New disaster management system in Turkey: a case study of the 2011 Van earthquake

F. Oktay, C. Tetik, O. Gokce & G. Cebi
Republic of Turkey Prime Ministry,
Disaster and Emergency Management Presidency, Turkey

Abstract

The 2011 Van-Erciş earthquake had a destructive magnitude 7.0 Mw and struck eastern Turkey near the city of Van, October 23, 2011. The earthquake caused heavy shaking across much of eastern Turkey. The number of casualties was 604 and of injured people more than 4000, caused by collapsed or heavily damaged public, residential and commercial buildings. 17 days after the Van-Erciş earthquake, the region was hit by another earthquake with a magnitude of 5.6 Mw on November 9, 2011. This second earthquake resulted in the collapse of 25 buildings which were mostly damaged during the first earthquake in Van city centre. The total of dead and injured people caused by this earthquake was 40 and 30, respectively. Just after the earthquake, the government declared that all disaster and emergency units of related ministries – agencies would work according to 7 x 24 working principle in order to be able to carry out search and rescue, temporary sheltering, debris removal, medical and psychosocial support uninterruptedly etc. until the next notice. After respond and relief works that continued some couple of weeks, 17,341 new housing units were built in the urban areas in less than 11 months during recovery works. The recovery policy in Turkey aims to reach a safe, improved life environment with respect to pre disaster situations. Schools damaged during the earthquake were rebuilt until the next fall semester with 2,600 new classrooms. During all respond, relief and recovery stages of this disaster, the Disaster and Emergency Management Presidency of Turkey was the key actor of management, coordination and implementation. This study summarizes Turkey's new disaster management system and improvement policy.
Keywords: Van earthquake, respond, recovery, disaster and emergency management.


WIT Transactions on Ecology and The Environment, Vol 179, © 2013 WIT Press
www.witpress.com, ISSN 1743-3541 (on-line)
doi:10.2495/SC131182

1 Introduction

Turkey is a tectonically active country that experiences frequent destructive earthquakes. On a broad scale, the seismotectonics of the region near the October 23, 2011 earthquake are controlled by the collision of the Arabian Plate and the Eurasian Plate, with northerly convergence of the Arabian plate at a rate of approximately 24 mm/yr [1]. In the West of the October 23, 2011 earthquake epicentre, the tectonic regime is dominated by strike-slip faulting on the East and North Anatolian fault zones. These large fault systems extend across much of central and western Turkey accommodating the western motion of the Anatolian block as it is being squeezed by the converging Arabian and Eurasian Plates. In the area of Lake Van and further east, tectonics are dominated by the Bitlis Suture Zone in eastern Turkey and Zagros fold and thrust belt of Iran (Fig. 1).

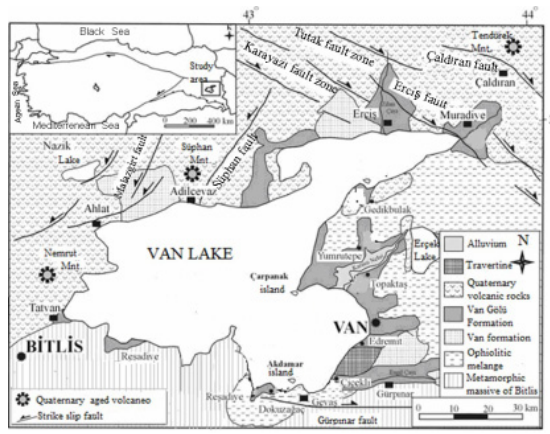

Figure 1: Simplified geological map of the close vicinity of Van Lake (modified Üner *et al*. [3]).

The Van-Erciş earthquake with a moment magnitude (Mw) of 7.0 and a local magnitude of 6.7 occurred at 13:41 local time on October 23, 2011 in the Van province in eastern Turkey [2]. The earthquake resulted from the movement of a 50 km long and 20 km wide thrust fault trending about E-W direction from Erçek Lake into Van Lake. According to the official report of the Disaster and Emergency Management Presidency (AFAD), the casualties were 604 and the number of injured people more than 4000. A number of buildings collapsed, particularly in the Erciş district and Van centre.

