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## ECONOMIC AND PHYSICAL IMPACT OF TSUNAMI IN INDIA – AN OVERVIEW

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### ABSTRACT

*The biggest tsunami, which struck eleven nations that border the Indian Ocean, was a total surprise for the people living there. A lot of seismic networks recorded marine earthquake, but there was no tidal sensors other than wave sensors to provide confirmation as to whether a tsunami had been generated. There were no established communication network or organization infrastructures to pass a warning of any kind to the people living at coastlines. No tsunami warning system exists for the Indian Ocean as it exists in the Pacific Ocean. There should need for early warning Centre set up in the Indian Ocean and every country within the Indian Ocean part of this for sharing information.*



**KEYWORDS:** *Tsunami, India, Physical and Economic impact, Indian Ocean.*

### INTRODUCTION

Tsunamis are huge waves originated by earthquakes or volcanic eruptions under the sea. Out in the depths of the sea, tsunami waves do not radically increase in height. But as the waves journey inland, they build up to higher and higher heights as the depth of the ocean decreases. The speed of tsunami waves depends on ocean depth rather than the distance from the source of the wave. Tsunami waves can travel as fast as jet planes over deep waters, only slowing down when reaching shallow waters (NOAA, 2018).

The tsunami that started in the Indian Ocean on 26<sup>th</sup> December 2004 and caused giant waves travelling at about 500 km per hour to punch the coastline of fifteen countries along the ocean caused countless extensive devastation. In India, over 16,000 people lost their lives, about half of whom were in Tamil Nadu. And also the enormous loss of materials in the marine fisheries sector in Tamil Nadu. The livelihood security of lakhs of coastal rural folk who are directly or indirectly dependent on marine fisheries has been shattered by obliteration of their houses and more importantly their only means of earnings, namely, the craft and gear. The Andaman & Nicobar Islands were the most awful affected and among the coastal states, Tamil Nadu and Pondicherry suffered the most horrible damage, some parts of Kerala and Andhra Pradesh also the loss of human lives and their property in India.

The 9.1 magnitude earthquake off the coast of Sumatra was estimated to occur at a depth of 30 km. The fault zone that caused the tsunami was roughly 1300 km long, vertically displacing the sea floor by several metres along that length (Campbell Phillips, 2011). The ensuing tsunami was as tall as 50 m, reaching five km inland near Meubolah, Sumatra. This tsunami is also the most extensively recorded, with nearly one thousand combined tide gauge and eyewitness measurements from around the world reporting a rise in wave height, including places in the US, the UK and Antarctica (Chu Yonghai and Li Jiancheng, 2014). An

estimated US \$ 10 billion of damages is attributed to the disaster, with around 230,000 people reported dead (**Campbell Phillips, 2011**).

### CONCEPT OF TSUNAMI

Tsunamis are giant waves, initiated by an unexpected change (normally in the relative position of submerged tectonic plates). The sudden change is typically enough to propagate the wave; however, its power can be improved and fed by lunar positioning and boundaries that focus its energy (**Sarthak Hatwar**). Tsunami is a great sea wave produced by a submarine earthquake, volcanic eruption, or large landslide. Tsunamis can contain heights of up to 30 m (98 ft) and reach speeds of 950 km (589 mi) per hour. They are branded by long wavelengths of up to 200 km (124 mi) and long periods, more often than not between 10 and 60 minutes.

