Master of Science Program in Architecture Construction City

Post Disaster Resilience: The Reconstruction of Hatay, Turkey

Analysis of the Government Policies and Contributions

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Abstract

The thesis addresses the Turkish governmental policies and crisis management measures taken following the devastating earthquake of February 6th, 2023, that struck the east of Turkey and parts of Syria. Furthermore, the essay also analyzes the Turkish academic sphere and performs a series of objective analysis of its academic structure and influence in order to judge whether or not it can successfully develop the country's future, and combat new challenges linked to misinformation and low engagement of the youth in this field of study.

Also, the essay will establish a series of conclusions on the efficiency or lack of it of the Turkish governmental policies and crisis management measures, by analyzing mainly governmental documents such as post-disaster reports output by the relevant ministries, but also international papers writing on this subject in order to have internal and national sources. Turkey's academic sphere is analyzed through internationally recognized ranking institutions and academic output analysis in comparison to other comparable countries like Italy.

Finally, the essay answers the following questions regarding post-earthquake resilience in the country of Turkey: Is the Turkish government efficient in managing and producing post-disaster policies? Can Turkey's academia develop the country's earthquake culture and technical prowess? The essay will highlight both the successes and shortcomings of the Turkish government post-earthquake policies, while highlighting the future challenges facing Turkey's academic scene in the form of misinformation during natural disasters in a context of limited influence of its academic sphere.

Keywords: *earthquake, Hatay, urban planning, resilience, post-disaster, Turkey, policies, academia, regulation, masterplan*

Introduction

On the 6th of February 2023, the Turkish region of Hatay that borders the country of Syria was struck by a devastating earthquake. Indeed, the earthquake of February 2023 has been one of the worst natural catastrophes Turkey has known in its history, even as an earthquake prone nation. The former events have put enormous stress on the country's governmental institutions, highlighting how they operate as well as their limitations. Moreover, the earthquake has also positioned the Turkish academic sphere in the limelight as the role of Turkey's academia and its ability to develop Turkey's technical and earthquake culture has become an even more potent question for the country's future.

This essay aims at answering the following questions emerging from the previous observations: Is the Turkish government efficient in managing and producing post-disaster policies? Can Turkey's academia develop the country's earthquake culture and technical prowess? Thus, the essay will analyze the country's governmental response to the February 2023 events by analyzing past and current laws promoted by the government, as well as assess the capabilities of Turkish academia to influence societies on these topics.

This essay aims to deliver a set of unbiased conclusions regarding the management of the crisis by the government alongside an objective evaluation of its academic structures and its ability to prepare the country for future crises. Such conclusions will derive from the analysis of official governmental documents published by the Turkish state. The Turkish government has published two crucial reports provided by the Presidency of Strategy and Budget (Stratejik ve Bütçe Başkanlığı - SBB) and affiliated regulations, ministries, municipalities, as well as scientific articles produced internationally. Finally, a neutral quantitative analysis of university academic outputs of Turkey's academic system, produced by internationally recognized criteria, is used to evaluate the country's academy.

The essay is structured in a total of six chapters. The first chapter introduces the Turkish Urban Planning Framework and its hierarchy to explain the road to Hatay's reconstruction efforts. Chapter 2 explains the parameters the decision-makers ought to consider such as demographics and the region's heritage; Chapter 3 reports the findings of how the collective memory is founded by the history of earthquakes in the region. Chapter 4 assesses the February 2023 earthquake with its consequences and aftermath. Chapter 5 outlines the governmental response with various actors and the institutional dialogues within local and central powers, and the key points to consider such as Building Amnesty. Finally, Chapter 6 analyzes the effect of Turkish academia and what Turkish academics and institutions should do to increase their outreach and capability.

The essay concludes on governmental policymaking regarding the reconstruction of Hatay. Whilst closely examined, the regulations regarding the earthquake code were deemed sufficient by the experts, however, its execution should be tested further. The institutional dialogues could be improved over the political differences. Furthermore, the essay highlights the favorable dynamics earthquakes like these can have on the influence and growth of the country's academia, while highlighting areas of weakness of the Turkish academia such as a lack of influence within OECD countries, but also, a lack of engagement amongst in young population with the study of earthquake related disciplines at a time where misinformation regarding the topic is rising.

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I would like to express my sincere gratitude to my supervisor, Prof. Mario Artuso, for his invaluable guidance, feedback, and support throughout my thesis process. His extensive knowledge and experience were instrumental in the completion of this dissertation. Prof. Artuso always shared his wisdom with me throughout my studies at Politecnico di Torino and having a professor like him is a privilege.

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...to the memory of those who tragically lost their lives in the February 6th, 2023 earthquake in Turkey.

Acronyms/Nomenclature

AFAD: Ministry of Interior and Disaster Management Presidency (Turkey)

BAYETAV: Bir Arada Yaşarız Eğitim ve Toplumsal Araştırmalar Vakfı

BOUN: Boğaziçi University

DOGAKA: Dogu Akdeniz Kalkinma Ajansi (Eastern Mediterranean Development Agency)

EAFZ/EAF: East Anatolian Fault (Zone)

GDP: Gross Domestic Production

ITU: Istanbul Technical University

JCR: Journal Citations Report

KOERI: Kandilli Rasathanesi ve Deprem Araştırma Enstitüsü (Kandilli Observatory and Earthquake Research Institute)

METU: Middle Eastern Technical University

Ms: Surface wave magnitude scales

Mw: Moment magnitude scale

NAF: North Anatolian Fault

OECD: Organisation for Economic Co-Operation and Development

RC: reinforced concrete

SBB: Strateji ve Bütçe Başkanlığı (Budget and Strategy Department)

TOKI: Toplu Konut İdaresi Başkanlığı (Mass Housing Development Administration)

TTV: Turkiye Tasarim Vakfi (Turkish Design Council)

TUİK: Turkiye İstatistik Kurumu

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Chapter 1

Turkish Urban Planning Framework

In order to understand the governmental plans for Hatay, first we must examine the Turkish urban framework and what that entails for the administrative hierarchy.

The history of the Turkish spatial system goes back to the Ottoman Empire, especially in the second half of the nineteenth century. The attempts back then were called spatial arrangements instead of 'urban planning.' The situation was not so different in 1920-1930s, right after the foundation of the new Turkish republic. Once the first Development and Zoning Law in 1956 (no. 6785) went through, urban spatial planning became institutionalized. This date is remarkable as it set the ground for speeding up the process of urbanization of Turkey alongside industrial improvements.

New urban planning efforts on spatial planning were set off with the law accepted in 1956, as the citizens from rural areas and villages began to migrate to the metropolitans for job opportunities, such as Istanbul and Ankara. This law granted a rational understanding of the Turkish spatial planning system.

The first law of Development and Zoning was accepted in 1956, and the main planning authority became the municipalities. The law couldn't prevent faux urbanization because it was focused on the physical dimension part of planning. The law was replaced by the law (no.1605) in 1972, resulting in the authority being given to the central authorities instead of municipalities. As the rapid urbanization progressed, the law and planning efforts were not enough, and another law was enacted (no.3194) in 1985. This law is still operating with minor modifications. The law elaborates on rational urban planning. Once it was accepted, it was criticized for how to include participation how the major decisions were taken, and how policies were defined and executed in the urban areas.

As the new bylaws were implemented, a new debate was raised about social and economic issues. Globalization and the reach for information became a filter for this shift. Also, lack of environmental protection and decreasing natural resources were considered in the shift. (Dede, 2016)

1.1 The Hierarchy Behind the Turkish Urban Planning

The Turkish urban planning system is based on rationality with a strict hierarchy of the variety of plans. The urban design is executed at the project level, and the provisions about urban design were implemented in the legislation. Precisely, the application of the urban decisions is shown at the scale of the 'Implementation Plan level.'

The "Regulation of Making Spatial Plans" was accepted in 2014, which explicitly describes the aforementioned hierarchical system of Turkish urban planning. The hierarchy is one of the most predominant characteristics of the rational urban planning structure.
In terms of the hierarchy for general planning, the variety of the plans could be listed below:

– Country Plans
– Regional Plans
– Spatial Strategy Plans
– Environmental Order Plans
– Master Development Plans
– Implementation Plans

Whilst the country plans and regional plans are based on socioeconomic properties, the special strategy plan is mixed with socioeconomic and physical plan levels. The environmental order Plans regard the high physical plan level, however, the Master Development Plan and Implementation plan levels are associated with the local physical plan levels. The plan-making process has a clear rational hierarchy that is divided into four main groups:

a. Spatial Strategy Planning
b. Environmental Order Plans
c. Master Development Plans
d. Implementation plans

The common characteristic of the spatial planning system requires that all plans have to obey the decisions of the superior plans as the hierarchical order goes. In terms of the land use and build up environment, the parties involved have to obey the decisions that were made by Spatial Strategic Plans, Environmental Order Plans and Master Plans. Local governments have to respect the hierarchy of the superior Environmental Order Plans whilst developing the Master Development Plan and Implementation Plan. (Dede, 2016)

1.1.1 Spatial Strategic Plans

The Spatial Strategic plans are used to integrate national development policies as well as the strategies for regional development on a spatial level. It means that the plan level connects the socioeconomic level and the physical plan level. It aids the policymakers in transferring the decisions of national and regional plans into spatial planning. (Dede, 2016)

The characteristics of spatial strategic plans are:
They regard the National Development Policies and Regional Development Policies at the spatial level and they describe the strategies in regard to urban growth, transportation, and social and technical infrastructure. The scales used in these plans are on 1/250000 or 1/500000 or more. The principles behind spatial strategic plans are to sustain spatial harmony, conserve historical and cultural heritage, minimize the risk of disasters, (in this case, the earthquake) issue the infrastructure as well as services, and be involved in the conversation of other actors such as the NGOs, development agents, chambers, local universities. (Dede, 2016)

1.1.2 Environmental Order Plans

Article 5 of the Zoning Law No. 3984 titled "Definitions" defines the environmental layout plan as "In accordance with the country and regional plan decisions. This Plan determines settlement and land use decisions such as housing, industry, agriculture, tourism, transportation".

Organization of the Ministry of Environment and Forestry dated 01/05/2003 and numbered 4856. Although Article 2/(h) of the Law on the Ministry and its Duties lists environmental order as one of the duties of the ministry, it is not clear from this definition of duties. It is possible to derive a definition for the plan. From this regulation, a definition can be derived as follows: "The aim of balanced and sustained development in order to ensure rational natural resource utilization that allows economic and ecological decisions to be considered together, development plans and plans made based on regional plans are landscaping plans." While Law No. 3984 defines the environmental plan in terms of its subject matter, the definition derived from Law No. 4856 emphasizes the objective element more comes to the forefront.

The Environmental Plans issued by the Ministry of Environment, published in the Official Gazette dated 04/11/2000 and still in force "Definitions" of the Regulation on the Principles of Article 4 defines the environmental plan as "In accordance with the country and regional plan decisions as settlement and land use such as housing, industry, agriculture, tourism, transportation "a plan that determines the decisions and is prepared on a scale of 1/25.000, 1/50.000, 1/100.000 or smaller". (Yilmaz, 2007)

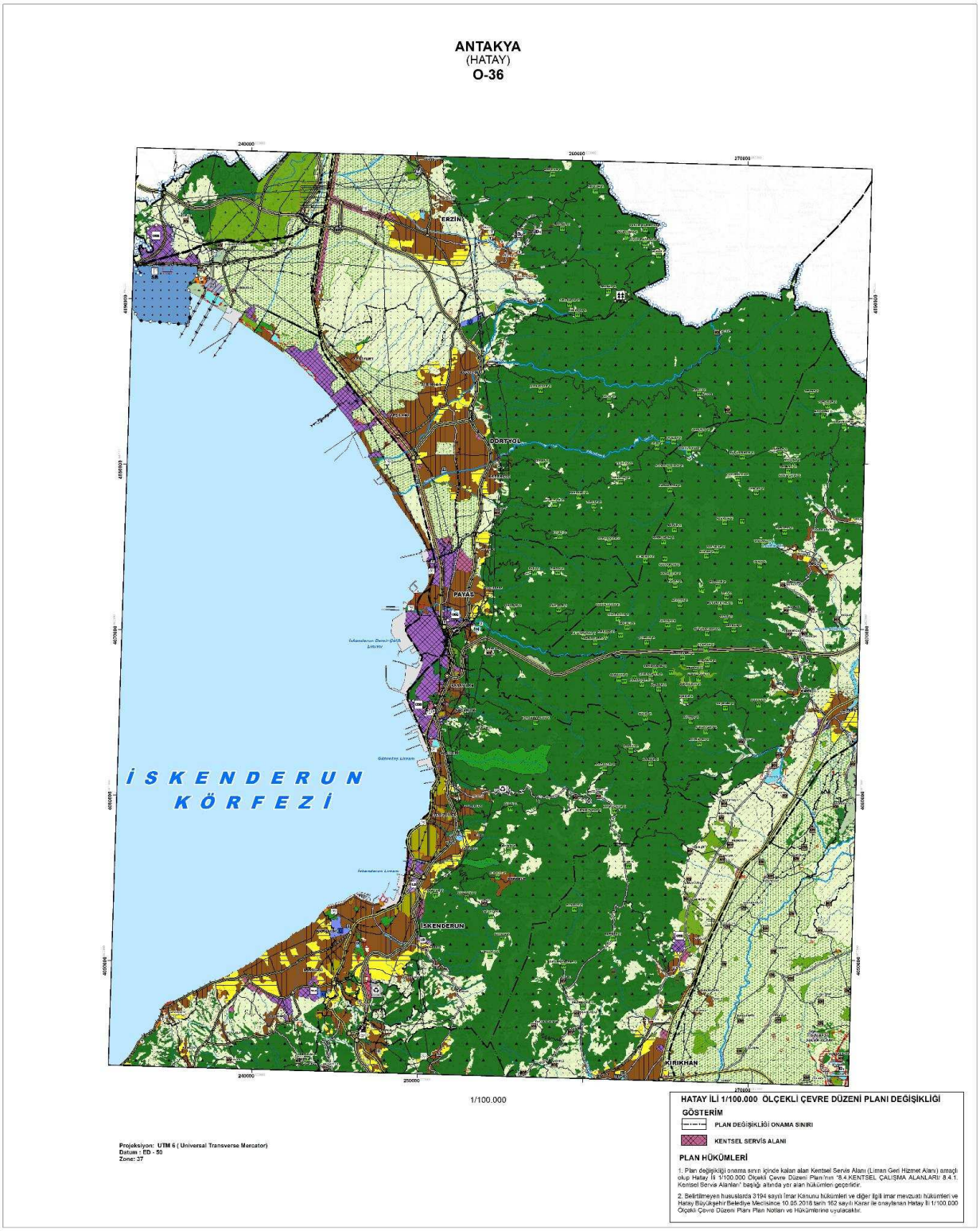


Figure 1: Pre-Earthquake Hatay Province 1/100,000 Scale Environmental Plan Change (2022), (Source: Environment and Urban Planning of Türkiye)

Environmental layout plans can be categorized into two types: provincial and regional and basin based. The Provincial Plans use an artificial measure for the location, whilst the regional and basin plans use scientific principles and requirements. The law uses region and basin concepts to avoid limiting planning activities to physical areas.

The Ministry-prepared environmental layout plan which eliminates problems from artificial boundaries and make sure that there's prevention measures for environmental pollution and land use decisions. The Ministry can create plans covering multiple provinces or specific parts of multiple provinces. However, the Ministry of Environment and Forestry cannot create a plan at the scale of a single province, as per Laws No.2872, 5302, and 5393.

On the other hand, this might not always be the case as a single province may be regarded as a region in some unique circumstances when it is important to achieve the goals of preventing environmental pollution or safeguarding the ecological balance. In that case, the Ministry could create an environmental plan but only a portion of a province may also be regarded as a region. There are aspects of administrative and geographical function should be taken into account in the Ministry's plans for the environmental organization. (Yilmaz, 2007)

1.1.3 Zoning plan

The Zoning Law No. 3194 has maintained its initial weakness in this regard until today by recognizing upper-scale plans as binding “if any”. For example, Article 5 of Law No. 3194, while defining the master development plan, sets forth one of the elements of the definition as compliance with “regional or environmental layout plans, if any”. A similar provision is repeated in Article 8(b) of the same law. (Tekeli, 2023)

In order for Hatay to have its own reconstruction, there are some aspects in terms of planning that we have to consider. Prof. Dr. Ilhan Tekeli, who’s a renowned academic specializing in urban planning warns the decision makers. “...The city [Hatay] already has a valid zoning plan. The earthquake caused the buildings to collapse but did not cancel the plan. The plan continues to be valid. The ownership of the demolished and debris-cleared area is in the shared ownership of the floor owners of the demolished building. In general and in the public opinion in Antakya, there is a consensus, albeit for different reasons, that the city should be restored to its old location.’’

His expertise suggests that the collaboration is crucial and the participation of the earthquake survivors is crucial for the new city planning. He suggests that a detailed micro-zonation study should be made on the ground to predict soil behavior during earthquakes. This study, based on geology, geophysics, and geotechnics, divides research areas into homogeneous regions based on earthquake behavior. It differentiates soil characteristics, such as amplification of wave amplitudes, desensitization of structures, and liquefaction. This helps civil engineers determine where buildings can be built without collapse and which areas should be left empty. The second study will be based on earthquake history and city plans.

As a result, in the past earthquake devastations, the main areas that were destroyed will be determined, compared with the areas that were destroyed in the last earthquake, the areas where no buildings should be built in the city will be determined, and suggestions will be made on what kind of buildings should be built for new development areas.
A third research will be conducted by taking into account the existing zoning plan and the criticisms and counterproposals about the city life before the earthquake, by interviewing the previous mayors, the parties involved in planning and by conducting focus group studies with the participation of opinion leaders and NGO members. (Tekeli, 2023)

Chapter 2

Hatay and its Heritage

2.1 Historical Heritage

The province of Hatay is located in the Southern part of Turkey. It is on the eastern shore of the Gulf of Iskenderun and is surrounded by the Mediterranean Sea to the west, the Republic of Syria to the south and east as well as Adana to the northwest. Throughout its history, Hatay has always been an important trade center and port settlement due to its important location in the Mediterranean region. (Doğaka: T.C. Doğu Akdeniz Kalkınma Ajansı 2024)

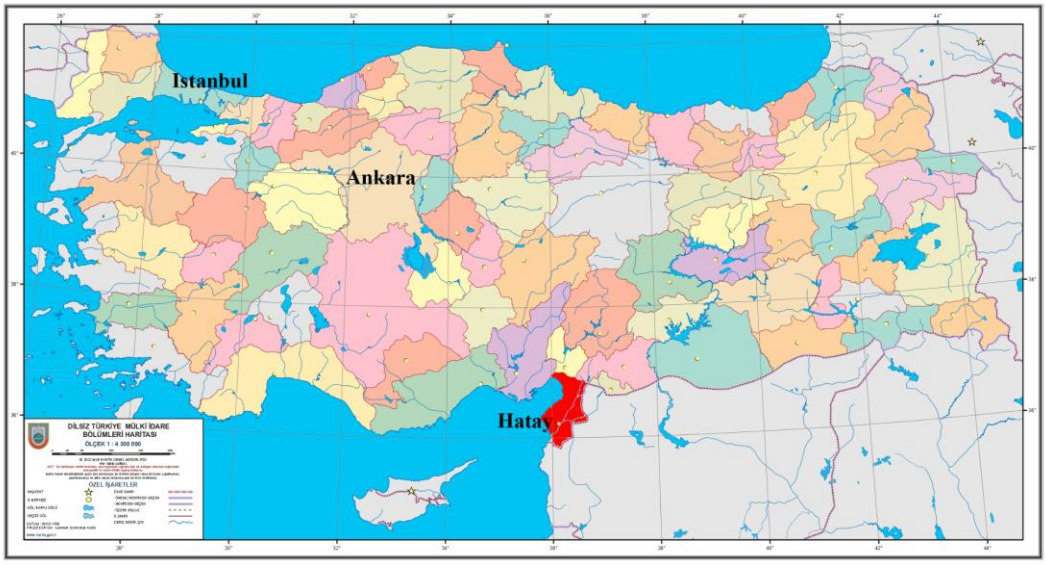


Figure 2: Location of Hatay in Map of Civil Administration Divisions of Türkiye, (Source: Ministry of National Defense, General Directorate of Mapping, 1984)

Antakya[1], currently the capital of Hatay province, boasts a rich and intricate history marked by the influence of numerous civilizations. Before it was established as Antioch by the Seleucid Empire in 300 BC so the city's roots extend into prehistoric times. Its significance grew during the Roman Empire era, following the Hellenistic period which ended in 64 BC. Antakya emerged as the Roman Empire's third-largest city, after Rome and Alexandria, and served as the capital of Syria. During this period, it become an imporatnt center for early Christianity. The city's development continued under the Byzantine Empire from 395 AD. However, its importance began to decline

[1] Hatay is a province located in the southernmost part of Turkey, in the Mediterranean Region, with coasts on the eastern end of the Mediterranean. The center of Hatay province is Antakya, which was called Antioch.

after 638 AD during the Arab period. The Byzantine Empire recaptured the city in 968-969 AD, this was the period for the city to attempt to regain its former importance through various renewal projects.

Figure 2-bis: Antakya within Hatay Civil Administration Province Map, (Source: Ministry of National Defense, General Directorate of Mapping, 2023)

From 1085 to 1098, Antakya was under the Seljuk Empire, followed by the Crusader period from 1098 to 1268, and then the Mamluks from 1268 to 1516. Throughout these periods, the city made efforts to reclaim its significance, through its emergence as a silk production center during the Crusader period. Despite these attempts, Antakya's importance gradually declined, transitioning from once a Christian city to an Islamic urban center. Under the Ottoman rule from 1516 to 1919, Antakya was notably influenced by its position on the hajj route. In addition, Antakya was frequently impacted by severe earthquakes that happened throughout these periods.

As a consequence, "the queen of the East became the delicate bride of Islam" (Türk, 2011, p. 98). With the onset of the French Mandate period, Antakya went through another significant transformation, driven by development plans and archaeological excavations of Antioch conducted by Princeton University. This era was important to discover the city's historical heritage whilst shaping its future at the same time. In 1938, Antakya was declared the capital of Hatay State, and in 1939, it joined into the Republic of Turkey after a referendum. Described as "a blessed city, drunk with splendor, victim of disasters" (Tekin, 2011), Antakya today retains its ancient settlement on the east side of the river, while the newer parts of the city have developed on the opposite side, demonstrating ongoing urban growth. (Dönmez, 2022)

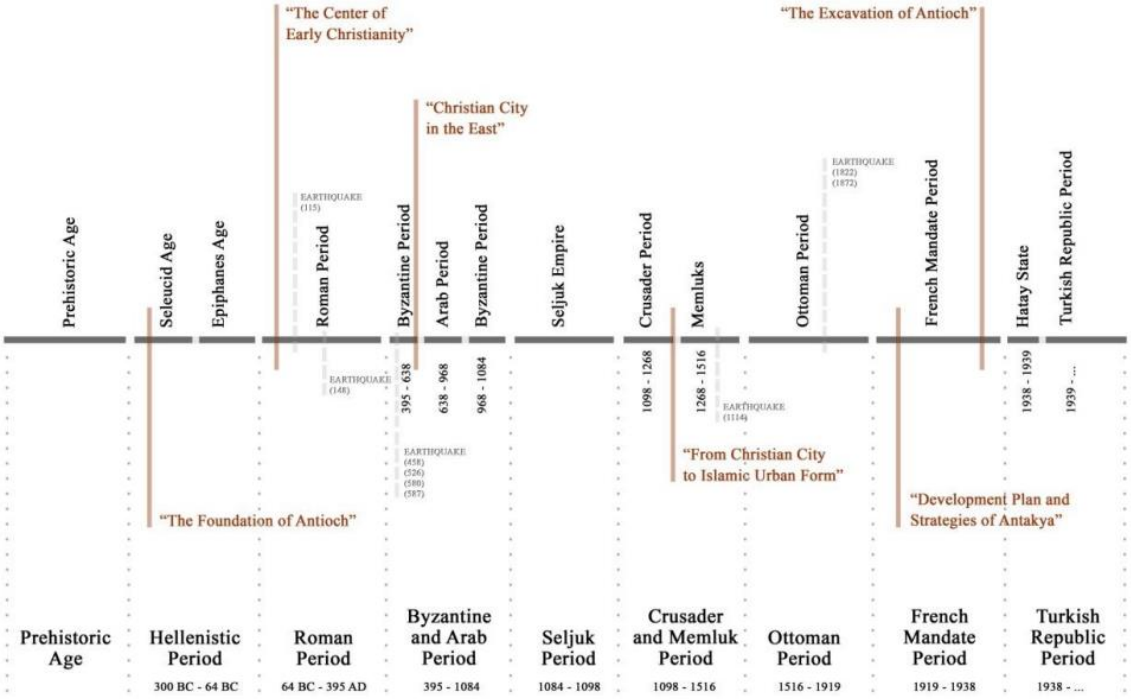


Figure 2.1: The timeline of the historical process of Antakya, (Source: Dönmez, 2022)

2.1.1 Collective Memory

According to the research of BAYETAV, (Bir Arada Yaşarız Eğitim ve Toplumsal Araştırmalar Vakfı); one of the key elements in shaping Antakya's identity or perception is the ability of its diverse cultural groups to live together simultaneously. Nearly all the participants who were interviewed by BAYETAV, to varying extents, highlight Antakya's "culture of communal living" as the city's most important positive attribute.