The 23 October 2011 Van-Merkez earthquake is unique from several aspects. Such a high number of aftershocks had not previously been experienced within such a short period after the event. During the first week after the earthquake, 114 earthquakes occurred with magnitudes of between 4.0–4.9, 7 earthquakes occurred with a magnitude of Ml>5.0. In addition, in the first month after the earthquakes a 180 aftershock occurred (Fig. 2). The amount of energy released

after the 23 October 2011 earthquake is calculated as 2.09x1015 Joule which is 33.2 times bigger than the amount of atom bomb released in Hiroshima, Japan. When considering aftershocks, the amount increases to 2.36x1015 Joule which is equal to 37 atom bombs [2].

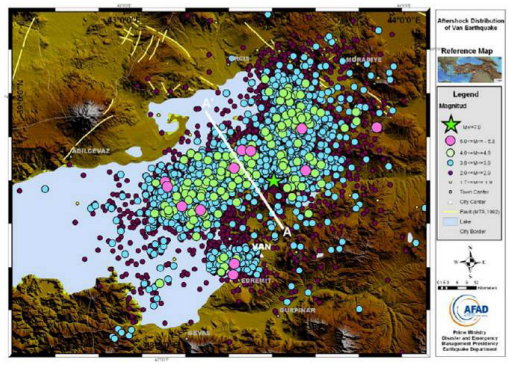

Figure 2: Aftershock distribution of the Van earthquake (Earthquake Department, AFAD).

17 days after the Van-Erciş earthquake, a 5.7 (Mw) earthquake occurred on 9 November, 2011 at 21:23 local time. Because the epicentre of this earthquake is located near Edremit, which is a town on the eastern shore of Van Lake about 16 km to the south of Van city centre, the earthquake is called the Van-Edremit earthquake. The total number of dead caused by this earthquake was 40. This earthquake also caused additional damage to some buildings. The major causes of the heavy damage to reinforced concrete buildings were basically poor quality of construction materials, lack of implementation of design codes, the existence of soft floors (weak floors), pounding, lack of ductility, poor integrity of reinforced concrete (RC) frame with in-fill walls, poor quality of workmanship and poor ground conditions.

2 Respond and relief: 24 hours/7 day for Van

Immediately after the first earthquake, all necessary information about the earthquake was transmitted to the National Crisis Management Center established at AFAD headquarters and to high level local authorities of Van. The Deputy Prime Minister who is responsible for disaster and emergency management and the first team of the AFAD (Earthquake Department) arrived in Van 4 hours after the event and contributed to crisis management at Van (Table 1). Field studies were also initiated immediately after (Fig. 3).

In addition, the government sent 10 Turkish air force planes, 16 army planes, 33 generators, 95 portable toilets, 10,064 food parcels, 21 portable kitchens, 2,619 kitchen sets, 3,812 catalytic stoves and 425 sleeping bags in the first 24 hours.

Table 1: Personnel and equipment list which were sent to the region in the first 6 and 24 hours.

Personnel and Equipment	First 6 hours	First 24 hours
Search and rescue personnel	903	2,522
Medical team and personnel	159 + 7 team	699
Construction machinery and vehicle	192	384
Ambulance	40	113
Air ambulance	5	7
Rescue dog	9	12
Tent	2,471	8,544
Blanket	7,046	25,299
Food package	1,120	1,120

Figure 3: The search and rescue team race against time (Erciş and Bayram Hotel).

AFAD which has regional offices in 11 cities, local offices in 48 provinces organized the transportation and distribution of 39 civil defence and rescue teams, health and first aid personnel, equipment and humanitarian supplies by 80 Turkish Airlines, 76 military and private cargo aircraft. Totally, 176 aircraft were sent to the region by air and land to various instruments also. Also scheduled Turkish Airlines aircraft to the region, the search and rescue team from the 300th time, equipment, and sent to various staff (Table 2).

