**INTERNATIONAL JOURNAL OF SOCIAL SCIENCE, INNOVATION AND EDUCATIONAL TECHNOLOGIES (ONLINE) - ISSN: 2717-7130**

*Vol:6 Issue: 22 pp: 45-63*

***JEL Codes: I2, I20***

ERNEZ, D., AKINCI, Y., BATMAZ, M., ALINCA AYYILDIZ, Y. (2025). **"Analysis and Visualization of Earthquake Data with POWER BI in Türkiye: An Evaluation from the Perspective of Education and Guidance"**. *International Journal of Social Science, Innovation and Educational Technologies (Online)"*, Vol: 6, Issue: 22, pp: 45-63

***Keywords:*** education, guidance services, Türkiye earthquake, local governments, risk management, SQL, Power BI

**Article Type** Research Article

# Analysis and Visualization of Earthquake Data with POWER BI in Türkiye: An Evaluation from the Perspective of Education and Guidance

| Arrived Date | Accepted Date | Published Date |
|---|---|---|
| 28.02.2025 | 20.03.2025 | 30.04.2025 |

**Demir ERNEZ [1], Yahya AKINCI [2], Metin BATMAZ [3], Yasemen ALINCA AYYILDIZ [4]**

## Abstract

Earthquakes are among the natural disasters that have serious effects in many regions of our country and directly affect the lives of individuals, families and societies. Minimizing the damages that may be caused by these disasters is possible by increasing the level of both individual and social awareness. In this context, the disaster awareness of citizens and local governments should be supported by the right guidance and training activities. This study was needed in order to better identify possible risks and to raise awareness on this issue. In the study, Power BI, a business intelligence and data analysis platform developed by Microsoft, was used for the analysis of earthquake data in Turkey. Using the open data source provided by Boğaziçi University Kandilli Observatory and Earthquake Research Institute (BDTIM), data on earthquakes that occurred across Turkey between 30.12.2022 and 30.12.2023 were collected. Data set; It was designed with a Structured Query Language (SQL) query to include earthquake number, province, location, latitude, longitude, magnitude, depth and date information and transferred to the Power BI platform. With this study, in which regions of Turkey earthquakes are more intense, how often large earthquakes occur, and the relationship between earthquake magnitude and depth were examined. The findings

[1] demirernez@gmail.com, Sur District Director of National Education, Sur District Directorate of National Education, Diyarbakır /TÜRKİYE

[2] yahya.akinci@meb.gov.tr, Branch Manager, Diyarbakır Sur District Directorate of National Education, Diyarbakır /TÜRKİYE

[3] metinbatmaz@hotmail.com, Co Manager, Şehit Mehmet Mecit Yalçın Anatolian High School, Diyarbakır /TÜRKİYE

[4] yasemenalinca@gmail.com, Guidance Teacher, Atatürk Primary School, Diyarbakır /TÜRKİYE




http://dx.doi.org/10.54603/iss.225

are an important resource especially for educators, psychological counselors and guidance specialists. Because shaping the guidance activities to be carried out before and after the disaster with a data-based understanding will contribute to making the society more resistant to disasters. In this context, awareness-raising activities prepared according to regional earthquake risks in school guidance services and community-based education programs can help create disaster awareness among students and families. At the same time, it is of great importance to use such analyzes in the preparation of post-disaster psychosocial support plans. The limitation of the study is revealed by analyzing only the data of the last year. Planning future studies to cover longer periods of time will both increase data reliability and ensure that training and guidance studies are placed on a more solid basis. As a result, this study can be considered as an important step to strengthen disaster education and guidance services, to raise awareness of individuals against disasters and to increase social resilience.

**INTRODUCTION**

Turkey, one of the most geologically active regions in the world, is a country that has been under the influence of earthquakes throughout history. In Turkey, which experiences frequent earthquakes due to its complex geological structure, the impact of these natural disasters on individuals and societies is not limited to physical destruction; At the same time, it deeply affects human psychology, social fabric and educational processes. Turkey's earthquake history clearly shows the effects of disasters on individuals' quality of life, access to education, and public health. Large earthquakes seriously affect not only structures but also human life and social living spaces (Giuliani et al., 2022:79). For this reason, it is not enough to take physical precautions in the process of preparing for disasters, but also guidance and training activities that will increase the psychological resilience of individuals are needed. For example, according to the records of the Disaster and Emergency Management Presidency (AFAD), on February 06, 2023, at 04:17, a major earthquake with a magnitude of 7.8 and a focal depth of 8.6 km occurred on the East Anatolian Fault Zone, with the epicenter in Pazarcık (Kahramanmaraş) (AFAD, 2023). Likewise, on February 20, 2023, an earthquake with a magnitude of 6.4 occurred in the Defne district of Hatay, followed by 32 aftershocks up to a magnitude of 5.8 (AFAD, 2023). Such large and aftershocks can cause serious psychosocial effects such as fear, anxiety and trauma in individuals. In this context, the aim of this study is to understand the current situation regarding the earthquake risk in Turkey and to create a scientific basis for training and guidance studies aimed at raising disaster awareness. In the study, basic features such as the number, impact, magnitude and geographical distribution of earthquakes were examined; The data obtained are presented as a guide for preventive measures to be taken by both individuals and local governments. In addition, the results of these analyzes will be an important resource especially in disaster awareness trainings to be carried out in schools, psychological counseling and guidance services, and post-disaster recovery studies. Thus, it is aimed to increase the resistance of individuals against disasters and to create a healthy disaster management culture throughout the society.

## Literature Review

### Some research on reducing earthquake risk

Reducing earthquake risk is possible not only through engineering and infrastructure works, but also through education of the society and increasing individual risk awareness. Risk analysis is a qualitative or quantitative process in which potential hazards, exposures and vulnerability are evaluated together. This process aims to identify elements that can harm people, property, services, livelihoods and the environment (Covello & Mumpower, 1985; Giuliani et al., 2022:80). These analyses play an important role in the grounding of disaster education and guidance studies. While the analysis of the built environment is especially important in terms of the durability of buildings in the face of seismic events such as earthquakes (Calvi et al., 2006; Giuliani et al., 2022:80), it is observed that in cases where social sensitivity is high, lack of education and awareness may increase risks. Demographic distribution, social structure and the level of risk awareness of individuals are among the important factors that determine the extent of the damages to be experienced after the earthquake. In their study, D'Ayala and Paganoni (2011:27) focused on strengthening structures and understanding the mechanisms of damage; They emphasized the importance of predicting these mechanisms through observations in the field. Such technical information is data that can be used directly in structuring disaster education programs and raising public awareness.

