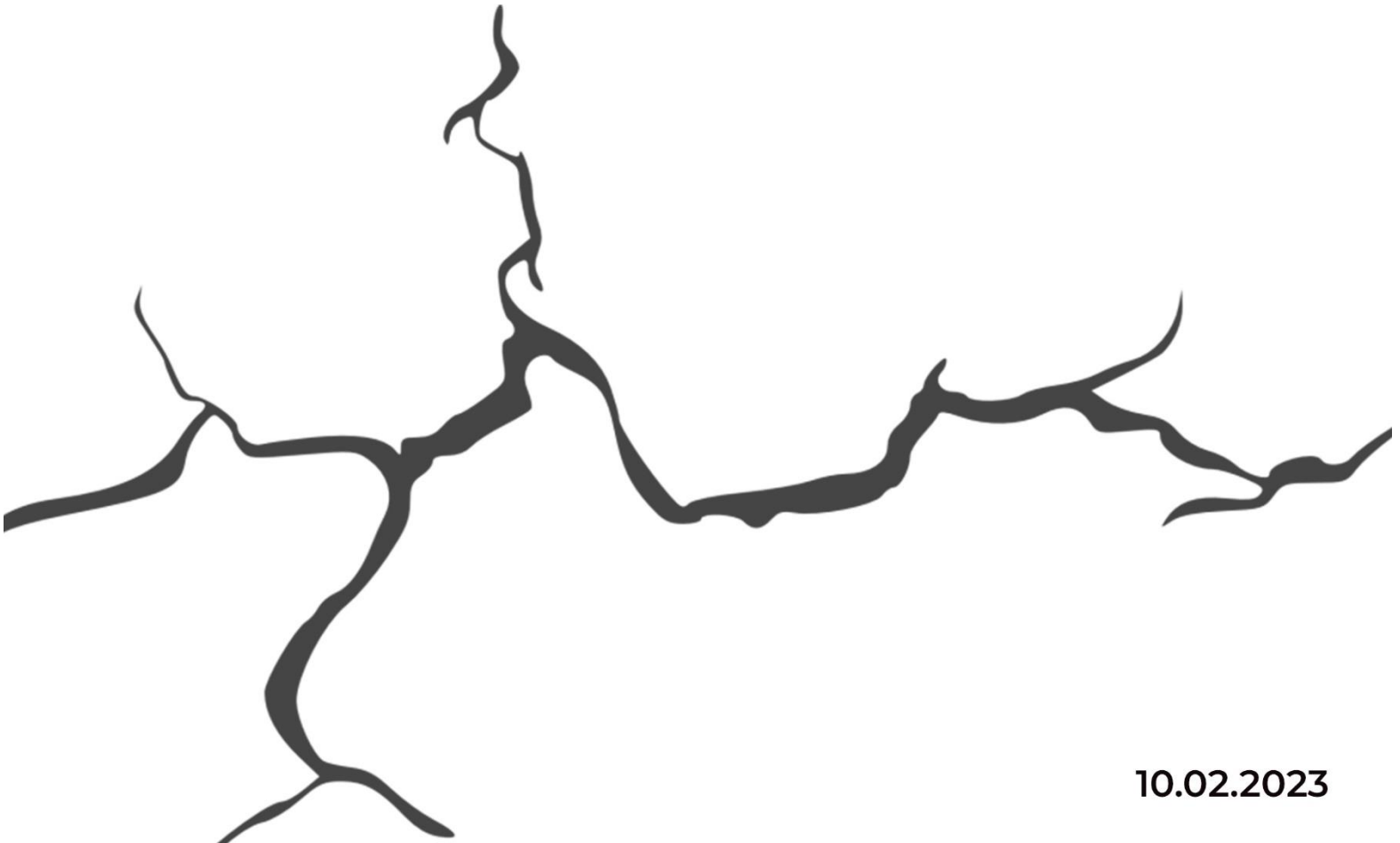
TÜRKONFED

2023 KAHRAMANMARAŞ EARTHQUAKE

PRE-ASSESSMENT & STATUS REPORT



10.02.2023

1. Current Status of the Disaster: Two Major Earthquakes

1.a) The First Earthquake (Mw 7.7)

Type & Size of the Disaster	Earthquake / Mw7.7
Date & Time of the Disaster	6 February 2023 / 04:17
Epicenter	Sofalaca-Şehitkamil-Gaziantep
GPS Coordinates	37.1123 N 37.1195 E
Distances of City Centers of 10 Provinces to the Epicenter	Gaziantep 23 km, Kilis 45km, Kahramanmaraş 52 km, Osmaniye 76 km, Hatay-İskenderun 101 km, Hatay- Antakya 130 km, Adıyaman 122 km, Malatya 169 km and Diyarbakır 282 km.