270,000 food items were distributed at 16 food distribution points in Van and Erciş. In the case of disabled citizens, food was delivered to their homes. More than 200 social workers, sociologists, psychologists supported the victims of the earthquake and psychological guidance counselling was provided. Because of the cold winter conditions, 115,000 tons of coal and clothes were distributed to protect citizens.

3 Structural damage after earthquakes

Most of the buildings in Van and partly in Erciş are typically multi-story commercial/residential reinforced concrete structures. A large percentage of the

Table 2: Total personnel and equipment aid after the earthquake.

Search and rescue personnel	5,267
Medical personnel	2,976
Rescue dog	34
Construction machinery and vehicle	732
Ambulance	201
Air ambulance	18
Portable hospital	11
Generator	146
Projector	79
Toilet and shower containers	151
Tent	76,802
General purpose tent	480
prefabricated house	310
Mevlana house	3,794
Blanket	336,089
Quilt	1,940
Bed	2,007
Portable kitchen	37
Kitchen set	3,149
Stove/heater	27,573
Sleeping bag	7,192
Mobile bakery	1

collapsed or severely damaged buildings in these settlements were generally in the 5–7-story range. The minarets of many mosques and chimneys of buildings had toppled and adobe buildings commonly built in villages collapsed and/or were heavily damaged. There was also some damage to highway bridges. The highway connecting Van to Erciş town and to the city of Ağrı city was also slightly deformed at a certain location ruptured by the earthquake fault.

The earthquake resulted in heavy damage to buildings and significant casualties in this province, particularly in Erciş district. A number of 5–7-story RC buildings collapsed particularly in Erciş and Van centre. The major causes of the heavy damage to reinforced concrete buildings were basically similar to the observations in previous earthquakes such as poor quality of construction materials, lack of implementation of design codes, the existence of soft floors (weak floors), pounding, lack of ductility, poor integrity of RC frames with in-fill walls, poor quality of workmanship and poor ground conditions (Fig. 4).

Figure 4: Photos showing destroyed and damaged urban and rural buildings.

Buildings in rural areas and villages are of brick masonry or stone masonry type. Timber houses (hımış in Turkish) are quite rare due to lack of forests in the earthquake affected area. In addition to poor quality construction and inappropriate construction materials, the damage was caused partly by the settlement and lateral spreading of liquefied ground to buildings. When these buildings are constructed with the consideration of having a mat concrete or firm base, light roof, hatıl (timber or concrete confining beams) at certain intervals, lime (cement)-based bonding, utilization of saman (straws) in kerpiç (adobe) bricks and plastered walls, the damage was none or slight [4].

However, in contrast to the surface rupture of the 1999 Kocaeli earthquake of Turkey, since the earthquake fault didn't result in a continuous and clear rupture on the surface, except a few concrete canal linings and asphalt pavements at limited locations, no damage to structures due to surface rupture had occurred.

One of the typical effects of this earthquake is a change in the shoreline of Van Lake. The measurements at certain locations on the lake shore at the northern and eastern parts of the earthquake region indicated that uplift of the recent shoreline ranging between 15 and 35 cm has occurred.

4 New disaster management system and recovery policy in Turkey

The main purpose in the post disaster recovery stage is to maintain the needs of disaster victims including vital activities like communication, transportation, water, electricity, education, social activities, temporary and permanent settlement, economical activities etc. after disaster and to develop these activities, to make sustainable in a reasonable time schedule [5]. The recovery policy in Turkey aims to reach a safe, improved life environment with respect to pre disaster situations.

Indeed, recovery affairs performed with the existence and content of the Disaster Management Law 7269 (year 1959) in Turkey, cover more

comprehensive and advanced issues than most of the worldwide country examples' issues. It includes more or less all subjects related with recovery, such as the following:

1. Evaluating the disasters and damage assessment.
2. Compensation.
3. Recognizing householder disaster victims (determining beneficiaries).
4. Resettlement site selection.
5. Reconstruction by public service.
6. Social recovery.
7. Economic recovery.

