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The Role of Social Media in Earthquake Awareness and Earthquake Preparedness in Myanmar

Hla Hla Aung[1*] and Kye Mon Min Swe[2]

[1]Myanmar Earthquake Committee, Federation of Myanmar Engineering Societies, Yangon, Myanmar.
[2]Department of Population Medicine, Faculty of Medicine and Health Science, University of Tunku Abdul Rahman, Kuala Lumpar, Malaysia.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Myanmar is an earthquake-prone country in SE Asia and all types of faulting such as strike-slip, normal, and reverse are occurring all over Myanmar territory. Apart from surface faults, the India oceanic plate is subducting obliquely beneath Burma continental plate along Sunda subduction zone. The interaction between the India plate, the Burma plate and Eurasia plate appears to be characterized by the initiation of major movements between plates switching from one to another within this tectonic region. The Sagaing Fault is a primary plate boundary between the Burma plate and Indochina plate along which most of the relative motion has occurred and will continue to occur for the geologic future. According to seismicity record in Myanmar, most of the earthquakes occurred either in the evening or at midnight or at dawn. So the people become scary because earthquake occurs without warnings. During such situation, people run immediately outside the building to the open space due to people's survival instincts. People have anxiety which is a normal response to frightening situation. The social media interviews the earthquake researchers/ earthquake geologists why the earthquake occurs and how to protect them during earthquake. By disseminating the information on social networks, people become aware of the earthquake disaster and become focusing on effective preparedness.

**Corresponding author: E-mail: hhlaaung@gmail.com;*

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1. INTRODUCTION

Myanmar is situated in the South East Asia region which is located on the boundary of the Indo-Australia and Eurasia plates. Myanmar is a part of the Alpine-Himalayan-Indonesia Seismic Belt where Himalayan Seismic Belt lies in the northwest and Indonesian Arc in the southeast. The region is tectonically very active as indicated by frequent occurrence of earthquakes all over Myanmar region. The earliest earthquake on record is the Great 1762 earthquake occurred at 5:00 p.m. on 2nd April, 1762. In the years: 1839, 1912, 1929, 1930, 1931,1946,1956,1975, Myanmar experienced large earthquakes with magnitude ≥7.0 respectively. Since the year 2011, the new era of seismic activity took place again. The events are the 2011 M 6.8 Tarlay earthquake, the 2012 M 6.8 Thabeikkyin earthquake, the 2013 M 3.4 Yangon earthquake, the 2013 M 5.4 Thayet-Aunglan earthquake, the 2015 M 5.0 Monywa-Kani earthquake, the 2016 M 6.9 Mawlaik earthquake, the 2016 M 6.8 Chauk earthquake, the 2017 M 5.1 Taikkyi earthquake, the 2018 M 6.0 Bago Yoma earthquake, the 2019 M 3.4 Yangon earthquake, the 2020 M 5.9 Falam earthquake and the 2021 M 5.5 Thabeikyin earthquake. Most of the NNW-striking faults that dominate the area appear to be presently active, as shown by recent seismicity which includes historical earthquakes [1].

1.1 Tectonic Background

Myanmar has seven tectonostratigraphic terranes. In the Central Myanmar Basin, the majority of strain is accommodated along strike-slip faults and border faults of the sub-basins. These faults are easy to find when the individual earthquake struck on each fault. Focal mechanism solution of earthquakes and fault orientations give strong extension axis in an NNW-SSE direction and maximum compression axis direction in an E-W or ENE- WSW. Depth distribution of earthquakes shows that the majority of earthquakes occur at depth from 0-40 km [2, 3]. The Shan plateau belongs to the Indochina plate which is between the Red River fault and Papun –Three Pagoda fault. Southeastward extrusion of the Indochina plate controls the active tectonics of eastern Myanmar. The stress fields of the region from the studies of focal mechanism solution of earthquakes indicate that this area has been undergoing NW-SE extension and NE-SW compression [4,5]. Northward and northeastward movement of India oceanic crust under the Burma plate is the most important part for tectonics of Myanmar in Tertiary time. The significant intermediate-depth intraplate events have shown considerable destructiveness and these earthquakes occur in the interior of downgoing slab of the India plate. The frequency of the subduction zone earthquake increased recently in the 2016 to date [6].

2. METHODOLOGY

2.1 Setting

This paper aims to investigate the role of social media in earthquake awareness and earthquake preparedness. Background history of Myanmar earthquakes is reviewed as database. The 2011M 6.8 Tarlay earthquake was taken as a case study. An earthquake of 6.8 magnitude occurred at 01:55:12 UTC) on 24th March, 2011 (USGS). It was a violent earthquake. Six aftershocks occurred the same year. Its epicenter was situated in 20km west of Tarlay (20.705°N-99.949°E) at depth (10 km). The earthquake damage was disastrous. There were earthquake cracks, arch bend, erupting sand and gush water, etc. in many places. As a result of the strong earthquake, 224-305 houses were seriously damaged, (74) people were killed, (124) injured and 95,000 people were affected. The shock was felt in Northern Thailand in the south and Laos in the east.

