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How did the Myanmar earthquake occur?

Has there been a history of earthquakes along the Sagaing fault? Has the earthquake caused damage in Bangkok as well? How did neighbouring eastern parts of India avoid any damage from the earthquake? Why is the plate boundary in Southeast Asia an active tectonic feature?

EXPLAINER

C. P. Rajendran

The story so far:

The powerful earthquake in Myanmar on March 28 had its source in central Myanmar, about 20 km from Mandalay, the country's second-largest city. Mandalay, located on the east bank of the Irrawaddy river, is close to one of the most seismically active faults in the region, called the Sagaing fault, named after a town not far from Mandalay on the river's opposite side. The earthquake of magnitude 7.7 struck around 12:50 pm local time, followed by several strong aftershocks, including one of magnitude 6.4, which occurred 11 minutes after the major event.

What effect did the quakes have?

The quakes were very devastating: they affected the entire region, left thousands of people dead, and destroyed many homes. The damage zone extended to Bangkok, the capital of neighbouring Thailand, which is about 1,000 km from the earthquake's epicentre.

However, the damage in Bangkok was minimal, confined to the complete collapse of a 33-storey high-rise under construction, and causing water from a swimming pool on the top of another high-rise building to overflow. However, these incidents were given much hype because of the city's place on the global tourism circuit. The outpouring of water from the rooftop pool was due to seismic seiches — oscillations in the water triggered by the passage of seismic waves through the area. Even though the building was located far from the earthquake's source, slower, long-period seismic waves can cause the top floors to sway more and amplify the seiches, as observed in this case.

The damage prediction models of the U.S. Geological Survey estimated that the total death toll in the region could reach well over 10,000. Mandalay itself is home to over 1.5 million people and was hit the hardest, with many buildings, including pagodas, mosques, and bridges, either partially damaged or completely collapsed. A review of the damage pattern reveals that much of the devastation was concentrated in the southern areas of the Sagaing fault because this region is sitting on a thicker pile of alluvium, deposited by the Irrawaddy, which amplifies the seismic energy, as compared to the northern parts of the fault. This also explains why China's southwest Yunnan Province, which is north of the fault, escaped earthquake-induced damage. The depth to the source of the 2025 earthquake on the Sagaing fault was only 10 km, which is another contributing factor for the heavy damage and a large felt area (area where the earthquake's shaking is felt).

The neighbouring eastern parts of India also escaped damage because the energy released by the earthquake dispersed in a north-south direction, following the trend of the fault.

Are quakes common in South Asia?

South Asia, including Myanmar, is highly prone to earthquakes due to its proximity to the complex assemblage of some of the largest tectonic features on earth, including the Himalayas, the Shillong Plateau, the Southern Indo-Burman Range, and the Andaman-Nicobar subduction zone. Originating from the collision of the Indian and the Eurasian Plates some 40 million years ago, the plate boundary in Southeast Asia is an active tectonic feature that generated one of the largest earthquakes in history, of magnitude 9.2, and a transcontinental tsunami in 2004.

The tectonic stress accumulating on these plate boundaries is the cause of frequent seismic activity in the region. The earthquake of 1792 was also a great 'megathrust' earthquake of magnitude 8.5, with its epicentre located somewhere along the Arakan coast of Myanmar. This seismic event generated a tsunami in the northern Bay of Bengal and caused widespread soil liquefaction in the Chittagong areas of Bangladesh. The large thrust fault extends further north onto the Chittagong-Tripura fold belt, where several moderate earthquakes continue to occur. It is still not clear whether this part of the deformation front can generate future great earthquakes.

Southeast Asia is a tectonic museum that exhibits structures that host earthquakes of varying faulting mechanisms, occurring at depths ranging from as shallow as 5 km to 200-400 km. The deeper ones occur in the southern regions closer to Indonesia or the Indo-Burmese regions in the north, bordering the subduction front along the Indo-Eurasian plates. The 2025 Mandalay earthquake in Central Myanmar was sourced from within the continental part of the mountain range. In the tectonics of mountain building, such features develop when sediment piles up and rocks are scraped off from the subducting Indian plate, which get plastered onto the overriding Asian plate.

What is the geodynamic context of the Sagaing fault?