### TSUNAMI IN HISTORY

- A volcano caused a flood in Sicily eight thousand years ago that packed up into the sea at 200 mph, triggering a crushing tsunami that spread across the entire Mediterranean Sea. There are no historical records of the event only geological records but scientists say the tsunami was taller than ten story building (**Live Science Staff, 2011**).
- **November 1, 1755:** After a colossal earthquake smashed Lisbon, Portugal and rocked much of Europe, people took refuge by boat. A tsunami result, as had huge fires. Overall, the incident killed more than sixty thousands people.
- **August 27, 1883:** Explosion from the Krakatoa volcano fuelled a tsunami that drowned thirty-six thousand people in the Indonesian Islands of western Java and southern Sumatra (**Mary Bagley, 2017**). The strength of the waves pressed coral blocks as large as six hundred tons onto the shore.
- **June 15, 1896:** Waves as high as a hundred, spawned by an earthquake, and cleaned the east coast of Japan. Some twenty- seven thousand people died.
- **April 1, 1946:** The tsunami, activated by an earthquake in Alaska, killed 159 people, mainly in Hawaii ((**Live Science Staff, 2011**)).
- **July 9, 1958:** The largest recorded in modern times, the tsunami in Lituya Bay, Alaska was the reason by a landslide activated by an 8.3 scale earthquake (**Live Science Staff, 2011**). Waves attained a height of 1,720 feet in the bay, except given that the area is comparatively cut off and in a unique geologic setting the tsunami did not cause much injure elsewhere. It sank one boat only, killing two fishermen.
- **May 22, 1960:** The largest recorded earthquake, magnitude 8.6 in Chile, created a tsunami that hit the Chilean coast within fifteen minutes. The surge, up to 25 mts high, killed an estimated 1,500 people in Hawaii and Chile.
- **March 27, 1964:** The Alaskan Good Friday earthquake, the scale was 8.4, generated a 201 feet tsunami in the Valdez Inlet (**Sosial Budaya, 2011**). It travelled at over 400 mph, killing more than one hundred twenty people. Ten of the deaths occurred in Crescent City, in northern California, which saw waves as high as twenty feet (**Live Science Staff, 2011**).
- **August 23, 1976:** The southwest Philippines a tsunami killed eight thousand people on the heels of an earthquake.
- **July 17, 1998:** A magnitude 7.1 earthquake generated a tsunami in Papua New Guinea was killed more than two thousand people.
- **December 26, 2004:** A colossal earthquake with a magnitude between 9.1 and 9.3 shook Indonesia and killed approximately 230,000 people, mostly due to the tsunami and the lack of aid afterwards, coupled with conflicting and unsanitary conditions. The quake was named the Sumatra Andaman earthquake, and the tsunami has become known as the 2004 Indian Ocean tsunami. Those waves travelled the globe as far as Nova Scotia and Peru (**live Science Staff, 2011**).

## IMPACT OF TSUNAMI IN INDIA

The first recorded tsunami in India dates back to 31<sup>st</sup> December 1881 (**Alpa Sheth, et al., 2006**). A quake of level more than seven on the Richter scale, with its epicentre believed to have been under the sea off the Coast of Car Nicobar Island, caused the tsunami (**News 18Test Sharma, 2012**). The previous evidence of tsunami in India happened on 26<sup>th</sup> June 1941, caused by an earthquake with scale exceeding 8.5 (**Gopal Raj N, 2004**). This caused extensive damage to the Andaman Islands. There are no other well - documented records of Tsunami in India (**Alpa Sheth, et al., 2006**). The Bay of Bengal was severely affected by the tsunami waves in the morning hours of 26<sup>th</sup> December 2004 (between 09.00 – 10.30 AM). The forceful waves were activated by an earthquake of measuring 8.9 on the Richter scale that had an epicentre near the west coast of Sumatra in Indonesia (**Lareef Zubair, 2004**).

It was all quiet on the waterfront on the Sunday morning after Christmas in 2004, at Kanyakumari, the famous Marina Beach in Chennai, Kerala coast and Andaman Nicobar Islands (**Preeti Zachariah, 2015**). There was the enthusiasm of a holiday with an offbeat mood with the group of people on the seafront and children playing cricket, man and women on their morning work and walking at the Marina in Chennai. In another place, fishermen were putting out to sea for the day's catch. Then all on an unexpected, a curious thing happened. The travellers at Kanyakumari were enthralled when the sea moves away from the shores. In the present tsunami, India was the third country severely battered after Indonesia and Sri Lanka. Some States of India severely affected by the tsunami, were Tamil Nadu, Pondicherry, Andhra Pradesh, Kerala and Andaman and Nicobar Island.

