The Progress of Earthquake Risk Reduction and Recovery in Turkey: From Marmara to Van

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ABSTRACT: Since 1939, there have been several important earthquakes in Turkey. However, from the Erzincan quake in 1939 through the Marmara quake in 1999 and then the Van quake in 2011, the number of people dying in earthquakes has steadily decreased. In the 1999 Marmara earthquake, more than 17000 people were killed and a great deal of regional infrastructure was destroyed. Almost 12 years after the Marmara earthquake there were many fewer deaths in a similar magnitude earthquake in Van. What had changed in Turkey during this time? This paper compares these two earthquakes and reveals big differences in terms of preparedness, mitigation, and response. The sources of these changes are explained, focusing on institutional changes regarding Turkey’s disaster risk reduction system as well as urban transformations in Ankara and Van.

Keywords: The Marmara earthquake, the Van Earthquake, response, recovery, mitigation and preparedness.

1. INTRODUCTION

Turkey is located in a high seismicity region and in its recent history, has suffered extensive losses due to several major earthquakes. Since 1939, the North Anatolia fault has been home to several earthquakes whose magnitudes (Richer scale) were more than 6.0 (Ercan, 2015). The biggest of these occurred on December 26, 1939 in Erzincan, a 7.8 earthquake that killed approximately 32700 people.

More recently there were two major earthquakes in 1999 in Turkey. The epicenter of the Gölcük (Marmara region) earthquake was on the North Anatolia fault on August 17, 1999. The second earthquake hit Düzce that also lays on North Anatolia fault on November 12, 1999. More than 18000 people were killed by these two earthquakes. Even though the Düzce earthquake area was located in the western part of Black Sea Region this earthquake influenced the Marmara Region, too (Efe, 2014).

![The seismic hazard map of Turkey](image)

Fig. 1: The seismic hazard map of Turkey (Gunes, 2015)

There are three main faults in Turkey: the North Anatolian fault, the East Anatolian fault, and the West Anatolian fault. The North Anatolia fault stretches from Van Lake towards Gulf of Soros and its length is 1100 km. The East Anatolia fault is a broken fault in Eastern Anatolia Region, and it is located between the Anatolia plate and the Arabian plate. These two faults converge into the East Anatolian vicinity, in north of Karlova / Bingöl. See Fig. 1 (Gunes, 2015).
On October 23, 2011 another very powerful earthquake struck in Van. The epicenter of this earthquake was in Tabanli Village that 30 km north of Van in Eastern Anatolia Region (Cakir, et al, 2015). According to Hekimoğlu et al. (2015), this earthquake had a Richter scale magnitude of 7.2. It destroyed 2262 buildings, but compared to the 1999 earthquakes there were far fewer casualties. Approximately 601 people died and 4152 people were injured in the Van earthquake. A second earthquake hit Edremit Village in Van on November 9, 2011 (Magnitude in Richter Scale 5.6). The casualties in this quake were also very low: 40 people died and 30 people were injured (Hekimoğlu, et al, 2015).

The different outcomes associated with these two earthquakes offer an opportunity to assess the progress of earthquake management in Turkey during this 12-year period. This paper explores this dramatic improvement in progress, comparing experiences in these two quakes and the changes in Turkey’s political and emergency management institutions. The Marmara earthquake experiences were the impetus for major advances in earthquake risk reduction. The government established new regulations to prevent and mitigate the damages. Civil associations whose members are mostly volunteers have been founded to help rescue processes during earthquakes. However, these advances have been made alongside a period of major economic development in Turkey, development which brings new challenges.

This paper compares the Marmara and Van earthquakes, revealing big differences in terms of preparedness, mitigation, and response. The sources of these changes are explained, focusing on urban transformations in Ankara and Van and institutional changes regarding Turkey’s disaster risk reduction system.