As the main subject of this report, on 06 February 2023 and at 04:17 A.M. local time, a devastating earthquake occurred at the epicenter of the Sofalaca Village of Şehitkamil District. The moment magnitude (Mw) of the earthquake in question is 7.7 and the focal depth of the earthquake has been measured as being approximately 5 km. This devastating ground shaking was felt in a wide area covering Southeastern Anatolia, Eastern Anatolia, Central Anatolia and Mediterranean Regions[1].

Figure-1: Epicenter of the First Earthquake (Mw 7.7) and Measurements [2]

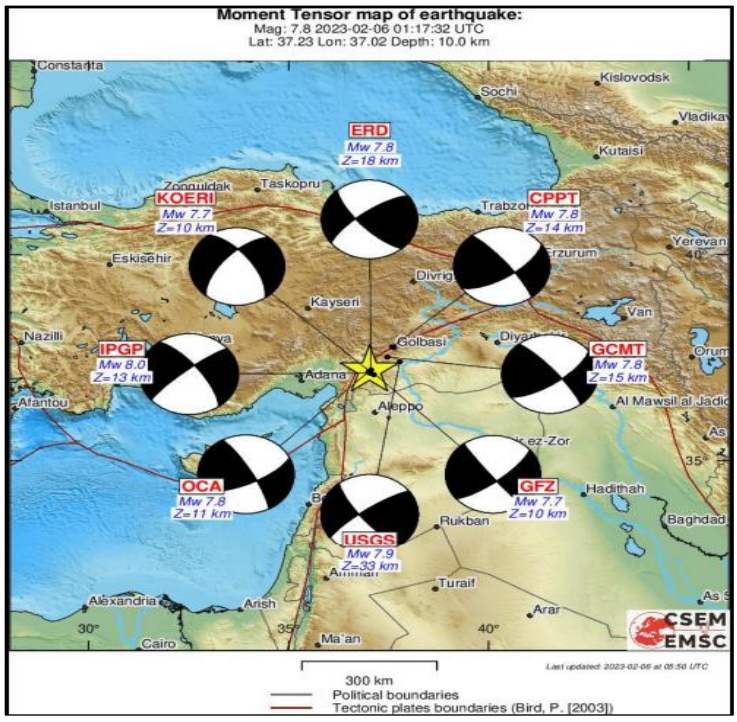
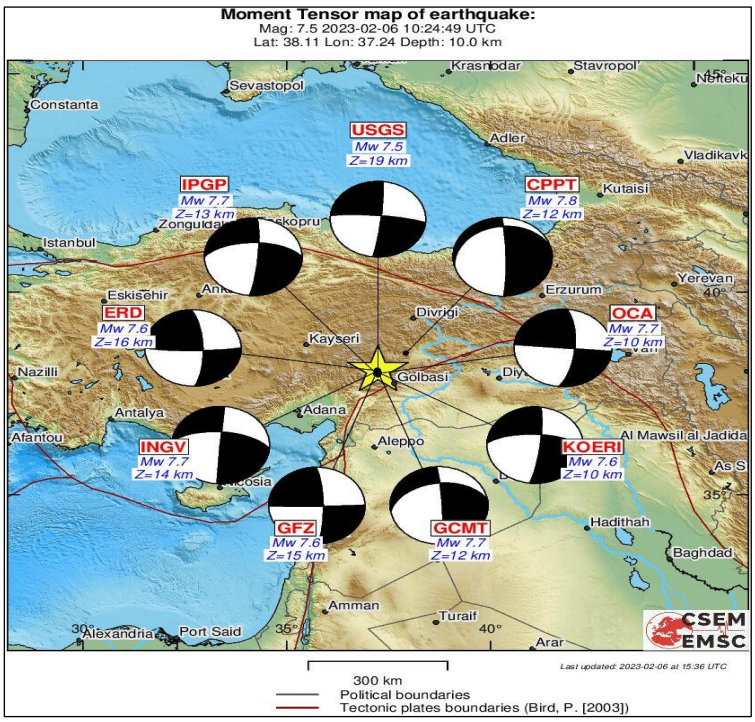


Figure -2: Epicenter of the First Earthquake (Mw 7.7) and Measurements



* Although this earthquake is named as Kahramanmaraş Earthquake in this document, it is also referred to with different titles such as Gaziantep-Kahramanmaraş or Southeastern Anatolia Earthquake.

