UNDERSTANDING NATURAL HAZARDS: RISKS FACING INDONESIA

JANUARY 2025

KEY HIGHLIGHTS

Indonesia is exposed to multiple natural hazards including earthquakes, tsunamis, volcanic eruptions, cyclones, floods, landslides, and drought. (As seen in Figure below and on pg. 3) Located on the Pacific Ring of Fire, and at the intersection of three active tectonic plates, the country is exposed to significant seismic and volcanic activity. Indonesia is vulnerable to extreme weather events, and the risk, impact and occurrence of natural hazards is expected to increase.

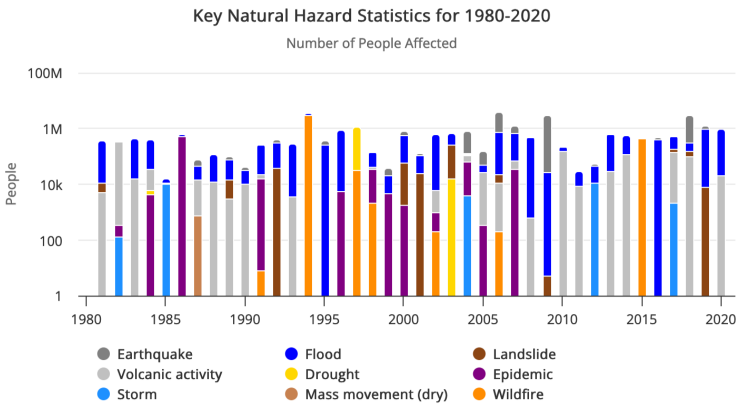
- The climate is tropical, with the wet season occurring between November and April, while May through October is typically dry[1]
- The World Risk Report puts Indonesia as second among countries with the highest disaster risk worldwide[2]
- Indonesia is at risk of megathrust earthquakes, which are among the most powerful and can generate destructive tsunamis, such as the 2004 Indian Ocean earthquake and tsunami, where a magnitude (M) 9.0 earthquake originating from the Sunda megathrust off the coast of Aceh province triggered a massive tsunami and affected over a dozen countries in the region, leaving over 230,000 dead. More than 167,000 lost their lives in Indonesia[3]

FAST FACTS

Geography: Indonesia is the world's largest archipelago, comprised of over 17,500 islands, with over 81,000 km of coastline, with varied geography, topography, and climate[10]

Total Population: 281.6 million (2024).[11] Indonesia is the fourth most populous nation in the world[12]
Population of Jakarta: 10,562,088 (city proper)[13]

Administration: Indonesia is comprised of 31 provinces, the autonomous province of Aceh, special region of Yogyakarta, and the National Capital District (Jakarta)[14]



Source: World Bank. Indonesia: Natural Hazard Statistics.
https://climateknowledgeportal.worldbank.org/country/indonesia/vulnerability

Vulnerability Factors

- According to government estimates, 97 percent of the population live in areas prone to disasters. Earthquakes are the highest-risk events, with 62.4 percent of the population exposed. Additionally, 63.7 million people are exposed to flooding, 40.8 million to landslides, 4.2 million to tsunamis, and 3.9 to million to volcanic activity[4]
- High population density in hazard prone areas, along with strong dependence on the country's natural resource base increase vulnerability.[5]

Impact on Communities

- Natural hazards put the population, infrastructure and development at risk. During 2020-2023, thousands of natural disasters affected the country, with around six thousand disasters from 2020-2021. In 2023, natural disasters increased by around 39 percent over 2022 with at least 4,940 disasters, affecting over 8.7 million people. [6, 7] During 2010-2021, 6.5 million new displacements were attributed to disasters. Since 2000, the country has lost at least US$16.8 billion annually from disasters.[8]
- A global risk analysis ranks Indonesia as 12th out of 35 countries facing a relatively high mortality risk from multiple hazards[9]

OVERVIEW OF NATURAL HAZARDS

Earthquakes

Seismic risks in the country stem from the interaction of the Pacific, Eurasian and Australian plates, which produce frequent and sometimes destructive quakes, including powerful megathrust earthquakes. Areas likely to be affected by megathrust earthquakes include: western coast of Sumatra, southern coast of Java, West and East Nusa Tenggara, North Sulawesi, West Papua, and Maluku.[15]

Indonesia experiences an average of 20 earthquakes a day, although most are too weak to be felt.[16] Recent earthquakes, such as the M5.6 temblor which struck Cianjur district in West Java province in November 2022, leaving 338 dead and affecting over 117,000 people,[17] and in January 2021, when a M6.2 quake struck West Sulawesi, leaving 107 dead and displacing 71,000 people,[18] remain a constant threat.