2. WHAT WENT WRONG IN THE MARMARA EARTHQUAKES?

The Marmara earthquakes in Gölcük and Düzce created a severe amount of trauma and loss. The population of Gölcük was 18,000 before the earthquake. In 2004, the population of this district was 6,540. Some people died during the earthquake. Some of them migrated. The differences shows clearly that the people migrated because of heavy disaster (Südaş, 2004, pp.4-6). Many of those who remained were children and teenagers who lost their family. They were transferred to child protection homes. But the living conditions were bad in those houses. Some teenagers escaped from these houses. Some of them were captured by mafia and enforced to engage in prostitution (Pincha, 2009, p.32). In addition to human losses, there were huge effects on infrastructure. According the report of the Association of August 17th, 90% of the roads were destroyed in Gölcük. Many of the governmental and military buildings and shipyard collapsed.

Why were the damages and deaths so high during the Marmara Earthquake? Among the primary reasons: Quick and irregular urbanization, poor selection of urban dwelling spaces, squatting, bad planning and unrestraint. In addition, the Gölcük district had been "swampish" in its history. The swamp region had been dried and later the city Gölcük was created on this area. This fact resulted in increased structural damages in the earthquake (Südaş, 2004, p.8).

Warning systems were also dysfunctional. The communication was totally broken during the Gölcük earthquake. The disaster warning system on cellphones collapsed as critical infrastructure was destroyed. Because of broken communication rescue processes were much more disorganized than they might have been otherwise. Rescue teams could not be warned on time because of lack of communication systems (Varol, 1999).

In addition, there were other dysfunctional aspects of the rescue process that contributed to fatalities. Dr. Varol was in the region a couple days after earthquake hit the Gölcük in order to observe the rescue process. He noticed that the preparedness of the government was disorganized. Rescue processes were done randomly. For example, during the rescue process of some people who laid under collapsed buildings, excavator machines were used unorderedly to dig the rubbles. Shovels of an

Table 1: Notable earthquakes in Turkey’s history (Ercan, 2015)

<table>
<thead>
<tr>
<th>Year</th>
<th>Place</th>
<th>Magnitude (M)</th>
<th>Number of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/26/1939</td>
<td>Erzincan</td>
<td>7.8</td>
<td>32700</td>
</tr>
<tr>
<td>12/20/1942</td>
<td>Tokat-Niksar-Erbaa</td>
<td>7.0</td>
<td>3000</td>
</tr>
<tr>
<td>11/26/1943</td>
<td>Samsun-Ladik</td>
<td>7.4</td>
<td>4000</td>
</tr>
<tr>
<td>02/01/1944</td>
<td>Bolu-Gerede</td>
<td>7.5</td>
<td>3959</td>
</tr>
<tr>
<td>08/17/1949</td>
<td>Bingöl-Karlıova</td>
<td>6.8</td>
<td>430</td>
</tr>
<tr>
<td>08/13/1951</td>
<td>Çankır-Kuryunlu</td>
<td>6.9</td>
<td>50</td>
</tr>
<tr>
<td>05/26/1957</td>
<td>Bolu-Abant</td>
<td>7.1</td>
<td>52</td>
</tr>
<tr>
<td>08/19/1966</td>
<td>Muş-Varto</td>
<td>6.7</td>
<td>2396</td>
</tr>
<tr>
<td>07/22/1967</td>
<td>Adapazan-Madunlu</td>
<td>7.2</td>
<td>89</td>
</tr>
<tr>
<td>05/22/1971</td>
<td>Bingöl</td>
<td>6.8</td>
<td>1000</td>
</tr>
<tr>
<td>03/13/1992</td>
<td>Erzincan</td>
<td>6.8</td>
<td>498</td>
</tr>
<tr>
<td>08/17/1999</td>
<td>Marmara (Gölcük)</td>
<td>7.4</td>
<td>17118</td>
</tr>
<tr>
<td>11/12/1999</td>
<td>Düzce</td>
<td>7.2</td>
<td>894</td>
</tr>
<tr>
<td>03/08/2010</td>
<td>Elazığ-Karakoçan</td>
<td>6.1</td>
<td>41</td>
</tr>
<tr>
<td>10/23/2011</td>
<td>Van-Ereçit</td>
<td>7.2</td>
<td>601</td>
</tr>
</tbody>
</table>
excavator machine hit a person head that resulted in his death. This event was defined as an accident of the rescue process. In fact, it was a fault of the drivers of excavator machine because he dug carelessly.