[1] 06 February 2023 Sofalaca Şehitkamil Gaziantep Earthquake Press Release. Boğaziçi University Kandilli Observatory and Earthquake Research Institute, Regional Earthquake-Tsunami Monitoring and Evaluation Center.

[2] European-Mediterranean Seismological Centre (EMSC), Moment tensors.

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1.b) The Second Earthquake (Mw 7.5)

Type & Size of the Disaster	Earthquake / Mw7.5
Date & Time of the Disaster	6 February 2023 / 13:24
Epicenter	Ekinözü-Kahramanmaraş
GPS Coordinates	37.1123 N 37.1195 E
Distances of City Centers of 10 Provinces to the Epicenter	Gaziantep 110 km, Kilis 150 km, Kahramanmaraş 70 km, Osmaniye 147 km, Hatay-İskenderun 198 km, Hatay- Antakya 237 km, Adıyaman 114 km, Malatya 112 km and Diyarbakır 274 km.

In this context, another devastating earthquake occurred in the epicenter of Ekinözü District of Kahramanmaraş on 06 February 2023 and at 13:24 local time. The moment magnitude (Mw) of the earthquake in question was 7.5 and the focal depth was measured as approximately 5 km. The mentioned ground shaking was felt in a wide area covering Southeastern Anatolia, Eastern Anatolia, Central Anatolia and Mediterranean Regions[3].

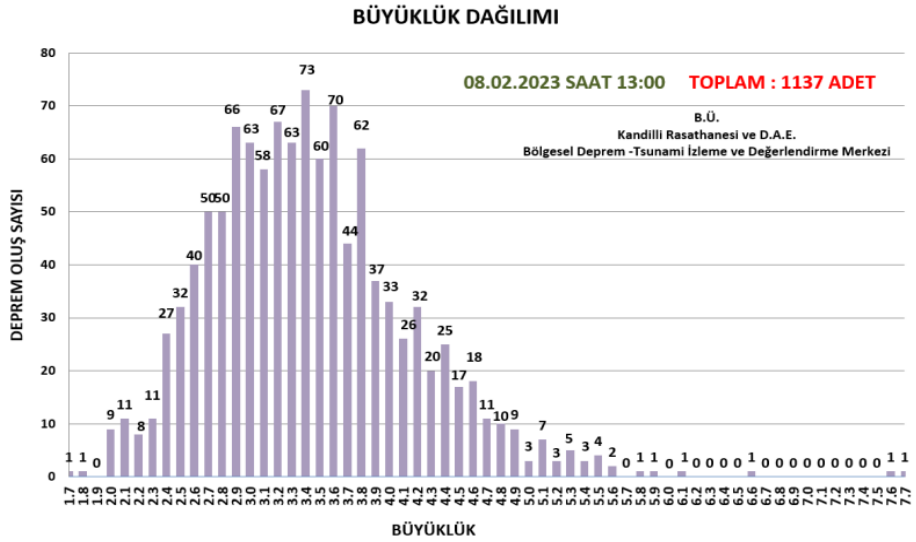
The distance between the epicenters of the two major earthquakes with magnitudes 7.7 and 7.5, respectively, is approximately 105 km. The time between the two earthquakes was about 9 hours, and the second earthquake, which did not show the characteristics of an aftershock, increased the fatal effect of the disaster.

1.c) Aftershocks

Being the subject of this report, an earthquake occurred at 04:17 A.M. in the morning hours of February 6, 2023. In this context, according to the Kandilli Observatory data, the earthquake in question occurred in Gaziantep Şehitkamil with a magnitude of 7.7. Only 10 minutes after the first earthquake in question, another 6.6 magnitude aftershock occurred approximately 27 km west of the epicenter. On the other hand, on February 6, 2023, at 13:24 P.M., a second earthquake with a magnitude of 7.5 occurred. About 11 minutes after this second earthquake, an aftershock with a magnitude of 6.0 occurred 52 km northeast of the epicenter. The magnitude of the aftershocks also caused an increase in the level of damage to the buildings.