Marin et al. (2021:1), on the other hand, considered the different components of risk (hazard, exposure, vulnerability and resilience) from a holistic perspective and integrated them with the Disaster Risk Assessment Tool (DRAT). Thanks to this tool, disaster management and training strategies have been developed in regions that differ geographically or administratively. Such tools are especially important in terms of planning regional risk awareness studies in educational institutions and organizing student-parent trainings. Scott and Few (2016:145) discussed the concept of capacity building for disaster risk management and discussed who should be involved in this process. This perspective emphasizes that not only technical personnel, but also educators, psychological counselors and local community leaders should be included in disaster preparedness processes. Because ensuring psychological resilience and social cohesion after a disaster requires an effective training and guidance approach. The United Nations Office for Disaster Risk Reduction (UNISDR, 2009:10) defines disaster risk management as an integrated process of strategies, policies and capacity building practices necessary to reduce the negative effects of hazards. This definition reveals the importance of increasing the knowledge and resilience level of the society before, during and after the disaster, especially for educators and guidance specialists.

Zuo et al. (2017:135) brought the concept of "Risk Governance" to the agenda and drew attention to the importance of institutional structures and policy processes in managing disaster risks. Klinke and Renn (2012) and Handmer and Dovers (2007) stated that losses from disasters are often due to inadequate institutional capacity and wrong policies. This situation shows that not only government policies should be improved, but also the level of individual education, disaster awareness and local community participation. In this context, it is of great importance to carry out comprehensive guidance studies in order to empower individuals through education, to increase their psychological resilience and to act consciously in the face of disasters in the management of natural hazards.

**SQL**

SQL (Structured Query Language) is popular for being an open, standard language that is easy to use. SQL is a programming language used in relational database management systems (RDBMS) to store, manage, and query data. SQL is used to perform many operations on databases.

Errors in data analysis can lead to unexpected values, which can include different types of data, including null values. Common tools such as Microsoft Excel, Python, R, and Power BI can be used to avoid such situations. Also, it's important to remember SQL; because most database management systems (DBMS) do not have the full range of statistical calculations as in other packages.

However, analyses can be performed on earthquake data using SQL queries (Alwan, 2022). Spatial data in SQL is preferred for studying earthquakes (Wagner, 2018). In this study, data table creation and editing processes were applied to create a SQL database. SQL queries are written to access the information in the database and query the requested data.

SQL data platforms are general-purpose and versatile data management systems. Engineering Strong Motion (ESM) databases, on the other hand, are systems that specialize in time series data focused on a specific area of engineering and seismology. Despite the wide flexibility and usage areas of SQL platforms, ESM databases are optimized for seismic data analysis and offer high performance in this field. The waveforms contained in the ESM are mainly related to events with a magnitude of 4.0, recorded in the Euro-Mediterranean regions and the Middle East (Luzi et al., 2020). Therefore, which platform to use depends entirely on the need and usage scenario. In this context, it was deemed appropriate to use SQL data platform in this study.

**Microsoft Power BI**

Microsoft Power BI is a powerful business intelligence and data visualization tool used for data analysis and reporting (Unitech, 2023). Typically, businesses use Power BI to collect, visualize, analyze, and share their data. It is used to transform data into visuals with advanced data analysis tools, artificial intelligence features, and a user-friendly report generation tool (Microsoft, 2023). In this study, Power BI was used to visualize and obtain insights from the data on the earthquakes that took place in Türkiye in the last 1 year in a meaningful and understandable way with various graphs, tables and visuals.

**Method**

Data analysis methods used in disaster education and awareness-raising activities are of great importance to develop accurate and effective strategies. While the increasing variety of date and time information in the data is still considered a standard type of data, the accurate collection and analysis of location information is of particular importance, especially for disaster risk assessments. Location information; It can be captured in different formats, such as addresses or geographic names at the continent, country, city, and neighborhood level, but in order for this information to be displayed correctly on the map, explicit geocoding in latitude and longitude format is required (Mahajan, 2022).

In this study, the data of the earthquakes that took place in Turkey between 30.12.2022 and 30.12.2023 were designed using Structured Query Language (SQL) queries and the necessary geocoding was completed. The data were obtained from Boğaziçi University Kandilli Observatory and Earthquake Research Institute (BDTİM) open data source. The data obtained; It includes province, location, latitude, longitude, earthquake magnitude, depth and date information and was analyzed using the Microsoft Power BI platform. Thanks to its user-friendly interface and powerful data visualization capabilities, Power BI has been preferred as an effective tool especially in understanding the spatial and temporal distribution of disaster data. This method not only served the technical analysis of the data, but also made it possible to obtain clear and understandable visual outputs in order to raise the awareness of the society about earthquake risk in the training and guidance processes. Thus, individuals and local governments will be able to take healthier steps in assessing their own risk levels in the light of concrete data and being prepared for disasters.

## Findings

In order to keep together the codes related to the earthquake data that took place in Türkiye in the last year, a database called "earthquakes database" was created by the researcher. The SQL Code created for this is given in Figure 1.

```sql
CREATE DATABASE Earthquakes_Turkey;
```

**Figure 1. Earthquakes Database SQL Code 1**

SQL codes have been created to pull the data for the last 1 year for the preparation of the dataset containing the earthquake data that took place in Türkiye between 30.12.2022 and 30.12.2023. This code is shown in Figure 2.

```sql
-- Use the earthquakes_database
USE earthquakes_database;

-- Select earthquake data between specified dates
SELECT *
FROM turkey_earthquakes
WHERE date BETWEEN '2022-12-30' AND '2023-12-30';
```

**Figure 2. Türkiye Earthquake Data SQL Code**

Source: Figure 2 created by the authors

This SQL code assumes you have a table named Türkiye earthquakes within the earthquakes_database that contains earthquake data with a column named date storing the date of the earthquake.

This code will retrieve all columns (*) for earthquake events that occurred in Türkiye between December 30, 2022, and December 30, 2023.

```sql
-- Use the earthquakes_database
USE earthquakes_database;

-- Count occurrences of earthquakes in each province between specified
SELECT province_name, COUNT(*) AS earthquake_count
FROM turkey_earthquakes
WHERE date BETWEEN '2022-12-30' AND '2023-12-30'
GROUP BY province_name;
```

**Figure 3. Earthquake Count SQL Code**

Source: Figure 3 created by the authors

This SQL code will count the occurrences of earthquakes in each province (province_name) within the specified date range (BETWEEN '2022-12-30' AND '2023-12-30'). The GROUP BY clause groups the earthquakes by province, and COUNT(*) counts the occurrences of earthquakes for each province within the specified timeframe.