"Diversity" and "commonality" represent two sides of the same coin for Antakya's identity. This identity, which emerges from the unity of differences, is supported by tangible and intangible cultural assets. As an example, Antakya is home to places of worship for Judaism, Christianity, and Islam, all coexisting in one city. Antakya uniquely offers opportunities and spaces for interactions among people of these religions more than anywhere else in Turkey.

These interactions and coexistence enable the rituals of different religions to be recognized and naturally internalized by people of other faiths. The symbolic relationship created by the presence of the three religions is demonstrated by the religious symbols of "bell (for the church) – hazzan (the person who sings hymns in a synagogue) – call to prayer also known as Ezan (for Islam)." These symbols of different religions are referenced not only by civil society or the everyday language of plurality but also by the official authorities of Hatay.

To elaborate on the diversity of the urban fabric even further, the celebration of different religions could be taken as an instance. The festive seasons are often used to highlight the diversity of Antakya. When the various religious groups and their sub-sections celebrate their festivals throughout the year, it creates a rich array of celebrations. What is more noteworthy is that these festivals are not confined to their groups. Whether in their neighborhoods or shared spaces, different groups experience each other's festivals, and the collective celebration of many festivals becomes a natural part of social and cultural life.

“In other words, the nostalgic narrative often evoked when referring to the multicultural past of Turkey—such as, "We used to celebrate our Christian neighbors' Easter. The neighbours would share the eggs they dyed on Easter with us; they would also celebrate our Ramadan and Sacrifice Feasts"—still holds some popularity in today's Antakya. For that reason, festivals like "Ghadir Khumm," "Passover," "Easter," and "Eid al-Adha” become celebrations for all public. People considered "minorities" protect each other. They can close their shops, wishing each other "Happy Brotherhood Festival," and celebrate in solidarity together.”
To talk about urban fabric in Antakya, the relationship between various cultures, whether it's ethnic or religious comes to mind instantly, but it is significant to comprehend the intangible cultural heritage or tangible cultural heritage of the city and the existing urban life from the past to present and how these elements continue to produce. This cultural heritage can be associated with significant cultural entities, as seen in tangible cultural assets (e.g. Habib-i Neccar Mosque or the St. Paul’s Church) to result in becoming part of Antakya's architectural identity.

At the forefront of this cultural heritage are festivals and holy days. These holidays days, which extend to two-thirds of the calendar year bring the people of Antakya together for celebrations,

often with different combinations of participants in various neighborhoods. In Antakya, in addition to major Muslim holidays like Ramadan and Eid al-Adha, many other religious holidays are celebrated. Some of these are shared by Christians and Alevis, such as Saint Barbara's Day, also known as the Festival of Abundance, Easter. There are also grape blessing ceremonies from pagan times which became the Feast of the Assumption of Mary in Christianity, the Armenian Feast of the Assumption of Mary, and the Arab Alevi holidays of Ghadir Khumm and Evvel Temmuz. These sacred days offer significant insights into the multicultural social interactions within Antakya's community. Certain festivals remain primarily local. For example, "Evvel Temmuz," a ritual that marks the harvest and welcomes July, symbolizing abundance, has predominantly been celebrated as a festival in Samandağ for many years. (Kentel, 2024)

2.1.2 Cultural Heritage Affected by the Earthquake

Unfortunately, due to the consequences of the earthquake in 6th of February, a lot of the cultural heritage values in Hatay city centre, specifically in Antakya region were destroyed completely or damaged significantly. The importance of Hatay is demonstrated by its 150 archaeological sites, 5 natural sites (Antakya, Harbiye, Reyhanlı-Yenişehir, Kırıkhan, Gölbaşı, Erzin), and 1 urban protected area are located in the province of Hatay. Apart from the colossal buildings like churches, synagogues, inns, baths, madrasahs, and mosques, the area boasts a rich archaeological and urban legacy. Among them is Antakya— one of the most well-liked cultural tourism destinations of the past 20 years, with a site that features traditional bazaar architecture and religious architecture with variety and these works also have a special significance for Turkey's diplomacy and foreign relations. (Ersoy, 2024)

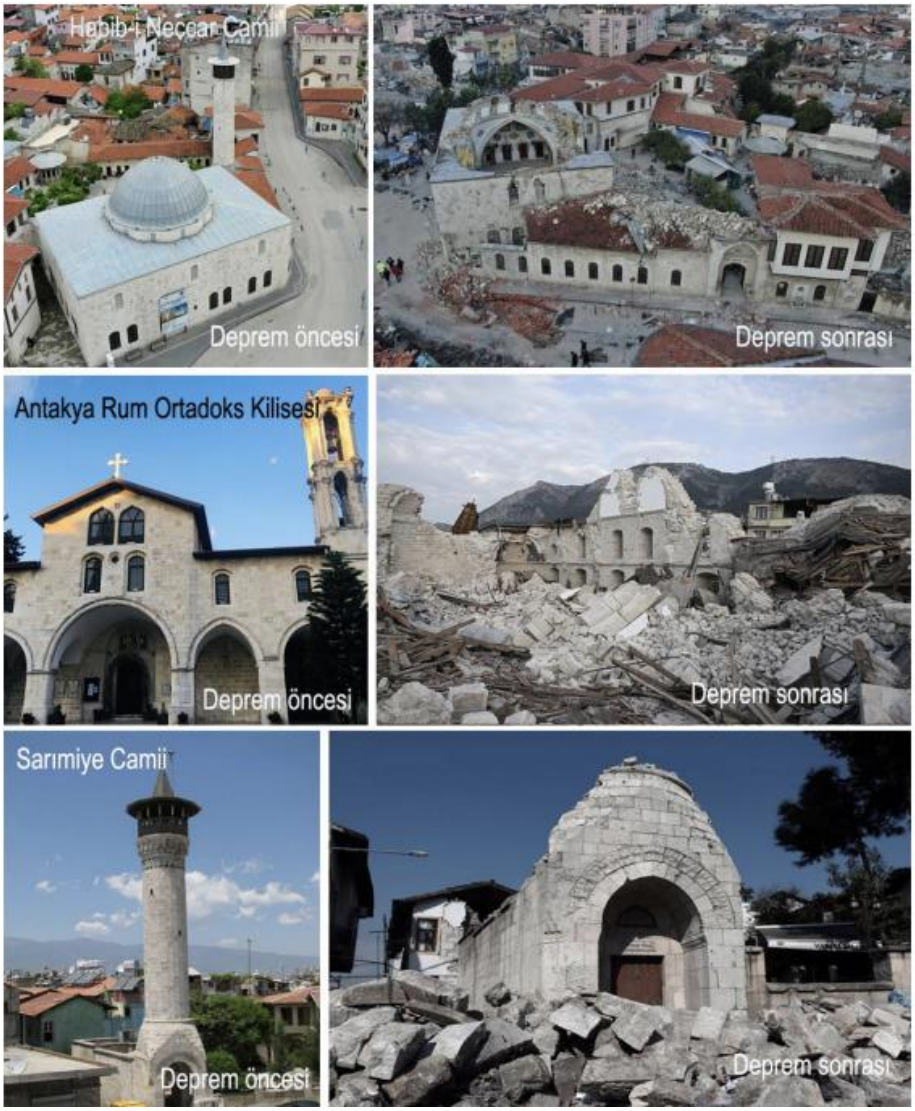


Figure 2.1.2 : Hatay cultural heritage sites before and after the earthquake (Source: Uzun & Somuncu, 2023)

Some of the damages done to the heritage sites as it follows:

- The retaining wall of the Saint Pierre Church has collapsed.
- The dome of the Habib-i Neccar Mosque has collapsed, and its walls have collapsed.
- The minaret of the historical Sarımiye Mosque has collapsed (Figure 2.1.2).
- The Antakya Synagogue and the Antakya Turkish Catholic Church located near this mosque have collapsed (figure 2.1.2
- The historical and religiously important Antakya Saints Peter and Paul Greek Orthodox Church has also been largely destroyed (figure 2.1.2)
- The Ulu Mosque on the banks of the Asi River has been completely destroyed.
- The Antakya Protestant Church in the building previously used as the French embassy and bank has also been destroyed.

On top of all this, there were many traditional houses in Old town Antakya, which had undergone a functional transformation, were destroyed. A part of the Hatay Archaeology Museum has been

demolished. In order to protect the portable artifacts in the museum, 20 containers were delivered to the Ministry of Culture and Tourism by the United Nations Development Program. (UNDP) (Uzun & Somuncu, 2023)

The surface is approximately 300 hectares long and includes the zones where Antakya urban cultural heritage areas are concentrated after the earthquake. The former area has been declared a risky area in accordance with Article 2 of the Law No. 6306 on the Transformation of Areas at Disaster Risk, as published in the Official Gazette dated April 5, 2023. The target of this law is to generate the procedures regarding the improvement, liquidation and renewal of areas at disaster risk and lands where risky structures are located outside these areas, in order to create safe living environments in accordance with scientific and artistic norms and standards.

When the cultural heritage elements in the area within the boundaries of the law are examined (figure 2.1.3), it is obvious that all the major structures belonging to various periods and different cultures of the city of Antakya remain within this area except for the St Pierre Church, the first cave church of Christianity and the Hatay Archeaological Museum. This area is an area where traditional Antakya houses built in narrow streets, which have an important place in Antakya's geographical appearance. They used to be densely located, and both daily life and cultural tourism continued before the earthquake took place here.

However, it is important to note that the historic structures in Turkey are not obligated to comply with TBDY 2018, the Turkish Building Earthquake Code. Instead, there is a guide on seismic compliance of the historical building for earthquake risk management. The Earthquake Management Guide on Historical Buildings was published for the performance evaluation of historical masonry structures. This guide provides methods for seismic evaluation of historic structures and gives valuable information on principles of retrofitting applications. (Ersoy, 2024)

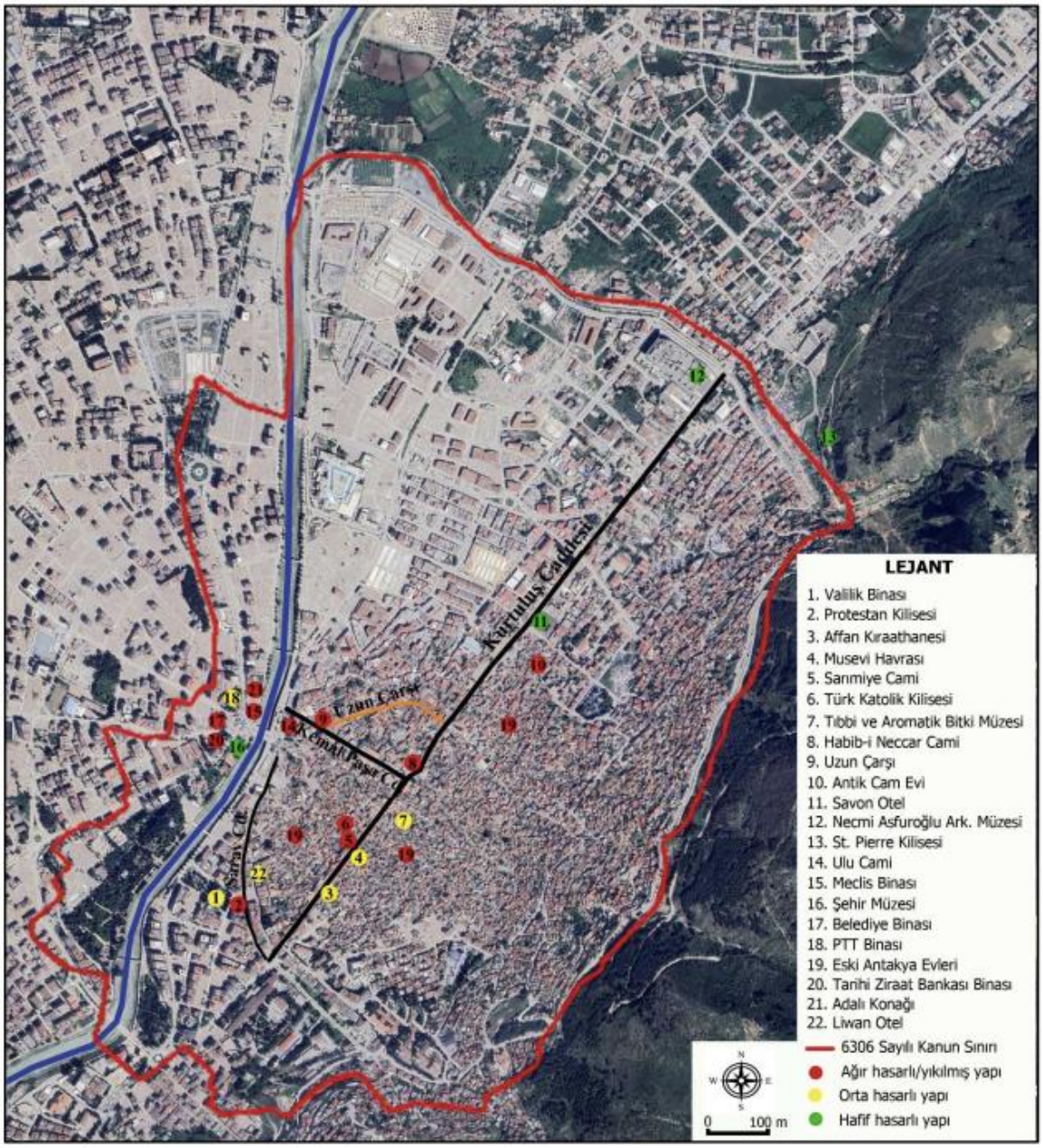


Figure 2.1.3: Cultural heritage structures affected by the earthquake in Antakya city center and the law boundary numbered 6306. (Source: Uzun & Somuncu, 2023)

2.2 Demographic Structure

According to the data provided by TUIK (Turkish Institute for Statistics), Hatay ranks as the 13th most populated province in Turkey with an average population of 1.5 million. The surface area of Hatay is 5524 square kilometers which resulted in Hatay's population growing rapidly, particularly since the 1970s. The most recent annual growth rate is 11.1‰, while the net migration rate stands at -4.3‰. The unemployment rate is 12.2%. From 2010 to 2012, Hatay's socioeconomic development index dropped from 20th to 22nd place.

Tables 2.2 and 2.3 provide detailed population census data for Hatay Province. The slowest population growth happened between 1940-1945 and 1990-2000. However, the highest growth rates were seen between 1950-1965, 1975-1980, and 2000-2010. The 1950s saw significant migration waves, leading to a dramatic increase in the urban population.

Years	Population		Years	Population
1940	246138		2010	1480571
1950	296799		2011	1424223
1960	441209		2012	1483674
1965	506154		2013	1503066
1970	591064		2014	1519836
1980	856271		2015	1533507
1990	1109754		2016	1555165
2000	1253726		2017	1575226
2007	1386224		2018	1609856

Figure 2.2: Population censuses in the province of Hatay. (Source: TUIK, 2019, table by the author)

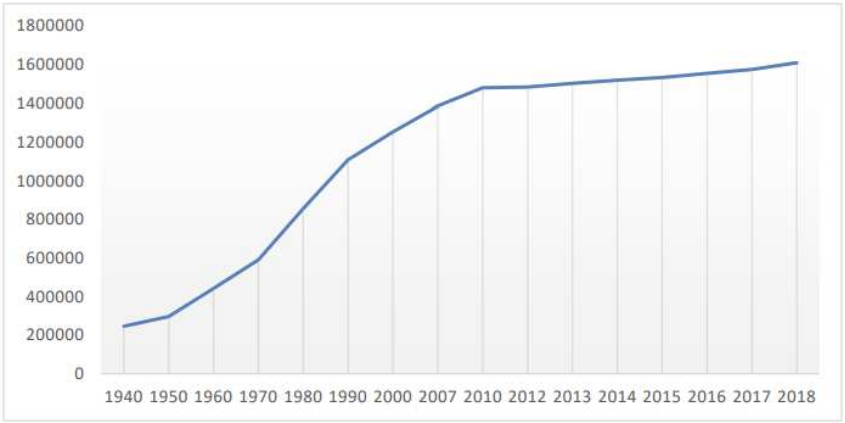


Figure 2.3: Population censuses in the province of Hatay (1940 - 2018). (Source: TUIK, 2019, table by the author)

Table 2.4 presents data on population density, annual population growth rate, and annual net migration rate for Hatay from 1940 to 2017. Notably, 2013 saw the highest annual net migration rate, despite the simultaneous accommodation of Syrian refugees at the beginning of the Syrian Civil War. This data indicates that the province experienced major emigration during this period.

Years	Population density. (person/km^2)	Annual population growth rate (‰)	Annual net migration rate (‰)
2007	238	-	-
2008	242	19.33	-2.24
2009	249	24.55	-2.58
2010	254	21.96	-2.68
2011	253	-4.30	-5.18
2012	255	6.39	-5.30
2013	258	12.99	-6.79
2014	273	11.10	-4.27
2015	276	8.99	-5.63
2016	279	14.12	-2.2
2017	283	12.89	-4.36

Figure 2.4: Population density, annual population growth rate, and annual net migration rate of Hatay (1940-2017), (Source: TUIK, 2019, table by the author)

To examine the data provided by TUIK at the national level, as of December 31, 2019, the population of Turkey is 83154997. Hatay has a population of 1628894, with 50.2% (817,998 people) being male and 49.8% (810,896 people) being female. In terms of total population, Hatay ranks 13th among the 81 provinces, the same as in 2018.

In 2019, the annual population growth rate of Turkey was 13.9 per thousand. Hatay's annual population growth rate was 11.8 per thousand (21.7 per thousand in 2018). In terms of annual population growth rate, Hatay ranks 22nd among the 81 provinces.

The age group pyramid of Hatay shows that, compared to the national average, the province has a higher proportion of people in the 0-19 age range and a lower proportion in the 20-40 age range. This situation is attributed to the birth rate in the region being higher than the national average, and a movement of people from the region to other areas for education and employment after their twenties.

While the population pyramid indicates that Hatay has a young and dynamic population structure compared to the Turkish average, an examination of the age group proportions from 2007 to 2016 reveals that both Turkey's and Hatay's populations are gradually aging. In 2007, the proportion of Turkey's population aged 0-14 was 26.4%, and the proportion aged 65 and over was 7.1%; by 2016, these figures had changed to 23.7% and 8.3%, respectively. For Hatay, in 2007, the proportion of the population aged 0-14 was 30.1%, and the proportion aged 65 and over was 5.7%; by 2016, these figures had changed to 28.5% and 6.7%, respectively. (Dogaka, 2017)

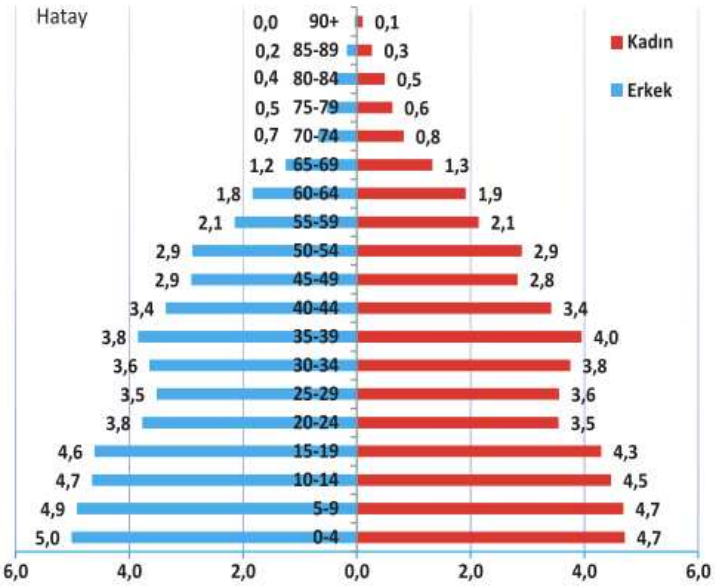


Figure 2.5: The population pyramid sorted by gender in Hatay (Source: Dogaka, 2017)

An interpretation that can be made about the figure 2.5 is that the population is relatively young, especially considering its European counterparts. For instance, if we examine the data in figure 2.5.1, we can observe the European age pyramid is on a different trend with the young population decreasing, however, Hatay's population pyramid sorted by the gender states a different scenario with young people upcoming for the population outlook.

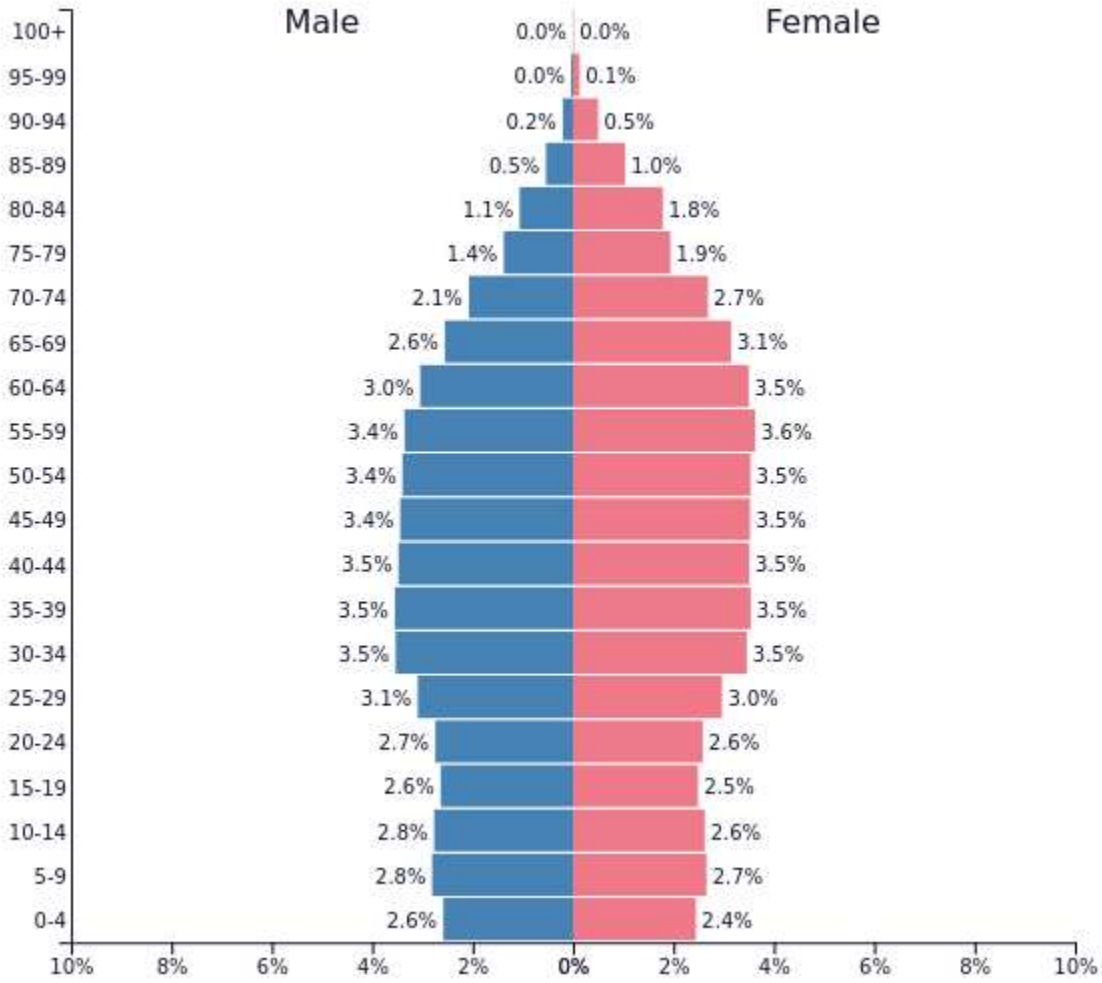


Figure 2.5.1: European Union population age pyramid sorted by gender, (Source: Eurostat, 2020)

2.2.1 Immigration

With the start of the conflicts in Syria, Turkey implemented an open-door policy, leading to an increasing number of Syrians seeking refuge in Turkey, reaching 3 million by 2017. During this period, Turkey established camp areas for the refugees under the coordination of the Prime Ministry Disaster and Emergency Management Authority (AFAD).