As can be seen in Graph-3 below, a total of 1137 earthquakes took place until 13:00 P.M. on February 8, 2023, according to the Kandilli Observatory data. Almost all of these earthquakes are aftershocks. The number of earthquakes with magnitude 4.0 and above in the relevant time period is 234.

Figure-3: Magnitude Distribution of the Major Earthquakes and Aftershocks



DISTRIBUTION OF MAGNITUDE
- Number of Earthquakes (Right)
- Total: 1137 (Left)

[3] 06 February 2023 Sofalaca Şehitkamil Gaziantep Earthquake Press Release. Boğaziçi University Kandilli Observatory and Earthquake Research Institute, Regional Earthquake-Tsunami Monitoring and Evaluation Center.

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2. The Demographic and economic data of 10 provinces affected by the disaster

2.a) The demographic data of 10 provinces within the disaster region:

A total of 13.3 million people live in provinces declared disaster areas. In other words, this figure corresponds to 15.7 percent of the total population in Turkey. In this context, it should be stated that while the population density in Turkey is 110, this rate is 151 in the disaster area.

Table-1: Population Structure

Province	Number of Households	Population	Share in Total Population	Population density
10 Provinces Total	3.304.737	13.421.699	15,7%	151
Adana	632.875	2.274.106	2,7%	163
Şanlıurfa	411.421	2.170.110	2,5%	114
Gaziantep	522.947	2.154.051	2,5%	312
Diyarbakır	394.867	1.804.880	2,1%	119
Hatay	449.151	1.686.043	2,0%	287
Kahramanmaraş	311.458	1.177.436	1,4%	82
Malatya	230.499	812.580	1,0%	69
Adıyaman	155.300	635.169	0,7%	90
Osmaniye	156.199	559.405	0,7%	177
Kilis	40.020	147.919	0,2%	102

[Source: Turkish Statistical Institute, 2021]

The following details can be presented regarding the buildings in 10 provinces that were affected by the disaster, where 13 percent of the 25.3 million households in Turkey lived: 52 percent of the buildings in question were after 2001, 26.4 percent between 1981 and 2000, the remaining 10 percent. It was built before 1980. Households whose building age cannot be classified consists of 12 percent at this point. To summarize, the number of households living in buildings constructed before 2001 is at least 36.5 percent. The proportions of households living in buildings constructed before 2001 are as follows: 47.8 percent in Adana; 46.1 percent in Hatay and 42.1 percent in Malatya.

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2.b) The National Income levels of 10 provinces in the disaster region

Table-2: Share of provinces in national income

Province	Share of Total GDP	Agriculture, forestry and fishery Sector Share	Industrial Sector Share	Manufacturing Industry Sector Share	Construction Sector Share	Services Sector Share	Financial and insurance activities Sector Share
10 Provinces	9,3%	14,3%	11,2%	11,3%	8,7%	7,1%	4,4%
Adana	2,0%	2,5%	2,2%	2,1%	1,7%	1,9%	1,5%
Hatay	1,4%	1,3%	1,8%	1,9%	1,0%	1,4%	0,5%
Kahramanmaraş	0,9%	1,4%	1,4%	1,3%	0,8%	0,4%	0,3%
Osmaniye	0,4%	0,6%	0,7%	0,7%	0,3%	0,2%	0,1%
Malatya	0,5%	0,9%	0,5%	0,5%	0,7%	0,3%	0,3%
Gaziantep	2,0%	1,3%	3,6%	4,0%	1,7%	1,5%	0,8%
Adıyaman	0,3%	0,8%	0,3%	0,2%	0,3%	0,2%	0,2%
Kilis	0,1%	0,2%	0,1%	0,1%	0,1%	0,1%	0,0%
Şanlıurfa	0,8%	3,0%	0,4%	0,3%	0,8%	0,5%	0,3%
Diyarbakır	0,9%	2,2%	0,4%	0,2%	1,2%	0,5%	0,4%

[Source: Turkish Statistical Institute, 2021]

It should first be stated that the share of the provinces in the earthquake are from the total national income is 9.3 percent. In addition, the share of agriculture, industry and manufacturing sectors is above the share of general GDP (Gross Domestic Product). The agricultural sector of 10 provinces has an important share in the national income of the country mounting up to 14.3 percent. In this context, the share of the finance and insurance sector appears to be only 4.4 percent. The percentage of total enterprises in the disaster area is 11.7; income tax active payers 11.1. Whereas, there are 9.2 percent of corporate tax active taxpayers and 10.5 percent of VAT active taxpayers.