The following are some main principles of the recovery process:

1. Local communities should have some role in recovery works.
2. Local governments should share some responsibilities during the recovery process.
3. Resource usage policies should be developed between recovery and mitigation.
4. Comprehensive recovery planning is an important activity of disaster policy framework.

Turkey's New Disaster Management Law 5902 (year 2009) related with the foundation and duties of AFAD says that "in the regions affected by disasters, public foundations and agencies, local governments, universities and non-governmental organizations must cooperate with each other and prepare recovery and reconstruction plans etc." In fact, this means all recovery works performed after a disaster must be turned into and presented as a report which related agencies and foundations must cooperate and agree with each other about.

In Turkey, the post disaster recovery process includes emergency response, debris removal, temporary settlement, damage assessment, recognizing and evaluating the householder disaster victims, lending long term house credits, resettlement, and reconstruction of permanent houses and business places. The recovery process takes some time; from a couple of months to some years according to the severity/type of the disaster and the number of people affected by disaster. As can be examined, there is no clear, worldwide accepted procedure, step by step guide or a comprehensive document related to the preparation of recovery planning in national and international literature. However, after the Van earthquake, Turkey tried to design a recovery plan with main topics and contents following especially recovery works which are already performed after disasters.

Main parts of recovery can be summarized as follows: damage assessment is divided into two parts, namely preliminary and definite. Preliminary damage assessments are performed to obtain the needs of emergency relief and temporary housing. Definite damage assessments are more detailed and door-to-door assessments. Buildings are classified according to their damage level like

heavily damaged, moderately damaged, slightly damaged or collapsed building. Both assessments are performed under the responsibility of the Governor.

After damage assessment studies are finished, beneficiary management studies begin. These are can be summarized as follows:

1. The owners of the heavily damaged or collapsed buildings are accepted as the beneficiary candidates.
2. If they satisfy the required conditions during the beneficiary management process, then they are approved of beneficiary.
3. Government provides loan assistance to the beneficiaries for reconstruction.
4. Beneficiaries pay back that loan in 20 years.

In order to build permanent houses (disaster houses) for beneficiary disaster victims, the first step is to find a suitable, safe place, so resettlement site selection studies are carried out. Resettlement site selections are performed under the responsibility of the Governor. During this process not only the geological surveys but also social and economic issues are considered. According to the related regulations, if necessary, expropriation works are performed and municipal plans are prepared.

After resettlement site selection studies are finished, the reconstruction process begins. By reconstructing earthquake resistant buildings, not only the recovery phase but also the mitigation phase is performed. During the recovery period there are many opportunities like reconstruction to enhance mitigation thus reducing vulnerability. As can be seen, there is no distinct point at which the response phase changes into recovery and then into the mitigation phase.

5 Recovery studies after the earthquake

Damage assessment was conducted in Van shortly after the earthquake. Representatives from the Ministry of Environment and Urban Planning, the AFAD, local municipalities and the Turkish Union of Engineers and Architects' Chambers worked together to map out the state of the province's buildings.

They classified 30,242 buildings in the city of Van, the district of Erciş and villages as severely damaged, while 19,206 were classified as having medium damage, 90,819 were classified as having minor damage, while only 65,085 buildings were classified as undamaged. So far, about 8,500 buildings have been demolished. After the new settlement area for new housing units was selected, constructions of these units began after just 39 days following the earthquake, respectively.

The official damage assessment conducted by AFAD refers to housing units (instead of buildings) and is essentially conducted to sort out families (rather, property owners) that the government will legally provide housing units (to ones with damage beyond repair, at very low interest levels) and credit for repair (to ones with medium damage) and cash assistance (to those with light damage).

After the Van Earthquake, AFAD have benefited from the opportunities of high technology products as much as possible during the first evaluation and damage assessment. Orthophotos produced by General Command of Mapping (HGK) provided benefits to the post-disaster rehabilitation and recovery activities (Fig. 5). Those images were provided by HGK very promptly and periodically, so they contributed to the monitoring of temporary settlement areas of tents, site selection activities. It also revealed the fact that acquisition of those images will be very useful for future disaster events.