With this code, the number of earthquakes in the relevant date range on a provincial basis was accessed from the table named "Earthquake Table". The province column represents the provinces, and COUNT(*) represents the number of earthquakes in each province. In this context, the tabulated version of the number of province-based earthquakes in Türkiye is given in Table 1.

| Province | Number of Earthquakes |
|---|---|
| Adana | 4917 |
| Adıyaman | 5932 |
| Afyonkarahisar | 227 |
| Ankara | 396 |
| Antalya | 552 |
| Aydın | 574 |
| Balıkesir | 607 |
| Bingöl | 515 |
| Bitlis | 124 |
| Bolu | 290 |
| Burdur | 167 |
| Bursa | 401 |
| Çanakkale | 1749 |
| Çorum | 316 |
| Denizli | 851 |
| Diyarbakır | 366 |
| Düzce | 201 |
| Elazığ | 1729 |

| | |
|---|---|
| Erzincan | 204 |
| Erzurum | 631 |
| Gaziantep | 2221 |
| Hatay | 3360 |
| Isparta | 135 |
| İzmir | 1741 |
| Kahramanmaraş | 20119 |
| Kayseri | 473 |
| Konya | 638 |
| Kütahya | 505 |
| Malatya | 15240 |
| Manisa | 622 |
| Mersin | 164 |
| Muğla | 2267 |
| Muş | 206 |
| Niğde | 133 |
| Osmaniye | 845 |
| Sakarya | 172 |
| Şanlıurfa | 245 |
| Sivas | 587 |
| Tunceli | 152 |
| Van | 338 |
| Toplam | 70912 |

Source: Table 1 Created by the authors

When Table 1 is evaluated, it is seen that the highest number of earthquakes occurred in Kahramanmaraş (20,119) and the least earthquakes occurred in Bitlis (124). In the context of these results, a funnel of the total number of earthquakes was created according to the provincial criterion and it was revealed that the total number of earthquakes in Kahramanmaraş in the last 1 year was the highest province.

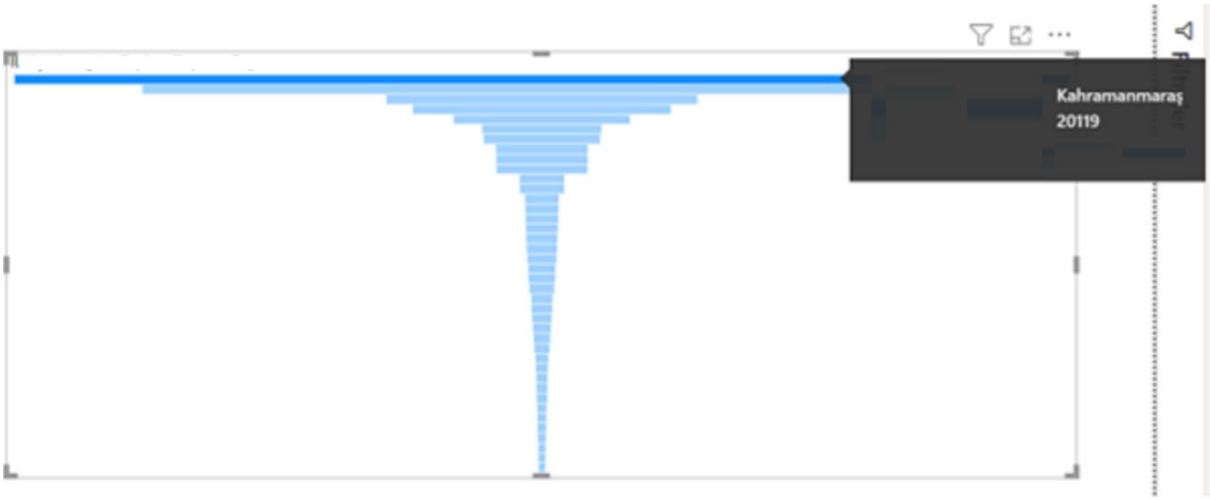


**Figure 4. Türkiye total number of earthquakes funnel by provincial criterion**

Source: Figure 4 created by the authors

Figure 5, which was created in order to see the situations in the provinces at a rate of %, is given below.

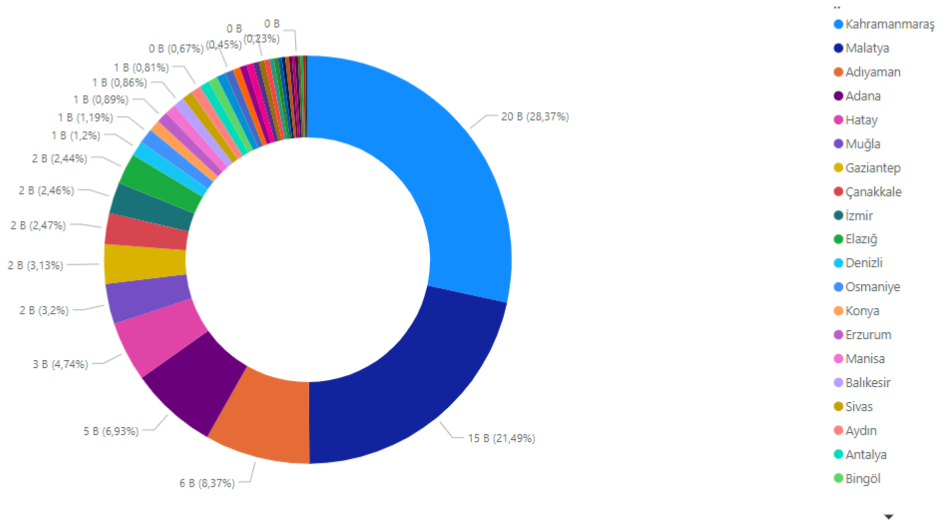


**Figure 5. Rates of Türkiye Earthquakes by Provincial Criterion**

Source: Figure 5 created by the authors

**Table 2. Rates of Türkiye Earthquakes by Provincial Criterion (%)**

| **Provinces** | **%** |
|---|---|
| Kahramanmaraş | %28, 37 |
| Malatya | %21, 49 |
| Adıyaman | %8, 37 |
| Adana | %6,93 |
| Hatay | %4, 74 |
| Muğla | %3,2 |
| Gaziantep | %3,13 |
| Çanakkale | %2, 47 |
| İzmir | %2, 46 |
| Elâzığ | %2, 44 |
| Denizli | %1,2 |
| Osmaniye | %1, 19 |
| Konya | %0, 89 |
| Erzurum | %0, 86 |
| Manisa | %0, 81 |
| Balıkesir | %0, 67 |
| Sivas | %0, 45 |
| Aydın | %0,23 |
| Antalya | %0, 22 |
| Bingöl | %0,21 |