Because of the complex interplay of plate motions and the resulting geodynamics in the eastern margin of the Indian Ocean, the northeast-directed convergence of the India and Eurasia plates takes place in a slanted fashion rather than happening head-on. This oblique convergence of the plates causes the overall strain to become partitioned, with part of the deformation being perpendicular to the plate boundary and the other part occurring parallel within the interiors. The north-south running Sagaing fault forms the tectonic boundary between the Central Myanmar Lowlands and the Indo-Burman Range. An elongated micro-tectonic block that exists between the Indian plate and the Sagaing fault is commonly called the Burma plate or the Burma sliver. It owes its origin to the strain partitioning occurring at the subduction front.

Studies have revealed that this fault, with its subsidiary parallel structures, accommodates much of the strike-slip part of the oblique convergence, with a slip rate of 15-25 mm a year and an accumulated slippage of 100-700 km. The Sagaing fault accommodates about 50-55% of the overall plate motion in the region. Unlike the vertical motions of fault blocks along the frontal part of the convergence zone, where one tectonic block is pushed up on the other, the movement is horizontal on the Sagaing fault, with the blocks sliding past each other. The San Andreas fault in the western U.S. is another such example. Unlike thrust faults, where earthquakes originate at either shallow or deeper sources, earthquakes on strike-slip faults are almost always shallower (10-15 km).

Classified as a typical ridge-trench transform fault, the Sagaing fault system runs 1,400 km between the spreading centre under the Andaman Sea in the south to the eastern Himalayan bend in the north. It has a long history of earthquakes. Moderate and occasional strong earthquakes of magnitudes 7 and above are common in central Myanmar, where six strong quakes of 7.0 magnitude or more struck between 1930 and 1956 along the Sagaing fault or on adjacent structures. Analyses of historical earthquakes have revealed that about half of the Sagaing fault has ruptured in the last few decades. Thus, the 2025 earthquake is not a surprise event but a part of the earthquakes occurring sequentially on this structure to release the accumulating stresses from the ongoing active plate interactions.

What does the Mandalay earthquake portend?

Historical records support the occurrence of an earthquake in 1839, called the Ava earthquake, that killed more than 500 people in central Myanmar. This event may have originated on one of the segments of the Sagaing fault with a hypothesised magnitude of 7.8. Equally interesting is the earthquake of 1927, reportedly felt strongly north of Yangon, Myanmar's largest city with a current population of more than four million people. Records also indicate that an earthquake occurred in 1946, possibly on the Sagaing fault north of Mandalay and with a magnitude of 7.7, like that of the 2025 temblor.

The historic city of Bagan in Central Myanmar, densely packed with religious monuments, has also been subjected to several damaging earthquakes. The latest one to hit this town was in 2016.

Science helps us understand the processes behind earthquakes and provides approximate locations of future earthquakes and their possible magnitudes. The Sagaing fault is not merely a scientific curiosity: it has a tragic impact on the millions who live with the restless fault beneath their feet. Myanmar is struggling to cope with the aftermath of the latest earthquake, with a rising death toll and extensive damage to infrastructure, both complicated by the ongoing civil war.

The 2025 Mandalay earthquake should serve as a warning to India. As the country most prone to earthquakes in South Asia, India should introduce scientifically tested safety measures and procedures to mitigate the impact of earthquakes.

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Mass destruction: A damaged pagoda in the aftermath of the earthquake in Amarapura township, Mandalay, Myanmar, on April 2. AP