Provinces exposed to earthquake disasters produce 20.9 percent of the country's crop production, and 12 percent of cereals and other crops. Again in these provinces, it has 14.5 percent of the total cultivated agricultural area, 12 percent of the cattle and 16.3 of the small cattle.

The 10 provinces concerned have a share of 9 percent in total loans and 5.2 percent in deposits. At this point, the share of non-performing loans is 17.6 percent. The distribution of other loans is as follows: Textile and textile products sector loans 40%, metal and processed mining sector loans 18.3%, agriculture and fishery sector loans 15.5% and total consumer loans 10.4%.

2.c) Export figures of 10 provinces in the disaster area

First of all, the provinces in the earthquake zone in question meet 8.7 percent of the total exports. More than half of the export, which was 19.76 billion dollars in 2022, was realized in Gaziantep with 10.52 billion dollars. After that, Hatay 3.56, Adana 3 and Kahramanmaraş exported 1.46 billion dollars. Cereals, pulses, oil seeds and their products, steel, agricultural products, textiles and raw materials, ready-made clothing products are the leading export items.

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Table-3: Exports according to the legal centers of the enterprises and according to the provinces

Provinces	Export Share	Billion dollars
Grand Total	8,72%	19,76
GAZIANTEP	4,64%	10,52
HATAY	1,57%	3,56
ADANA	1,33%	3,01
K.MARAŞ	0,65%	1,46
MALATYA	0,20%	0,46
DIYARBAKIR	0,13%	0,29
OSMANIYE	0,16%	0,37
ŞANLIURFA	0,11%	0,26
ADIYAMAN	0,04%	0,10
KILIS	0,04%	0,10

[Source: Turkish Exporters Assembly, 2022]

3. Impact Analysis

3.a) Macroeconomic Impact Analysis[4]

Table-4: 1999 - 2023 Earthquake Damage Statistics

	Marmara Earthquake (1999)	Marmara Earthquake (1999)	Kahramanmaraş Earthquake (2023)
Statistics	*By 1999 data*	*By 2021 data*	*By 2021 data*
Magnitude	7,4	7,4	7,7
Number of provinces	8	8	10
GDP (Thousand $)	42.505.524	101.674.062	62.432.052
Population (person)	6.072.315	8.742.179	11.767.542
Income Per Capita ($)	7.000	11.630	5.305
Employment	2.283.624	3.287.684	4.425.436
Number of households	1.894.863	2.727.993	2.955.626
Household Size	3,2	3,2	4
Damage			
Loss of Life (person)	18 373	26 451	72 663
Injured (person)	48 901	70 402	193 399
Damaged Building (pcs)	317.493	457.088	1.010.671
Financial Loss			
GDP Loss (Thousand $)	7.084.254	16.945.677	10.405.342
Housing Loss (Thousand $)	9.291.106	31.996.141	70.746.954
Loss of working days (Thousand $)	698.789	2.163.296	2.911.937
Total Loss (Thousand $)	17.074.149	51.105.114	84.064.233

[4] Macroeconomic impact analysis is made by Economist Dr. Haluk R. Tükel.

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In the light of the table above, when we look at the data for the period of 1999 Marmara and 2023 Kahramanmaraş Earthquakes, taking into account the 2021 dollar data, we will have the opportunity to emphasize the differences and similarities, and to make a healthy comparison in terms of total loss of life and financial damage[5].

Conclusion:

- The loss of life in the Marmara Earthquake is estimated at 18,373 people, and the financial damage is calculated as 17.1 billion dollars at 1999 dollar date. If the Marmara Earthquake had occurred in 2021, it would have caused 26,451 deaths and $51.1 billion in financial damage.

- When we compare the methodology used for the Marmara Earthquake data and the Kahramanmaraş Earthquake with the 2021 dollar data, we calculate 72,663 casualties and 84.1 billion dollars of financial damage.