Major earthquakes include:

- 2009: A M7.6 earthquake hit off the coast of Padang City, capital of West Sumatra on September 30. A second earthquake of M7.0 struck the next day in Jambi province, Central Sumatra. The two quakes left 1,117 people dead and affected 2.5 million[19]
- 2006: A M6.3 earthquake in May struck Yogyakarta and surrounding areas of Central Java, leaving around 5,800 killed and around 140,000 houses destroyed[20]

NATURAL HAZARDS (CONT.)

Tsunami

More than 4 million people live in areas where they are at risk of tsunamis.[21] The health of coral reefs may be an important factor in tsunami mitigation, as the loss of reefs may cause tsunamis to be more destructive as energy would be less dissipated compared to healthy reefs.[22]

The 2004 earthquake and tsunami prompted Indonesia to enact legislation on disaster management in 2007 and to establish the National Disaster Management Agency (Badan Nasional Penanggulangan Bencana, BNPB) in 2008.

Major tsunamis include:

- 2018: In September, a series of earthquakes struck Central Sulawesi, with one triggering a large tsunami. At least 2,227 were killed and over 1.5 million were affected[23]



Hundreds of displaced people from Indonesia prepare to board an Indonesian C-130 aircraft in Palu, Indonesia Oct. 10, 2018. Source: DVIDS. Photo by Master Sgt. James May. https://www.dvidshub.net/image/4824242/indonesian-humanitarian-relief-expands-with-multinational-support-efforts

Volcanoes

Volcanic activity in the archipelago is common, as a string of volcanoes runs southeastward through Sumatra, Java, Bali, and Nusa Tenggara, and then hooks north and westward to the Banda Islands of Maluku and North Sulawesi. There are roughly 130 active volcanoes.[24] The most active volcanoes are: Sinabung, Merapi, Kaba, Kerinci, Anak Krakatau, Papandayan, Slamet, Bromo, Semeru, Batur, Rinjani, Sangeang Api, Rokatenda, Egon, Soputan, Lokon, Gamalama, Dukono, Karangetang, Ibu, and Talang.[25]

The Centre of Volcanology and Geological Hazard Mitigation (Pusat Vulkanologi dan Mitigasi Bencana Geologi, PVMBG) estimates more than 5 million are within the danger zone of a volcano.[26] A recent eruption of the Lewotobi Laki-laki volcano in East Nusa Tengarra Province in November 2024 left at least 10 dead[27] and displaced more than 15,000.[28]

Major volcanic eruptions include:

- 2021: In December Mt Semeru in East Java killed 34 people, and affected 5,205 people[29]
- 2010: An eruption at Mount Merapi in Central Java left 353 dead[30]

Tropical Cyclones (TC)

While TCs pose a risk, Indonesia's location straddling the equator means activity is less than neighboring countries such as the Philippines. Powerful cyclones are uncommon but potentially damaging. The Meteorology, Climatology, and Geophysics Agency (Badan Meteorologi, Klimatologi dan Geofisika, BMKG) warns that once rare TCs are happening more often.[31] Between 2008 and 2016, one tropical cyclone struck the country every few years, however, between 2016 and 2021 one or two storms have struck annually.[32] Indonesia is affected by TCs in the southeastern Indian Ocean between January and April and in the eastern Pacific between May and December.[33]

Historical cyclones:

- April 2021: Cyclone Seroja was the most powerful cyclone on record to hit the country, leaving 181 dead, and affecting 500,000 people in East and West Nusa Tenggara[34]
- 10 TCs since 2008: Durga (2008), Anggrek (2010), Bakung (2014), Cempaka (2017), Dahlia (2017), Flamboyan (2018), Kenanga (2018), Lili (2019), Mangga (2020), and Seroja (2021)[35]