THE GIST

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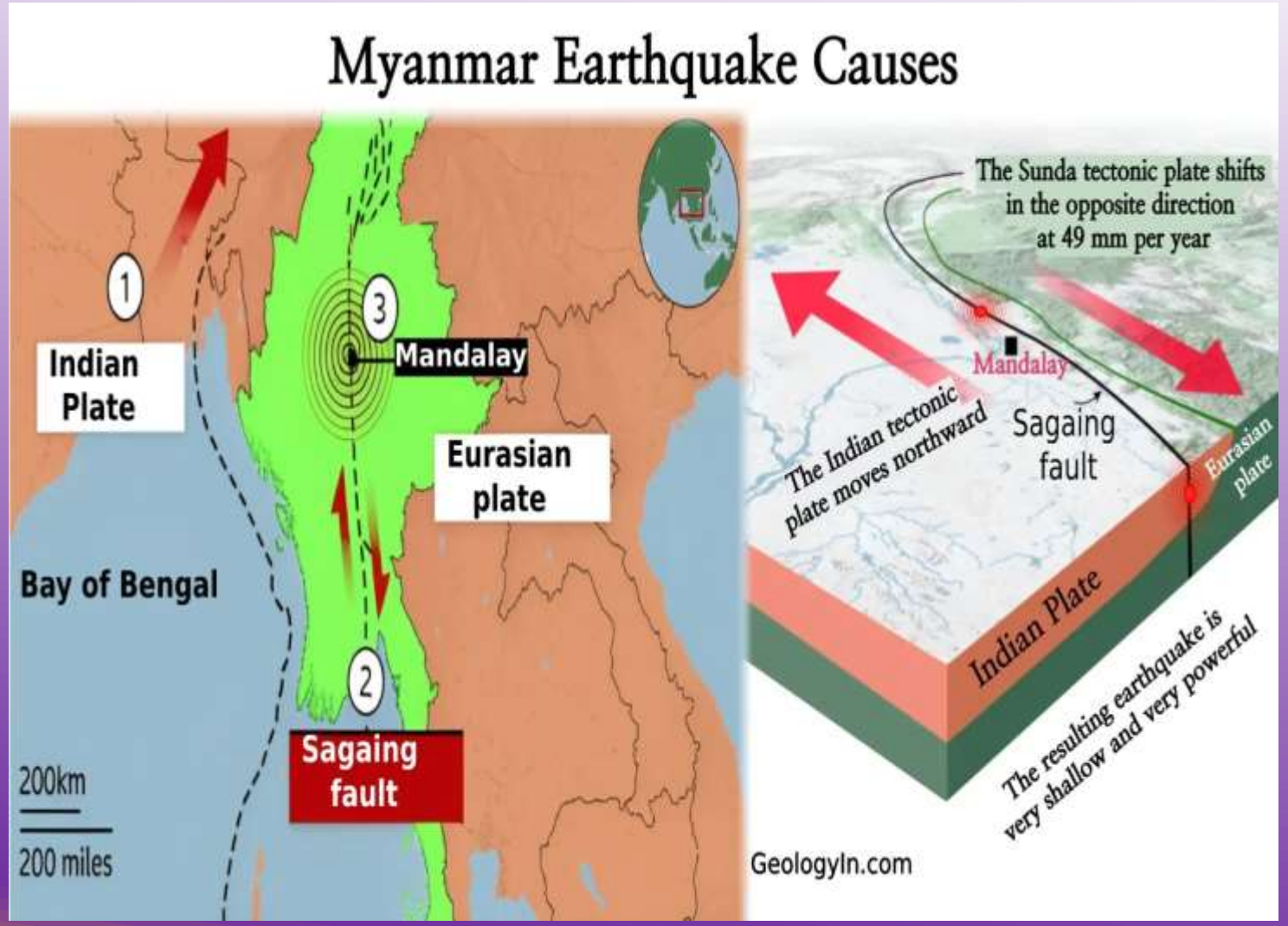
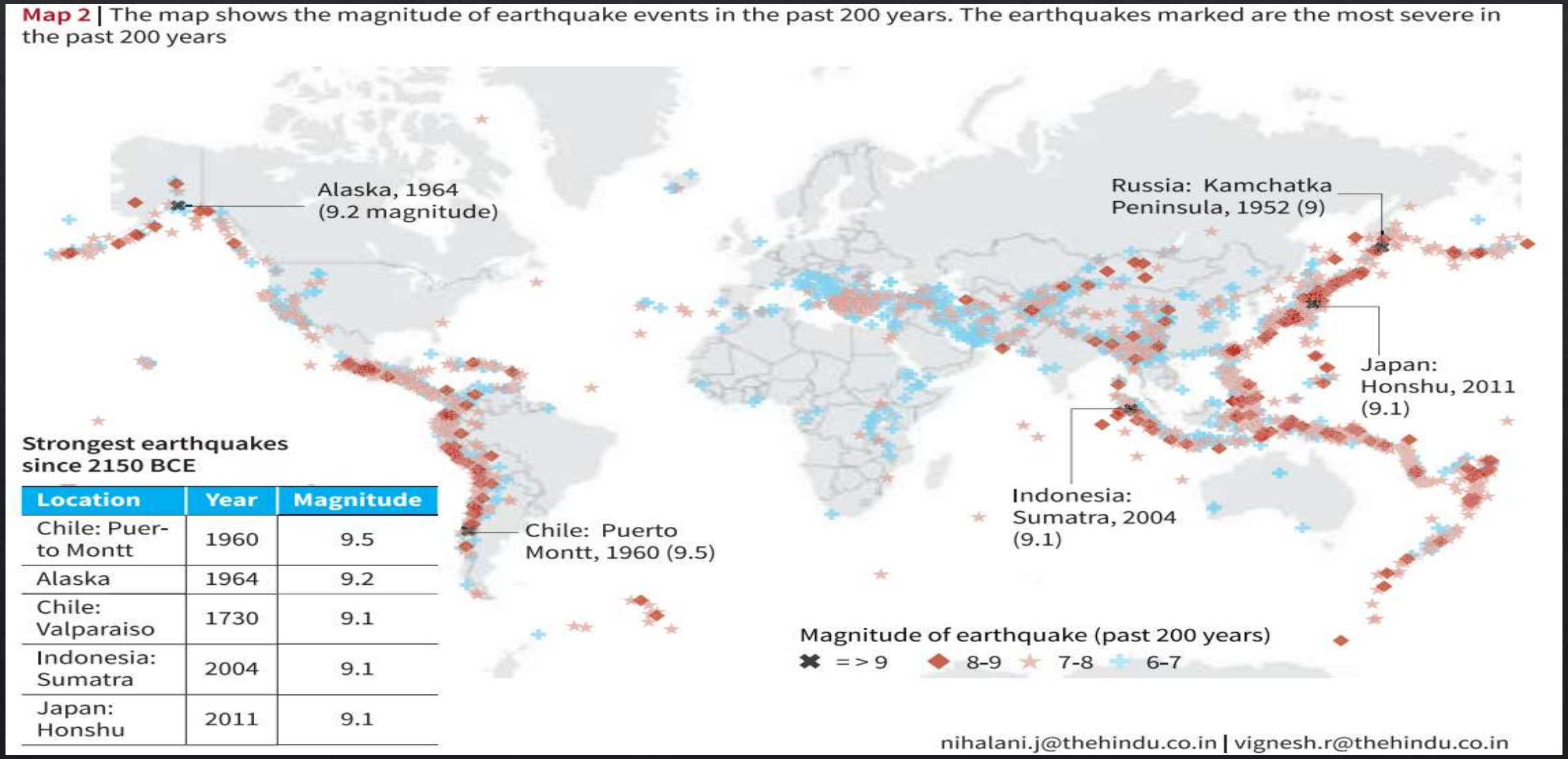