Figure 5: Manual determination of collapsed building in Erciş district by high resolution orthophotos ((a) before earthquake image, (b) after earthquake image).

After the earthquake, 76,806 tents were pitched in 13 tent cities in 18 days. Also already 175,070 people were placed in 35 container cities in 2.5 months (Fig. 6). Furthermore, the Turkish government stated that people living in tents would be permitted to use electricity for free. Many people lived in tents or hand-made shelters just outside of their own houses, on their own land. They ran electrical extension cords from inside their houses to operate heaters in the tents. A total of 35,000 earthquake victims were located into public facilities. Victims were sheltered in 28,619 containers, 425 prefabricated houses and 3,794 Mevlana houses at 33 points.

Figure 6: Photos showing temporary tents and containers.

After the earthquakes, the evaluation of damage on the public hospital and school buildings showed that the performance of these buildings have been much better than the general building stock on the average. However, the Ministry of Education terminated educational activities in the affected region for about 70 days since many schools in the area had collapsed or were seriously damaged. On the basis of the investigations conducted by the Ministry of Education, it was announced that about 2,000 out of the total 7,100 classrooms in primary and high schools were unusable due to the heavy damage.

The Van earthquake caused limited damage to critical life systems such as electric and water systems and there was almost no damage to the transportation network and the natural gas supply network. The water supply at Van city was interrupted for about a week due to the repair of damages at some pumps and pipes.

On the other hand, embankment failures at several localities were easily noticed. The major ones were observed on the Van-Ağrı Highway. The embankment settled and slightly moved towards Van Lake. There were many slope failures and rock falls from adjacent slopes or high mountains along the section of Van-Ağrı City; 61 kms of highway were restored. All this recovery studies' costs approached almost 4,853,702,763 TL (~ $ 2.6B) as of May 25th, 2013.

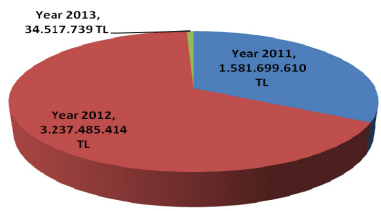

Figure 7: Total cost for all recovery studies after the Van earthquakes.

Figure 8: Permanent houses in Van City.

After 11 months, 17,341 new housing units were built in the city (Fig. 8) and given to rightful beneficiaries, their rightful owners. (The owners of the heavily damaged or collapsed buildings are accepted as the beneficiary candidates according to the Disaster Law in Turkey and then if they satisfy the required

conditions during beneficiary management process, they are approved as rightful beneficiaries). Delivery of housing units in such a short time is indeed a great success story. The government rebuilt 61 social facilities (27 schools, 23 mosques, trade and health centres) too.

6 Conclusion

Recovery activities are mostly accepted as efforts of the government to heal wounds created by disaster. In fact, recovery is a stage in disaster management and an integral part of risk reduction and mitigation works. Successful applications performed at this stage must be accepted as risk reduction activities. Countries' disaster management systems are shaped by their geological, geomorphological, climatic characteristics, vulnerabilities, socio-cultural and economic structures, their traditions, customs, educational – teaching approaches – and even their life style and mentality, etc. After the Van earthquakes, the government implemented recovery studies with great success.

The Recovery Department of AFAD prepared a guideline which is about Post Disaster Recovery Effort in Theory and in Practice published in 2012. This guideline includes subjects like disaster management and basic principles, national and international examples, existing laws and regulations related with recovery works and sustainable post disaster recovery [6].

At 2013, AFAD is working on a more effective disaster management policy for all steps of the disaster management cycle. The National Disaster Response Plan (NDRP) which covers all of the response activities in cases of any disaster or emergency and defines the processes, roles, duties, communication ways, logistics and all other details is prepared by AFAD. The plan needs the support from all other actors which have a role in the response phase. The plan links completely the central and local management and the supporting actors.

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