Source: Table 2 created by the authors

In the last year, earthquakes have occurred in 40 provinces in Türkiye and the total number of earthquakes has been distributed between 124 and 20,119. According to Figure 5 and Table 2 Kahramanmaraş province accounts for 28.37% of the earthquakes that occurred in the last 1 year. Subsequently, Malatya province ranks first as the province with the highest number of earthquakes with a rate of 21.49%. These data show that the earthquake risk levels of different regions are different from each other. Provinces with a high number of earthquakes, such as Kahramanmaraş and Malatya, can be considered as regions with a higher earthquake risk. Although these data show that there may be more earthquake risk in that region, a more comprehensive examination was needed for a more detailed risk analysis in this study. In this context, the latitude, longitude, impact size and depth of the earthquakes in the provinces were also analyzed.

Since it is aimed to include latitude and longitude in the data set, the SQL code created in this context is given in Figure 6.

sql Copy code

```sql
-- Use the earthquakes_database
USE earthquakes_database;

-- Retrieve earthquake data with latitude and longitude between specifi
SELECT latitude, longitude, province_name
FROM turkey_earthquakes
WHERE date BETWEEN '2022-12-30' AND '2023-12-30';
```

**Figure 6. Location, Latitude, Longitude, Magnitude, Time Based SQL Code of Earthquake Data**

Source: Figure 6 created by the authors

This SQL code selects the latitude, longitude, and province_name columns from the Türkiye _earthquakes table within the specified date range (BETWEEN '2022-12-30' AND '2023-12-30'). The code in Figure 7 has been added to determine the effect of earthquakes on the code created in Figure 6.

```sql
-- Use the earthquakes_database
USE earthquakes_database;

-- Analyze impact types of earthquakes between specified dates
SELECT impact_type, COUNT(*) AS occurrences
FROM turkey_earthquakes
WHERE date BETWEEN '2022-12-30' AND '2023-12-30'
GROUP BY impact_type;
```

**Figure 7. Impact Based SQL Code of Türkiye Earthquake**

Source: Figure 7 created by the authors

This SQL query will count the occurrences of each impact_type within the specified date range ('2022-12-30' to '2023-12-30') from your Türkiye earthquakes table. This code assumes that your database contains a column representing different types of impact caused by earthquakes and you want to count the occurrences of each impact type within that date range.

With these SQL commands, data has been added to the "EarthquakesDatabase" and the "Earthquakes" table. The results obtained in the context of the data obtained are given in Figure 8, Figure 9 and Figure 10. Mag (the magnitude of the earthquake) and Der (impact value) in the figures express it. The location column (column 6), earthquake magnitude (column 5), impact value (column 4), longitude (column 3) and latitude (column 2) are shown in the column.

| Column6 | Column5 | Column4 | Column3 | Column2 |
|---|---|---|---|---|
| AYDINLAR-AKCADAG (MALATYA) | 1.2 | 25.6 | 38.1018 | 38.3108 |
| KARAKOSE-SINCIK (ADIYAMAN) | 2.0 | 7.0 | 38.4767 | 38.0980 |
| KARACAY-PAZARCIK (KAHRAMANMARAS) | 1.2 | 5.0 | 37.1285 | 37.3473 |
| BUYUKECELI-GULNAR (MERSIN) | 1.5 | 0.0 | 33.5597 | 36.1383 |
| HALILBEYLI-SAIMBEYLI (ADANA) | 1.6 | 13.3 | 36.1870 | 37.7872 |
| FETHIYE-(BALIKESIR) | 0.9 | 5.0 | 27.9060 | 39.7410 |
| TASOLUK-HEKIMHAN (MALATYA) | 2.0 | 28.8 | 37.8678 | 39.0368 |
| KARAKUYU-SAIMBEYLI (ADANA) | 1.4 | 5.4 | 36.2453 | 37.8433 |
| CIGSAR-ANDIRIN (KAHRAMANMARAS) | 1.2 | 5.2 | 36.2710 | 37.7787 |
| YAVUZLAR-DARENDE (MALATYA) | 1.5 | 5.9 | 37.4523 | 38.4503 |
| KURKCUYURT-ALTINYAYLA (SIVAS) | 1.5 | 5.1 | 36.8910 | 39.1738 |
| YIRCA-SOMA (MANISA) | 1.3 | 1.6 | 27.6642 | 39.2088 |
| GIRIT ADASI (AKDENIZ) | 2.2 | 19.7 | 23.0623 | 35.0093 |
| AHMETCIK-GOKSUN (KAHRAMANMARAS) | 1.6 | 5.0 | 36.6450 | 38.0370 |
| TOPALLAR-SAIMBEYLI (ADANA) | 1.3 | 17.8 | 36.2638 | 37.8782 |
| KUCUKCAMURLU-GOKSUN (KAHRAMANMARAS) | 1.6 | 14.3 | 36.3610 | 37.8545 |
| CITLIK-ELBISTAN (KAHRAMANMARAS) | 2.0 | 8.7 | 37.2753 | 38.2322 |
| KAZANCIK-ALTINOZU (HATAY) | 1.4 | 14.8 | 36.2575 | 36.1657 |
| AYVACIK-SAIMBEYLI (ADANA) | 1.4 | 6.8 | 36.1352 | 37.7828 |
| KAYNAR-(KAHRAMANMARAS) REVIZE01 (2023.12.29 18:41:04) | 1.3 | 11.0 | 36.5507 | 37.8052 |
| GEMLIK KORFEZI (MARMARA DENIZI) | 2.1 | 8.9 | 28.8218 | 40.4295 |
| TABURLAR-ELMADAG (ANKARA) | 1.7 | 5.3 | 33.1233 | 39.7943 |
| IZMIR KORFEZI (EGE DENIZI) | 2.2 | 5.4 | 26.8578 | 38.5137 |
| AKDENIZ | 2.0 | 11.9 | 31.2038 | 36.2055 |
| GOYNUK-PAZARCIK (KAHRAMANMARAS) | 2.2 | 5.1 | 37.4327 | 37.6835 |
| DILIMLI-(VAN) | 1.9 | 7.5 | 43.4745 | 38.6540 |
| KARAKOY-DATCA (MUGLA) | 2.2 | 5.8 | 27.6315 | 36.7975 |
| CAVDAR-SARIZ (KAYSERI) | 1.3 | 3.1 | 36.7445 | 38.7028 |
| ADALI-BIGADIC (BALIKESIR) | 1.6 | 7.3 | 28.2800 | 39.3985 |
| ZEYNELLI-YAYLADERE (BINGOL) | 2.0 | 7.8 | 40.2103 | 39.2072 |
| GIRIT ADASI ACIKLARI (AKDENIZ) | 3.5 | 17.8 | 25.6718 | 34.2485 |
| KOZLUCA-AKCADAG (MALATYA) | 2.1 | 1.7 | 37.6537 | 38.4058 |