- In the light of the available data, we estimate that 193,399 people will be injured and 72,663 people will lose their lives.

- On the other hand, we expect the 2023 Kahramanmaraş Earthquake to cause a total of 84.06 billion dollars in damage. The breakdown of this is as follows: 70.75 billion dollars of housing loss, 10.4 billion dollars of national income loss and 2.91 billion dollars of loss of working days.

- In parallel with the decrease in the contribution of the provinces to the national income, it can be estimated that the exports of the 10 provinces that were exposed to disasters may fall below the level of 15 billion dollars, due to the deterioration of the port infrastructure that bears the exports.

- As a result of all these, we estimate that a large migration wave will occur from Adana to a wide area as a natural consequence of the earthquake. Although there is no data or official statement for now, there are expert opinions that the demographic structure of the provinces will change in the coming period. As TÜRKONFED, we will discuss the socio-economic effects of disaster-induced domestic migration in our next report.

- Before the earthquake, the 2023 budget deficit was targeted as 659.6 billion liras. Bloomberg's economics division estimates that earthquake-related public spending could be equivalent to 5.5 percent of GDP. In this context, we can expect the budget deficit to exceed at least 1 trillion TL under the current conditions. Considering that nominal national income is expected to exceed 18 trillion TL in 2023, it is quite possible that the ratio of budget deficit to national income will be above 5.4 percent.

3.b) Infrastructure Damages

Transportation	Although it was announced that there is no route closed to traffic according to the statement made by the General Directorate of Highways on February 8th, problems continue on the Hatay Airport and Hatay-Reyhanlı road. According to the information and images from the field, the roads of many districts and villages are not suitable for continuous transportation. Many collapses occurred on the roads, especially Gaziantep, Hatay, Gaziantep-Osmaniye, Adıyaman-Çelikhan roads. While repairs are ongoing, road infrastructures need to be rebuilt at some points.

[5] The above given earthquake damage calculation is based on the 1999 Gölcük/Marmara earthquake data,thus, it does not include an absolute statistical estimation. Details on the basic assumptions in the calculation method can be found in Appendix-1 at the end of the report.

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Electricity	Transformers were destroyed in a significant part of the provinces affected by the earthquake. However, in some areas the electricity distribution grid was damaged to the point of extinction. It is thought that the re-commissioning of transformer and grid facilities may take place in a long time. Although the problems in the main energy transmission facilities and lines have been resolved, problems continue in the inner-city distribution sections in some districts and provincial centers.
Natural gas	With the earthquake, explosions occurred in natural gas pipelines. As a result, BOTAŞ quickly cut off gas flow to Gaziantep, Hatay and Kahramanmaraş. It was officially announced by the ministry that there were breakdowns and ruptures in the main transmission lines of BOTAŞ and that the damage was re-established with aftershocks in the repaired areas. Controlled and partial natural gas flows to Adıyaman, Gaziantep and Kahramanmaraş city centers started. It is planned to deliver natural gas to the city entrance stations of Hatay city center and Kırıkhan district on Friday, February 10.
Oil Lines	BOTAŞ stopped the oil flow in the terminal to inspect the facility after the first earthquake on Monday. No leaks or damage were found at this point. It resumed the flow of crude oil to BOTAŞ's Ceyhan export terminal on the Mediterranean coast late Tuesday. The KRG (Iraqi Kurdish Regional Government) administration also confirmed that the oil flow continues.

Communication/Network	There are a total of 11.5 million mobile subscribers in the disaster area. Although the telecommunication services do not stop completely in the provinces and districts where the subscribers live, serious disruptions are experienced. According to the statement of the Association of Mobile Telecommunication Operators, of which Turkcell, Türk Telekom and Vodafone are members, 2,451 base stations were out of service due to the earthquake. In order to restore communication, 190 mobile stations were sent to the region and 3 thousand 485 generators were urgently sent to the region to meet the energy needs. Disruptions mostly continue in villages and districts.
Hospitals	Block A of Iskenderun State Hospital, which had a negative earthquake resistance report in 2012, was used to provide intensive care services. The block in question collapsed with the earthquake. While two state hospitals were demolished in Hatay Province, many private hospitals were also destroyed or permanently damaged. The number of destroyed hospitals has not yet been shared by the official authorities. In this context, the need for field hospitals and non-doctor health workers in the field is indicated.
Schools	The Ministry of National Education announced that all schools in 81 provinces will open on Monday, February 20, 2023. It has been announced that students studying in 10 provinces affected by the earthquake will be able to transfer to the provinces they want. Official information on the number of schools that have collapsed has not yet been announced.