Additionally, the Directorate General of Migration Management was established along with its provincial organizations to regulate the intense migration movements according to international and local legislation. (KDK, 2018)

Cities	Registered Syrians	City population	Population total	Percentage
İstanbul	501.929	14.804.116	15.306.045	3,4%
Şanlıurfa	439.826	1.940.627	2.380.453	22,7%
Hatay[4]	377.643	1.555.165	1.932.808	24,3%
Gaziantep	339.697	1.974.244	2.313.941	17,2%
Diğer İller	334.007	37.011.584	37.345.591	0,9%
Adana	166.247	2.201.670	2.367.917	7,6%
Mersin	157.285	1.773.852	1.931.137	8,9%
Kilis	127.576	130.825	258.401	97,5%
Bursa	117.682	2.901.396	3.019.078	4,1%
İzmir	115.356	4.223.545	4.338.901	2,7%
Mardin	95.926	796.237	892.163	12,0%
Kahramanmaraş	94.569	1.112.634	1.207.203	8,5%
Ankara	82.676	5.346.518	5.429.194	1,5%
Konya	80.945	2.161.303	2.242.248	3,7%
Kayseri	63.308	1.358.980	1.422.288	4,7%
Osmaniye	46.708	522.175	568.883	8,9%
Toplam	3.141.380	79.814.871	82.956.251	3,9%

Figure 2.6: Distribution of Syrian Refugees in Turkey by Province (Person) (Source: Directorate General of Migration Management, 2017).

According to the data from the Directorate General of Migration Management for August 2017, Istanbul has the highest number of Syrian guests in Turkey. Şanlıurfa ranks second, while Hatay is the third province with the most registered Syrian refugees. However, when evaluating the proportion of registered Syrians to the provincial population, Kilis ranks first with 97.5%, and Hatay ranks second with 24.3%. (Dogaka, 2017)

In Hatay, when assessing the distribution of Syrians by district, most of the Syrians have been registered in the Reyhanlı district. Reyhanlı, being the district closest to the Cilvegözü border gate, has a ratio of Syrians to the local population of 143%. Following Reyhanlı, the highest number of Syrians have been registered in the Antakya and Kırıkhan districts, respectively. (Dogaka, 2017)

2.2.2 Population Post-Earthquake

According to the Address-Based Population Registration System (ADNKS)[2] results from the Turkish Statistical Institute (TÜİK), the population in all of the six provinces affected by the earthquake has decreased. Moreover, in comparison to the rest of the provinces, Hatay saw the most significant drop, losing its 141403 people, followed by Malatya with 69855, and Kahramanmaraş with 60818. In total, the population in these six provinces declined by 307814 over the past year.

[2] For more information regarding Address-Based Population Registration System, please refer to: https://nip.tuik.gov.tr/Home/Adnks

In 2022, Hatay's population was 1686043. By 2023, it had decreased by 141403 people, resulting in a population of 1544640.

Cities	Total	(0-17)	(15-24)	(15-29)	(0-29)	(15-64)	65+
Adana	2.274.106	650.919	337.196	500.939	1.040.186	1.523.411	211.448
Adıyaman	635.169	213.088	104.216	151.927	329.544	404.271	53.281
Diyarbakır	1.804.880	677.944	323.328	479.726	1.051.408	1.140.208	92.990
Elazığ	591.497	152.439	93.264	136.714	262.186	401.774	64.251
Gaziantep	2.154.051	790.077	373.459	543.469	1.206.932	1.366.161	124.427
Hatay	1.686.043	537.008	265.090	382.846	828.626	1.102.478	137.785
Malatya	812.580	215.978	126.831	184.285	361.013	545.210	90.642
Kahramanmaraş	1.177.436	373.637	193.881	278.382	586.363	764.905	104.550
Şanlıurfa	2.170.110	974.864	403.597	580.835	1.414.726	1.246.531	89.688
Kilis	147.919	48.947	27.599	39.283	80.164	95.119	11.919
Osmaniye	559.405	171.036	87.769	125.901	266.411	366.904	51.991
Region total	14.013.196	4.805.937	2.336.230	3.404.307	7.427.559	8.956.972	1.032.972
Men	7.049.219	2.461.656	1.196.670	1.731.596	3.792.656	4.524.779	463.380
Women	6.963.977	2.344.281	1.139.560	1.672.711	3.634.903	4.432.193	569.592
Türkiye	85.279.553	22.578.378	12.949.817	19.502.986	38.238.097	58.092.773	8.451.669
Men	42.704.112	11.585.839	6.633.224	9.967.663	19.580.385	29.341.142	3.750.248
Women	42.575.441	10.992.539	6.316.593	9.535.323	18.657.712	28.751.631	4.701.421

Figure 2.7: Earthquake-Affected Province Population Structure 2022 (Source: TUIK, ADNKS)

As of December 31, 2023, Hatay, which suffered the most casualties in the earthquake, saw its registered population drop compared to the previous year. In 2022, Hatay's population was 1686043, but as a consequence of the February 6 earthquakes, it fell to 1544640 in 2023, with a decrease of 141403. The population growth rate in Hatay declined from 9.1‰ in 2022 to -87.6‰ in 2023. However, it is estimated that the actual migration might be higher since some earthquake victims moved to other cities without changing their registered addresses. (Republic of Turkey Presidency, Strategy and Budget Department 2023)

2.3 Administrative Framework of Hatay

In this part, it’s necessary to examine the administrative framework of Hatay, especially the institutions that are in charge of city planning and earthquake management at a municipal level. The main parties that participate in city planning through governmental agencies are the Hatay Metropolitan Municipality and its subdivisions. The most influential subdivision is the Department of Planning and Urbanisation as their main role is the implementation and supervision of zoning plans.

2.3.1 Hatay Metropolitan Municipality

The number of metropolitan municipalities in Turkey has risen to thirty with the enactment of Law No.6360, which established new municipalities. This law connects the boundaries of metropolitan municipalities with those of the provinces. Hatay became one of the newly designated metropolitan municipalities under this law. The transition to a metropolitan municipality in Hatay led to have a new administrative structure within the province. The law's impact has been observed not only in administrative level but also in other levels such as politically, financially, and socially. Exceptionally, the creation of new districts by dividing larger ones and altering the boundaries of some districts has had important effects. (Adıgüzel, 2014) The main goal of the Metropolitan Municipality is to preserve Hatay's historical and cultural heritage while ensuring citizen satisfaction by addressing the city's common needs.

2.3.1.1 Hatay Metropolitan Municipality's Department of Planning and Urbanization

The duty of the Municipality of Hatay and its Department of Planning and Urbanization comes from Article 69 of Municipal Law No. 5393, dated 03/07/2005, the municipality ensures orderly urban development by producing zoned and serviced plots to meet the housing, industrial, and commercial needs of the town, excluding areas that require preservation and agricultural lands. It reviews and submits to the council the implementation of zoning plans prepared by district municipalities in accordance with the master plan and monitors their execution. If district municipalities do not prepare their implementation and parceling plans within a year of the master plan's enactment, the municipality takes over and prepares them.

The municipality also manages all urban planning tasks related to urban renewal and development projects, including zoning plans, parceling plans, building permits, occupancy permits, and similar procedures. It handles the naming and numbering of public spaces like squares, streets, and the buildings on them. It carries out duties assigned by the Regulation on the Establishment and Operation of Conservation, Implementation, and Supervision Bureaus, Project Bureaus, and Training Units, published in the Official Gazette on 11/06/2005 (No. 25842).

In line with the authority granted by Article 11 of the Metropolitan Municipality Law No. 5216, dated 10/07/2004, the municipality handles the necessary correspondence for evacuating, terminating utilities, and demolishing buildings with a demolition order. It prepares and implements the environmental plan and, within municipal boundaries, drafts the master zoning plan for scales between 1/5,000 and 1/25,000, ensuring alignment with the approved environmental plan. (Official Gazette Turkey, 2005)

Chapter 3

Hatay's Past in regard to Environmental Challenges

In order to undertake any serious endeavor of rebuilding Antakya and neighboring cities, architects and engineers alike must first study and understand the geological setting in which they will work. In order to achieve this, architects and engineers may study previous events that have occurred in the region, but also learn from modern studies made possible thanks to old and modern techniques. In this chapter, we shall focus on Hatay's environmental setting and challenges prior to the 2023 earthquake. This chapter will serve as an informative introduction to the recent earthquake and current challenges facing Hatay, post-disaster.

One area on which experts should place a strong emphasis on, of course, is the particular and challenging seismic context of the region. Indeed, Hatay's seismic context has been well documented throughout the past and should be considered alongside the current tackling of the post-disaster recovery and rebuilding of the 2023 earthquake as it serves as the best illustration of challenges that Hatay will face in the future.

3.1 Turkey's General Faulty Lines Context

First and foremost, architects and engineers should be aware of Turkey's overall complicated geography, being placed at the crossroads of many different faulty lines, making it particularly exposed to seismic catastrophes.

Türkiye is located over the Alpine-Himalayan belt, one of the most significant seismic belts in the entire world. Indeed, Turkey is located more specifically on the Anatolian microplate which is pushed towards the Eurasian plate by the Arabian plate with a moving speed of about 1–2 cm/a to the north. (Wang et al., 2023) This configuration is represented in Figure 0, alongside the fault distribution. The area of interest for this thesis is more specifically the East Anatolian Fault Zone (EAFZ)[3] which is located between the Arabian plate and the Anatolian plate. Being at the crossroads of many differing plates, it has geologically developed based on the ongoing movements of these plates, as well as the enclosure of the Tethys Ocean, located between these plates, throughout the Bitlis-Zagros suture zone. (SBB Report, 2023, page 17)

[3] More information regarding Eastern Anatolian Fault Zone could be found here:

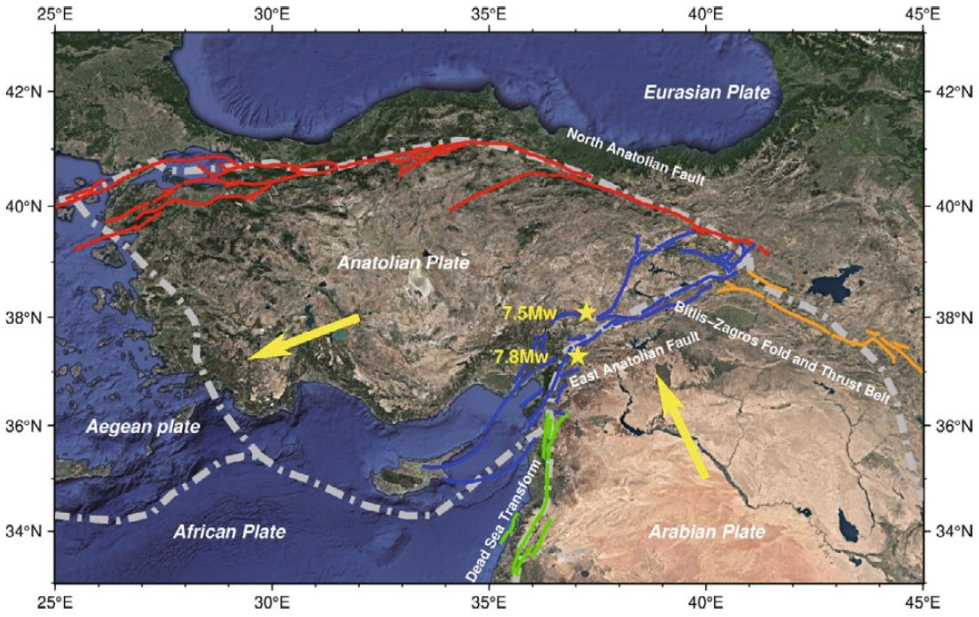


Figure 3: Fault distribution around Anatolian microplate (Source: Wang et al., 2023, page 1)

Seismic activities in and around Türkiye are a direct consequence of the ongoing complex plate tectonics between the Eurasian, African, and Arabian plates. Amongst these complex tectonics, we can for example name subduction, continental collision, extension, and escape tectonics. (SBB Report, 2023, page 17)

In fact, because the Eurasian plate is heavy, the Anatolian microplate is extruded to the west and forms both the complex left-lateral east Anatolian fault and the right-lateral north Anatolian fault (Wang et al., 2023, page 1). The east Anatolian fault forms a left-lateral strike-slip fault zone where the two earthquakes happened in February of 2023, and are the areas of focus for this thesis.

In order to recapitulate the seismic situation of the country, the Türkiye Earthquake Hazard Map was published by the Turkish government and took effect in 2018. It shows that the risk of earthquake, affects major areas of the countries, in many different zones and areas regardless of one's geographical location.

Figure 3.1: Turkey seismic Hazard map published by AFAD (Source: SBB Report, 2023, page 18

3.2 Approaching Antakya's seismic past through the lens of history.

Architects and urban planners should begin their reconstruction work on the study of EAFZ's history of seismic and natural catastrophes. Indeed, it is well documented that in the past 2000 years, the areas of interest have been subjected to devastating earthquakes; with deformation rates of several dozens of millimeters per year (Reilinger et al., 2006). The archives underline the necessity of taking Antakya's geological context seriously as the events of 2023 were not a one-time-off. Furthermore, a collection of differing seismic catalogs (Adams, 1996) (Ambraseys, 2009) (Miniati, 1995) (Congourdeau, 2007) available online summarizes the most significant seismic events the regions have been subjected to previously.

As authors in (Taftsoglou et al., 2023, pages 2-3) suggest, we can point out a series of four particularly devastating earthquakes in Antakya's history, excluding the 2023 one. These events were so devastating for the urban tissue and free land areas that they have all been scientifically linked to disastrous secondary effects such as ground openings, river slumping, and sand ejection.

The first series of these earthquakes was composed of three devastating separate earthquakes that occurred near the city of Antioch (see Figure 3.2). They took place on the dates 14 September 458 AD, 29 March 526 AD, and 29 November 1114 AD, more than 2000 years ago. They respectively had Ms levels of 6.5, 6.8, and 6.8 (Taftsoglou et al., 2023, page 3). Albeit devastating, their MS

levels remained below those that the region has known in the 21st century. These three earthquakes emerge as the oldest well-documented earthquakes of the region in the available literature.

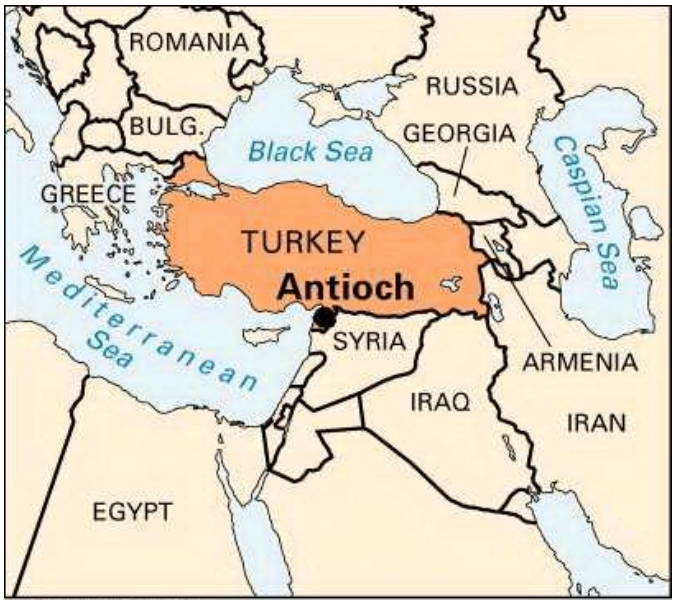


Figure 3.2: Sketch of Turkey with Antioch (Source: Google)

A second notable series of earthquakes that hit EAFZ occurred on the 13th of August in 1822 (Taftsoglou et al., 2023, page 3). This time, a 7.4 MS earthquake devastated the southeastern Anatolian region and in particular, damaged the cities of Gaziantep, Antakya, and Aleppo in northern Syria. This earthquake is particularly interesting to the author of the current thesis as it is quite similar to the 2023 one. Indeed, both the Turkish city of Antakya and the Syrian city of Aleppo were hit as in the 2023 one, but also the Ms value is similar to the recent one. The former observations demonstrate that these earthquakes have been part of Antakya's past, and they could very well be part of its future.

Finally, the most recent earthquake of grand scale that struck the EAFZ before 2023 is most probably the 2020 earthquake of Mw 6.8 that ruptured and fragilized more than 45 km of the EAFZ, preceding the 2023 earthquakes.

Other major Turkish earthquakes have been documented in the literature and could also serve as a basis for the study of the region. For example, the 1975 Lice (Ms 6.7) and 1992 Erzincan (Mw 6.7) (Taftsoglou et al., 2023, page 3) events to name a few, were both followed by many significant aftershocks around the Northern Anatolian Fault Zone. Indeed, many academics who have studied this topic point out the rich history of earthquakes that have affected the EAFZ. In (Wang et al., 2023, page 2), the authors recapitulate the main earthquakes contained in the history of the EAFZ on a map depicted in Figure 3.3.

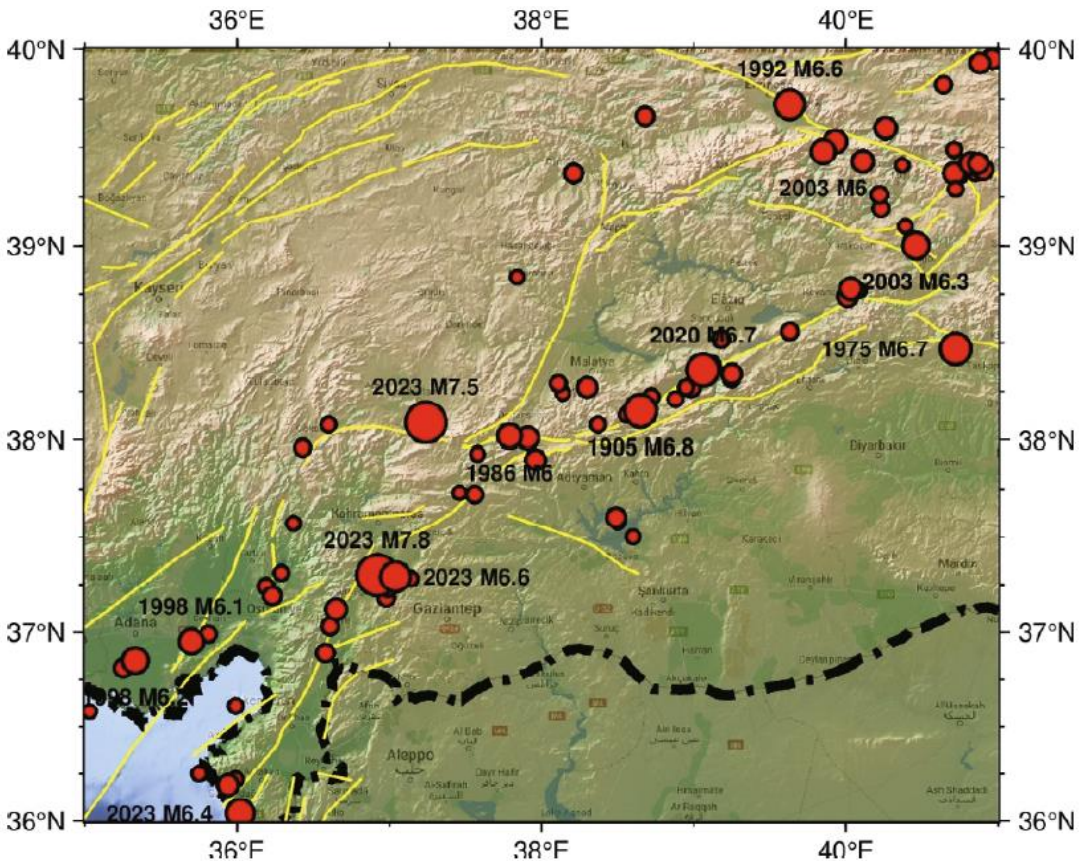


Figure 3.3: Distribution of history earthquakes in the east Anatolian fault (Source: Wang et al., 2023, page 2)

As mentioned previously, many different records of past historical earthquakes can be found thanks to open-access sources. Perhaps the most interesting are the sources that come directly from the government. According to governmental sources itself, the oldest earthquake in this geography occurred in 411 B.C. Moreover, according to the Turkish government, there have been exactly twenty earthquakes with a magnitude of 7 or higher recorded since 1900. This places Turkey among the top-listed countries in the whole world, affected by earthquakes. (SBB Report, 2023, pages 17-18)

If we include earthquakes of all different kinds of magnitude levels, in Türkiye, there have been exactly 269 earthquakes that caused loss of lives and economic damage between the years 1900 and 2023. In terms of loss of lives and economic damage, the top three of these earthquakes were the 2023 Kahramanmaraş Earthquake, the 1939 Erzincan Earthquake, and the 1999 Marmara Earthquake (epicenter: Gölcük). (SBB Report, 2023, pages 17-18)

The following table summarizes the history of the most significant earthquakes on Turkish land since the beginning of the 20th century:

Location	Date	Ms	Mw	Magnitude
Pütürge - Malatya	04.12.1905	6.8		IX
Şarköy - Tekirdağ	09.08.1912	7.4		X
Burdur	03.10.1914	7.0		IX
Tokat	24.01.1916	7.1		
Ayvalık - Balıkesir	18.11.1919	7.0		IX
Köprüköy - Erzurum	13.09.1924	6.8		IX
Offshore Kaş	18.03.1926	6.8		X
Offshore Datça	26.06.1926	7.7		IX
Kaman - Kırşehir	19.04.1938	6.6		
Dikili - İzmir	22.09.1939	6.6		
Çayırlı - Erzincan	26.12.1939	7.9		
Erbaa - Tokat	20.12.1942	7.0		
Adapazarı - Sakarya	20.06.1943	6.6		
Ilgaz - Çankırı	26.11.1943	7.2		
Gerede - Bolu	01.02.1944	7.3		
Offshore Edremit	06.10.1944	6.8		
Offshore Izmir	23.07.1949	6.6		
Tercan - Erzincan / Yedisu - Bingöl	17.08.1949	6.7		
Çerkeş - Çankırı	13.08.1951	6.9		
Yenice - Gönen - Çanakkale	18.03.1953	7.2		
Söke - Aydın	16.07.1955	6.8		
Mediterranean Sea	25.04.1957	7.1		
Abant - Bolu	26.05.1957	7.1		
Karacabey - Bursa	06.10.1964	7.0		
Varto - Muş	19.08.1966	6.9		
Adapazarı - Sakarya	22.07.1967	6.8		
Offshore Bartın	03.09.1968	6.5		
Alaşehir - Manisa	28.03.1969	6.5		
Çavdarhisar - Kütahya	28.03.1970	7.2		
Bingöl	22.05.1971	6.8		
Lice - Diyarbakır	06.09.1975	6.6		
Çaldıran - Van	24.11.1976		7.0	
Narman - Erzurum	30.10.1983		6.6	
Armenia	07.12.1988		6.7	
Erzincan	13.03.1992		6.6	
Gölcük - Kocaeli	17.08.1999		7.6	
Düzce - Bolu	12.11.1999		7.1	
Sultandağı - Afyon	03.02.2002		6.5	
Merkez - Van	23.10.2011		7.1	IX
Offshore Bodrum (Gökova Gulf)	21.07.2017		6.5	VII
Sivrice - Elazığ	24.01.2020		6.8	IX
Offshore Seferihisar, Izmir	30.10.2020		6.6	VIII
Pazarcık - Kahramanmaraş	06.02.2023		7.7	XI
Elbistan - Kahramanmaraş	06.02.2023		7.6	X
Defne - Hatay	20.02.2023		6.4	IX

Table I: The Turkish earthquakes since 1900 (Source: SBB Report, 2023, pages 17-18)

We can see in Table I that several of these earthquakes have occurred in the region of interest, on the EAFZ. Nevertheless, many of these earthquakes have also occurred on the NAF and could still serve as a reference for future post-earthquake measures on Turkish land.