The **Tamil Nadu** state had been the most awful affected on the mainland, with a death toll of 7,793. Nagapattinam District has had 5,525 casualties, with entire villages had been destroyed. District of Kanyakumari has had 808 people died, Cuddalore District 599, the state capital Chennai 206 and Kancheepuram District 124 (**Pradyumna P. Karn and Shanmugam P. Subbiah, 2011**). The death tolls, in other Districts of Tamil Nadu were Pudukkottai (fifteen), Ramanathapuram (six), Tirunelveli (four), Thoothukudi (three), Tiruvallur (28), Thanjavur (22), Tiruvarur (10) and Viluppuram (47). Those killed in Kanyakumari include pilgrims taking a holy dip in the sea. Of about seven hundred people trapped at the Vivekananda Rock Memorial off Kanyakumari, 650 were rescued (**Sherley Gnana Sathiya, et al., 2014**). In Chennai, people walking on the Marina beach and those who take a Sunday morning stroll were washed away, in addition to the fisherfolk who lived along the shore and those out at sea (**The Times of India, 2017**). The death toll at Velankanni in Nagapattinam District is currently 1,500. Most of these people were visiting the Basilica of the Virgin Mary for Christmas, while others were residents of the town. The Kalpakkam nuclear power station was closed after sea water rushed into a pump station (**The Rediff Interview, 2005**). No radiation leak or destroy to the reactor was reported.

Approximately thirty thousand people are homeless in the Union territory of **Pondicherry**. The current official toll was 560. The affected Districts were Pondicherry (107 dead), Karaikal (453 dead). Karaikal was the most devastated area from the Pondicherry Union territory, where massive destruction and loss of casualties occur. This mishap occurs because of uncovering stone block. Mostly fisherfolk were affected due to location and distance between sea and their village. Fishing peoples were just preparing for venturing into the sea and within a fraction of seconds everything washes away and their boats had damaged they lost everything in terms of life and property. More than 453 people died so far and still, some were missing (**Jayant Verma, 2013**).

The official toll was 168. The affected Districts are Kollam (131 dead), Alappuzha (32 dead), Ernakulam (five dead).The tsunami that hit the **Kerala** coast on December 26, 2004 , were three to five metres high, according to the National Institute of Disaster Management,(NIDM) which functions under the ministry of home affairs. The Tidal up source had affected 250 kilometres of the Kerala coastline and entered between one or two kilometres inland. Pounded 187 villages affecting 24.70 lakh persons in the state, as many as 6,280 residences were destroyed. As many as 84,773 persons were expatriated from the coastal areas and accommodated in 142 Relief Camps opened in Kollam, Alappuzha and Ernakulam Districts. In

Andhra Pradesh, the official toll was 105. The affected Districts were Krishna (35 dead), Prakasam (35 dead), Nellore (20 dead), Guntur (four dead), West Godavari (eight dead) and East Godavari (three dead).

The Andaman and Nicobar Islands contain 572 islets, out of which 38 are occupied, both by people from the mainland and native tribes. The isle lies just north of the earthquake epicentre and the tsunami entered a height of 15 mts in the southern Nicobar Islands (**Alpa Sheth, et al., 2006**). The official death toll was 812, and about 7,000 were still missing. The unofficial death toll (including those missing and presumed dead) was estimated to be about 7,000 (**Rajib Shaw, 2006**).

The Car Nicobar and Great Nicobar islands were the most awful hit among all the islands because of their closeness to the quake and relative flatness (**Rajib Shaw, 2006**). Aftershocks continue to rock the area. Twenty percentage of the population of the Nicobar islets was said to be dead, hurt or missing. Chowra Island has lost two-third of its population of 1,500. Entire islands have been washed away, and the island of Trinket has been split in two (**Rajib Shaw, 2006**). Communications had just reinstated with the Nancowry group of islands, some of which have been totally underwater, with the whole number of the population still out of contact exceeding 7,000. Among the casualties in Car Nicobar, hundred Indian Air Force personnel and their family members were washed away when the wave hit their air base, which was reported to have been severely damaged (**George Pararas Carayannis, 2005**).