Distriution of EQ

Map 2 | The map shows the magnitude of earthquake events in the past 200 years. The earthquakes marked are the most severe in the past 200 years



Strongest earthquakes since 2150 BCE

Location	Year	Magnitude
Chile: Puer-to Montt	1960	9.5
Alaska	1964	9.2
Chile: Valparaiso	1730	9.1
Indonesia: Sumatra	2004	9.1
Japan: Honshu	2011	9.1

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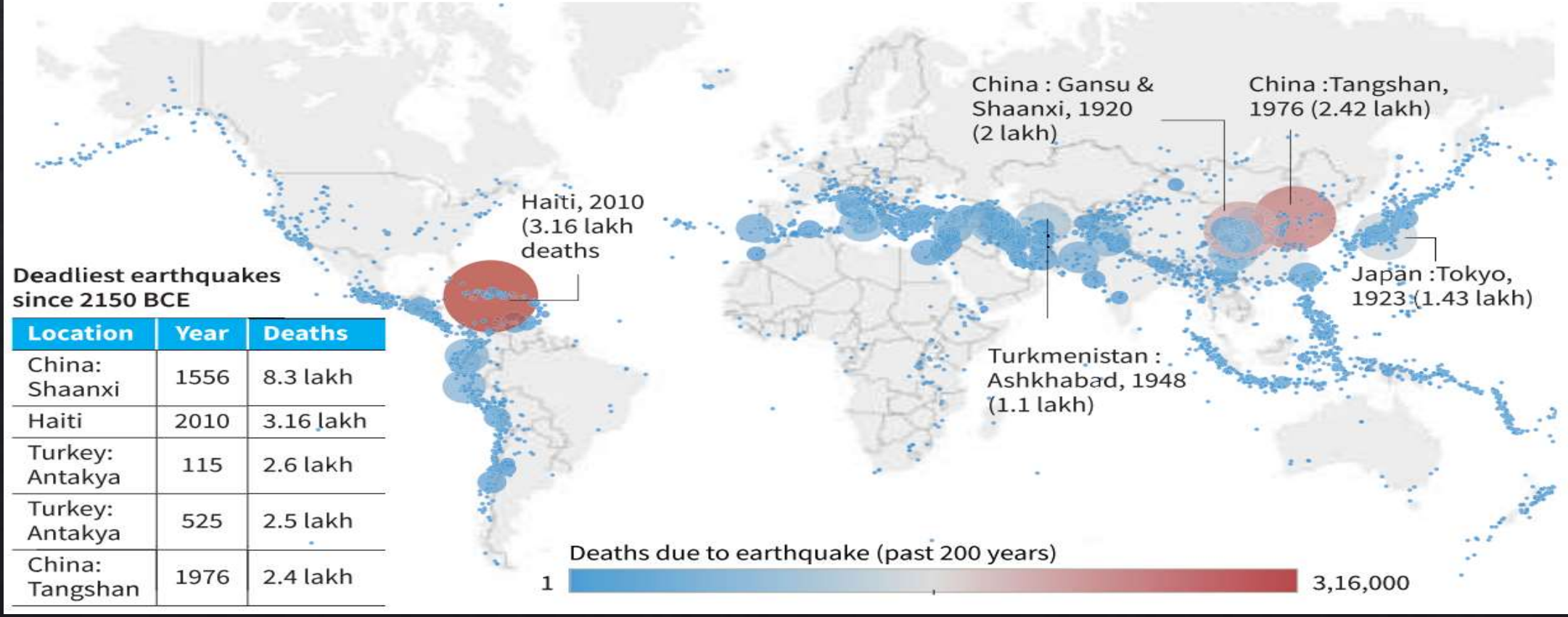
Distriution of EQ

Devastating tremors

The data for the maps have been sourced from National Centers for Environmental Information, a U.S. government agency

Map 1 | The map plots the death toll from significant earthquake events in the last 200 years. The bigger the circle, the higher the number of deaths related to those quakes. The earthquakes marked are the deadliest in the past 200 years



Deadliest earthquakes since 2150 BCE

Location	Year	Deaths
China: Shaanxi	1556	8.3 lakh
Haiti	2010	3.16 lakh
Turkey: Antakya	115	2.6 lakh
Turkey: Antakya	525	2.5 lakh
China: Tangshan	1976	2.4 lakh

The challenges of public health education in India

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The decision by the United States to withdraw from the World Health Organization (WHO) and drastically reduce the scale of the United States Agency for International Development (USAID) is one that has sent shock waves through the aid and public health world. This move has disrupted essential health-care services in many low- and middle-income countries. However, India has been largely unaffected, as international aid accounts for just 1% of its total health expenditure. Nevertheless, the cessation of such funding threatens to further shrink an already constrained public health development sector, which relies heavily on international support. More importantly, this development directly impacts the public health job market, reducing opportunities for thousands who are pursuing their Master of Public Health (MPH) and similar postgraduate courses.

Public health plays a critical role in shaping a nation's well-being and health-care delivery. The Constitution of India, through Article 47, underlines the state's responsibility to improve public health care. Public health is a specialised field that requires specific knowledge and skills to effectively address people's health needs. There is an urgent need for a dedicated workforce in India trained in public health, a fact that was very starkly realised during the COVID-19 pandemic. Beyond government systems, such a workforce is essential for civil society organisations, academic institutions, and research organisations engaged in public health.