As mentioned previously, in the past, the EAF system has produced many major earthquakes. Nevertheless, according to government sources like AFAD (Disaster and Emergency Management

Presidency, Afet ve Acil Durum Yönetimi Başkanlığı), throughout history, the EAZ system was most active until the early 1900s, especially in the 19th century.

Nonetheless, the EAF system has been more active in the 2000s and produced several destructive earthquakes. (SBB Report, 2023) On page 20, the authors mention the following events:

- Bingöl (Mw 6.3) on 01.05.2003
- Karlıova, Bingöl (Mw 5.8) on 14.03.2005
- Doğanyol, Malatya (Mw 5.7) on 21.02.2007
- Kovancılar, Elazığ (Mw 6.1) on 08.03.2010
- Sivrice, Elazığ (Mw 6.8) on 24.01.2020
- Karlıova, Bingöl (Mw 5.7) on 14.06.2020.
- Pazarcık, Kahramanmaraş (Mw 7.7)
- Elbistan, Kahramanmaraş (Mw 7.6), at 04:17 and 13:24 local time, respectively, on 06.02.2023.

These precisions come and complete the data that is offered in Table I and give specifics for the earthquakes that have hit the specific EAFZ. While some of these earthquakes have much less devastation power than the 2023 one, they underline the persistent risk of seismic catastrophe in the EAFZ. Indeed, in the 21st century, the EAF system produced a total of 13 earthquakes with magnitude levels Ms above 5.0, which caused damage even in this period, when it was quieter than the 19th century in terms of producing major earthquakes. However, none of these earthquakes had a surface wave magnitude (Ms) over 6.8. The distribution of these earthquakes by epicenter tends to concentrate at the boundaries between the segments (SBB Report, 2023, page 20). This trend highlights the trend that in the 21st century, the EAFZ has been subject to increasingly dangerous seismic activity that led to the devastating events of 2023.

We could even go back as far as the 18th century to find specific governmental data about past earthquakes. Indeed, (SBB Report, 2023, at pages 20 -21) mentions:

- 1789 Palu earthquake, which was followed by 1822, 1866, 1872, 1874, 1875, and 1893 earthquakes.

- 1905 Malatya earthquake

3.3 Some of Eastern Anatolian Fault Zone's Seismic Particularities

The East Anatolian Fault (EAF)[4] system is one of the most active and energetic fault systems in Türkiye. It is for this reason that it deserves to be studied apart as it distinguishes itself from the NAF (North Anatolian Fault) and is considered separately. Indeed, the EAF system is unique in that it forms the border between both the Anatolian and Arabian plates. Alongside the NAF, it produces the westward motion of the entire Anatolian block. According to current GPS data, the current slip rate is approximately 11 ± 2mm per year.

We can specifically define the EAFZ or EAF system as found in governmental sources, for example on (SBB Report, 2023) on page 20:

"Starting from the Karlıova junction point (Kargapazarı) in the northeast, the EAF system extends as a single zone towards the west of Çelikhan, where it splits into two branches. There, the southern branch of the fault extends through the Gölbaşı basin and the north of Pazarcık until the Türkoğlu junction point in the southwest. The fault makes a right-lateral motion in the south of Türkoğlu, and progresses by forming a border for the Sağlık, Kocagöl, and Amik plains from the west, and scatters and ends up in the south of Kırıkhan."

It can also be noted that the motions and seismic characteristics of the EAFZ should not be considered as one monolithic block. In fact, within the EAFZ, we can distinguish different zones that make the area complex and particular in comparison to the NAF for example. For example, in the south of Türkoğlu, sources indicate the presence of a depression basin that englobe both the Sağlık and Narlı plains bordering on the west side, the Dead Sea Fault Zone. However, the northern branch of the EAFZ is linked to the morphology of the Taurus Mountain Belt forming a "convex bend to the north" (SBB Report, 2023, pages 20 - 21 - 22).

[4] The East Anatolian Fault (Turkish: Doğu Anadolu Fay Hattı) is a ~700 km long major strike-slip fault zone running from eastern to south-central Turkey. It forms the transform type tectonic boundary between the Anatolian sub-plate and the northward-moving Arabian Plate. Source https://en.wikipedia.org/wiki/East_Anatolian_Fault Further scientifical references: https://www.argusmedia.com/en/news-and-insights/latest-market-news/2566727-turkey-s-new-eaf-capacities-to-trigger-scrap-shortage

Chapter 4

Assessing the February 2023 Earthquake & Immediate Consequences

Let us now examine the specifics of the disaster of February 2023 that struck the province of Hatay and what were the consequences on the region and the country, in terms of physical, economic, and humanitarian damage.

4.1 Recollecting the events of February 2023: Antakya's earthquake.

Despite Antakya's history of plentiful devastating earthquakes, there is a consensus amongst authors that the 2023 earthquake was particularly devastating, even in comparison to the worst earthquakes the region has known in history. Several considerations can lead us to believe that the February earthquake of 2023 was amongst the worst the region has ever known.

The first and most obvious consideration that sustains the former affirmation is the severity, magnitude, and scale of both main shocks. The initial event was characterized by an Mw 7.7 shock that occurred on the 6th of February 2023 at 01:17 GMT according to AFAD. The former shock hit the Pazarcık district in Kahramanmaras with a focal depth of 8.6 km at coordinates (N37.288, E37.043) according to AFAD. The initial event occurred on a splay fault structure below Narli Basin near Pazarcik, and then the rupture expanded across the entire EAFZ (Taftsoglou et al., 2023, page 2). The initial event was followed by a second shock at 10:24 GMT, in Elbistan of Mw 7.6 and a focal depth of 7.0 km according to the AFAD. This time, the epicenter was located at coordinates (N38.089, E37.239). The length of the second rupture was 150–170 km with the surface displacements on the order of 2–8 m, while the total rupture length of the initial shock was measured as 310–350 km with a surface rupture mapped length of 270 km (Taftsoglou et al., 2023, page 3). Both epicenters are represented with yellow stars in Figure 1. Furthermore, the two earthquakes were considered as a "twin" by many experts, due to their comparable size and the different fault structures.

Secondly, the severity and quantity of the aftershocks that followed the main events in February 2023 have also largely contributed to the disaster. Tragically, the two major earthquakes of February 6th with the epicenters in Pazarcık (Mw 7.7; focal depth: 8.6 km) and Elbistan (Mw 7.6; focal depth: 7 km) were not the end of the story. On 20 February 2023, another earthquake with a magnitude of Mw 6.4 occurred, with the epicenter in Yayladağı, Hatay at 20:04 local time (SBB Report, 2023, pages 25 -26). Furthermore, after the first main shock, a total of 390 aftershocks

with magnitudes superior to MS 3.5 have been recorded until the date of March 15, 2023 (Wang et al., 2023, pages 1-2-3). Amongst these 390 aftershocks, 40 were above Ms 5.0. Some aftershocks even had magnitudes above Ms 6.0 with one aftershock of Mw 6.7 occurring 17 minutes after the main shock. Even two weeks after the main shock, the south of the Hatay province was subjected again to a Mw 6.4 aftershock. Isoseismal maps available in the literature allow us to retrace the intensities of the major earthquakes alongside their aftershocks. From the isoseismal maps of Figure 4, it can be seen that the largest intensity of the Mw 7.8 event was distributed along the Amonos segment of the EAFZ from Hassa to Antakya.

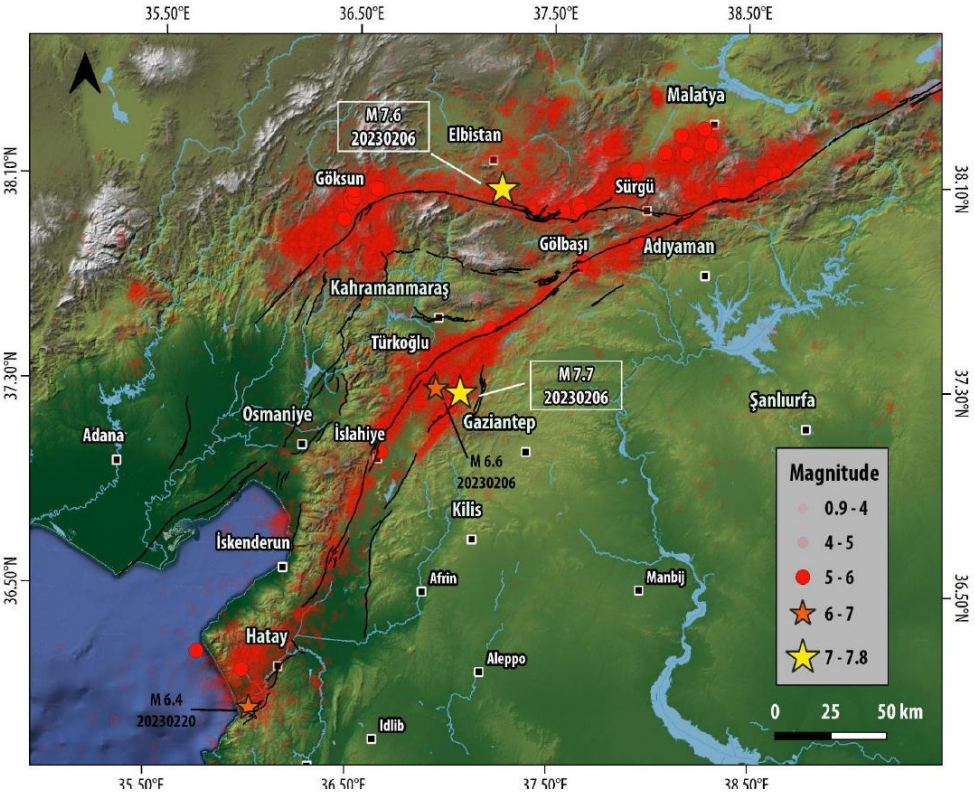
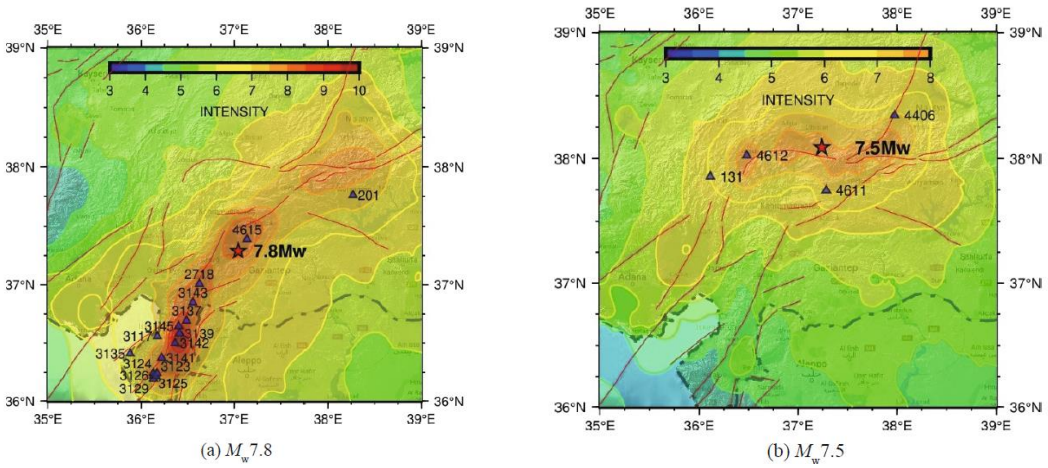


Figure 4: Aftershocks for the M7.7 and M7.6 earthquakes. Epicenter locations derived from AFAD catalog (6 February 2023–2 May 2023) (Source: Taftsoglou et al., 2023, page 3)



(a) M_w7.8 (b) M_w7.5

Figure 4.1: Isoseismal maps of Turkey earthquake and location of observation stations (left side for 7.8 Mw event, right side for 7.5 Mw event) (Source: Wang et al., 2023, page 3)

Finally, the earthquakes of 2023 can be considered particularly devastating due to the extent of provinces and infrastructures that were affected. Indeed, a total of 11 provinces endured substantial damage bringing the death toll above 50,000 people. Not to mention that many transportation and energy infrastructures were damaged and will have to be replaced under the reconstruction efforts (Taftsoglou et al., 2023, page 4). Indeed, because of the extensive damage, a series of primary and secondary phenomena resulting from the earthquakes can be observed and should be taken into account during the rebuilding process. Primary consequences include drastic surface ruptures, while secondary consequences include liquefaction, rockfalls, and landslides.

In summary, the Turkish government in (SBB Report, 2023) on page 26 concludes that that the earthquake with an epicenter in Pazarcık broke a line starting from Çelikhan in the northeast and encompassing Erkenek (65 km between Çelikhan and Gölbaşı), Gölbaşı (90 km between Gölbaşı and Türkoğlu), Amanos (110 km between Türkoğlu and Kırıkhan) segments of the Eastern Anatolian Fault System and the Narlı segment at the the northern end of the Dead Sea Fault System. However, the second earthquake with an epicenter in Elbistan was related to the Çardak Fault and the Doğanşehir Fault Zone.

4.2 Assessing the Physical Damage

After such a disaster, it is natural for authorities of any country to start the rebuilding process with a quantification of the consequences of the disaster. The consequences of such a disaster can be categorized in different sectors. Of course, a good starting point consists in evaluating the physical damage of the disaster.

4.2.1 The Raw Numbers of the Physical Destruction

According to official sources like the AFAD, it is estimated that approximately 280,000 buildings collapsed and/or sustained severe damage to the core's structures, alongside significant material losses that were reported in a total of eleven provinces located on and around the NAF Line. (SBB Report, 2023, pages 26-27) More specifically, as of 6 March 2023, different damage assessment studies were completed for a total of 1,712,182 buildings among the eleven provinces affected by the earthquake and summarized in the government document (SBB Report, 2023, at pages 26-27-28). In summary, the Turkish government asses that in March 2023:

- 35,355 buildings collapsed.
- 17,491 buildings should be demolished urgently.
- 179,786 buildings were severely damaged.
- 40,228 buildings were moderately damaged.
- 431,421 buildings were slightly damaged.

Furthermore, in addition to the damage that was observed to residential buildings, also historical and cultural structures, schools, administrative buildings, hospitals, and hotels collapsed or sustained severe damage during the seismic events. Indeed, the following tables recapitulate the different buildings present in the eleven regions before the earthquake and the buildings that suffered damage.

Province	Resident	Workplace	Public	Other	Overall Total
Adana	404,502	29,920	8,916	7,779	451,117
Adıyaman	107,242	5,765	4,370	3,119	120,496
Diyarbakır	199,138	11,412	11,964	3,165	225,679
Elazığ	106,569	7,221	2,872	7,051	123,713
Gaziantep	269,212	22,829	5,480	8,162	305,683
Hatay	357,467	33,511	10,382	5,489	406,849
Kahramanmaraş	219,351	12,358	6,879	4,565	243,153
Kilis	33,399	1,526	1,651	736	37,312
Malatya	159,896	8,370	6,670	4,051	178,987
Osmaniye	128,163	9,428	3,105	2,384	143,080
Şanlıurfa	347,902	18,847	11,790	4,089	382,628
Total in 11 Provinces	2,332,841	161,187	74,079	50,590	2,618,697

Table I.I: Summary of the buildings in each of the 11 provinces before the earthquake (Source: SBB Report, 2023, page 27)

Status	# of Buildings	# of Detached Units
Undamaged	860,006	2,387,163
Lightly Damaged	431,421	1,615,817
Moderately Damaged	40,228	166,132
Severely Damaged	179,786	494,588
Collapsed	35,355	96,100
Requiring Urgent Demolition	17,491	60,728
Not Assessed	147,895	296,508
Total	1,712,182	5,117,036

Table II: Number of buildings present in the damage assessment of March 2023 (Source: SBB Report, 2023, page 27)

Unfortunately, the government document (SBB Report, 2023) doesn't give precise information regarding the portion of damaged buildings in regards to each category mentioned in Table I (Resident, Workplace, Public, other). Indeed, following the previous observation that states that the non-compliance with building laws or the lack of quality of some constructions was a factor in the extent of the damage, it could have been interesting to assess whether some categories of buildings were more affected than others, highlighting potential patterns in construction laws bypassing.

Moreover, the Turkish government has estimated in the weeks following the February events that a total of 37 risky areas, representing about 1237 square hectares of land, were to be considered. Indeed, within these risk-ridden areas, about 83,634 units were considered dangerous, and about 17,686 of them were demolished by March 2023. (SBB Report, 2023, p29).

City	Number of Risky Buildings	# of Areas	# of detached units	# of demolished units
Adana	9.882	8	15.342	455
Adıyaman	2.683	3	1.642	97
Diyarbakır	3.385	3	23.518	3.784
Elazığ	19.967	7	8.160	6.349
Gaziantep	999	4	22.844	5.105
Hatay	9.612	2	6.215	250
Kahramanmaraş	5.584	3	3.995	1.149
Kilis	37	0	0	0
Malatya	4.999	5	1.071	484
Osmaniye	1.009	0	0	0
Şanlıurfa	5.876	2	847	13
Total 11 Provinces	64.033	37	83.634	17.686

Table III: Distribution of Risky Areas and Buildings in Earthquake-Affected Region (Source: SBB Report, 2023, p 29)

Since the earthquakes happened over one year ago, we can diversify the sources when it comes to estimating the damage. The authors of (Wang et al., 2023) present for example, a more detailed perspective of the damage assessment than the government report (SBB Report, 2023). In (Wang

et al., 2023) , it is estimated that only 11 % of the buildings in Malatya had been examined in the early government reports of 2023. Amongst these 11 % of buildings examined in Malatya, about a third (32.5 %) had been found to be collapsed and dangerously damaged. However, the statistics of other cities vary.

- In Hatay, 14% of the buildings were examined and 23.6% of them were considered collapsed or dangerously damaged.
- In Kahramanmaras provinces,19% of the buildings were examined and 21.6% of them had collapsed or been heavily damaged.
- In Gaziantep, heavily damaged or collapsed buildings comprised only 9.5% of the examined buildings.

Table IV recapitulates the statistics enumerated by the authors (Wang et al., 2023):

Provinces	Max intensity	Surveyed buildings	Untouched		Light		Moderate		Heavy / Collapse	
			Number	(%)	Number	(%)	Number	(%)	Number	(%)
Hatay	X	64,475	29,188	45.3	17,212	26.7	2,827	4.4	15,248	23.6
Kahramanmaras	IX	60,014	25,420	42.4	20,556	34.3	1,058	1.8	12,980	21.6
Gaziantep	IX	135,888	89,092	65.6	29,471	21.7	4,361	3.2	12,964	9.5
Sanliurfa	VII	34,108	19,585	57.4	13,507	39.6	550	1.6	466	1.4
Diyarbakir	VII	26,120	18,039	69.1	6,725	25.7	713	2.7	643	2.5
Adana	VII	7,365	1,688	22.9	5,314	72.2	304	4.1	59	0.8
Adiyaman	VIII	69,791	21,365	30.6	38,823	55.6	2,613	3.7	6,990	10.0
Malatya	VIII	25,733	7,463	29.0	8,960	34.8	945	3.7	8,365	32.5
Osmaniye	VIII	32,872	22,041	67.1	8,034	24.4	266	0.8	2,531	7.7
Kilis	VIII	6,006	2,849	47.4	2,208	36.8	137	2.3	812	13.5
Elazig	VII	25,837	9,503	36.8	15,532	60.1	138	0.5	664	2.6

Table IV: statistics of destroyed buildings according to (Source: Wang et al., 2023, p856)

Moreover, in order to assess the true extent of the damage and perfectly quantify the damage, we can look at the details of the housing sector pre-earthquake and post-earthquake in the eleven provinces that were affected. Indeed, as shown in Table V, besides the two provinces of Adana and Gaziantep, the percentage of people that owned houses in the affected regions is above the national Turkish average. In fact, according to government statistics dating back to 2021, almost 61% of the houses were owned by the people living there while almost 28% of them were tenants (SBB Report, 2023, p34) , thus meaning that many people lost houses in the disaster that were privately owned and not public goods.

Provinces	# of HH Residing in Housing	# of Owners	% of Owners	# of Tenants	% of Tenants	Others
Adana	632,875	357,430	56.5	163,758	25.9	111,688
Adıyaman	155,300	98,012	63.1	40,705	26.2	16,583
Diyarbakır	394,867	245,655	62.2	109,581	27.8	39,630
Elazığ	173,836	114,463	65.8	40,522	23.3	18,850
Gaziantep	522,947	290,044	55.5	188,756	36.1	44,148
Hatay	449,151	294,845	65.6	93,831	20.9	60,476
Malatya	230,499	156,250	67.8	45,010	19.5	29,240
Kahramanmaraş	311,458	206,833	66.4	68,669	22.0	35,956
Kilis	40,020	25,083	62.7	10,743	26.8	4,195
Osmaniye	156,199	105,087	67.3	31,253	20.0	19,859
Şanlıurfa	411,421	274,185	66.6	102,241	24.9	34,995
Region Total	3,478,573	2,167,887	62.3	895,069	25.7	415,620
Türkiye	25,329,833	15,384,812	60.7	6,991,720	27.6	2,953,301

Table V: Percentages of ownership of the houses in the affected regions according to the government (Source: SBB Report, 2023, page 35)

Furthermore, we can also assess how many "new" and how many "old" buildings have been destroyed in the earthquake. Indeed, the same governmental report indicates detailed statistics about this information. In particular, we can make a couple of observations:

- about 10% of the people were residing pre-earthquake in buildings that were constructed in 1980 or before, whereas it is 12.6% throughout Türkiye. Nonetheless, in the three provinces of Adana, Hatay, and Kilis it is more than 12.6%.
- Within the eleven affected regions, 27.6 % were residing in buildings that had been built before 2000 but after 1980. This number is inferior to the national average of 31%. However, in the specific regions of Adana and Hatay, it is the inverse trend that can be observed.
- 51.1% of the people residing in the affected regions were residing in buildings that were built after 2001 while only 47.4% of the Turkish people have that luxury on a national level. Thus, a more potent segment of the population lived in modern buildings, in fact much more than the Turkish average except in the specific provinces of Hatay, Kilis, and Adana had visibly older stocks of buildings been lived in.

The former observations are very important as the fact that we notice large destruction within a stock of relatively "new" buildings highlights the fragility of buildings that perhaps should have been built with stricter and more modern considerations. It is also an indicator that other "new" buildings in the country could react if other parts of Turkey were struck by similar events.