### ECONOMIC AND PHYSICAL IMPACT OF TSUNAMI

- The fishing economy along the coast has been seriously endangered. Thousands of fishermen were missing, lost their fishing equipment, like nets, fishing boats, rowing rods etc.
- The Mannakudi Panchayat nearby Kolachel (Tamil Nadu) was a cluster of villages, including Melamanakudi, which was badly affected (**Alpa Sheth, et al., 2006**). A 160 meters long viaduct had been specially made in 2002 to attach with the villages of Kelamanakudi and Melamanakudi on opposite banks of the Pazhyar River. The bridge went missing after the tsunami. It was originally built with four spans, all of which were washed away by the tsunami. The two end spans travelled upstream by 100 m and were beached on the banks; the central spans were not visible, apparently having sunk into the waters. The substructure appeared to be intact except at the apron. There were no restraints between the superstructure and the foundation. Melamanakudi is a prosperous and picturesque hilly village built on the waterfront. A road from the village of Palam to Melamanakudi was reportedly built by levelling the sand dunes in the region, in violation of the coastal regulation zone (CRZ) rules. Numerous houses were built on the seashore not more than 50 m from the shoreline, apparently after the levelling of sand dunes. These houses suffered complete devastation. Structures 250 m from the shoreline suffered little or no damage because the land sloped upward (**Alpa Sheth, et al., 2006**).
- Sothavilai has a beautiful beach and was being actively developed by the state for tourism. The beach slopes upward from the shoreline and folds into sand dunes about 8 to 10 m high along parts of the beach. A seaside resort has been built inside beyond the sand dunes. Numerous tea shops and other food stalls lined the path leading to the beach. The tsunami waves lashed and made their way over the ridges of this dune sand beyond them through the numerous small drainage channels running into the sea from the city, causing loss of life and much scouring while receding. An estimated two hundred people mainly stall owners and visitors, died at this beach.
- The town of Velankanni, 12 km from Nagapattinam, houses the Church of Mary of Good Health and is a very popular pilgrimage centre among believers for its healing powers. The central axis of the church is aligned with the main road leading to the beach. Thousands of people attending worship had crowded to this city for Christmas, and many of them were at the beach on the morning of 26<sup>th</sup> December after attending Mass. More than 2,000 people died in this town. A tsunami waves approximately five meters high first struck the shore at 9:20 A.M., followed by four more waves between 9:20 A.M. and 10:00 A.M. The waves crashed into the shore and continued on their rampage along the main road leading to the

town. Though the water did not enter the church, it gushed up to the bus stand, inundating several shops and houses.

- Silver Beach had been recently developed for tourism and recreation activities, such as boating and a small amusement park. Two rivers discharge into the sea at this scenic location. The shore is at sea level. The first tsunami wave arrived at 8:35 A.M., with two subsequent waves within the next 15 minutes. The waves threw boats upstream into the rivers and subsequently onto the shores. The waves destroyed most of the small structures built on the beach, such as a police booth, a boathouse, water tanks, and electricity poles. The newly built road was washed away completely, as was the new Neyveli Lignite Corporation (NLC) amusement park.
- The Kancheepuram District has special significance because of the presence of the Kalpakkam nuclear power plant. The plant area did not affect by the tsunami. On the other hand, the housing colony was very badly affected. Almost 1,000 houses were damaged, and a seawall two mts high and four km long collapsed. The waves rushed into the colony, with a runup height of about 1.5 mts. Almost all courtyard walls of the houses for one km collapsed. There was almost no vegetation near the shore. A new estuary was formed. A school's compound wall was damaged, and electric poles were uprooted near the school grounds. The tsunami waves deposited a large quantity of sand near a pedestrian bridge. Water pipelines along the bridge were thrown off the bridge.
- The tsunami waves hit the Andhra Pradesh coast at 9:05 A.M. The waves destroyed dwellings and the livelihoods of fishermen and caused numerous kinds of secondary damage, such as loss of fruitful land and loss of employment (**Alpa Sheth, et al., 2006**). Fishing and agriculture are the two main occupations in the villages along the coastline in Andhra Pradesh. The tsunami washed away most of the fertile topsoil and deposited heaps of sand, which ultimately left people with the choice of either changing the land use or changing the crop pattern (**Madan Kumar Jha, 2010**).
- The imports and exports of marine products like fish, prawns, coral reefs, oysters, pearl fishing etc were jeopardized.
- Heavy monetary and property loss was found at Chennai Harbour. The cargo sheds of the Chennai Port have been devastated beyond repair.
- The reconstruction and restructuring of what has been lost would impair the ongoing projects of future extension or developmental programmes.
- Recapitalizing the damaged industrial units is a daunting task.
- As high as 30,000 hectares of Cauvery delta area has turned saline, making the land unfit for cereal cropping. The area needs reclamation.
- The winter crops on coastal area especially in Districts of Nagapattinam, Tiruvarur, Cuddalore, as 20,000 hectares were inundated.
- Casuarinas saplings, groundnut and horticultural crops raised in areas at Kodiyakarai in Cuddalore District have withered.
- Having lost the standing crops, the crop loss estimate may even touch 5-7 crores of rupees.
- The agricultural activities were halted at 123 coastal villages in Nagapattinam District 53 villages at Cuddalore District. Farmers say that the cultivation could not be taken up for a few years in view of salinity of the soil.
- In few Districts, the Paddy fields in some areas were sand cast up to a height of 15cms.
- The water in wells far away from the sea has also become saline.
- The most significant change caused by is the “cartographic changes; that is entire Indian continent was dragged to east by 9mm.
- The entire marine ecology along Tamil Nadu has been shattered.
- Though Nagapattinam and Tiruvarur Districts were known for their natural drainage system, the silted canals and tall bunds put up by aquaculture farms contributed to water clogging for several hours in