**Figure 8. Location, Magnitude, Impact Value, Latitude, Longitude, and Latitude Based Result of Earthquake Data-1**

(Coloumn6: Location, Column5: Magnitude, Column4: Impact Value, Column3: Latitude, Column2: Longitude, and Latitude Based Result of Earthquake Data-1)

Source: Figure 8 created by the authors

| Column6 | Column5 | Column4 | Column3 | Column2 |
|---|---|---|---|---|
| GEMLIK KORFEZI (MARMARA DENIZI) | 1.4 | 12.0 | 28.9258 | 40.4160 |
| KURUCAOVA-DOGANSEHIR (MALATYA) | 2.7 | 5.4 | 38.1433 | 37.9657 |
| BAKLANCAKIRLAR-CAL (DENIZLI) | 1.9 | 7.7 | 29.2588 | 37.9098 |
| CAGLAYAN-(KAHRAMANMARAS) | 1.6 | 8.9 | 36.6502 | 37.8325 |
| GIRIT ADASI (AKDENIZ) | 2.6 | 22.6 | 24.4532 | 36.0895 |
| SOGUT-DOGANSEHIR (MALATYA) | 1.9 | 11.2 | 37.7340 | 38.0807 |
| TURKIYE-IRAN SINIR BOLGESI | 2.7 | 5.0 | 44.9005 | 38.5390 |
| IZMIR KORFEZI (EGE DENIZI) | 2.1 | 9.7 | 26.6908 | 38.3762 |
| HALILBEYLI-SAIMBEYLI (ADANA) | 1.1 | 5.0 | 36.1662 | 37.7743 |
| YAYLACIK-(HATAY) | 1.3 | 11.4 | 36.0518 | 36.2448 |
| KARAGOZ-(MALATYA) | 1.0 | 7.9 | 38.3165 | 38.2845 |
| ELDELEK-ELBISTAN (KAHRAMANMARAS) | 1.4 | 9.2 | 37.2295 | 38.2563 |
| TURKIYE-IRAN SINIR BOLGESI | 3.0 | 5.0 | 44.7212 | 38.7082 |
| GEMLIK KORFEZI (MARMARA DENIZI) | 1.7 | 8.5 | 28.8788 | 40.4277 |
| TOKTAMIS-CEYHAN (ADANA) | 0.7 | 21.8 | 35.7948 | 37.0045 |
| KUMYAKA-MUDANYA (BURSA) | 1.5 | 9.7 | 28.8442 | 40.4143 |
| KIBRIS-ISKELE | 1.3 | 6.0 | 33.7702 | 35.2782 |
| CEVIZDERE-(ELAZIG) | 1.9 | 7.4 | 39.3692 | 38.5077 |
| BALATCIK-GERMENCIK (AYDIN) | 1.4 | 4.6 | 27.4797 | 37.9392 |
| OZSOGUKSU-KIRIKHAN (HATAY) | 4.1 | 10.3 | 36.3268 | 36.4407 |
| KIZILOREN-MERAM (KONYA) | 0.9 | 8.1 | 32.0743 | 37.8728 |
| HACIKODAL-GOKSUN (KAHRAMANMARAS) | 0.8 | 2.7 | 36.2877 | 37.9165 |
| KARABUK-MANAVGAT (ANTALYA) | 1.7 | 97.9 | 31.1830 | 37.1612 |
| EGE DENIZI | 1.7 | 9.9 | 25.4085 | 39.5767 |
| DOGANALAN-MUSTAFAKEMALPASA (BURSA) | 2.1 | 6.6 | 28.6837 | 40.0835 |
| ERMENISTAN | 3.4 | 5.0 | 44.2262 | 41.0483 |
| KUCUKCAMURLU-GOKSUN (KAHRAMANMARAS) | 1.3 | 4.6 | 36.3345 | 37.8667 |
| TOPALLAR-SAIMBEYLI (ADANA) | 1.2 | 3.5 | 36.2727 | 37.8788 |
| TURKIYE-IRAN SINIR BOLGESI | 2.6 | 5.0 | 44.5893 | 38.7233 |
| HASANLI-SINCIK (ADIYAMAN) | 1.1 | 22.4 | 38.4852 | 38.0042 |
| CAMLICA-PAZARCIK (KAHRAMANMARAS) | 1.2 | 4.9 | 37.2493 | 37.5573 |
| GIRIT ADASI ACIKLARI (AKDENIZ) | 3.6 | 11.6 | 24.8525 | 34.8810 |

**Figure 9. Location, Magnitude, Impact Value, Latitude, Longitude, and Latitude Based Result of Earthquake Data-2**

(Coloumn6: Location, Column5: Magnitude, Column4: Impact Value, Column3: Latitude, Column2: Longitude, and Latitude Based Result of Earthquake Data-2)