Provinces	Building Construction Percentage (%)			
	1980 or before	1981-2000	2001 or after	Unknown
Adana	13.0	34.8	38.7	13.5
Adıyaman	8.7	23.6	52.3	15.4
Diyarbakır	6.5	26.6	58.1	8.8
Elazığ	10.0	23.6	52.8	13.6
Gaziantep	6.6	25.9	51.6	15.9
Hatay	13.5	32.6	50.0	3.9
Malatya	11.7	26.9	58.1	3.3
Kahramanmaraş	11.2	21.7	52.3	14.9
Kilis	14.0	28.1	48.4	9.5
Osmaniye	10.5	25.7	46.5	17.3
Şanlıurfa	5.5	18.5	61.0	14.9
Total 11 Provinces	10.0	27.6	51.1	11.3
Total Türkiye	12.6	30.9	47.4	9.1

Table VI: Percentage of buildings that were built in specific time segments (Source: SBB Report, 2023, page 36)

Finally, the best manner in which one can quantify the damage is by estimating the ratio of buildings that have been destroyed. Tables VII and VIII are to be confronted as they depict the raw amount of buildings in each region that were affected, and the number of buildings that were affected according to three levels of severity:

- Urgent and/or severely damaged and/or collapsed houses
- Moderately damaged houses
- Lightly damaged houses

Provinces	2021
Adana	972,561
Adıyaman	216,744
Diyarbakır	563,295
Elazığ	292,406
Gaziantep	893,558
Hatay	847,380
Kahramanmaraş	481,362
Kilis	74,976
Malatya	345,536
Osmaniye	243,436
Şanlıurfa	718,063
Total in 11 Provinces	5,649,317
Total in Turkiye	40,200,000

Table VII: Numbers of total buildings in the eleven affected provinces as of 2021 according to government (SBB Report, 2023, page 35)

Provinces	Total Number of Urgent + Severely Damaged + Collapsed Houses	Number of Moderately Damaged Houses	Number of Lightly Damaged Houses
Adana	2,952	11,768	71,072
Adıyaman	56,256	18,715	72,729
Diyarbakır	8,602	11,209	113,223
Elazığ	10,156	15,22	31,151
Gaziantep	29,155	20,251	236,497
Kahramanmaraş	99,326	17,887	161,137
Malatya	71,519	12,801	107,765
Hatay	215,255	25,957	189,317
Kilis	2,514	1,303	27,969
Osmaniye	16,111	4,122	69,466
Şanlıurfa	6,163	6,041	199,401
Total	518,009	131,577	1,279,727

Table VIII: Raw numbers of damaged households in the 11 earthquake-affected regions according to the government (Source: SBB Report, 2023, page 37)

4.2.2 Understanding the different types of Physical Destruction

When it comes to evaluating the physical damage a region has endured, it is important to distinguish the different kinds of damage a building can endure. Indeed, not all "ways" of building collapse are the same, and understanding this can aid us in understanding the reasons for the extent of the damage.

Authors (Wang et al., 2023) on pages 858-859 distinguish for example between three types of building collapse modes for RC buildings :

- overturned collapse
- laminated collapse
- story collapse

Figure 3: Different modes of collapsing for the considered concrete buildings (Wang et al., 2023)

Indeed, as the reader can notice in Figure 3 (a), (b), and (c), if the columns on the same side in the bottom story sustained larger axial forces than the other side, due to the overturning moment, they would fail earlier. Then the large lateral inertial forces in the upper
stories would further overturn the building. This is what we refer to as "overturned collapse". It is for this reason that the slabs are generally aligned in parallel and large spaces for people to survive exist, as shown in Figure 3 (a).

In a different manner, if the columns in the first story lose their bearing capacity at the same time because of the large axial force ratio under gravity, then the margin to resist an earthquake action is very limited or even insufficient. Then, if the upper stories in Antakya were also built with low-strength material, they would collapse subsequently to the first story and the slabs finally piled one above another, as shown in Figure 3 (b). We can refer to this as the "story' collapse. However, if the upper stories were strong, they could perhaps have survived during the earthquake, and resulted in "shortened buildings as shown in Figure 3 c. This is "laminated collapse".

Then there are "combinations" of these different modes: for example in Figure 3 (d) and (e), we can see that the bottom stories collapsed and several columns in the fourth story.
still supported the upper stories. However, in Figure 3 (f), it has all collectively failed. Finally, we could also consider the particular case of buildings that were still being built when they were subjected to the earthquake which would also be composed of a mixture of the former failing modes, but perhaps with a weaker basis to survive the earthquake in the beginning.

The authors of (Wang et al., 2023) have been able to link satellite imagery observations with in-field conclusions in order to illustrate different modes of building collapse in the case of Antakya. Keep in mind that most buildings in real life will collapse as a combination of these three modes. Also, the severity of the damage will vary from one building to another. For example, figure 4 (a) depicts a ten-story building composed of an RC frame which is considered "severely damaged". We can see that while this building has survived the physical event, the RC beam-to-column joint and sand beam ends have been completely destroyed. Furthermore, it can be noticed in Figure 4

(b) that the earthquake also induced the concrete spalling off at the beam-to-column joints and the steel rebars result completely exposed. Similar damage can be observed in Figure 4 (c), where a shear crack penetrated the whole beam-to-column zone. Figure 4 (d) goes as far as to expose the bending, and the bending-shear mixed cracks on the different RC beams. In fact, we can conclude that in this case, the vertical bearing capacity was provided only by the rebars with tensile suspension effects.

Figure 4: Example of a severely damaged building in Antakya (Wang et al., 2023, p 856)

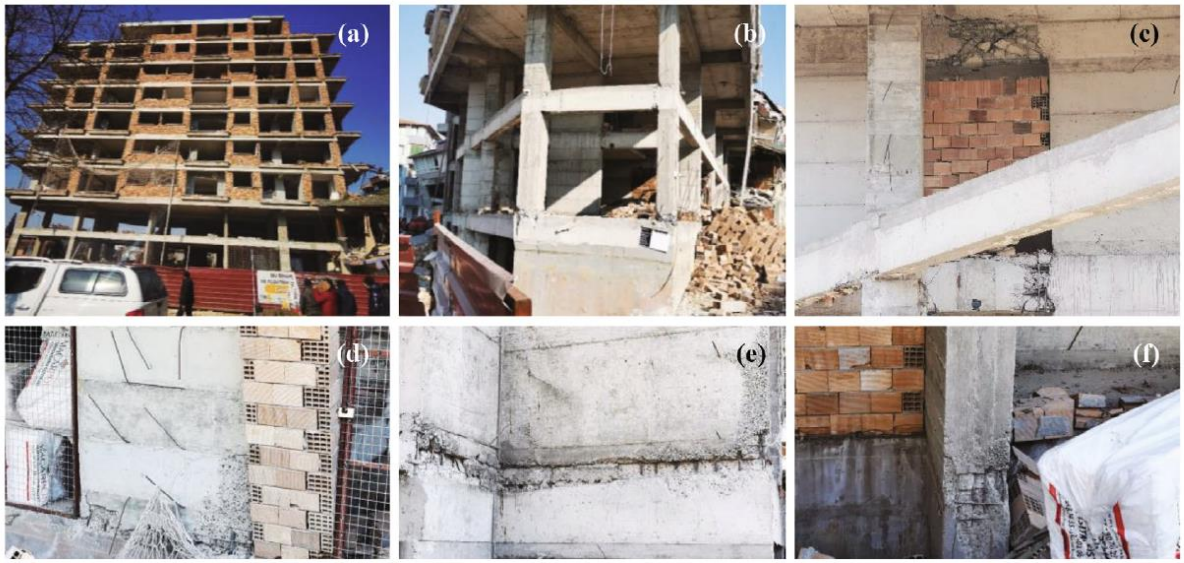


Figure 5: A "moderately" damaged building in the downtown of Antakya (Wang et al., 2023, p 860)

In order to put into perspective what a "severely" damaged building is compared to a "moderately" damaged building or a "slightly" damaged building, we can also look at examples of different buildings referenced by (Wang et al., 2023) in volume 2. For example, figures 5 and 6 depict

respectively “moderately” and “slightly” damaged buildings taken from the downtown of Antakya, in comparison to figure 4.

Indeed, according to both governmental sources like (SBB Report, 2023) and independent sources like (Wang et al., 2023), the downtown area of Antakya was less damaged in the sense that fewer buildings ended up in the “severely” damaged classification. For example, figure 5 depicts a building that was under construction when the earthquake happened. In this case, the building was a ten-story building with one story underground, where only the infilled masonry walls had been constructed. This building was an RC frame-wall dual structural system, with a section length of the wall of about 1–2 m. As you can see in Figure 5, only a small number of them were destroyed during the earthquake. From Figure 5, one may draw several conclusions (Wang et al., 2023, pages 858-861):

- figure 5 (b) shows that the column foot and the beam end were damaged.
- figure 5 (c) shows that the coupling beams which usually represent the first seismic defense line, were seriously damaged. Indeed, both bending cracks and shear cracks were observed.
- figures 5 (d), (e), and (f) show that concrete was crushed at the toes of the wall and construction joints buckled. Furthermore, the images show that the main components supporting the vertical loads were not substantially damaged, meaning the building is still somewhat viable, even after the earthquake.

Figure 6 this time depicts another building from downtown of Antakya that is in a better condition than the building depicted on Figure 5. Indeed, it was a five-story RC frame-wall structure. This building depicted in Figure 6 was also still in construction, and only the infilled walls had not been installed. This time, there was no visible damage observed on the primary structural components, such as columns, beams, and walls. However, we can observe that the RC stair was damaged at the fourth story due to the geometric irregularity.

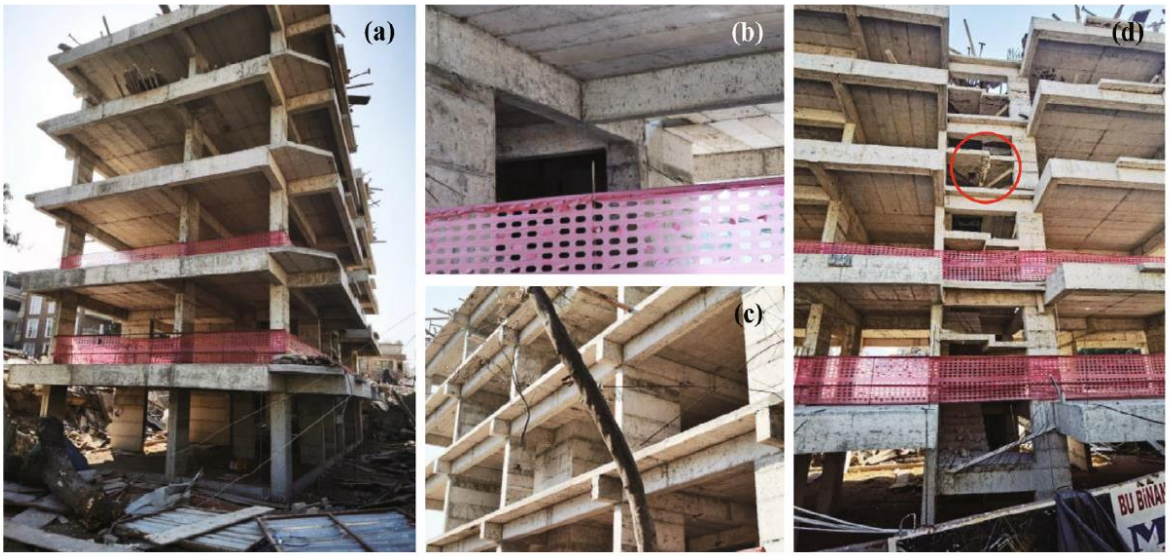


Figure 6: A "slightly" damaged building in the downtown of Antakya (Wang et al., 2023, p 860)

Analyzing these different cases of damaged buildings (Figure 4,5,6) helps us understand that clearly some buildings have resisted more than others. Thus, comparing different buildings between them can help us understand what elements were lacking in the most severely damaged buildings, in order to identify potential reasons for the extent of the damage.

4.2.3 Understanding the Severity of the Physical Damage

Alongside the neutral assessment of physical damage and its detailed categorization, it is important to understand the reasons why the damage has reached the extent that was observed. Indeed, several government-trusted sources like ITU and METU have underlined different sources explaining the extent of the damage (SBB Report, 2023, pages 26-27). According to METU and ITU, the main determining factors in the destruction of buildings were:

- the severity of ground motion
- the low bearing capacity of the soils where buildings' foundations were laid.
- the deficiencies in the quality of buildings in terms of design and construction
- the ages of the buildings
- the non-compliance of the construction of buildings with the legislation
- difference between floor levels of buildings constructed adjacently.

Unfortunately, according to these sources, some of the damage and its extent could have been avoided. Indeed, while humans have no control over aspects that are intrinsic to the earthquake motions, better compliance with construction laws, the respect of quality of construction, and strong design principles could have mitigated some of the material and life loss.

If we take the particular case of the city of Antakya, a city with an initial population of roughly 270,000 people where buildings are mostly tall about six to ten stories, built with RC frames, we can see the extent of the damage and collapsed building via satellite imagery:

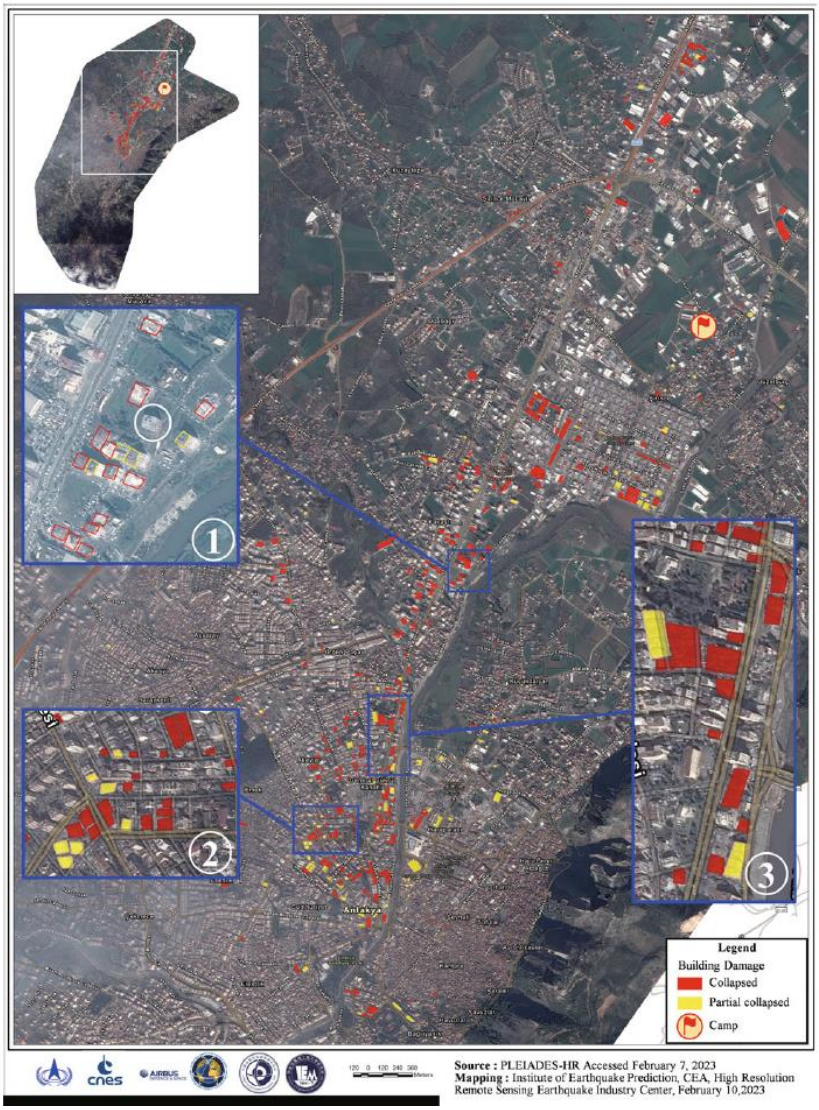


Figure 7: Satellite image of the city of Antakya highlighting the extent of the damage (Wang et al., 2023, p858)

The satellite imagery allows us to observe that on the west bank of the river cutting through Antakya, more buildings have collapsed than on the east. One of the reasons is speculated that the west bank is much closer to the fault, or the west bank has a thicker sedimentary layer. Three blocks along the river were investigated by the authors of (Wang et al., 2023) using modern techniques linked to satellite imagery. Thanks to these analyses, they were able to underline different reasons that could explain the extent of the damage.

4.3 Subsequent Economic Consequences

Of course, in the wake of a massive catastrophe such as an earthquake, besides the quantification of the physical and humanitarian damage, economic consequences will be a concern for governmental institutions.

4.3.1 Immediate Cost of Disaster Mitigation

Economic consequences can be quantified by distinguishing between different categories of costs. First and foremost, we can take a look at the immediate costs in terms of support to the population. Indeed, as we have discussed previously, considering the large quantities of people that have lost their own houses, either because they have totally collapsed or because they have been damaged lightly or moderately, the government must put in place economic support measures for these people.

According to governmental reports, right after the events of February 2023, the Turkish government decided to give 10.000 TRY in cash assistance to all the households that had been affected by the earthquake. In total, this represented the first investment of 19.13 billion TRY for the Turkish government. Furthermore, households whose houses were completely collapsed or defined as “moderately” damaged, received from the government one-off moving allowances of about 15,000 TRY, followed by, 000 TRY or 5,000 TRY monthly housing benefit for one year for tenants and house owners, respectively. These benefits amounted to over 33 billion TRY in total. (SBB Report, 2023, pages 38-39)

	Billion TRY	Billion USD
Total Damage		
Reconstruction Cost of Unusable Housing	1,032	54.7
Reconstruction Cost of Unusable Barns	3	0.2
Reconstruction Cost of Unusable Businesses	39	2
Repair Assistance for Lightly Damaged Housing[2]	12.8	0.7
Furniture Cost in Unusable Housing	58.5	3.1
Total Damage	1,145.3	60.7
Total Loss		
Debris Removal and Cleaning Cost[3]	29.8	1.6
Household Payments for Housing with Severe Damage + Requiring Urgent Demolition + Moderate Damage	6.5	0.3
Temporary Accommodation	25	1.3
Meal and Accommodation	40.5	2.1
Total Loss	101.8	5.3
Total Damage and Loss	1,247.1	66

Table IX: Estimated costs of the immediate economic measures according to the government (Source: SBB Report, 2023, page 38)

Finally, immediate support measures such as the purchasing of tents, blankets, and temporary accommodation by the government for the victims have been estimated to cost around 25 billion TRY, while food and meals offered by the government to the victims represent almost 41 billion TRY.

4.3.2 Costs of Rebuilding Plans

The conomic costs linked to the disastrous events of 2023 are not only merely linked to costs needed to support the population as the events unfold. Indeed, economic costs also include the projected costs linked to the rebuilding of the devastated regions.

According to governmental sources, the Turkish government projects to build within the eleven affected regions a total of 405.505 houses alongside 83.149 village houses. The village houses include infrastructures such as barns, gardens, and more generally, infrastructures linked to agriculture. The government estimates that the construction of the 405.505 houses should represent a total of almost 609 billion TRY (32.2 billion USD) excluding the purchasing of the lands, while the village houses represent an investment of 192.7 billion TRY (10.2 billion USD).

Province	# of Planned Houses	# of Planned Village Houses
Adana	1,900	7
Adıyaman	47,350	13,987
Diyarbakır	6,000	716
Elazığ	4,500	1,602
Gaziantep	27,150	6,506
Kahramanmaraş	88,500	18,874
Malatya	66,230	21,549
Hatay	146,650	14,997
Kilis	1,800	1,368
Osmaniye	12,425	2,731
Şanlıurfa	3,000	812
TOTAL	405,505	83,149

Table X: Turkey's projected reconstruction plans as of March 2023 (SBB Report, 2023, page 40)

4.3.3 Estimating financial burdens on the different economic sectors of the region

Alongside the costs of rebuilding and costs linked to population support, it is also important to try to assess the economic consequences on the main economic sectors of the affected regions. Indeed, we can quantify the loss of economic output by first taking a look at the economic contributions of the eleven affected regions to the country pre-earthquake:

- the eleven affected regions represented about 9.8 % of the country's GDP in 2021 (SBB Report, 2023, page 13)
- An approximate 87 billion USD is generated by the eleven affected regions in 2022 (SBB Report, 2023, page 13)
- The 11 earthquake-affected provinces contributed 0.98 points to the national economic growth in 2021. While the most affected 5 provinces had a contribution of only 0.6 points, which is below the national average (SBB Report, 2023, page 13)

	Agricultur e. forestry and fishery	Industry	Manufact uring industry	Construct ion	Services	Informat ion and communi cation	Financial and Insurance Activities	Real Estate Activities	Professio nal, administr ative, and support serviec activities	Public administr ation, education, human health and social work activities	Other Service Activities	GDP
Adana	2.5	2.2	2.1	1.7	1.9	0.7	1.5	1.6	1.6	2.3	1.5	2.0
Hatay	1.3	1.8	1.9	1.0	1.4	0.1	0.5	1.3	0.8	1.6	0.6	1.4
Kahramanmaraş	1.4	1.4	1.3	0.8	0.4	0.1	0.3	0.8	0.4	1.1	0.3	0.9
Osmaniye	0.6	0.7	0.7	0.3	0.2	0.0	0.1	0.5	0.1	0.6	0.2	0.4
Malatya	0.9	0.5	0.5	0.7	0.3	0.1	0.3	0.8	0.3	1.1	0.4	0.5
Gaziantep	1.3	3.6	4.0	1.7	1.5	0.2	0.8	1.6	1.1	1.8	0.7	2.0
Adıyaman	0.8	0.3	0.2	0.3	0.2	0.0	0.2	0.5	0.2	0.7	0.2	0.3
Kilis	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.1
Şanlıurfa	3.0	0.4	0.3	0.8	0.5	0.1	0.3	0.8	0.6	1.7	0.8	0.8
Diyarbakır	2.2	0.4	0.2	1.2	0.5	0.6	0.4	1.1	0.7	2.2	0.6	0.9
Elazığ	0.8	0.2	0.2	1.3	0.3	0.1	0.2	0.5	0.4	1.0	0.4	0.5
Total	15.1	11.4	11.5	10.0	7.4	2.2	4.6	9.7	6.3	14.1	5.6	9.8

Table XI: Share of Earthquake-Affected Provinces in GDP and Subsectors (2021) according to government as of March 2023 (SBB Report, 2023, page 14)

As indicated by both governmental and non-governmental sources, the two provinces of Adana and Gaziantep are much larger contributors to the national GDP than the other regions.

Provinces	Population	GDP (Billion dollars)	Number of buildings	Pre-2000 (%)	2001 and after (%)	Unknown (%)
Hatay	1,253,726	8.823	449,151	46.1	50	3.9
Kahramanmaras	1,002,384	6.501	311,458	38.6	58.1	3.3
Gaziantep	1,285,249	14.102	522,947	32.5	51.6	15.9
Sanliurfa	1,443,424	6.075	411,421	24.0	61	14.9
Diyarbakir	1,362,708	6.802	394,867	33.1	58.1	8.8
Adana	1,849,478	14.096	632,875	47.8	38.7	13.5
Adiyaman	623,811	2.397	155,300	32.3	52.3	15.4
Malatya	853,658	4.203	230,499	42.1	48.4	9.5
Osmaniye	458,782	2.755	156,199	36.2	46.5	17.3
Kilis	114,724	0.720	40,020	32.9	52.3	14.9
Elazig	569,616	3.495	173,836	33.6	52.8	13.6

Table XII: Statistics of earthquake-affected provinces (Wang et al., 2023, p2)

Furthermore, governmental sources like AFAD, describe these eleven regions as regions that rely mainly on agriculture, manufacturing industries such as the textile and services, but also a bit of tourism. Indeed the regional GDP is according to (SBB Report, 2023, pages 12-15) comprised of:

- 8.6% of agriculture
- 30.5% of industry
- 5.2 % Construction
- 45.2% of services
- 10.6 % tax subsidies

We can also quantify the financial burden of the earthquake by analyzing the trade outputs linked to the different affected regions. Indeed, according to the government, the eleven affected regions made up about 8.6% of the share exports of the country in 2022. In particular, Gaziantep represents the 6th province of Turkey with the highest share in total exports. This is economically significant for the country, as Turkey is a country that has been having a constant trade deficit in the last decades, with a deficit reaching over 110 billion USD in 2022. Thus, the effect on the exports of the region will only contribute to widening the deficit. In particular, the manufacturing textile industry was affected which contributed to most of the exports of the region.