2.2 Method of Analysis

Detailed morphotectonic studies were carried out using satellite image, 1:24,000 scale aerial photographs and 1:63360 scale topographic maps to correlate the seismicity with tectonics. From these studies, it is found that there are two prominent lineaments striking in NE-or ENE- and N-S or NNE- direction. The field survey for the 2011 M 6.8 Tarlay earthquake was carried out in April, 2011 to map the evidence of co-seismic deformation related to the earthquake.

3. RESULTS

Tarlay area is located in Than Lwin suture zone between Loi-se-Loi-len fault and Chiang Rai Tectonic Line [4]. The presence of bookshelf

faults and seismicity in the region points to the rejuvenation of tectonic process (Fig.1a and b). The 2011 Tarlay earthquake is a significant event that occurred in a plate-interior setting [7]. Most common coseismic features were sand boils, ground rift, rise of ground, ground subsidence. All these phenomena appear either together, in isolated spots or in linear structures. Sand boil and gushing water are often associated with ground rifts. The volume of sand extruded was large and found in the paddy fields. In Tarlay, many ground fissures appeared on the Tarlay Road. Graben-like step depression was formed between two ground rifts. Wells overflowed, some fell in, and some subsided in many places. Liquefaction affected many paddy fields mostly in Tarlay, Kyar-ku-ni and Nar Yawng villages.Ground displacements are found in the paddy field (Fig.2.a,b,c,d,e,f,g,h). The geological structure around the town is complex. Mong Lin, Nar Yawng, Kya-Ku-Ni village-tracts are among the most affected areas. The shock was felt in Northern Thailand in the south and Laos in the east. The damage was distributed linearly east and west of the epicenter. Some of the ground seismic damage appears over a large area. Buildings are damaged in different ways. Some buildings collapsed, some split open and others settled unevenly. All of these reflected the different basic geological conditions [7].

3.1 Earthquake-Related Psychological Disorder

People have anxiety which is a normal response to frightening situation, especially after the shaking of ground posed by an earthquake. People who experienced a strong shaking of the previous earthquake, they have anxiety all the time that another earthquake could hit in any time. This kind of feeling is called post-traumatic stress disorder. The impacts of the earthquake include deaths, injuries, the destruction of buildings and livelihoods, and financial losses. The earthquake hazard has had serious psychological consequences for the community living in the area. Unlike many other natural disasters, earthquakes occur without warning, and often linger for days, months and sometimes years in the form of on-going aftershocks [8]. Aftershocks can act as a powerful visceral stimulus for the reactivation of terror, uncertainty, helplessness, and confusion [9, 10]. Studies have found that 92% of their earthquake sample reported fear of small tremors [11]. Increased fear of aftershocks predicted immediate distress [12]. These studies suggest anxiety related to aftershocks may increase general psychological symptoms like anxiety, depression and posttraumatic stress.

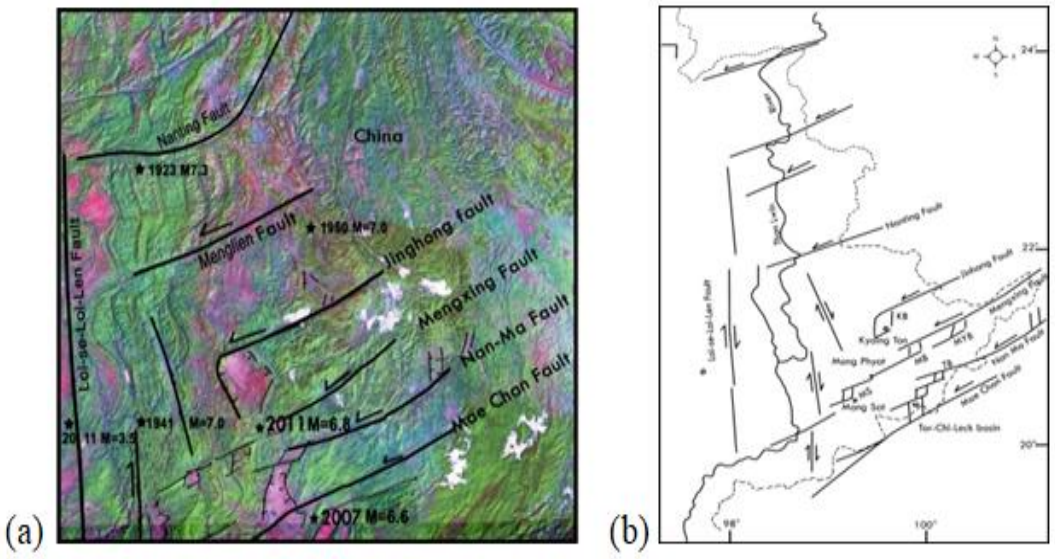

Fig.1. (a) A Google map shows sharpness of topographic features and ENE-WSW trending active faults in the Paleo-Tethys suture zone, easternmost part of Myanmar. Earthquake occurrences are shown with associated extensional basins. (b) Line drawing map showing extensional basins on segments of left-lateral strike-slip faults