The evolution of training and jobs in India

Though the surge in public health education in India is relatively recent, its history dates to the colonial era. In the early days, public health was largely embedded within medical teaching. This narrow approach persisted despite the establishment of the All India Institute of Hygiene and Public Health, Kolkata in 1932 and the subsequent inclusion of preventive and social medicine — later known as community medicine — as an essential part of medical education. Specialists in community medicine, well-trained in public health provided public health services and met human resource needs in this field. However, their numbers were limited, and they were often engaged in medical teaching. Many students pursued MPH courses abroad in countries such as Australia, the European Union, the United Kingdom and the U.S. Yet, the supply of public health professionals remained constrained. Recognising the growing need and demand, MPH institutions and teaching expanded in India.

The number of institutions offering MPH and related courses in India has grown rapidly. Currently, over 100 institutions offer master's level courses in public health, whereas in 2000, there was only one. This expansion coincided with the launch of the National Rural Health Mission (NRHM) in 2005, which opened public health system roles to non-medical public health specialists. A wide range of institutions, from social science faculties to community medicine departments within medical institutions, have begun offering MPH courses. However, after an initial surge in demand, government recruitment for public health specialists plateaued, while the number of schools, programmes, and graduates continued to rise. As a result, securing jobs has become increasingly difficult for graduates.

Compounding this issue are challenges such as the lack of standardised training, insufficient practical learning opportunities, faculty shortages, and varied curricula that inadequately prepare students for real-world public health challenges. In addition, institutions offering public health courses are unevenly distributed, with large and populous States such as Assam, Bihar and Jharkhand, and many smaller and hilly States, having none or only a limited number of seats.

The key issue is the mismatch between supply and demand, with shrinking job opportunities and the dominance of the private sector

Hurdles graduates face, issues in education

The foremost challenge is the mismatch between supply and demand, with limited and shrinking job opportunities for graduates. Today, entry-level positions in public health, such as research or programme assistants, attract a very high number of applications, with a significant proportion of candidates being eligible. The success rate remains exceptionally low, with only a few positions available. Moreover, the shrinking of public health roles and institutions within the public system has further limited job prospects. Efforts to establish public health management cadres in States have been hindered by multiple factors.

In recent times, the changing landscape of health care, marked by the growing dominance of the private sector in public health, further restricts employment opportunities. The private sector prioritises hospital and business management professionals over public health specialists. With limited opportunities in both the public and private sectors, the research and development sectors remain the primary employers for graduates. However, these sectors rely largely on foreign grants, and India is no longer one of the priority countries for such international funders. Similarly, the development sector is constrained by limited funding, which is expected to worsen further due to recent decisions in the U.S. The national research and health development funding remains in its early development and is significantly underfunded. Thus, the job scarcity for public health professionals continues and can exacerbate further.

Beyond job scarcity, there are concerns about the quality of MPH education. The rapid spread of public health schools has led to intense competition to attract students, often at the expense of compromising admission standards. Many students enrol in these courses without a clear understanding of the field or passion needed to thrive in this field. Further, public health faculty often lack adequate training and real-world experience. The absence of a standardised curriculum and clear outcome measures, despite the Health Ministry's model course framework further exacerbates concerns. In India, MPH courses are currently not mandatorily regulated by any regulatory body. Neither the National Medical Commission (NMC) nor umbrella organisations such as the University Grants Commission (UGC) oversee MPH training. In the absence of these quality measures, the overall quality of graduates is also impacted.

Approaches to consider

To address these challenges, a multi-pronged approach is required. The most urgent priority is to create public health jobs at all levels, from primary care to State and national health systems. In most developed countries with established public health education systems, governments are the largest employers of public health professionals. Similarly, establishing a dedicated public health cadre within State governments would be a significant step. This would not only create employment but also strengthen public health systems.

Next, a robust regulatory mechanism must be introduced by constituting a dedicated regulatory body or a specialised public health education division within existing regulatory agencies such as the NMC or UGC. This department, led by public health experts, should be responsible for setting curriculum standards and minimum training requirements while allowing room for institutional innovation, given that public health is a dynamic and evolving discipline. Moreover, public health training in all institutions must be closely integrated with practical learning opportunities within public health systems. There is a need to foster the growth of public health institutions in States where there are none or only a limited number. The emerging global situation calls for more national action and the building of local ecosystems for sustainable development in health.

The views expressed are personal