	Exports		Imports		
	million USD	Percentage Share	million USD	Percentage Share	Foreign Trade Balance
Gaziantep	11,197	4.4	8,493	2.3	2,704
Hatay	4,067	1.6	7,611	2.1	-3,544
Adana	3,117	1.2	4,876	1.3	-1,759
Kahramanmaraş	1,412	0.6	1,731	0.5	-319
Diyarbakır	422	0.2	129	0	293
Malatya	456	0.2	171	0	285
Şanlıurfa	313	0.1	336	0.1	-23
Elazığ	368	0.1	46	0	322
Osmaniye	375	0.1	910	0.3	-535
Adıyaman	97	0	83	0	14
Kilis	122	0	59	0	63
Total	21,946	8.6	24,446	6.7	-2,500
Türkiye	254,172	100	363,711	100	-109,539

Table XIII: Foreign trade (Imports & Exports) in 2022 in the eleven affected regions according to the government (SBB Report, 2023, page 14)

Province	Product or Sector	Percentage Share
Gaziantep	Carpet	60.6
Gaziantep	Cereals, Pulses, Oil Seeds and Products	31.7
Gaziantep	Fruit and Vegetable Products	17.4
Gaziantep	Textiles and Raw Materials	16.8
Hatay	Wet Fruits and Vegetables	15.6
Malatya	Dried Fruits and Products	15.5
Gaziantep	Leather and Leather Products	9.9
Gaziantep	Dried Fruits and Products	9.5
Hatay	Steel	9.1
Kahramanmaraş	Textiles and Raw Materials	8.5
Gaziantep	Furniture, Paper and Forestry Products	7.2
Gaziantep	Air Conditioning Industry	6.0
Adana	Textiles and Raw Materials	5.9
Adana	Aquaculture and Animal Products	5.1
Adana	Wet Fruit and Vegetables	4.9
Gaziantep	Chemicals and Chemical Products	4.7
Adana	Cereals, Pulses, Oil Seeds and Products	3.8
Adana	Chemicals and Chemical Products	2.6
Gaziantep	Machinery and Hardware	2.3
Hatay	Mining Products	2.1
Adana	Automotive Industry	2.0

Table XIV: Share of Earthquake-Affected Provinces in Total Exports, by Product or Sector 2022 according to the government (SBB Report, 2023, page 15)

Furthermore, some economic sectors of primordial importance in terms of GDP output pre-earthquake for these eleven stuck regions, deserve a more in-depth discussion. Such sectors include:

- The agricultural sector
- The manufacturing industry (especially textile)
- The tourism industry

4.3.3.1 The agricultural sector

Let's take a look at the agricultural sector which was significant in the eleven affected regions. Indeed, amongst the 8.6 % contribution of these eleven regions to national GDP, 15.3% of it came from the agricultural sector representing about 61 billion TRY. Furthermore, besides Gaziantep, the share of agriculture in the economy is above the country average. Moreover, the total of agricultural lands comprising the eleven affected regions make up for 16.9% of the total agricultural land of the country.

Moreover, other significant figures linked to the agricultural sectors include:

- the affected regions represented in 2022, 26% of fruit growing areas; mostly apricots, almonds, pomegranates, and olive growing.
- the affected regions represented in 2022 13% of bovine animals and 17.8% of ovine animals.

- the affected regions represented un2022, 42.6% of the total national production of silkworms.
- In 2022, there were 140 storage plans and 234 irrigation facilities in operation in the earthquake-affected, which represented the irrigation of 943,778 hectares.

The Turkish government in (SBB Report, 2023, pages 91-95) has estimated the extent of the damage to the agricultural sector post-earthquake. In particular, the government as of March 2023 estimates that have died:

- over 8,241 bovine animals
- 64,260 ovine animals
- 42,000 poultry
- 533,000 chicks in Adıyaman
- 168,000 chicks in Malatya

Furthermore, it is estimated that livestock breeders lost around 31.9 million USD due to animal deaths and out of the 233,230 barns and pens in the earthquake-affected regions, 13,284 collapsed.

Ownership	Item	Unit	Quantity	Unit Cost (TRY/unit)*	Cost (TRY)	Data Source
Private	Bovine animals	piece	8,241	40,000	329,640,000	MoAF
Private	Ovine animals	piece	64,260	4,000	257,040,000	MoAF
Private	Poultry animals	piece	42,000	50	2,100,000	MoAF
Private	Chicks	piece	701,000	20	13,720,000	MoAF
Private	Beehives	piece	5,756	1,494	8,600,000	MoAF
Private	Product Depot (Private)	piece	12	-	221,000,000	TMO
Public	Product Depot (TMO)	piece	10	-	81,600,000	TMO
Public	TIGEM Facilities	piece	2	-	134,100,000	TIGEM
Public	Fishing Harbours	piece	4	-	489,700,000	UAB
Private	Fish	Tonne	101	70	7,070,000	MoAF
Private	Fish Fries	piece	37,427,000	1.5	56,140,500	MoAF
Public	Food Control Laboratory	piece	1	-	50,000,000	MoAF
Public	Sugar Factories	piece	2	-	1,300,000	TurkSugar
Public	Dams and Ponds	hm^3	-	-	4,105,000,000	DSI
Public	Flood Control Facilities	piece	787	1,175,349	925,000,000	DSI
Public	Irrigation Facilities[2]	hectare	923,976	11,981	11,070,307,851	DSI
Public	Drilling Wells	piece	39,113	14,829	580,000,000	DSI
Private	Land Aggregation and TİGH	hectare	864,000	889	768,000,000	DSI
Public	DSI Land Aggregation	m^2	89,380	22,634	2,023,000,000	DSI
Public	OGM Land Aggregation	m^2	224,000	13,572	3,040,050,000	OGM
	Total				**24,163,368,351**	

Table XV: Itemized Distribution of Assessed Damage in the Agriculture Sector according to government as of March 2023 (SBB Report, 2023, page 94)

Furthermore, the government has noted significant damages to the irrigation infrastructures that will affect the entire agricultural potential of the regions:

Facility Type	Unit	Quantity	Unit Cost (TRY/unit)	Estimated Cost (TRY)
Dams and Ponds [1]	hm^3	-	-	4,105,000,000
Flood Control Facilities	piece	787	1,175,349	925,000,000
Irrigation Facilities [2]	hectare	923,976	11,981	11,070,307,851
Drilling Wells	piece	39,113	14,829	580,000,000
Facilities of Regional Directorate [3]	m^2	89,380	22,634	2,023,000,000
Land Aggregation and TIGH	hectare	864,000	889	768,000,000
Total				19,471,307,851

(1) While cost calculations were performed based on the extent of damage that occurred in the dams, unit prices were not taken into account since the damage characteristics of each dam are different. However, detailed status of major dams that sustained damage in the earthquake zone has been provided in the following table, (2) Although the damage assessment of irrigation facilities continues, since it is not possible to supply water to the channels due to seasonal conditions, the amount of damage has been determined with a holistic approach and as an estimate, (3) Damages were detected in a total area of 89,380 square meters in the buildings and facilities of the regional and affiliated branch offices of DSI located in the earthquake zone. Of this figure, 68,730 square meters are the facilities collapsed due to the earthquake, and 20,650 square meters are the facilities with minor damage..

Table XVI: Estimated Costs of Damage to Irrigation Sector in Earthquake-Affected Region according to government as of March 2023 (SBB Report, 2023, page 93)

4.3.3.2 The manufacturing sector

Amongst the 8.6 % contribution of these eleven regions to the national GDP, 11.5% of it came from the manufacturing sector representing about 21.9 billion USD in exports.

4.3.4 Summary of the financial global burden on the country

Finally, to close the analysis of economic consequences on the Syrian-Turkish earthquakes of 2023, we can mention the summary of global costs that was established by the Turkish government as of March 2023. This summary takes into consideration most importantly the costs of:

- economic costs of destruction on the affected physical assets of the eleven regions
- the magnitude of emergency economic costs to take into account the consequent decline in local capital stocks
- the economic costs linked to the removal of debris & materials linked to unstable buildings.

	million TRY	million USD
Emergency Appropriation	271.0	14.4
Additional periodic apportionment from the Social Assistance and Solidarity Promotion Fund (SASPF) to 1,003 Social Assistance and Solidarity Foundations	225.0	11.9
10,000 TRY cash aid per household affected by the earthquake	16,790.0	890.2
To households in damaged buildings, 15,000 TRY as cash aid for moving per household, and additionally 5,000 TRY of monthly rent aid per house owner, and 3,000 TRY per tenant, for a duration of 1 year	33,000.0	1,749.7
100,000 TRY cash aid to survivors of those killed by the earthquake for emergency needs, and fuel assistance to earthquake victims who move by their own vehicles to provinces outside the earthquake-affected region	2,200.0	116.6
Expenditures for procurement of tents, in-tent materials (blankets, beds, bed-linen, heater etc.) and containers for temporary accommodation of earthquake victims	25,000.0	1,325.6
Expenditures for accommodation and food for earthquake victims	40,500.0	2,147.4
Other Miscellaneous Estimated	10,000.0	530.2
Total	127,986	6,786

Table XVII: Emergency Expenditures both in TRY and USD estimated by the Turkish government as of March 2023 (SBB Report, 2023 page 132)

Estimated total Costs (1)	billion TRY	billion USD	Rate of GDP (%)
Emergency Expenditures	128.0	6.8	0.6
Estimated Public Damage (2)	242.5	12.9	1.1
Estimated Private Damage (3)	222.4	11.8	1.0
Estimated Housing Damage (requiring urgent demolition + collapsed + severely damaged)	1,073.9	56.9	5.0
Costs of Domestic Goods	58.5	3.1	0.3
Cost of Excavation (100-120 million m3) + Crusher (Public + Private)	41.9	2.2	0.2
Damage to Private Motor Vehicles (4)	6.1	0.3	0.0
	1,773.2	94.0	8.2
Cost of Motor Vehicle Insurance Compensation (4)	1.2	0.1	0.0
DASK (5)	36.4	1.9	0.2
Revenue Loss by Tradespersons (6)	13.9	0.7	0.1
GDP Output Loss (7)	130	6.9	0.6
Grand Total	1,955	*103.6*	*9.0*

(1) Estimates based on damage assessments as of 01.03.2023.
(2) Quantities reported from the field including public service buildings, machinery and equipment.
(3) Including tradespersons, industry, houses of worship.
(4) Compiled from regional motor insurance data
(5) DASK estimate based on total claims and damage in the region.
(6) Excludes losses of rental revenues, real-estate-related revenues, and relevant banking sector revenues.
(7) The implied amount calculated at the current exchange rate over the GDP output loss.

Table XVIII: Total costs of damage and expenditures both in TRY and USD estimated by the Turkish government as of March 2023 (SBB Report, 2023, page 132)

From this summary, we can pick out a couple of significant figures to quantify the global costs of the economic burden linked to the disaster:

- **6.8 billion USD**: the costs of the expenditures linked to the initial search & rescue efforts, initial emergency repairs for infrastructure damage, emergency humanitarian aid including temporary housing.

- **12.7 billion USD**; the costs linked to the total damage in the public sector including service-linked buildings like hospitals and schools as well as public machinery, vehicles and equipment.
- **56.9 billion USD**: is the costs imposed by the damage on housing units. It represents about 55% of the total estimated financial burden.
- **11.8 billion USD**: the damage inflicted on the private sector including damage to industry, energy, communications and tourism related infrastructures.
- **103.6 billion USD**: the total estimated costs of the 2023 earthquake, all aspects considered.

Perhaps the most important figure is the last one: about 104 billion USD to cover all the costs related to the earthquake. Indeed, in order to put this figure in perspective, in 2023, the total GDP of Turkey is estimated to be around 1103 billion USD. In other words, the total costs of the earthquakes represent about 9.4% of the overall Turkish GDP in 2023.

Chapter 5

The Government Policies and Reconstruction Efforts

5.1 Government Response and Planning

One of the most important approaches by the Turkish government towards earthquake management was to enact Law No. 7269 in 1959, which regards the regulation of measures to be taken in disasters and emergency management of disasters. This law laid the foundation of the legal framework for preparing for a disaster, its response, and recovery. (Official Gazette, 1959) Then came Emergency Management Law No.6305, which was enacted on 18th of June 2014. This law majorly updated the aforementioned law and made it focus more coordinated within involved parties. (Official Gazette, 2014)

The first version of the Building Code which included the groundwork for earthquake-resistant design was established in 1975. (Official Gazette, 1975) However, The Turkish Earthquake Code was revised and updated in 1997, followed by the 1999 Marmara Earthquake. This version with "Specification for Structures to be Built in Seismic Zones" is the most important one when it comes to earthquake resistance. (Official Gazette, 1997) This code was revised twice again to catch up with the improvements in seismic engineering. There was much feedback and complaints regarding the Turkish Building Earthquake Code.

However, the experts argue that the building codes are simply up-to-date, and their execution is the problem when it comes to earthquake resistance. Dr. Yasemin Aktas, EEFIT Team Leader from UCL Civil, Environmental & Geomatic Engineering, said: "Our analysis suggests that resilience to major seismic events such as earthquakes in Türkiye and Syria is not only a technical problem but one of culture and governance. Engineers in these countries know how to build resilient structures and building regulations stipulate high standards that are simply not being met when buildings are being built." She also talks about how the Turkish government introduced the Mandatory Earthquake Insurance after the 1999 Marmara earthquake, yet the allocation of the funds is questionable. To support Dr Aktas' claim, Professor Emily So, EEFIT Team Leader from the University of Cambridge, said: "The 2023 Türkiye and Syria earthquakes were truly tragic, hitting an already fragile population, including migrants. Our fieldwork and remote analysis revealed many issues, including the issue of non-compliant buildings with little seismic resilience. Building code compliance needs to be strengthened." (Ucl, 2024)

Turkey is one of the nations that signed the Sendai Framework action protocol. On top of the worldwide studies conducted within this framework, Turkey is preparing several disaster management plans with the priority of AFAD (Disaster and Emergency Management Presidency). TAYSB (Türkiye Disaster Management Strategy Document), TARAP (Türkiye Disaster Risk Reduction Plan), TAMP (Türkiye Disaster Response Plan), and UDSEP (National Earthquake Strategy and Action Plan), are among the plans and strategic documents handled within the scope of Sendai Framework, which mainly focuses on the prevention. (Karaca & Dilsiz, 2023)

5.1.1 Building Amnesty

Despite all these prevention measures and regulations, some of the decisions and laws that have been put into practice have caused controversy, especially the one regarding the Zoning Amnesty. This means to forgive the buildings that were constructed illegally until a certain period of time that were not following the codes and regulations, and those that comply with the conditions specified in the law in terms of condition and location. It should be also noted that these buildings had not been complying with the engineering requirements such as the current seismic codes which are the most important parts of the construction legislation. (Karaca & Dilsiz, 2023)

The most recent Zoning Amnesty in Turkey was introduced in 2018 under the name Zoning Peace. During a press conference on June 6, 2018, then-Minister of Environment and Urban Planning Mehmet Özhaseki explained why such regulation was needed by stating that they estimated the number of non-compliant structures to be between 13 and 15 million, and said, "There is neither the power to demolish these structures nor would it be appropriate."

A practice such as zoning amnesty cannot work together with disaster management. It is to pay attention to preventative measures for the execution of zoning regulations in earthquake-prone regions and where construction should not be allowed. It is important to carry out the mandatory controls with the experts specific to the neighborhoods and to ensure the demolition of risky buildings – even if they have benefited from the zoning amnesties until now. Only when this happens, disaster risk management will be fully provided, and efficient results will be obtained in recovery works. (Karaca & Dilsiz, 2023)

5.1.2 Post Disaster Regulation Changes

Following the earthquake, there were several investigations conducted on the collapsed and severely damaged buildings to determine the manufacturing defects that led to their collapse. The common denominators of the damages were identified to prevent the same mistakes from happening in the future. As a result, the planned areas zoning regulation was amended, and the changes were published in the Official Gazette on May 12, 2023, coming into effect 95 days later.

The following paragraphs have been added to Article 5 of the Planned Areas Zoning Regulation, published in the Official Gazette No. 30113 dated 3/7/2017:

"(30) The following rules must be adhered to for the building types listed below:
a) For buildings containing residential units on the ground floors with non-residential functions: the ground floor height must not be less than 4.50 meters, the structural systems A12, A13, A14, or A15 from Table 4.1 of the Turkey Building Earthquake Regulation published in the duplicate Official Gazette No. 30364 dated 18/3/2018 must be used, short columns must not be formed, and mezzanine floors and enclosed projections are not permitted.
b) Enclosed projections are not permitted in buildings with four or more floors above the ground level. However, if the use of the plot's plan and the density rights granted by this Regulation cannot be utilized due to the prohibition of enclosed projections, up to 1 meter of the rear garden can be used, provided that the rear garden distance is not less than 2 meters, and it consists only of columns and/or walls (including sections extending to the foundation underground). This does not count as a violation of the garden distance or the base area. If even this does not fully utilize the density rights, up to 1 meter of the front garden can be used, provided it is not less than 4 meters from the road boundaries, and this space must not be enclosed with any material or walls, retaining its garden characteristic. No density increase can be granted based on the building's design with projections. In buildings not exceeding ground+4 floors, if enclosed projections are made, the columns forming the projection must be connected with beams meeting the criteria of clause (a) of section 7.5.1 of the Turkey Building Earthquake Regulation.
c) For adjoining plots, the required earthquake joint gap per the Turkey Building Earthquake Regulation must be left from the plot boundary. This gap must be closed with light materials along the building to ensure safety without hindering the building's sway.

(31) In the calculation of building construction areas, the horizontal projection of the area within the outer dimensions of the framework/structure built to carry photovoltaic panels for solar renewable energy systems is considered.

(32) During the construction of the foundations and/or basement floors of buildings, the design and application of support structures to ensure the stability of excavation pits must comply with the Regulation on Excavation Support Structures published in the Official Gazette No. 32047 dated 18/12/2022, and the excavation support structure and/or surrounding structures must be monitored." (Official Gazette Turkey, 2023)

Article 2: The second paragraph of clause (a) of the second subsection of Article 6 of the same Regulation has been amended as follows:

"2) In areas suitable for construction from 5 to 9 floors (including 9 floors): The width must not be less than the width determined per the first subparagraph, with an additional 60 centimeters for each floor." (Official Gazette Turkey, 2023)

Article 3: In Article 19 of the same Regulation, the term "3%" in clause (5) of the first subsection has been changed to "5%", the term "3%" in clause (6) has been changed to "5%", and the following paragraph has been added:

"(3) In parks, gardens, and squares designated as gathering areas per relevant legislation, the necessary toilets, washbasins, and prayer rooms can be constructed within the building conditions specified in this article, and the administration is responsible for this." (Official Gazette Turkey, 2023)

Article 4: The following subparagraph has been added to the second paragraph of Article 57 of the same Regulation, the following subparagraphs have been added to the sixth paragraph, and the following subparagraphs have been added to the seventh paragraph:

"ç) Except for structures of confidentiality due to state security and public order and areas under the Law on Protection of Cultural and Natural Assets No. 2863 dated 21/7/1983, the Law on Transformation of Areas Under Disaster Risk No. 6306 dated 16/5/2012, and other special laws: For buildings intended for public use in municipalities with a population exceeding 50,000, such as official buildings, places of worship, educational and health facilities, cultural buildings, entertainment structures, accommodation buildings, shopping centers, transportation stations, business centers, offices, passages, markets, commercial buildings, and central business areas, and structures deemed to be in this scope by the administration, the architectural project authorship can only be undertaken by architects with at least 5 years of professional experience, having been involved actively in the design process of at least 10,000 square meters and at least 4 different buildings with building permits, and who can document this experience. For architects with a master's degree in architectural science, the service duration and project criteria mentioned in this subparagraph are halved. The architectural projects prepared within this scope must be designed to reflect the building's function maximally, with architectural elements emphasizing the building’s usage function. The entrance facades must be designed in a way that makes the building’s function easy to understand, using architectural elements such as porches, porticos, or colonnades that match the facade and roof, giving depth to the facade, and creating an inviting effect with terraces, stairs, ramps, and level differences in the front gardens. Additionally, the architectural project must be compatible with the architectural elements of the reference building facade determined by the architectural aesthetics commission on the same street, or, if there is no reference building, it must be in harmony with the street silhouette." (Official Gazette Turkey, 2023)

"b) The authorship of static projects for buildings with 5 to 7 floors, excluding the ground floor, can only be undertaken by civil engineers with at least 3 years of professional experience, having been actively involved in the design process of at least 10,000 square meters and at least 4 different buildings with building permits, and who can document this experience.
c) The authorship of static projects for buildings with 8 to 15 floors, excluding the ground floor, can only be undertaken by civil engineers with more than 5 years of professional experience,

having been actively involved in the design process of at least 15,000 square meters and at least 6 different buildings, with at least one project meeting the criteria of subparagraph (b), and who can document this experience.
ç) The authorship of static projects for buildings with more than 15 floors, excluding the ground floor, can only be undertaken by civil engineers with more than 7 years of professional experience, having been actively involved in the design process of at least 20,000 square meters and at least 8 different buildings, with at least one project meeting the criteria of subparagraph (c), and who have a postgraduate degree in structural or earthquake engineering. (Official Gazette Turkey, 2023)
d) For civil engineers who meet the service duration and work experience criteria required by subparagraph (ç) as of the effective date of this subparagraph, a postgraduate degree is not required." (Official Gazette Turkey, 2023)

"c) The authorship of mechanical installation projects for residential buildings exceeding 30.50 meters in height and public buildings exceeding 2,000 square meters in the construction area can only be undertaken by mechanical engineers with at least 3 years of professional experience, having been actively involved in the design process of at least 10,000 square meters and at least 4 different buildings, and who can document this experience.
ç) The authorship of mechanical installation projects for all buildings exceeding 51.50 meters in height and public buildings exceeding 30,000 square meters in construction area can only be undertaken by mechanical engineers with at least 5 years of professional experience, having been actively involved in the design process of at least 10,000 square meters and at least 4 different buildings, with at least one project meeting the criteria of subparagraph (c), and who can document this experience." (Official Gazette Turkey, 2023)

Article 5: In the second paragraph of Article 66 of the same Regulation, the phrase "one of whom will be the chairperson" has been added after the word "Commission," the third paragraph has been amended as follows, and the following paragraphs have been added:

"(3) Relevant administrations may establish architectural aesthetics commissions with experts, including universities and relevant public institutions if necessary. The commission must include at least two architects, with the remaining three members selected from professions such as architecture, civil engineering, landscape architecture, art history, urban planning, and surveying engineering. The commission chairperson must be an architect with at least 5 years of service in public institutions and organizations, public economic enterprises, professional organizations in the nature of public institutions, or registered freelance architects with their office or have a master's degree in architectural science." (Official Gazette Turkey, 2023)

"(13) The commission also examines architectural projects within the scope of subparagraph (ç) of the second paragraph of Article 57 for compliance with the specified criteria. The commission is authorized to determine reference buildings and request changes in projects for these purposes. These projects must be reviewed by the commission within ten working days. Decisions can be acceptance, rejection, or conditional acceptance with specified corrections, or interim decisions can be made for modifications and resubmission for review. Final decisions of the commission are notified to the administration's unit authorized to issue building permits.

(14) The commission can also decide on buildings that can be used for advertising surfaces and their facades in the structures specified in subparagraph (ç) of the second paragraph of Article 57." (Official Gazette Turkey, 2023)

Article 6: The following paragraph has been added to the transitional Article 3 of the same Regulation:

"(5) For buildings that have applied for building permits before the effective date of this paragraph and those for which procurement decisions or tender dates have been set by public institutions and organizations, the thirtieth paragraph of Article 5, subparagraph (ç) of the second paragraph of Article 57, subparagraphs (b), (c), (ç), and (d) of the sixth paragraph, subparagraph. (Official Gazette Turkey, 2023)

The published regulation summarizes.

- Short column effect is aimed to be eliminated, mezzanine floor and banned indoor dating,

- Adjoining buildings may hit each other under the earthquake effect. preventing it from having a "hammering effect",

- There's encouragement for institutional dialogues between the universities, the government, and the professions. Architects, construction engineers, and civil engineers who will take part in the design and implementation of building experience requirements have been introduced for engineers and mechanical engineers.

5.1.3 The Reconstruction Process

After the earthquake, it was unclear for everyone affected how and when cities will be fully restored and when permanent living conditions will be reestablished. Many people in the earthquake-affected regions are still struggling to live in temporary shelters such as container cities and tents. There were 79395 containers distributed in 206 Container Cities. (Hatay Valiliği, 2024)

One of the most important promises of President Recep Tayyip Erdoğan in terms of the earthquake recovery, made before the 2023 elections, was to resolve the housing issue fast.