Source: Figure 9 created by the authors

| Column6 | Column5 | Column4 | Column3 | Column2 |
|---|---|---|---|---|
| SOGUT-DOGANSEHIR (MALATYA) | 1.9 | 11.2 | 37.7340 | 38.0807 |
| TURKIYE-IRAN SINIR BOLGESI | 2.7 | 5.0 | 44.9005 | 38.5390 |
| IZMIR KORFEZI (EGE DENIZI) | 2.1 | 9.7 | 26.6908 | 38.3762 |
| HALILBEYLI-SAIMBEYLI (ADANA) | 1.1 | 5.0 | 36.1662 | 37.7743 |
| YAYLACIK-(HATAY) | 1.3 | 11.4 | 36.0518 | 36.2448 |
| KARAGOZ-(MALATYA) | 1.0 | 7.9 | 38.3165 | 38.2845 |
| ELDELEK-ELBISTAN (KAHRAMANMARAS) | 1.4 | 9.2 | 37.2295 | 38.2563 |
| TURKIYE-IRAN SINIR BOLGESI | 3.0 | 5.0 | 44.7212 | 38.7082 |
| GEMLIK KORFEZI (MARMARA DENIZI) | 1.7 | 8.5 | 28.8788 | 40.4277 |
| TOKTAMIS-CEYHAN (ADANA) | 0.7 | 21.8 | 35.7948 | 37.0045 |
| KUMYAKA-MUDANYA (BURSA) | 1.5 | 9.7 | 28.8442 | 40.4143 |
| KIBRIS-ISKELE | 1.3 | 6.0 | 33.7702 | 35.2782 |
| CEVIZDERE-(ELAZIG) | 1.9 | 7.4 | 39.3692 | 38.5077 |
| BALATCIK-GERMENCIK (AYDIN) | 1.4 | 4.6 | 27.4797 | 37.9392 |
| OZSOGUKSU-KIRIKHAN (HATAY) | 4.1 | 10.3 | 36.3268 | 36.4407 |
| KIZILOREN-MERAM (KONYA) | 0.9 | 8.1 | 32.0743 | 37.8728 |
| HACIKODAL-GOKSUN (KAHRAMANMARAS) | 0.8 | 2.7 | 36.2877 | 37.9165 |
| KARABUK-MANAVGAT (ANTALYA) | 1.7 | 97.9 | 31.1830 | 37.1612 |
| EGE DENIZI | 1.7 | 9.9 | 25.4085 | 39.5767 |
| DOGANALAN-MUSTAFAKEMALPASA (BURSA) | 2.1 | 6.6 | 28.6837 | 40.0835 |
| ERMENISTAN | 3.4 | 5.0 | 44.2262 | 41.0483 |
| KUCUKCAMURLU-GOKSUN (KAHRAMANMARAS) | 1.3 | 4.6 | 36.3345 | 37.8667 |
| TOPALLAR-SAIMBEYLI (ADANA) | 1.2 | 3.5 | 36.2727 | 37.8788 |
| TURKIYE-IRAN SINIR BOLGESI | 2.6 | 5.0 | 44.5893 | 38.7233 |
| HASANLI-SINCIK (ADIYAMAN) | 1.1 | 22.4 | 38.4852 | 38.0042 |
| CAMLICA-PAZARCIK (KAHRAMANMARAS) | 1.2 | 4.9 | 37.2493 | 37.5573 |
| GIRIT ADASI ACIKLARI (AKDENIZ) | 3.6 | 11.6 | 24.8525 | 34.8810 |
| DEGIRMENCIELI-KINIK (IZMIR) | 1.9 | 0.0 | 27.4763 | 39.0683 |
| YENIKOY ACIKLARI-TEKIRDAG (MARMARA DENIZI) | 1.4 | 9.1 | 27.5185 | 40.7850 |
| YAZIDERE-AFSIN (KAHRAMANMARAS) | 2.0 | 5.0 | 36.9932 | 38.1352 |
| SENKOY-(HATAY) | 1.9 | 7.0 | 36.1378 | 36.0477 |

**Figure 10. Location, Magnitude, Impact Value, Latitude, Longitude, and Latitude Based Result of Earthquake Data-3**

(Coloumn6: Location, Column5: Magnitude, Column4: Impact Value, Column3: Latitude, Column2: Longitude, and Latitude Based Result of Earthquake Data-3)

Source: Figure 10 created by the authors

The data were transferred to Power BI in order to visualize and interpret the results in Figure 9, Figure 10 and Figure 11 on the map. It is necessary to select a location for mapping the transferred data. The image in which the data of Türkiye were selected in this selection is shown in Figure 11.

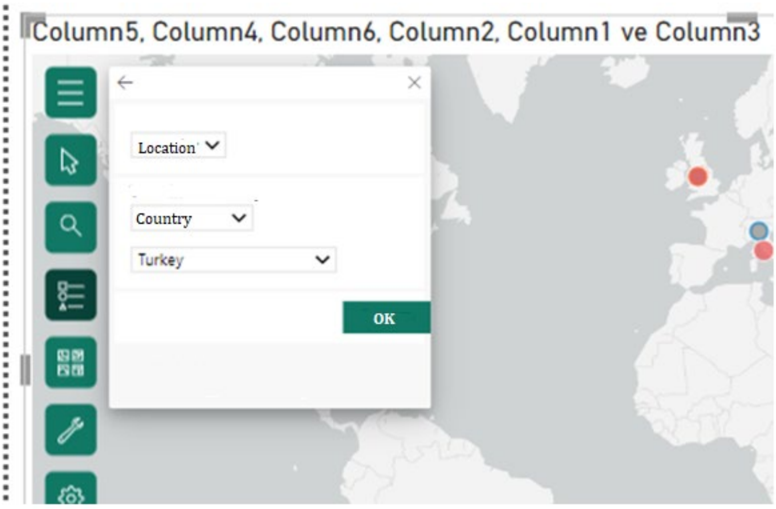


**Figure 11. Location Type**

(Coloumn6: Location, Column5: Magnitude, Column4: Impact Value, Column3: Latitude, Column2: Longitude, and Latitude Based Result of Earthquake Data)