Floods

Flooding caused by TCs, monsoon rains or a combination of both, pose a risk, and the country is affected by regular flooding and coastal inundation. The rainy season occurs between November and April.[36] During a La Nina period, Indonesia can expect wetter conditions.[37]

Repeated flooding is a problem for the Jakarta area. Jakarta is at risk of being submerged, as it is reportedly sinking some 16 – 17 centimeters annually due to development in and around Jakarta. Officials plan to relocate the capital to Kalimantan, due to a lower risk of natural hazards.[38]

The population exposed to an extreme river flood could grow by 1.4 million by 2035–2044, according to the Asian Development Bank.[39] Additionally, Indonesia is estimated to have one of the largest coastal populations exposed to flooding from once in 100-year storm surges.[40]

Historical Floods:

- 2004: flooding and landslides followed by heavy rains on the island of Sumatra in March left at least 263 people dead, forced the evacuation of 77,000 people, and affected 12 out of 19 districts in West Sumatra. The disaster followed flooding the previous month in Demak and Grobogan regencies in Central Java, which displaced 11,500 people and affected 71,000 in total.[41, 42]
- Heavy rains from mid-December 2019 through June 2020 led to 700 occurrences of flooding, landslides and tornadoes, likely causing at least 200 deaths and displacing more than 1.4 million[43]

NATURAL HAZARDS (CONT.)

Landslides

BNPB estimates that 40.8 million Indonesians are exposed to landslide risks. Landslides may be caused by various factors, including seismic activity, heavy rains, ground conditions, as well as human-induced, such as the building of roads and unplanned development in unstable land.

According to the BNPB, landslides have the highest occurrence compared to other natural hazards, such as floods, windstorms, and earthquakes. Due to the country's growing population and increasing urbanization, landslides have become more common. From 2015-2024, there have been 7,024 landslide incidents across the country.[44]

Historical landslides:

- 2021: In April, Cyclone Seroja caused solidified lava to tumble down the slopes of Ili Lewotolok in East Nusa Tengarra province and triggered flash floods. Natural debris carried by the cold lava flows and flash floods caused 46 deaths and displaced 1,104.[45]

Drought

Two drought types affect Indonesia: meteorological (associated with a precipitation deficit) and hydrological (associated with a deficit in surface and subsurface water flow). The EL Nino Southern Oscillation (ENSO) increases the likelihood of below normal rainfall conditions.[46]

Historical droughts:

- 2019: 50 million people were affected by a long-running drought. Some 92% of the country experienced some level of drought due to El Niño conditions that began in late 2018. Emergencies were declared in Banten, Central Java, West Java, East Java, Yogyakarta, West Nusa Tenggara, and East Nusa Tenggara.[47]

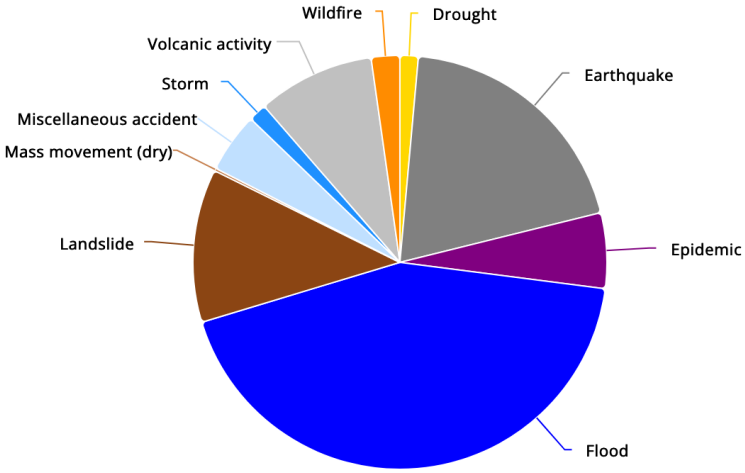
Extreme Weather Events

Indonesia is considered to be at risk due to its geography, demographics and exposure.[48] The country has high exposure to flooding and extreme heat. The intensity of these hazards is expected to grow and without effective adaptation, population exposure will rise.[49]

