a disaster that comes from Allah to rebuke His servants for their negligence as explained above in the surah meaning: “And the keys of all unseen are with Him; no one knows but Him. He knows what is on land and in the sea. Not a single leaf falls that He does not know about. There is not a single seed in the darkness of the earth, nor anything wet or dry, which is not written in the real Book (Lauh Mahfuzh).” (QS. Al-An'am: 59).
In the language of science, earthquakes and tsunami waves are considered normal natural events, namely events caused by faults in the earth's plates which result in large tidal waves (tsunami), but in the Qur'an, all disasters that occur are self-reflection from mistakes made by oneself. We are aware to remember Allah SWT. A tsunami is an event that begins with an earthquake that can kill hundreds or even thousands of people. What happens is due to a shift in the earth's plates which can cause mountains to fly as mentioned in Surah An-Naba verse 20 meaning: "And the mountains were moved so that they became mirages" (Q.S An-Naba: 20).

As a result of this mountain event, there is a shift in the earth's plates which can generate sea waves. The tsunami that occurred and the tsunami that will occur has been mentioned in Surah Al-Infitar verse 3. Meaning: "And when the sea becomes overflowing." (QS. Al-Infitar verse 3).

The earth has mountains filled with hot lava which can erupt at any time. If the plates are on the seabed and on the coastline, there will be a gap between the two earth's plates, then the sea water will heat up. The ocean becoming hot is explained in Surah At-Takwir verse 6. Meaning: "And if the ocean is heated." (QS. At-Takwir verse 6).

One of the sciences that discusses natural phenomena is science, and is included in physics because physics is a branch of science that studies various events in life and its causes, what happens is like an event caused by a fault in the earth's plates which results in a large tidal wave (Tsunami), but in the Qur'an, all disasters that occur are self-reflections from mistakes to make ourselves aware of remembering Allah SWT.

Tsunami waves are a material related to physics which discusses waves and amplitude propagation. Waves are the rising and falling movement of water in a perpendicular direction on the surface of sea water which forms a sinusoidal curve or graph. Waves have 2 types, namely ordinary (general) waves and tsunami waves, ordinary (general) waves are caused by wind, while tsunami waves that are initiated by earthquakes are caused by movements from within the earth, such as volcanic eruptions and shifts between the earth's plates. In physics, tsunami waves have several types, including longitudinal waves (p waves), transverse waves (s waves), and surface waves. P waves are longitudinal waves which have a propagating direction parallel to their movement, longitudinal waves have seismic wave movements with a speed of 6-7 km/sec.

4 Conclusion

According to the scientific view, tsunamis are like earthquakes due to plate movements that occur, allowing friction or collisions between plates to occur. The result of this collision will cause one plate to rise and the other plate to subduct, this is often called subduction. This event will cause an earthquake. The earthquake that occurred is very likely to cause a tsunami. The explanation outlined in the Book of Allah has a broad dimension of knowledge and insight, especially discussing science and nature. The Qur'an's view of tsunamis is that they are a disaster or calamity that occurs according to His will, tsunamis are absolutely due to the laws and provisions of Allah SWT for nature. These things are one of the signs of a small apocalypse, if tsunamis are in the Koran and are related to tsunamis.

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