Finally, prior to the Marmara earthquakes, education on earthquake preparedness and reaction was relatively low. For example, during the earthquakes the people who lived in tall buildings ran downstairs through stairwells to escape during the earthquake. But most of them were killed as other buildings in the area collapsed. Many people had not been educated regarding how they should react when an earthquake occurs.

3. WHAT CHANGED AFTER 1999?

After the catastrophic Marmara earthquakes, the government decided to create some regulations in attempt to mitigate and prevent damages in future earthquakes as well as improve the processes of response and recovery. Part of this change included an overhaul of its emergency management structure. Passed in November 1999, Law 1999/583 created the Turkish Emergency Management Directorate (TEMAD). TEMAD was tasked with coordinating post-disaster activities, forming a variety of sub-national emergency management units, promoting disaster mitigation and risk reduction measures, short- and long-term planning, collecting and managing data, coordinating relief equipment and vehicles, and forming technical committees (Ural, 2011). TEMAD reports directly to the Prime Ministry and works in conjunction with the Council of Ministers to formulate emergency management policy at the national level.

In addition to changes in its emergency management structure, Turkey established a Statement named Obligatory Earthquake Insurance General Condition that was published on the Official Newspaper on May 13, 2011 with the issued number 27933. According to this statement all damages caused by an earthquake are protected by insurance. All insured buildings are covered by this regulation. Even if a building was affected due to secondary fires, explosions, tsunami, landslides occurring as a result of an earthquake, it is included in this insurance system (Resmi Gazete, 2011). Following this, the Turkish government released a regulation called Turkish Compulsory Earthquake Insurance (TCIP-in Turkish DASK) at Official Newspaper (Date: August 15, 2012, Newspaper number: 28385). This is a compulsory earthquake insurance provided by the Turkish Government to ensure the compensation of the material damages on dwellings caused by earthquakes (Resmi Gazete, 2012).

Following the Marmara earthquakes there was also a significant improvement in earthquake-related education. Many television programs were released about being prepared for earthquakes. In addition, a new course was created for the pupils of the elementary schools in Turkey to teach protection methods from disasters (including earthquakes). A famous scientist in the field of earthquake whose name was Prof. Dr. Ahmet Mete Işıkkara (passed away) gave many seminars in the elementary schools. He prepared cartoons and released videos on YouTube demonstrating how the children could protect themselves from the damages of earthquakes (Işıkkara, 2013).

4. THE 2011 VAN EARTHQUAKES: PROGRESS BUT STILL CHALLENGES

On October 23, 2011 a 7.2 magnitude earthquake struck near the city of Van. On November 9, 2011 another earthquake, a magnitude of 5.7, hit the region between Van and Erdemir. While the quakes were similar in magnitude to the 1999 Marmara earthquakes, the death toll was much smaller. A 2013 damage assessment study conducted by the Turkish government placed the number of fatalities at 644 with another 1,966 people injured (Prime Ministry Disaster & Emergency Management Authority 2013). Many of the reforms enacted following the 1999 Marmara earthquakes created dividends in the 2011 Van earthquakes.

4.1. Progress on earthquake response

In the Marmara earthquakes, disaster alerts systems on cellphones had collapsed. This bad experience yielded new communication systems. If we compare the Marmara and the Van earthquakes in terms of communication facilities, we can say that no broken connections occurred by Van earthquakes. This was an important improvement in the communication systems. The Turkish government was also able to leverage new technologies in the 2011 earthquakes, proving better warning systems utilizing social media, TV, and radio during the Van earthquake.

The rescue processes were more coordinated in the Van earthquakes. The Turkish government partnered with volunteers in groups like the AKUT Association (AKUT, 2015). The government supported the volunteers with technical instruments during the rescue process.