Fig. 2. Photographs of surface deformation produced by the Tarlay earthquake along the rupture zone. (a,b,d) The ground crevices split and settle down like rifting on the road. (c) The ground crevices split and settle down like rifting in the paddy field. (e,f) columnar of the house shifted due to lateral displacement by the earthquake. (g) Sand extrusion as liquefaction features. (h) Ground fissure system in the village near Tarlay town
Source: MEC

For example, different levels of earthquake damage and different levels of financial resources had different degrees of earthquake-related disruption and loss, and these variables had varying influences on post-earthquake symptoms and functioning. Consequently neighbourhood damage, socioeconomic status, and earthquake-related disruption and loss may be hypothesized to play a role in aftershock response controllability and anxiety. Loss of resources following natural disasters such as damage to infrastructure, lifelines, power lines and dams reflects the earthquake hazard level.

Earthquake disaster has been consistently associated with psychological distress [13,14, 15]. According to the National Institute of Mental Health (NIMH), some of the most common symptoms of anxiety include:

- Feeling restless, wound-up, or on-edge
- Autonomic hyperactivity
- Trouble sleeping or sleeping well
- Being easily fatigued
- Having difficulty concentrating or feeling like your mind has “gone blank”

- Irritability
- Muscle tension
- Hyperactivity
- Difficulty controlling feelings of worry

Anxiety Treatment and Prevention include trying to remain involved with life and stick to your normal routines, expressing concerns and fears to supportive friends and family members, getting sufficient rest, relaxation and exercise and stick to a healthy diet, preparing for a future emergency preparedness [16, 17].

3.1.1 The role of social media in earthhquake awareness and earthquake preparedness

The degree of destruction in Tarlay and its surrounding area suggests that earthquake resistance design of the buildings, the bedrock depth, the engineering geologic condition of site and foundation are major governing factors to take into account for better preparedness.

The widespread occurrence of liquefaction also indicates that the area is covered with soft sediments. It means that the shallower the foundation depth the heavier the destruction and seismic waves travel faster through hard rocks than through softer rocks.

The important action to increase public awareness is earthquake education to improve public understanding of earthquake phenomena. Understanding earthquake mechanism can reduce the risk of property damage from earthquake. The cause of earthquake damage to people's lives and property is due to geological structures and characteristics of site area and foundation of the building itself. If construction plans and measures have not been drawn up so as to avoid such seismic hazards, the risk by earthquake would be much more disastrous.

Fig. 4. Photographs of community outreach program for earthquake education, (a,b) to the public in various townships. Earthquake education to the school children in various school and demonstration of earthquake drill exercise to the school (c,d,e). Lecture on earthquake science to the public (f,g,h,i)

Fig. 5. Photographs of interviews on media network (a,b). Earthquake articles in newspap er (c). Books on earthquakes history and earthquakes phenomena in English and earthquakes history and preparedness in Myanmar language (d,e,f)

Earthquake education to public is greatly required to let them know about earthquake science such as: why the ground is shaking, why the buildings are damaging, why there are ground failures and why people are killed, etc. The media comes forward to interview the earthquake researchers / earthquake geologist and disseminate the most authentic information to reach out to the people by the aid of the media platform.

The experience from previous earthquake events suggests that earthquakes do not kill people but poorly built buildings do. People have to take action to reduce the extent of damage and loss of life for future earthquake. This action is preparedness. Like remote sensing and GIS can minimize earthquake damage.

4. DISCUSSION AND CONCLUSION

Myanmar has all kinds of disaster, natural and man-made such as: storm, flood, earthquake, landslide, tsunami and man-made fire. Disaster risk reduction measures should be taken from a lesson learnt to prevent them from occurring and mitigate hazard. This is the need for better preparedness. In order to decrease seismic damage and loss of lives, effective preparedness and countermeasures through community level to regional level and national level are greatly required in nationwide to protect lives and property from natural hazard. Social media platform plays a major role to spread news of earthquake occurrence, awareness and preparedness through interviews. Ground shaking during an earthquake lasts about 10-30 seconds. When people experience a moderate or large earthquake, what they feel most is frightening. At the beginning of earthquake shaking, the shaking will be violent and it will be difficult to stand up. People cannot stay inside the building so that they run out to the open space and stay there until the shaking stop. They dare not go back to their apartments. They thought that there will be another ground shaking by earthquake. This is anxiety. Actually they should drop down as soon as they feel shaking and they should take cover under the table or desk or any other hard cover that protect them from fallen objects. People have anxiety which is a normal response to frightening situation. To reduce anxiety and to let them know what to do during earthquake shaking, community outreach

program have been carried out for earthquake education in the public places of various townships. Earthquake education lectures and demonstration of earthquake drill exercise are also given to the school children in various schools. For more widespread outreach to the public, interviews on media networks, earthquake articles in newspaper, books on earthquakes phenomena, earthquake preparedness, and historical earthquakes in Myanmar are written for the people. Disaster management personnel can coordinate emergency management through communication channels. By using social media in emergency management, Build Back Better can create a safer society from natural disaster.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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