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4. Economic Recovery After Disaster

At this point, it should be stated that there is no universal post-earthquake recovery plan for both individuals and nations in the economics literature. Therefore, the process of economic reconstruction should be specific to each country affected by the natural disaster. A decline in economic activity in the immediate aftermath of the disaster followed by a boom in economic growth in the restructuring phase can be seen in relatively wealthier countries. However, for local businesses, whether in developed or developing countries, the picture can unfortunately be much more complex. While they had to cope with the economic vulnerabilities that existed before the earthquake, when these vulnerabilities combined with the effects of the disaster, problems such as the need to relocate, loss of key personnel, changes in consumer behavior, disruptions in the supply chain and insurers' difficulties arise. Therefore, in order to ensure rapid post-disaster regional development, it is necessary to develop special policies for SMEs and centered on SMEs.[6].

It should also be noted that amid regional challenges, the changes caused by the deteriorating economy, including the location of consumers, changing demographics, insurance payments, geographic relocations and other changes, should be used for economic recovery. On the other hand, there is an inevitable need for restructuring, whether fueled by insurance payments, personal savings, or direct government intervention. As each sector repairs and replaces itself in the recovery process, both setbacks and opportunities will arise. Policymakers and business owners should review economic processes that can encourage troubled economic sectors that need help and highlight opportunities for growth. They should also know that they need to make medium and long-term planning in this context.

Suggestions:

1. Detailed examinations should be made about the macroeconomic and socio-economic analysis dimension of the economic effects of the earthquake, of which examples[7]-[8] are available. Impact analyzes will help in setting the right policies.

2. Legal regulation and corporate governance issues related to earthquakes should be put on the agenda and opportunities should be given to organizations “towards a better earthquake-resistant city planning”.

3. In the post-earthquake reconstruction and economic rehabilitation processes, the issue should be addressed within the framework of an economic development approach based on the market economy.

4. The scientific approach should be brought to the fore in future earthquake risk and economic preparation studies. For example, in a scientific paper published on May 30, 2020, co-authored by two Turkish seismologists-seismologists, Ezgi Karasözen from the University of Alaska and Didem Cambaz from Boğaziçi University, the 6.8 magnitude Elazığ Earthquake of 24 January 2020 indicated a major break in the Eastern Anatolian fault line[9]. It is indicated to inform.

[6] Seville, E., Vargo, J., & Noy, I. (2014). Economic recovery following earthquakes disasters. *Encyclopedia of Earthquake Engineering*, 1-14.

[7] Economıc Effects Of The 1999 Turkısh Earthquakes: An Interım Report Economıcs Department Workıng Papers No. 247 By Alexandra Bibbee, Rauf Gonenc, Scott Jacobs, Josef Konvitz And Robert Price-26 June 2000

[8] Turkey Marmara Earthquake Assessment, September 14, 1999 Turkey Country Office The World Bank-14 September 1999

[9] “The 2020 Mw 6.8 Elazığ (Turkey) Earthquake Reveals Rupture Behavior of the East Anatolian Fault”
Léa Pousse-Beltran, Edwin Nissen, Eric A. Bergman, Musavver Didem Cambaz, Élyse Gaudreau, Ezgi Karasözen, Fengzhou Tan First published: 30 May 2020

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APPENDIX-1: Basic Assumptions in Loss Calculation

- The intensity of the Kahramanmaraş Earthquake is similar to the Marmara Earthquake (Mw 7.4). The last two earthquakes in question are slightly higher and very intense, with moment magnitudes of 7.7 and 7.5, respectively.