The east and western parts of Java, coastal regions of Sumatra, parts of northern and western Sulawesi and southeastern Papua are all highly vulnerable to numerous hazards, including drought, floods, and landslides.[50]

By 2050, Indonesia will be in the top five countries in the region that have the highest assessed multi-hazard risk.[51] Indonesia is particularly vulnerable to sea-level rise, with the country ranked fifth highest in the world. Without adaptation, the population likely to be exposed to permanent flooding by 2070 – 2100 could reach over 4.2 million.[52]

Average Annual Natural Hazard Occurrence for 1980-2020



Source: World Bank. Indonesia: Natural Hazard Statistics.
https://climateknowledgeportal.worldbank.org/country/indonesia/vulnerability

DISASTER MANAGEMENT STRUCTURE

- The BNPB is the country's central governing body for all disaster-related activities
- Provincial and Local Disaster Management Agencies (Badan Penanggulangan Bencana Daerah, BPBD) respond at the provincial and local levels
- The Ministry of Energy and Mineral Resources (Kementerian Energi dan Sumber Daya Mineral, ESDM) is responsible for monitoring geologic hazards
- The Ministry of Foreign Affairs (Kementerian Luar Negeri) is the primary contact for international assistance requests and offers
- Indonesian Armed Forces (Tentara Nasional Indonesia, TNI) assists with delivering relief, and with search and rescue
- National Police (Kepolisian Negara Republik Indonesia, POLRI) protects people, assets, and environment from disaster and disturbance
- Ministry of Health (Kementerian Kesehatan) monitors health concerns
- The Ministry of Social Affairs (Kementrian Sosial, MOSA) manages the process of humanitarian assistance
- The Ministry of Transportation (Kementerian Perhubungan dan Transportasi) is responsible for repair and recovery of public transportation
- BMKG provides hazard monitoring and informs the public in times of emergency
- PVMBG provides research and services in volcanology and geological disaster mitigation[53]

MAJOR ACTORS IN A DISASTER RESPONSE

National:

- BNPB
- BPBD
- PVMG
- POLRI
- TNI
- Ministry of Defense (Kementerian Pertahanan)
- Indonesia Search and Rescue Agency (Badan SAR Nasional, BASARNAS)
- Rapid Response Team (Tim Respon Cepat, TRC)
- Ministries of Health, Foreign Affairs, Energy and Mineral Resources, Public Works and Public Housing, Social Affairs, Transportation
- Emergency Operations Center (Pusdalops-PB) and Field Posts (Puskolap)
- Indonesian Red Cross Society (Palang Merah Indonesia, PMI)
- Humanitarian Country Team (HCT)
- Civil Society Organizations (CSOs)[54]

International:

- UN Agencies: UN Office for the Coordination of Humanitarian Affairs (OCHA), UN Children's Fund (UNICEF), UN High Commissioner for Refugees (UNHCR), World Food Program (WFP), World Health Organization (WHO), International Organization for Migration (IOM)
- International Federation of Red Cross and Red Crescent Societies (IFRC)
- International NGOs
- ASEAN. The ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre) is in Jakarta
- Changi Regional HADR Coordination Centre (RHCC) in Singapore
- Bilateral donors: USA, UK, EU[55]

USINDOPACOM DISASTER RESPONSE

Over the last 20 years, USINDOPACOM has supported at least four major natural disaster response operations in Indonesia, including the international response to the 2004 earthquake and tsunami. In support of U.S. government relief efforts for that disaster, the DoD provided 16,000 military personnel, 26 ships, 58 helicopters and 43 fixed wing aircraft.

USINDOPACOM also supported the response to the earthquake and tsunami in Palu, Sulawesi, in 2018, supporting the air bridge operation between Balikpapan and Palu. The DoD also assisted response efforts in May 2006 for an earthquake in Yogyakarta, and in September 2009 to earthquakes in Sumatra.[56]

RESOURCES

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- **Indonesia Disaster Management Reference Handbook. CFE-DM.** https://www.cfe-dmha.org/LinkClick.aspx?fileticket=BcQ7lZPdVD4%3d&portalid=0

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