In March 2023, Erdoğan announced that 319000 homes would be delivered within a year and pledged to build a total of 650000 homes and village houses. On top of the pledged figure, it was mentioned that the goal includes constructing 850000 independent units, consisting of 680000 residences and 170000 commercial spaces. (AA, 2023)

In a statement on February 2, Interior Minister Ali Yerlikaya announced that 46,000 housing units would be distributed via a lottery draw, with the first ceremony scheduled for February 3 in Hatay and attended by President Erdoğan. Throughout this event, President Erdoğan oversaw the completion of the lottery distribution for a total of 7237 earthquake housing units in Hatay, consisting of 6572 urban units and 665 rural units. (Hatay Valiliği, 2024)

Since the earthquake on February 6, a total of 76000 housing units have been given through the lottery draw system. According to the Ministry of Environment, Urbanization, and Climate Change, the promised number of houses to be delivered by the end of March was 75364. Although the government has not completed as many housing units as it promised within the first year of the earthquake, it seems that the commitment made by the ministry for March has been fulfilled. It's evident that the execution of the delivery of the houses by the Ministry of Environment, Urbanisation and Climate Change is on point with the desired outcome, however, the reconstruction of houses is not fast enough due to various factors.

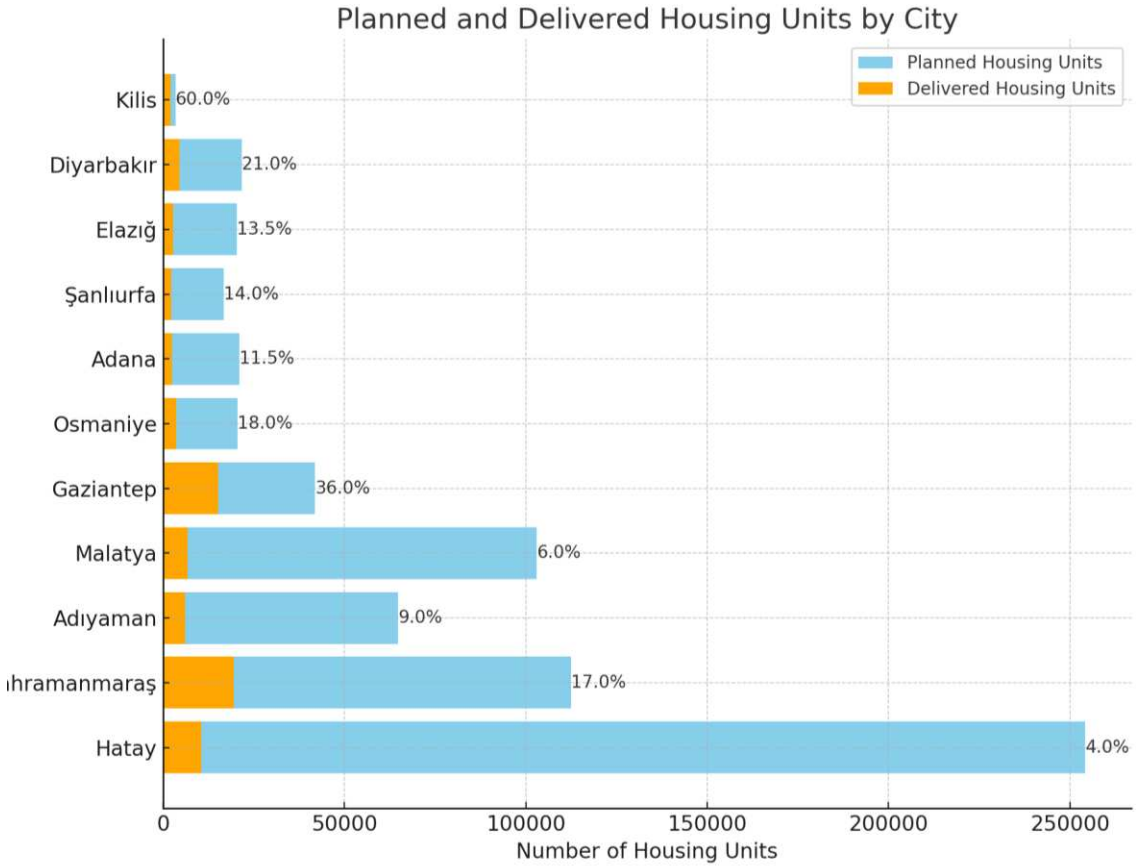


Figure 5.1: Planned and Delivered Housing Units by City (Source: Ministry of Environment, Urbanization, and Climate Change, 2023)

However, these numbers displayed in Figure 5.1 still fall short of the housing need. In reality, only 24% of the 319000 homes promised to be delivered within a year have been completed. This means that 243636 homes are not yet finished or ready for delivery. On February 6, President Erdoğan announced that 200000 homes would be delivered by the end of the year, a figure reiterated by Interior Minister Ali Yerlikaya during a handover ceremony on March 19.
However, these figures demonstrate that its lacking to match the required earthquake housing in the cities.

In Hatay, where the need is the biggest, the target is 254195 housing, but as of March 2024, only 10418 homes have been delivered. This means that only 4% of the planned and needed homes in Hatay have been completed.

According to the earthquake report from the Presidency, the earthquake affected 5649317 housing units across eleven provinces. Over 38000 buildings collapsed during the earthquake. After the earthquake, 518009 housing units were deemed collapsed or in urgent need of demolition, or severely damaged. Another 131577 units were identified as moderately damaged. Furthermore, in the affected regions, some of the moderately damaged buildings began to be treated as severely damaged. The Ministry of Interior issued a directive allowing for objections to be made for buildings that were considered suitable for reinforcement. (Republic of Turkey Presidency, Strategy and Budget Department 2023)

5.2 Ministry of Environment, Urbanisation and Climate Change

5.2.1 Urban Renewal “Kentsel Dönüşüm”

Under the effects of the economic transformation, it is experiencing and the choices of the political regime, Turkey's settlement system is also undergoing a continuous transformation. It is also impossible not to agree with the predictions that this transformation will differentiate and accelerate in the coming years. In this process, the practice of Turkey is both different in terms of time from the practices of Europe and North America that I mentioned at the beginning and is also based on the social aspect of the country as it should be.

A continuous transformation has been experienced in our cities since the practices in the 1950s. However, it is now known that this process is not carried out by the principles and methods of the fields of architecture and urbanism, but by economic, political, social, cultural and environmental dynamics. The discussions experienced today, especially in terms of the suitability of the examples produced as urban transformation projects with human/user needs and their consistency with the identity of the cities, are solid grounds for this determination. For this reason, it is necessary to criticize the practice of the concept of "urban transformation" in Turkey in two ways.

a) Perception of urban transformation as a physical space arrangement focusing on real estate,
b) Production of this arrangement without reference to architectural and urban identity, alienation of these new spaces from the spirit and space of the city.

These evaluations lead us to the conclusion that urban transformation practice in our country should be based on very detailed analyses and should be formed in line with long-term, participatory negotiation processes. The fact that the concept of urban transformation entered Turkish practice, especially with the 1999 Marmara earthquake fundamentally distinguishes the subject from the experiences experienced in the West. However, the fundamental problem of the urban transformation process in Turkey is the urban areas that have been illegally constructed and have become even more unhealthy with the zoning plans. These dynamics have led to the perception of the urban transformation process in Turkey as merely the demolition and

reconstruction of the physical texture. The public has exhibited different approaches in different periods against the slum and illegal construction process that has played a decisive role in the formation of cities since the 1950s. If we need to separate these in brief according to their periods:

The first type of action that can be evaluated within the scope of urban transformation is the slum population organizing within the scope of beautification associations and finding ways to benefit from urban infrastructures. This process, which developed as an initiative of local communities, constituted an important stage in the transformation of rural lands, which were attached to the peripheries of the city without infrastructure, into urban areas. • On the other hand, the tendency to demolish illegal construction until the end of the 1960s continued until the "Slum Law" of 1966. The aim of the "slum prevention zones" included in this law was to demolish existing shantytowns by the public to move to the regions and prevent new shanty houses to be built. The approach, which was planned to be realized by the public, in the nature of an urban transformation project of that period, could not fully achieve its goal.

The 1970s were the period when migration and illegal construction reached the highest level.

The zoning amnesty laws of 1983 and 1985 and the concept of an “improvement zoning plan” added to the law later granted the beginning of a new urban transformation process. In this period, as in the previous period, it was not content with just amnestying illegal constructions, but the right to build additional structures up to four floors was granted to a building. Apart from this, the provision that urban facility area standards, which are a prerequisite in zoning plans, were not sought in these plans was perceived as increasing all of these regions up to four floors and not allowing any facilities other than roads. In this context, with the zoning plans that were approved and put into effect without seeking their conformity to the master plan, a long-term and increasingly structural transformation process began in the illegally developed regions of the cities. This urban transformation movement, the infrastructure of which was prepared by the public and shaped by the local society's original capital accumulation processes and local political relations, is a process open to criticism in many respects when evaluated in light of today's realities. (Görgülü, 2009)

5.2.2 TOKI (Turkish Housing Development Agency)

The possibility of earthquakes and its complications related to irregular and unplanned urban development led municipalities and the Turkish Housing Development Agency (TOKİ)[5] to implement urban transformation projects These policies focus strengthening programs in high-risk areas and creating environmentally friendly urban living. The main goal is to modernize the existing buildings, reduce disaster risks, and improve the quality of urban life. Since 2003, Turkey has reached a significant milestone in its urban transformation efforts. For the first time, urban transformation has been established and implemented as a strategy, emphasizing collaboration between local governments and the private sector. In addition, a lot of efforts have been made to keep conservation and restoration of the historic residential areas and to improve housing

[5] For further information on this national institution, please refer to the https://www.toki.gov.tr/en/

conditions. Toki plays an important role in this process and has become an important agency for urban transformations.

In addition, legal provisions facilitated collaboration between Toki, the private sector and local government, enabling large-scale urban renewal projects Under Toki's leadership, these projects focus on physical architecture and social finance. Their aim is to strengthen architecture in various urban areas, plan for the environment, and create livable spaces. Furthermore, the integration of historical text preservation with contemporary urban vision has been an important step towards maintaining urban identity. During this period, the urban transformation process has gained significant momentum in Turkey's urban development process, contributing to urban transformation in terms of growth, energy, and habitat through large-scale infrastructure projects. (Görün & Kara, 2010)

The existing buildings constructed by TOKİ in the earthquake zone prior to the earthquake were praised by the Turkey Earthquake Sequence Seismic Engineering Field Study Team. According to their report, "The tunnel form buildings widely implemented by TOKİ (Housing Development Administration) have generally performed better compared to traditional reinforced concrete buildings due to their greater number of shear walls. Consequently, the current reconstruction practices are almost entirely carried out with TOKİ-type buildings. While this approach can generally improve earthquake resistance, it is undeniable that this one-dimensional approach to residential construction could lead to the erasure of diversity and richness in the built environment and associated living cultures in the medium term. It is important for reconstruction practices to take into account the characteristics of the built environment in the region, as this greatly impacts the sustainability of the solutions developed.'' (EEFIT Report, 2023)

5.2.2.1 TOKI's Contribution to Post-Disaster Reconstruction

The Ministry of Environment, Urbanization and Climate Change reported a total of 307,066 units under construction or tender phase in 11 provinces This number includes 218917 units by Toki, 44275 units from the Directorate General of Emlak Konut and 43874 units from Directorate General of Building Affairs The construction or tendering process for 373934 has not yet commenced. (AA, 2024) was published.

But of the 126348 housing units planned in 11 provinces in the Toki website, 113,612 commenced constructions by the end of the tender process This represents 35% of the 319,000 homes promised to be delivered in one year; just started, and only 16% of the 680,000 households need it.

These homes are still "under construction," and few are completely finished. Some are nearing completion, and the completion rate is about 90%. The completion rate in Afshin, Pazarcık, Dulkadiroğlu and Göksun districts is 92%.

Moreover, the number of planned and tendered housing units in particular cities is lower than targets. For Hatay, 254195 houses are planned, but only 32234 have completed the tender process and started construction, with an average completion rate of 48% 3110 houses are planned but

have not yet started. Payas district in Hatay has the highest housing completion rate of 84%, with 821 houses under construction, while other houses are at 70-80% completion.

Apparently TOKİ projects are also falling short of their targets. (Toki, 2024) 2024.

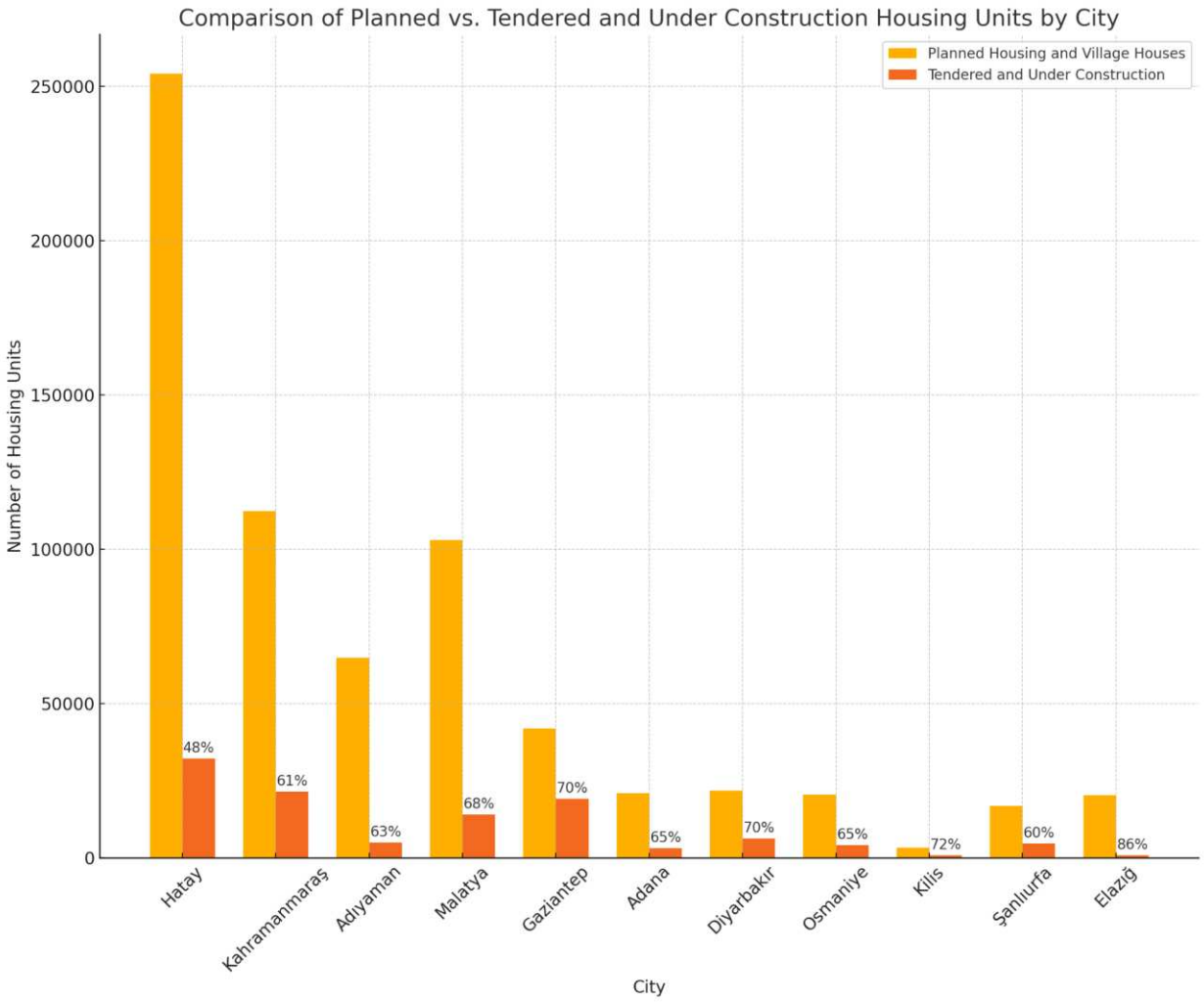


Figure 5.2: Planned vs Tendered and Under Construction Housing Units by City (Source: Ministry of Environment, Urbanization, and Climate Change, 2023)

The experts argue that the reason behind the unfulfilled promises is that the goals to build and complete the aforementioned numbers of housing weren't realistic to begin with. Mr. Yüzgeç said that such a big promise was made for pre-election purposes and that under current conditions it is not possible for TOKİ, which has built around 700,000 houses in the last 20 years, to build half that number in one year.

Additionally, the head of the Chamber of Civil Engineers also stated that such a rapid pace of housing construction may create risks: "Producing housing and re-planning cities is a time-consuming process that needs to take into account how cities will grow in the coming decades." (BBC, 2024)

According to the data shared by Anadolu Agency, TOKİ built 213000 houses throughout 2020, 2021 and 2022. Minister Özhaseki had said that it would not be an easy task for TOKİ, which built about 60-70 thousand houses a year until the 6th of February earthquake, to build 850000 buildings in such a short span, and that it was difficult to find reserve areas for construction. Therefore, the promised housing units were already above TOKİ's previous construction capacity.

5.2.3 Smart Cities "Akıllı Şehirler"

Whenever the topic is raised for urban renewal and disaster mitigation, the future outlook of the renewals comes up with governmental initiatives such as Smart Cities[6]. It has been determined that there is no single common definition for the concept of Smart City and that this definition is shaped according to the needs sought in the studies. Within the scope of the 2020-2023 National Smart Cities Strategy and Action Plan, the concept of Smart City is defined as:

"More livable and sustainable cities that are implemented through cooperation between stakeholders, use new technologies and innovative approaches, are justified based on data and expertise, and produce solutions that add value to life by anticipating future problems and needs."

Smart City is a complex concept and needs to be addressed structurally. As there are different Smart City definitions, there are different approaches in standards, maturity assessment models, indexes and architectural studies regarding the structure of the Smart City concept. Among these approaches, there are 6 basic components in the structure used by the European Parliament8. These Components are; Smart Economy, Smart People, Smart Governance, Smart Life, Smart Mobility and Smart Environment.

In terms of the post-disaster infrastructure, Smart Space Management refers to the issue of cities being resilient against natural disasters such as earthquakes, floods, landslides that may cause loss of life and property, being socially, culturally and economically livable and sustainable, and developing in accordance with the principles of urbanization.

Smart cities also contain Disaster and Emergency Management is a set of applications and systems that reduce possible damages by taking precautions, ensuring preparedness for disasters and emergencies, intervene when an event/situation occurs, analyzing disaster and emergency data intelligently, and cover the process of returning to normal life.

The first holistic high-level policy in the field of Smart Cities was determined in the Tenth Development Plan (2014-2018). In the plan, regarding Smart Cities:

"Livable Spaces, Sustainable Environment" No. 731 "The use of smart applications, especially in areas such as health, transportation, building, energy, disaster and water management, will be expanded. The transformation of cities into smart cities will be supported by increasing their

[6] For more information regarding Smart Cities, please refer to https://www.akillisehirler.gov.tr/

infrastructure, capacity and skill levels in the field of information and communication technologies."

The Maturity of the Disaster and Emergency Management Component will be Increased and its directly related to the governmental structure of Disaster and Emergency Management Presidency (AFAD) and Ministry of Environment and Urbanization - General Directorate of Local Administrations.

It's not only the AFAD And Ministry of Environment and Urbanisation being involved in the Emergency Management Component, a multidisciplinary approach within governmental policies is required which includes the parties of Presidency - Local Government Policies
Board, Ministry of National Defense, Ministry of National Education, Ministry of Health, Ministry of Energy and Natural Resources, Ministry of Transportation and Infrastructure, Ministry of Interior, Ministry of Treasury and Finance, Ministry of Agriculture and Forestry.

However, according to the survey report, it was determined that 237 local governments did not allocate a budget for Turkey's Smart City studies for the next year, that the local governments that allocated a budget did so, and that the maximum allocated budget was ₺25,000,000. Moreover, budget and resource allocations were provided with a legal basis by various laws. For example; Article 19 of the Disaster and Emergency Intervention Services Regulation states that the resources needed for emergency aid will primarily be provided by local means and that in the event that local resources are insufficient, upon the request of the Governorship or ex officio when necessary, resources will be transferred from the disaster and emergency activities allowance of the Presidency's budget to the disaster and emergency accounts to be opened on behalf of the governorships. (Smart Cities Plan, 2019)

5.2.4 TTV and its Protocol with the Turkish Government

The TTV[7] (Turkish Design Council / Turkiye Tasarim Vakfi) Hatay Design and Planning Collaboration Group is collectively carrying out design processes that involve various disciplines (especially architects, urban planners, civil engineers, archaeologists, geologists, landscape architects, and experts from different engineering fields) for the pilot areas identified in the centers of Antakya, Kırıkhan, Defne, and Samandağ districts in Hatay, following the earthquake.

[7] For further information regarding TTV Hatay, please refer to https://ttvhatay.com/

Figure 5.3: The Türkiye Design Council (TTV) held workshops and consultation sessions (Source, TTV, 2024)

In agreements with the Turkish Design Foundation, the Ministry of Environment, Urbanization and Climate Change of the Republic of Turkey, and the Ministry of Culture and Tourism, their spaces fulfill the planning and design process necessary for the revival of Hatay on the snow. In the course of the ongoing process, they voluntarily organize extensive research and data collection efforts related to historical archaeological studies, natural and social structures of the area, urban remains and architectural fabric located in Hatay.

Figure 5.4: TTV's planned masterplan for Hatay's reconstruction policies (Source: TTV, 2024)

5.2.4.1 Comprehensive Masterplan by Foster+Partners

Foster + Partners is developing the comprehensive master plan, in partnership with Buro Happold and MIC-HUB. Also, London-based architectural studio Foster + Partners develops urban planning guidelines for emergency rebuilding in the early stages of reconstruction. Burro Happold contributes to architectural design guidelines to make sure the new developments are earthquake-proof, while MIC-Hub focuses on comprehensive transportation infrastructure to reconstruct Hatay (Ahuja, 2024)

Foster + Partners' Masterplan

According to the design team of Foster + Partners, Antakya faces challenges due to flooding, especially affecting informal settlements. Despite this, it has strengths like a dense street network, permeable urban fabric, and a human-scale environment. However, the distribution of open spaces is uneven, with major parks mainly in the core area and not accessible in a simple way.

City-Wide Strategies

In the case of Land Use Planning: The main idea is to develop a plan that pays attention to flood risks by designating safe areas for reconstruction and promoting sustainability.

Transportation: Improve road hierarchy keep the existing network and position commercial centers within walking distance of residential areas to reduce vehicle dependency.

Pedestrian Routes: Create community-oriented, pedestrian-friendly routes linking social amenities to boost engagement and mobility.

Open Spaces: a diverse and fair distribution of green spaces throughout the city to improve accessibility and quality of life.

Planning Levels: Layering of the Districts

Establish 12 walkable districts centered around primary streets or waterbeds, featuring retail, commercial activities, and public transport. Utilize waterfronts for scenic and recreational

benefits. Include green spaces and plazas in each district to enhance walkability and community vibrancy.