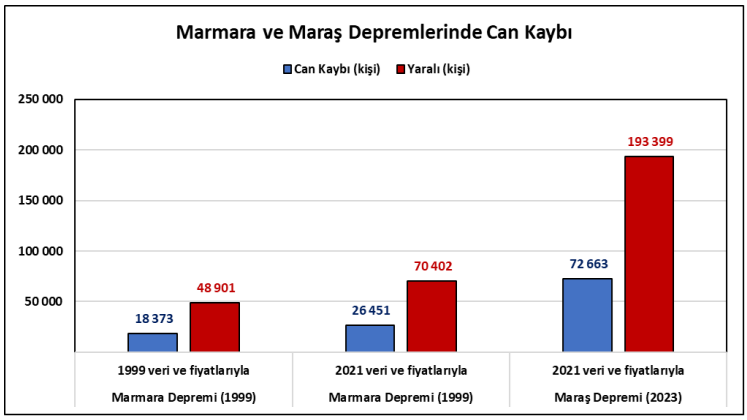
- The geographical impact area of the Kahramanmaraş Earthquake (30,000 km^2) is approximately 2 times the geographic impact area of the Marmara Earthquake (15,000 km^2)[10].

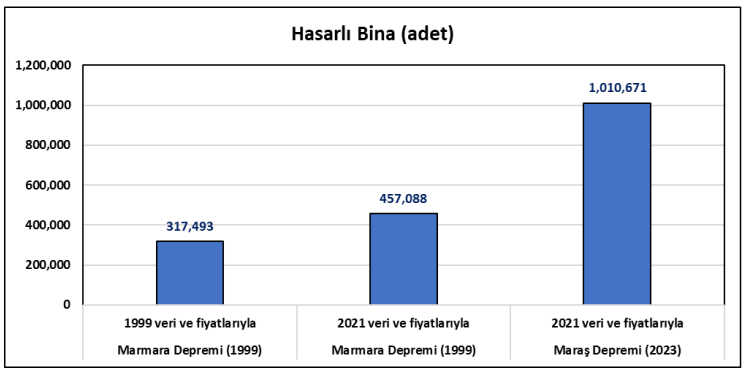
- Kahramanmaraş Earthquake region has a lower income but more population compared to the Marmara Earthquake region. However, this region contains more employment and more households.

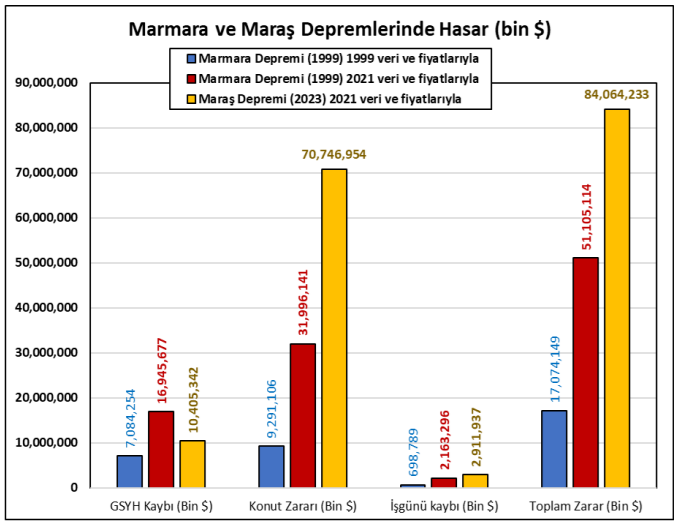
- We consider the added value and loss of working days to be equivalent to the region's GDP and employment for 2 months.

- We calculated the house damage by using the Marmara Earthquake "number of damaged houses/households" ratio in 2021 dollar data and multiplying it by 2.04. We have accepted the 1999 house price as 323 $ / m2, the 2021 house price as 700 $ / m2 and calculated 100 m2 per household.

- Within the scope of this report, we have assumed that the lost working days will be equal to the sum of the minimum wage for 2 months, calculated using the labor force and employment ratio, based on the population of the region. We get a monthly minimum wage of $153 in 1999 and $329 in 2021.







1-Marmara and Kahramanmaraş Earthquakes Loss of Life (above-right)
Blue: Loss of Life
Red: İnjured

2- Marmara and Kahramanmaraş Earthquakes Cost (above-left)
Blue: Marmara Earthquake (1999) data and prices by 1999
Red: Marmara Earthquake (1999) data and prices by 2021
Yellow: Kahramanmaraş Earthquake (2023) data and prices by 2021

3- Damaged buildings (pcs)

[10] Therefore, for the detection of loss of life, injured and damaged buildings in the Kahramanmaraş Earthquake, we use the parameters of the Marmara Earthquake by multiplying the parameters of the Marmara earthquake with a coefficient of 2.04, since the geography is wider (excluding Syria).

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