4.2. Progress on earthquake recovery

There is another improvement in terms of recovery of the disaster between Marmara and Van earthquakes. Since a new regulation named Obligatory Earthquake Insurance General Condition enacted in May 2011, a huge amount of money was collected in the relevant accounts. The government used this money during the rescue and new buildings that were constructed with this money. In addition, some television programs were done to collect money from the philanthropists under the control of government.
The children who lost their families during the Van earthquake were collected by the relevant offices of government. They have been protected in special designed Children houses and they have been sent to schools and all their expenses have been covered directly by the government.

Finally, post-Van recovery has seen improvements in urban development patterns as the government attempts to mitigate the effects of the next big earthquake in the region. The redevelopment of squatter housing settlements has been a primer policy of the governments in Turkey since middle of 1980s. The first redevelopment policy was based on the law called Amnesty Law (Law numbered 2981). This law enacted in 1984 and after this year a lot of modern constructions are built in the district Şentepe in Ankara (Özdemirli, 2014). At the first stage, the government had built temporary housing and then constructed permanent housing for the victims. Some of the people who resided in Van had migrated to other cities, for some of their dwellings were destroyed, and others were psychologically affected by the earthquake. However, some people came back as workers to Van from other cities because the starting of construction activities following the earthquake revealed new business opportunities (Hekimoğlu, et al, 2015).

According to Özdemirli (2014) during the last decade, the city Ankara has experienced a construction boom, especially in the form of development. Fig. 2 shows urban transformation in north Ankara. For example, in the north Ankara, in the direction of Esenboğa Airport a lot of shanties had existed. Urban Transformation in this area has been begun and almost of shanties have been destroyed, and new modern buildings have been constructed in that vicinity. Completed buildings have been distributed the owner of the shanties. These people have used mortgage and they have moved into these new apartments. Özdemir says that the negative impacts of urban transformation projects across Turkey are well documented, and residents have to move out or use the expropriation money as a down-payment and taking mortgage to own a new apartment in that area (Özdemir, 2014).

We can say that the same urban transformation methods have been used after Van earthquakes in Van to provide comfortable residence for the victims of the earthquakes. Fig. 3 shows the urban transformation that has done in Van after Van earthquakes.

4.3. Challenges Remain

According to Bayraktar and et al. (2013), 35,000 buildings were collapsed completely during the Erçiş and Erdemir earthquakes in 2011. It is indicated that the buildings completely collapsed because the reinforced concrete buildings were not constructed in accordance with Turkish Earthquake Resistant Design Code (Bayraktar, et al, 2013). Damages of the reinforced concrete buildings were usually considered lacks of the following: Ground failures, liquefaction of soils, poor quality of concrete, un-ribbed reinforcement steel, poor joints in the beam-columns, strong beam-weak columns, soft and weak stories, short columns, inadequate safe distance between buildings, faulty walls, unconfined gable walls, concrete slab failures, broken staircase slab, insulation materials, incorrect end hook angle, cracks at the corners of the doors and windows, inadequate transverse reinforcement, etc. (Bayraktar, 2013).
Fig. 3: Urban transformation in Van after Van earthquakes.

5. CONCLUSION

After the Marmara earthquakes there were many improvements in terms of mitigating, preventing, recovering and being prepared for earthquakes. These improvements directly contributed to the lower casualty rates in the 2011 Van earthquakes. However, Turkey needs more improvement in these areas. People who live in the rural area should continue to be educated for being prepared against earthquakes. The control mechanism of the new construction of the buildings should be improved. Ground studies should be investigated before allowing to build apartments on a ground. In the cities all concrete constructions should be investigated whether or not they are enough strong for earthquakes. If not these buildings should be reinforced. All shanties should be destroyed and new buildings should be constructed instead of shanties. Urban transformation should be applied in the provinces to mitigate the damage of earthquakes. Because of locating on faults, people must learn to live with earthquakes in Turkey. As Işıkkara said “Be not afraid of earthquakes but be afraid of being unprepared (Işıkkara, 2013).

6. REFERENCES


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