Source: Figure 11 created by the authors

Subsequently, RGB color codes were used to visualize the earthquake depth using the color scale in Power BI and to indicate the color scale. In this study, colors were defined and matched with the color scale in Figure 12.

```
SELECT
    CASE
        WHEN depth >= 0 AND depth <= 5 AND magnitude >= 0 AND      magnitude >= 0 AND magnitude <= 2.9 THEN '128, 0, 32'     -- Burgundy
        WHEN depth > 5 AND depth <= 10 AND magnitude >= 3 AND      magnitude >= 3 AND magnitude <= 3.9 THEN '255, 0, 0'      -- Red
        WHEN depth > 10 AND depth <= 20 AND magnitude >= 4 AND      magnitude >= 4 AND magnitude <= 4.9 THEN '255, 165, 0' -- Orange
        WHEN depth > 20 AND depth <= 40 AND magnitude >= 5 AND      magnitude >= 5 AND magnitude <= 5.9 THEN '255, 255, 0' -- Yellow
        WHEN depth > 40 AND depth <= 80 AND magnitude >= 6 AND      magnitude >= 6 AND magnitude <= 6.9 THEN '0, 128, 0'   -- Green
        WHEN depth > 80 AND depth <= 150 AND magnitude >= 7 AND      magnitude >= 7 AND magnitude <= 7.9 THEN '173, 216, 230' -- Light Blue
        ELSE '0, 0, 0' -- Default color (black) for other cases
    END AS rgb_color
FROM turkey_earthquakes
WHERE date BETWEEN '2022-12-30' AND '2023-12-30';
```

**Figure 12. Earthquake Depth Color Scale and Earthquake Magnitude Color Scale**

Source: Figure 12 created by the author

Then, RGB color codes were used to visualize the earthquake magnitude and indicate the color scale using the color scale in Power BI. In this study, colors were defined and matched with the color scale. Finally, in Power BI, earthquake magnitude and depth (impact) are matched to colors using this color scale. When the relevant match was made, the result in Figure 13 was reached.


**Figure 13. Earthquake Magnitude and Depth Color Scale**

Source: Figure 13 created by the authors

According to Figure 13;

The burgundy colors on the map indicate that the depth is d≥0 d≤5, the magnitude is m≥0 m≤2.9

The red colors indicate that the depth is d>5 d≤10, the magnitude is m≥3 m≤3.9

The orange colors indicate that the depth is d>10 d≤20, the magnitude is m≥4 m≤4.9

The yellow colors indicate that the depth is d>20 d≤40, the magnitude is m≥5 m≤5.9

The green colors indicate that the depth is d>40 d≤80, the magnitude is m≥6 m≤6.9

Light blue/blue colors indicate that the depth is d>80 d≤150 and the magnitude is m≥7 m≤7.9.

In this context, the effect of the earthquake on the surface decreases as the depth increases, so it is important to show the depth data by coloring it in order to understand the potential impact of the earthquake. The burgundy, red, orange, yellow, green and light blue colors each represent a certain depth range. For example, the red color indicates deeper earthquakes, indicating that the impact of these earthquakes on the surface may be stronger. In other words, for example, since earthquakes at depth 5 and below are closer to the surface, they are generally felt more by people and can cause more damage to the ground surface. Light blue, on the other hand, represents more superficial earthquakes and can generally be less impactful.

On the other hand, earthquakes with a depth of 80 and above occur at a deeper depth and these earthquakes generally have less impact on the ground surface. However, their size and distance from residential areas are also important. For example, a large earthquake near the surface can cause serious damage, while a small earthquake over a deeper area usually produces little impact.

As a result of these findings, the potential effects of the depths on the impact of the earthquake on the surface can be understood and necessary precautions can be taken by considering the regions where the earthquakes are located and their depths. In particular, residential areas and building quality can largely determine the effects of an earthquake. This study is thought to be effective for visualizing the depth of earthquakes on the map with this color scale, understanding the potential effects of earthquakes, and emphasizing the depth differences between regions. In addition, it is thought that businesses in these regions can use this information to update their positioning and contingency plans in a more strategic way. The use of earthquake depth maps and other earthquake data for businesses can provide more awareness and preparedness. It is important for businesses to use this information strategically to take proactive steps to ensure the safety of their employees and maintain their operational continuity. Such studies can help increase the resilience of businesses located in areas with high earthquake risk and minimize possible losses.

## Conclusion

As a result of the analyzes made in this study, it was observed that earthquake activity was intense, especially in regions such as Kahramanmaraş, Malatya, Hatay and Adana. In these regions with a high risk of earthquakes, the necessity of strengthening or rebuilding the building stock arises. However, as well as physical precautions, public awareness and education are also critical. Constantly informing the local people about earthquake preparedness is of vital importance in terms of exhibiting the right behavior in a crisis. In this context, it is recommended that emergency teams and local governments create rapid response and information plans against earthquakes and keep risk management dynamic by establishing continuous monitoring systems. Trainings and awareness-raising activities on how the public should behave during an earthquake will be effective in reducing the effects of disasters. In latitude and longitude-based analyses, it has been determined that earthquakes generally occur in areas close to settlements. This situation shows that disaster trainings and guidance studies should be disseminated in a way that reaches all segments of the society, not just technical information. Conducting risk analyses, assessing the building stock, creating emergency evacuation plans and determining assembly areas will increase individual and social preparedness. Understanding the frequency and magnitude of earthquakes contributes to the planning of necessary measures for the safety of structures and infrastructure. In regions with a high frequency of earthquakes, it is recommended to carry out more frequent control and strengthening works. In this context, it is of great importance to increase building safety and to carry out continuous information studies for earthquake preparedness in densely populated regions such as the Marmara Region (Istanbul, Bursa, etc.). As a result, it is thought that the findings of this study will make significant contributions to education, guidance and social awareness activities. The main way to create a society prepared for earthquakes is through continuous education, awareness studies and proper management of risks. The limitation of this study is that it only covers data from the last year. In future studies, it is recommended to conduct more comprehensive analyses for training and guidance purposes by using data sets containing larger time intervals. In addition, this approach offers a universal model that can be used in guidance and education studies not only for earthquakes but also for other natural disasters such as floods and fires.

## Suggestions

In line with the findings of this study, some suggestions have been made in order to raise awareness of the society against earthquake risk and to increase the level of preparedness for disasters. First of all, it is of great importance to carry out earthquake resistance analyzes of public buildings, enterprises and educational institutions. In buildings where the need for structural reinforcement is determined, the necessary interventions should be carried out quickly. In order to be prepared for earthquake risk, it is a critical need for individuals and employees of institutions to receive disaster training. In this context, systematic training programs to be organized by educational institutions and guidance services should ensure that individuals develop the right behavior in the event of an earthquake. Preparing emergency action plans and sharing these plans with all stakeholders is vital in terms of minimizing the loss of life and property during a disaster. Within the scope of training and guidance activities, regular information seminars should be held on evacuation routes, assembly areas and safe behavior rules, and this information should be reinforced with practical exercises. In addition, disaster education should be carried out periodically, supported by continuous and up-to-date information, not just once. Businesses and institutions should analyze the effects of a possible earthquake on business processes and create business continuity and disaster recovery plans that will ensure the continuity of critical activities. In line with these plans, it is necessary to regularly back up critical data, identify alternative workspaces and develop rapid transition strategies. In order to raise awareness of the society against disasters, guidance services should play an active role both in school environments and in public institutions. Psychosocial support programs should be designed by guidance units in order for individuals to cope with disaster psychology, to make healthy decisions in crisis situations and to reduce traumatic effects. As a result, in order to create a society resistant to disasters, it is necessary to increase the functionality of education and guidance services and to strengthen the knowledge, skills and attitudes of individuals. This process should be carried out in an inclusive and sustainable framework not only against the risk of earthquakes, but also for preparations for other natural disasters such as floods and fires.