some areas. The sea breeze added to the farmer's woes. Though the coconut, and cashew grooves withstood the onslaught.

- The coastal freshwater bodies have become saline, due to the slamming of ocean waves over them.
- The soil chemistry on the coastal & neighbouring areas has changed, from its original nature.
- The texture and the composition of beach sand have changed.
- LTL, HTL (low tide level and high tide level) of coast has been changed, observably.
- The extent of the marine fishing area has been reduced observably.
- The Two estuarine mouths of Adyar and Cooum rivers have been widened; the sandbars at the mouth area were washed away, allowing a free mix of water of sea and river.
- The width of the beach has been reduced; because the shoreline has been brought forward a few metres.
- Many coastal tourist spots have lost their attraction and charm hence the tourism income also has been reduced drastically. Income loss may be estimated at 15 to 20 crore.
- The word Tsunami had happened to the exhortation of whole Indian people.
- The economic slump caused by Tsunami in the sectors like agriculture and industries has affected the normal economic life.

## CONCLUSION

The biggest tsunami, which struck eleven nations that border the Indian Ocean, was a total surprise for the people living there. There were no established communication network or organization infrastructures to pass a warning of any kind to the people living at coastlines. No tsunami warning system exists for the Indian Ocean as it exists in the Pacific Ocean. There should need for early warning Centre set up in the Indian Ocean and every country within the Indian Ocean part of this for sharing information.

## REFERENCES

- Alpa Sheth, Snigdha Sanyal, Arvind Jaiswal and Prathibha Gandhid (2006), "Effects of the December 2004 Indian Ocean Tsunami on the Indian Mainland", *Earthquake Spectra*, Volume 22, No. S3, pp. S435-S473
- Barbara Ferreira (2011), "When icebergs capsize, tsunamis may ensue". *Nature*. <http://blogs.nature.com/barbaraferreira/2011/04/17/when-icebergs-capsize>. Retrieved 2011-04-27.
- Campbell Phillips (March 16, 2011), "The 10 most Destructive Tsunamis in History", *Australian Geographic*, Science Environment, <http://www.australiangeographic.com.au/topics/science-environment/2011/03/the-10-most-destructive-tsunamis-in-history/>
- Chanson H. (2010), "Tsunami Warning Signs on the Enshu Coast of Japan", *Shore & Beach*, Volume. 78, No. 1, pp. 52-54.
- Chu Yonghai & Li Jiancheng (2014), "Extraction of Two Tsunamis Signals Generated by Earthquakes around the Pacific Rim", *Geodesy and Geodynamics*, Volume 5, No. 2, pp. 38-47 <https://www.sciencedirect.com/science/article/pii/S1674984715300173>
- DonMcCue (2018), "Tsunami Timeline", <https://www.timetoast.com/timelines/tsunami-timeline-20eb80d4-7608-4de2-93db-a299d9c173eb>
- Fradin, Judith Bloom and Dennis Brindell (2008), "Witness to Disaster: Tsunamis", *Witness to Disaster*, Washington, D.C.: National Geographic Society, pp. 42- 43. <http://shop.nationalgeographic.com/product/977/4389/971.html>.
- Geology, <http://walrus.wr.usgs.gov/tsunami/basics.html>. Retrieved 2009-09-09.
- George Pararas Carayannis (2005), "The Great Earthquake and Tsunami of 26 December 2004 in Southeast Asia and the Indian Ocean", <http://www.drgeorgepc.com/Tsunami2004Indonesia.html>
- Gopal Raj N (December 27, 2004), "Tsunamis return after 60 years", *The Hindu*, <https://www.thehindu.com/2004/12/27/stories/2004122702951800.htm>