**Acknowledgment:** The authors have not received financial support from the University or any other institution/organization. The authors are grateful to the journal's anonymous reviewers for their extremely helpful suggestions to improve the quality of the manuscript.

**Conflicts of Interest:** The authors declare no conflict of interest.

**Data available on request from the authors**

In this study, Boğaziçi University Kandilli Observatory and Earthquake Research Institute (BDTIM) open data source was used to analyze earthquake data in Türkiye, using Power BI, a business intelligence and data analysis platform developed by Microsoft. Data set containing data of earthquakes that occurred in Türkiye between 30.12.2022-30.12.2023; It was designed using Structured Query Language (SQL) query and transferred to Power BI, including the number of earthquakes, province, location, latitude, longitude, earthquake magnitude, depth and date information. (http://www.koeri.boun.edu.tr/sismo/2/deprem-verileri/sayisal-veriler/)The data that support the findings of this study are available from the corresponding author, upon reasonable request.

**References**

Alwan, A. (Mayıs 22, 2022). Earthquake Anomaly Detection Using SQL https://medium.com/@maulialwan/anomaly-detection-using-sql-ae854cd27a52 (Erişim Tarihi: 01.12.2023)

AFAD, T.C., Başbakanlık Afet ve Acil Durum Yönetimi Başkanlığı Deprem Dairesi Başkanlığı. (2023). 20 Şubat 2023 Basın Bülteni https://www.afad.gov.tr/hatayda-meydana-gelen-64-buyuklugundeki-deprem-hk-basin-bulteni-1 (Erişim Tarihi 08.12.2023).

AFAD, T.C., Başbakanlık Afet ve Acil Durum Yönetimi Başkanlığı Deprem Dairesi Başkanlığı. (2023).

https://deprem.afad.gov.tr/depremkatalogu. (Erişim Tarihi 09.12.2023).

Boğaziçi Üniversitesi Kandilli Rasathanesi ve Deprem Araştırma Enstitüsü (KRDAE). http://www.koeri.boun.edu.tr/sismo/2/deprem-verileri/sayisal-veriler/ (Erişim Tarihi 30.12.2023).

Calvi, G.M., Pinho, R., Magenes G., Bommer, J.J., Restrepo-V´elez, L.F. & Crowley, H. (2006). Development of seismic vulnerability assessment methodologies over the past 30 years. *ISET J. Earthq. Technol.* 43, 75–104.

Covello, V.T.& Mumpower, J. (1985). Risk analysis and risk management: an historical perspective. *Risk Anal.* 5 103–120.

D'Ayala, D.F. & Paganoni, S. (2011). Assessment and analysis of damage in L'Aquila historic city centre after 6th April 2009. *Bull Earthquake Eng*, 9, 81–104. https://doi.org/10.1007/s10518-010-9224-4

Giuliani, F., Falco, A. D. & Cutini, V. (2022). Rethinking earthquake-related vulnerabilities of historic centres in Italy: Insights from the Tuscan area. *Journal of Cultural Heritage*, 54, 79-93. https://doi.org/10.1016/j.culher.2022.01.004

Handmer, J. & Dovers, S. (2007). Handbook of Disaster and Emergency Policies and Institutions, Earthscan, London.

Klinke, A. & Renn, O. (2012). Adaptive and integrative governance on risk and uncertainty, *Journal of Risk Research*, *15*(3), 273-292, DOI: 10.1080/13669877.2011.636838

Luzi L., Lanzano G., Felicetta C., D'Amico M. C., Russo E., Sgobba S., Pacor, F., & ORFEUS Working Group 5 (2020). Engineering Strong Motion Database (ESM) (Version 2.0). Istituto Nazionale di Geofisica e Vulcanologia (INGV). https://doi.org/10.13127/ESM.2

Mahajan, G. (Temmuz 14, 2022). SQLShack Analyzing spatial data with Azure Maps in Power BI. https://www.sqlshack.com/analyzing-spatial-data-with-azure-maps-in-power-bi/ (Erişim Tarihi 10.12.2023).

Marin, G., Modica, M., Paleari, P. & Zoboli, R. (2021). Assessing disaster risk by integrating natural and socio-economic dimensions: A decision-support tool. *Socio-Economic Planning Sciences.* 77101032, 1-13. https://doi.org/10.1016/j.seps.2021.101032

Microsoft (2023). Power BI Pro in Microsoft 365 E5, Acommissioned study conducted by Forrester Consulting on behalf of Microsoft, https://www.microsoft.com/en-us/power-platform/products/power-bi#footnotetext1

Scott, Z.& Few, R. (2016). Strengthening capacities for disaster risk management I: Insights from existing research and practice. *International Journal of Disaster Risk Reduction, 20,* 145-153. https://doi.org/10.1016/j.ijdrr.2016.04.010

UNISDR (2009). Terminology on Disaster Risk Reduction. The United Nations Office for Disaster Risk Reduction (UNISDR), Geneva, Switzerland. www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf

UNITECH (Aralık 4, 2023). Power BI ile Veri Görselleştirme. https://theunitech.com/power-bi-ile-veri-gorsellestirme/ (Erişim Tarihi: 06.12.2023)

Wagner, B. (Ocak 16, 2018) Importing GeoJSON Earthquake Data Into SQL Server. https://www.sqlservercentral.com/blogs/importing-geojson-earthquake-data-into-sql-server (Erişim Tarihi: 03.12.2023)

Zuo, W., Zhu,W., Wanga,F., Weia,J. & Bondara, A.(2017). Exploring the institutional determinants of risk governance: A comparative approach across nations. *International Journal of Disaster Risk Reduction*. 24, 135-143 http://dx.doi.org/10.1016/j.ijdrr.2017.05.022