- Gusiakov V (2009), "Tsunami Quantification: how we measure the overall size of tsunami (Review of tsunami intensity and magnitude scales)", <http://www.ngdc.noaa.gov/hazard/data/presentations/jtc/gusiakov.pdf>. Retrieved 2009-10-18.
- Haugen K, Løvholt F, Harbitz C, K, Lovholt, F and Harbitz, C (2005). "Fundamental mechanisms for tsunami generation by submarine mass flows in idealised geometries", *Marine and Petroleum Geology*, Volume. 22, No. 1&2, pp. 209–217.
- India Profile 2009 and 2010.
- Jayant Verma (2013), "Impact of Tsunami in India", *World Times*, <http://worldnewsatimeofindianfireworks.blogspot.com/2011/12/impact-of-tsunami-in-india.html>
- Kelly Gavin (2004). "Ammianus and the Great Tsunami", *The Journal of Roman Studies* Volume. 94, No. 141, pp. 141–167.
- Lareef Zubair (28<sup>th</sup> December 2004), "Scientific Background on the Indian Ocean Earthquake and Tsunami", <https://www.ldeo.columbia.edu/~lareef/tsunami/science.html>
- Madan Kumar Jha (2010), "Natural and Anthropogenic Disasters Vulnerability, Preparedness and Mitigation", Capital Publishing Company & co published by Springer, New Delhi, p. 74.
- Margaritondo G (2005), "Explaining the physics of tsunamis to undergraduate and non-physics students", *European Journal of Physics*, Volume. 26, No. 3, p. 40.
- Mary Bagley (2017), "Kakatoa Volcano: Facts About 1883 Eruption", *LiveScience*, <https://www.livescience.com/28186-kakatoa.html>
- News 18Test Sharma (April 11, 2012), "Earthquake and tsunami updates", <https://www.news18.com/news/india/earthquake-and-tsunami-updates-464216.html>
- Pradyumna P. Karn and Shanmugam P. Subbiah (2011), "The Indian Ocean Tsunami - The Global Response to a Natural Disaster", *The University Press of Kentucky*, USA, p. 101.
- Preeti Zachariah (December 26, 2015), "Photo Essay: 11 years later", <https://www.livemint.com/Leisure/ruLGZR5SyD0uhmwRrdOZzN/Photo-Essay-11-years-later.html>
- Rajib Shaw (2006), "Recovery from the Indian Ocean Tsunami Disaster", *Disaster Prevention and Management - An International Journal*, Vol. 15, No. 1, p.70.
- Sarthak Hatwar, "Tsunami and its Damages"<https://www.scribd.com/doc/65069352/Ppt-on-Tsunami>
- Sherley Gnana Sathiyar T, M. Anandan and G. Ragunath (2014), "Economic Impacts of Tsunami on Tamil Nadu - An Overview", *Indian Streams Research Journals*, Vol. 4, No. 3. pp. 1-5
- Smid, T. C. (1970). "Tsunamis' in Greek Literature", Volume. 17, No. 2, pp. 100–104.
- Sosial Budaya (2011), "Phobia Tanggal 26 - Hoax", <https://www.kompasiana.com/rifkidikompa/5509f419813311ff63b1e23a /phobia-tanggal-26-hoax>
- Statistical Report 2006, 2008 and 2010, Ministry of Statistical Department, Government of India.
- The American Heritage Stedman's Medical Dictionary (2008), "Tidal", *Houghton Mifflin Company*, [Dictionary.reference.com](http://Dictionary.reference.com).
- The Rediff Interview Nuclear expert L V Krishnan (January 07, 2005), <http://www.rediff.com/news/2005/jan/07inter1.htm>
- The Times of India (December 27, 2017), "Flowers, Pictures help fisher folk cope with 2004 tsunami losses", <https://timesofindia.indiatimes.com/city/chennai/flowers-pictures-help-fisherfolk-cope-with-2004-tsunami-losses/articleshow/62262342.cms>
- United States Geographical Survey (2008), "Life of a Tsunami", *Western Coastal & Marine*
- Voit S.S (1987), "Tsunamis", *Annual Review of Fluid Mechanics*, Volume. 19, No. 1, pp. 217–236.
- Wells, John C. (1990), "Longman pronunciation dictionary", Harlow, England: Longman, p. 736.