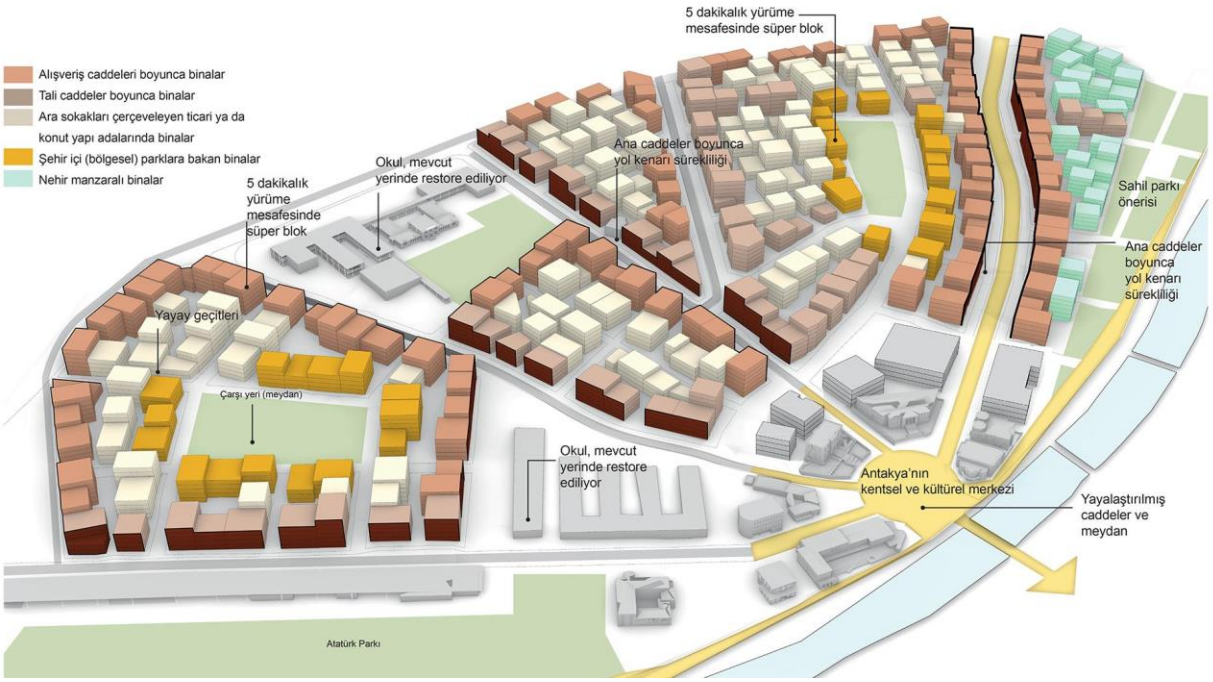


Figure 5.5: Foster + Partner's vision for the new masterplan (Source, TTV, 2024)

5.2.4.2 Principles for Replanning the City Center

There are planning efforts are ongoing in the provinces severely affected by the earthquakes on February 6th. The Turkish Design Foundation (TTV) is responsible for developing lower-scale pilot projects in line with the master plans prepared by the Ministry of Environment, Urbanization, and Climate Change (ÇŞİDB). It means is that the NGO's such as TTV is directly working with governmental bodies such as the Ministry and the Municipalities. The designers prioritize sharing information directly with all stakeholders during both the planning process and the preparation of these pilot projects. The key principles of these projects, which have been extensively discussed in multiple meetings with various groups, are as follows:

The master plan decisions, introduced in many previous meetings, are guided by the French plan from the 1920s. The practice of settling in riverbeds, which intensified the earthquake's damage, has been discontinued, and riverbanks and water edges have been designated as green areas. To prevent displacing property owners in the now more constrained settlement areas, building blocks have been combined and enlarged.

In accordance with the master plan, by restricting development along riverbanks and riverbeds, the total green space has been nearly doubled compared to pre-earthquake levels. The pilot project for the centre of Antakya is the first implementation within the comprehensive post-earthquake Hatay Master Plan. The project in Antakya, to be carried out by the Ministry of Environment, Urbanization, and Climate Change, considers the economic conditions following the earthquake and is critical as it will serve as a model and guide for future reconstruction efforts. This project area is considered a pilot for rebuilding Antakya into a "disaster-resistant and high-quality urban living" area.

The project is being made with the involvement of various disciplines and in collaboration with local government such as Hatay Metropolitan Municipality and NGOs. There are meetings and workshops have been held with experts and the local community in Hatay and Istanbul. Going forward, meetings with the local community will continue to gather input, listen to their needs, and provide updates.

According to the decisions made by the Ministry of Environment, Urbanization, and Climate Change, and the Ministry of Culture and Tourism, the demographic structure and property ownership within the project area are being preserved, and no additional housing units will be constructed. The project's primary goals are to maintain previous neighborhood ties and avoid bringing new populations into the area. In this context, the aim is to allocate housing units to owners in locations as close as possible to their pre-earthquake properties. The declaration of a "reserve building area" on November 14, 2023, for the project area in Antakya, seeks to resolve practical issues during the planning and implementation phases. The project is committed to protecting the property rights of the local community.

5.2.4.3 Key Principles of the Pilot Project Area

In the 200-hectare area, riverbanks and stream edges are being restricted from development and transformed into public open spaces and green areas. The transportation network across the region is being redesigned while maintaining the current main road routes, with a focus on pedestrians, cyclists, people, and public transportation. The use of private cars is being carefully regulated. Building heights within the entire project area are being gradually set to ground level plus 4, 5, or 6 stories. Common areas are being created in the pilot blocks to revive neighborhood connections and provide spaces for continuing daily local practices.

The designs within the area take into account pre-earthquake traces and urban memory elements, aiming to preserve these as much as possible to ensure residents remain connected to the area.

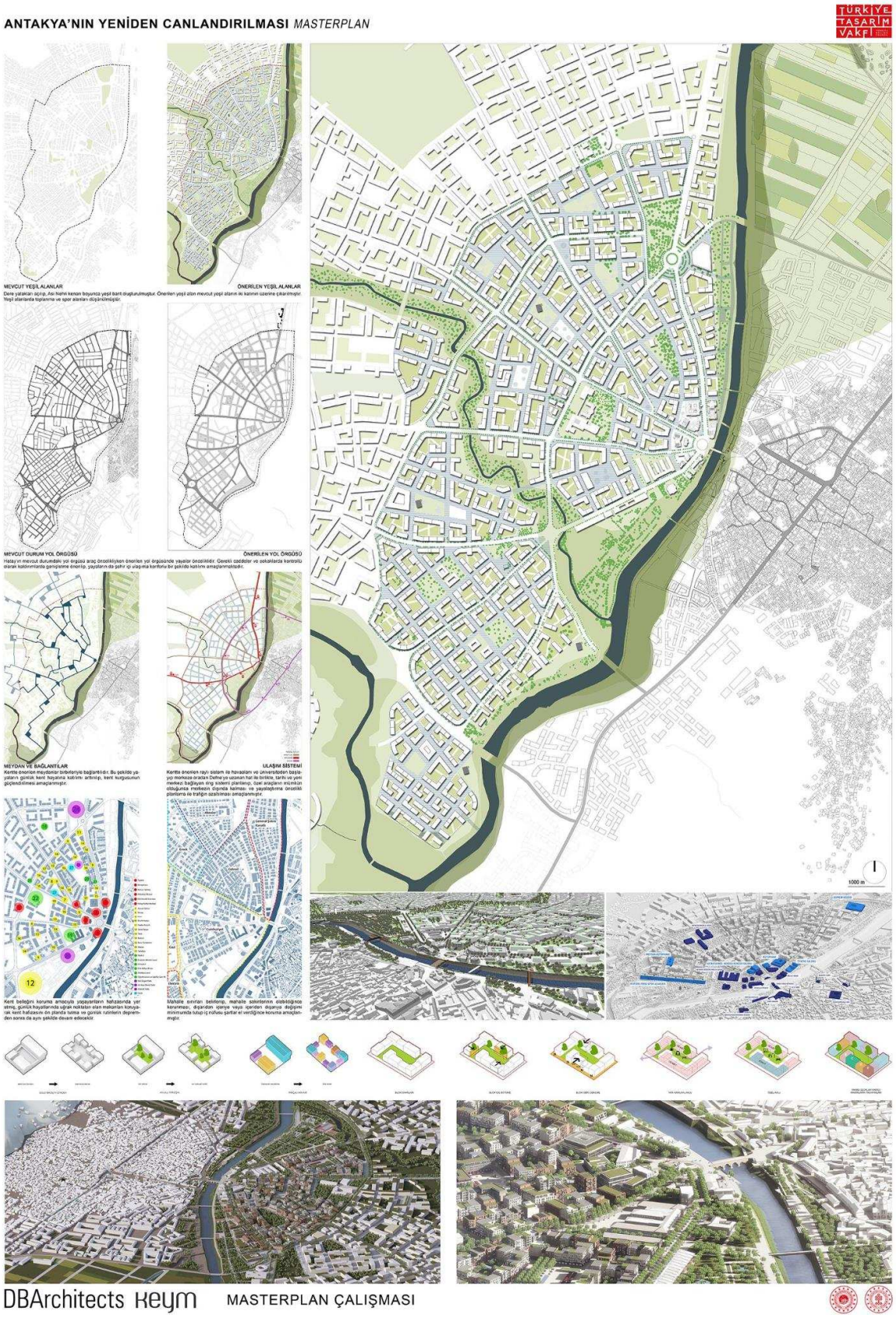


Figure 5.6: Masterplan suggested by Istanbul-based DB Architects, (Source: TTV, 2024)

Resilient City Strategies by Buro Happold

Antakya comprises the districts of Antakya and Defne, which together cover a much larger area than just the city itself. Therefore, using district boundaries as the project limits is not suitable.

Given the absence of an official municipal boundary defining urban development, Buro Happold states that they have chosen to use the boundaries of neighborhoods that match with the urban area of Antakya as the project area. These local boundaries coincide with the official urban development boundaries of Antakya, making them accessible for the purpose of their vision.

The project area includes 55 communities, 32 on the southeast side of the river and 23 on the northwest side of the river. By 2022, there will be 363,808 inhabitants in these areas, all of which are located on the borders of Antakya and Defne counties.

This area, and south of the river, is in the area outside the First Master Plan. While they will be considered in the development of the project, they will not be part of the master plan itself.

According to Buro Happold's vision it is important to clearly define vision and objectives from the start for any large and complex urban development project such as the redevelopment of Antakya guide the decision-making process, help ensure actions are aligned with the vision and monitored the improvement of the project.

A strong vision and guiding principles are not only important for the immediate execution of the first phase of the construction of Antakya but also to ensure the success of the subsequent phases of the project, aspects of the design vision some apply to the current phase, while others will be relevant later. As Pulomas' growth strategy evolves, the vision will evolve accordingly.

5.2.4.4 Controversies and Criticisms

There is a statement that was made by TMMOB[8] (Union of Chambers of Turkish Engineers and Architects) Chamber of City Planners which addresses the reconstruction efforts in Antakya. It points out that the TTV (Turkish Design Council), working with the Ministry of Environment, Urbanization, and Climate Change, is taking the lead to recovery process but there are concerns about the lack of a participatory planning approach. Instead, the efforts are based on a legally questionable masterplans and 3D visuals, with most of the work being done through workshops that take place in Istanbul and not in Hatay.

The statement simply criticizes the division of the city center among different architectural studios for reconstruction. It emphasizes the need for a thorough, inclusive planning process that addresses

[8] More information regarding TMMOB City Planners, please refer to https://www.spo.org.tr/

the destruction on a regional and urban scale. The current methods, which have reduced the scale of the problem and introduced rapid legal and administrative measures, are seen as inadequate.

The conclusion of the statement was stressing on the fact that Hatay needs a better planning, not just starchitects, TMMOB Chamber of City planners will continue to give knowledge for the Hatay's reconstruction plans. It also calls on other professionals related to the reconstruction and design to have a similar attitude. (TMMOB Chamber of City Planners, 2023)

Also, there are similar concerns that were raised by TMMOB Istanbul Chamber of Architects[9]. The press release states that there are some serious concerns regarding the reconstruction plans for Hatay. They criticize the approach by the Turkey Design Foundation (TTV) and their reconstruction process. They talk about how the city can't be well reconstructed by the division of it amongst a group of famous architects without a thorough plan.

Moreover, the Istanbul Chamber of Architects shows their disappointment by stating the lack of transparency and involvement in the planning process.

The release urges all stakeholders to engage in an approach to make sure of the potential successful and sustainable reconstruction of Antakya and the area in the vicinity which is severely affected by disasters. This development gave rise to a "hatay rebirth" presentation that offered the city's future prospects and services to interested parties and marginalized the Hatay people and the larger sector of Turkish architecture (TMMOB Istanbul Chamber of Architects, 2024).

5.3 Ministry of Interior

5.3.1 AFAD (Disaster and Emergency Management Presidency)

The 1999 Marmara earthquake, however, marked a turning point in the area of disaster management and coordination. This devastating disaster clearly demonstrated the need to reform disaster management and compelled the country to establish a single government institution to single-handedly coordinate and exercise legal authority in cases of disaster and emergencies. In line with this approach, the Turkish Parliament passed Law No.5902 in 2009 to form the Disaster and Emergency Management Authority[10] (AFAD) under the Prime Ministry and abolish various agencies under whose jurisdiction the issue previously fell. Turkey adopted a presidential system of governance after a referendum that took place on April 16, 2017. The new executive presidential system entered into force with the June 24 elections. Presidential Decree No. 4 which was published in the Official Gazette on July 15, 2018, and the Disaster and Emergency Management Authority (previously an agency under the office of the Prime Ministry) re-formed as an agency under the Ministry of Interior. (AFAD, 2024)

[9] More information regarding TMMOB Chamber of architects, please refer to: https://www.mimarist.org/
[10] For further information regarding AFAD (Disaster and Emergency Management Authority, please refer to: https://www.afad.gov.tr/)

In terms of the earthquake in Hatay, AFAD's participation began with assessing the two earthquakes that happened in Turkey. The first one occurred at 4:17 AM and the second at 1:24 PM local time, with magnitudes of 7.7 and 7.6 (Mw), respectively. The epicenters were in Pazarcık and Elbistan, both in Kahramanmaraş. These earthquakes affected 11 provinces and are considered the most destructive in Turkey in the past century. On March 20, 2023, AFAD reported that the death toll had reached 50096 with 107204 people injured.

Right after the earthquake at 4:17 am, the communication part of AFAD through their social media announced on their X account (formerly known as twitter) at 5:54 AM. Following the announcement, government of Turkish announced a level 4 high disaster status. All national capacity is used, and international assistance is called for when necessary. (AFAD Report, 2020). As soon as the news spread both domestically and internationally, the information accuracy became important to convey the right message to the public and the region affected.

The use of social media and communication tools were important for the region's wellbeing, as it is very effective for gathering first-hand information from the region and the distribution of the aid that arrived to the region. However, there are also disadvantages as the information could easily be manipulated. The uncertainty that would be caused because of the information which are not veritable without any sources and the way that the intentionally sourced misinformation especially during emergency situations. The importance is stressed on the risks posed by the uncertainties. (Kuşku Özdemir, 2024)

Due to the destruction caused by the earthquake and adverse weather conditions, the number of casualties continued to rise over time. According to the official figures released daily by AFAD, the number of deaths in the 10 affected provinces was 1161 on the first day of the earthquake. In the following days, as search and rescue efforts intensified, with increased national and international support and the deployment of equipment and machinery to the region, the number of people rescued from the rubble increased. As of the end of the first week after the earthquake, the latest data indicated that 31974 people had lost their lives. AFAD did not release any data on deaths and injuries for the seventh day of the earthquake. Additionally, the number of injured was not included in the reports for the following days. The number of vehicles and equipment sent to the region also increased over time. It was observed that international aid was directed to the region from the second day after the disaster and coordinated through communication efforts. (Kılıç, 2023)

Date	Time	Death Toll	Injuries	S&R Personnel	AFAD Personnel	International Support Teams	Const. Machines
06 Febr. 2023	21.00	1.651	11.119	19574	-	1.511	
07 Febr. 2023	19.00	4.544	26.721	60.217	3.251	4.746	
08 Febr. 2023	13.20	8.574	49.133	98.153	5.309	5.514	
09 Febr. 2023	20.50	17.134	70.347	120.344	6.479	12.241	
10 Febr. 2023	20.30	19.875	79.717	159.146	7.716	12.026	
11 Febr. 2023	19.30	22.327	80.278	218.417	8.294	10.436	
12 Febr. 2023		-	-	-	-	-	
13 Febr. 2023	10.55	31.643	-	238.459	9.793	12.322	
14 Febr. 2023	13.30	31.974	-	249.089	9.456	12.235	

Table I: Number of Dead and Injured Persons and Personnel, Vehicles, and Equipment Dispatched to the Region in the Earthquake (Source: AFAD Press Release on Earthquakes in Kahramanmaraş, 2023)

The misinformation regarding public institutions and their discrepancies results in the citizens putting trust into the administration. For instance, the results of Kandilli Observatory differ from the AFAD earthquake assessment because Kandilli uses the data showing the local magnitude (ML), also known as the Richter scale, which it shows as 6. However, AFAD uses the moment magnitude (Mw) as a magnitude indicator. That means that measurement units used by Kandilli and AFAD are different from each other, which creates confusion for people who are not well informed regarding the magnitudes.

Now let's take a closer look at what these values mean: Kandilli Observatory defines the magnitude of an earthquake as "a measure that indicates the size of the ruptured surface and therefore the level of energy released." AFAD, on the other hand, says that the magnitude of an earthquake is "the value found as a result of instrumental measurements and calculations that characterize the total energy released by the earthquake."

Therefore, as a country with an earthquake background, the Turkish government needs to encourage education regarding earthquakes to prevent future misinformation and restore faith in public institutions.

5.3.2 Public Debate Regarding Public Institutions and Administrations

To elaborate on the public debate, we must examine the role of AFAD (disaster and emergency management presidency) and how it faced criticism during the February 2023 earthquake in Türkiye causing a discussion about the relationship between central and local administrations.

As an elaborate perspective, it's handful to think through two unique perspectives to understand the public debate. Mainly, the Turkish government is being ruled by the Justice Development Party[11] (AKP) with the rulership of President Erdogan, local municipalities in some of the regions of the earthquake, including Hatay, was ruled by the opposition party Republican People's Party[12] (CHP) which then was ruled by Kemal Kılıçdaroğlu. These division of powers in between two ruling enstitutes caused an administrative chaos, therefore, the Turkish Public Administration should improve its communication and create an important framework within legal boundaries when a crisis arises.

Besides AFAD, there were two important actors aiding the earthquake. First of them was AHBAP[13] which is a non-governmental organisation leaded by the artist Haluk Levent having the public trust of the common opinion. The other one was KIZILAY[14] (Turkish Red Crescent), however, the recent controversies regarding their practices damaged the institution's credibility.

To conclude, it's extremely crucial to have the Turkish Public Administrations with all its actors to have a crisis and disaster management intact beyond the politics. In addition, it's important to note that the previous disaster management should be put under the microscope and should be improved within all the public institutions, whether it's local or central. The cooperation is one of the most important keys to achieve the execution of the well-planned disaster management alongside its civil initiatives. (Metin, 2024)

[11] AKP, Justice Development Party – https://www.akparti.org.tr/en
[12] CHP, Republican People's Party – https://chp.org.tr/
[13] For more information regarding the NGO Ahbap, please refer to: https://ahbap.org/
[14] Kizilay, Turkish Red Crescent – https://www.kizilay.org.tr/

5.4 Municipalities

5.4.1 Municipal System in Turkey

The metropolitan municipalities are a branch of the local government with major jurisdiction than municipalities in Turkey as they are formed by the presidential decree in any province with the provincial population (which means the city center's population + outlying districts and villages) exceeding 750000, according to the law regarding metropolitan municipalities. They have jurisdiction over provincial borders, whereas the regular municipalities are only assigned to govern their own city or district. The metropolitan municipalities engage with the responsibilities of the Special Provincial Administrations (Turkish: İl Özel İdareleri) which are assigned with the duty of providing some of the municipal services outside of the municipal limits. District municipalities are under the metropolitan municipality as far as the hierarchy goes, and the metropolitan municipality takes on the name of the provinces (e.g. Istanbul Metropolitan Municipality, Turkish: Istanbul Buyuksehir Belediyesi). As of 2024, there are 30 metropolitan municipalities in Turkey and Hatay is one of them. (Official Gazette, 2004)

5.4.2 The Role of Metropolitan Municipalities and Solidarity in Earthquake Response

It wasn't only the designers and architects participating the reconstruction of Hatay. There were also groups of municipal level response. Among these were groups where architects played a significant role, focusing directly on planning and rebuilding. At the same time, the Hatay Metropolitan Municipality, with support from the Istanbul Metropolitan Municipality, established a Hatay Planning Center and started its activities.

A group belonging to Hatay Reconstruction Workshop stated that there was a need for serious collaboration, and it has been emphasized. It has been suggested that the Istanbul Metropolitan Municipality[15] (IBB), Hatay Metropolitan Municipality (HBB), and the Ministry of Culture and Tourism work together on planning. However, it has been noted that political disagreements are causing problems in this regard, especially after the result of 2023 local elections. (TTV, 2023) As a result of the elections, Ekrem Imamoglu is the mayor of Istanbul Metropolitan Municipality, who is the affiliated with the opposition party CHP, whereas associated by AKP, Mehmet Öntürk is the mayor of Hatay Metropolitan Municipality.

[15] For more information regarding Istanbul Metropolitan Municipality, please refer to: https://ibb.istanbul/

5.4.2.1 Istanbul Metropolitan Municipality

As for the result of the earthquake and post-disaster planning, Istanbul Metropolitan Municipality established Hatay Planning Centre[16]. (in Turkish: Hatay Planlama Merkezi). The Hatay Planning Center aims to manage the recovery and redevelopment of Hatay using an approach that is inclusive, transparent, based on scientific data, and responsive to local needs. Their goal is to make collaborative decision-making easier for the Hatay's future by involving local governments, universities, national and international organizations, experts, and more importantly the residents of Hatay. This organisation is established through a partnership between Istanbul Metropolitan Municipality and Hatay Metropolitan Municipality by leaving politics behind.

In the previous year, their research and findings were shared on their website about Hatay's main issues and its needs. Ever since then, the "Hatay Open Data Source" has become an important public source. (HPC, 2024)

5.4.3 Responsibilities of Municipalities for “Urban Renewal”

The fast-urbanizing process in Turkey has brought the major problem of illegal constructions, also known as "gecekondulaşma." In order to pay attention to this issue and manage urbanization in a more systemic way, the zoning laws were enacted in Turkey. These laws have made it easier to have significant steps to prevent illegal constructions and to regulate building activities as well as guiding urban planning processes. The Building and Roads Law No. 2290 of 1933, the Zoning Law No. 6785 of 1956, and the Zoning Law No. 3194 of 1985 are considered the foundation of Turkey's urbanization policies. These aforementioned laws's purpose is to control illegal constructions, improve urban planning, and manage building activities within sustainability framework. (Köktürk & Köktürk, 2007)

The underlying reason behind the urban renewal in Turkey was the 1999 Marmara Earthquake. The earthquake exposed the poor quality and unstable building stock, especially in metropolitan areas. Before the earthquake, it was evident that unsafe and unhealthy buildings ought to have the priority to be replaced with healthy and safe ones stage by stage. Since Turkey is located in the 1st-degree earthquake zone, it has become mandatory to pay attention to post-earthquake construction conditions from another vantage point than our counterparts, precisely about how urban transformation practices are focusing on the reconstruction in earthquake-prone zones.

One of the most important driving force of urban renewal in Turkey was the Marmara Earthquake in 1999. This earthquake exposed the poor quality and unstable building stock, especially in metropolitan areas. Prior to the 1999 earthquake, it became clear that unhealthy and unsafe buildings should be prioritized and replaced with healthy and safe buildings. Since our country is located in the 1st-degree earthquake zone, it has become imperative to address post-earthquake construction conditions from a different perspective. In this context, urban transformation practices have focused on the redesign and reconstruction of earthquake-prone areas. Urban transformation

[16] Hatay Planning Centre, https://hatayplanlamamerkezi.com/tr-TR/

projects have been implemented with the aim of revitalizing abandoned areas and improving the quality of life, especially in areas with dense illegal construction. Right after the Marmara Earthquake, the urban renewal approach changed into an approach that takes into account not only the physical structure of buildings but also environmental, social, and economic factors. This process aims to create more resilient cities against earthquake risk. (Kocar Uzan, 2023)

Chapter 6

The role of Turkish Academia in post-earthquake reconstruction policies

In this chapter, we will seek to provide a comprehensive and unbiased examination of Turkish academia and related public institutes. More specifically, this chapter will analyze the capabilities and influences of the previously mentioned institutes and compare them to similar neighboring Mediterranean countries institutes. Furthermore, this chapter will attempt to evaluate the Turkish academia's capability to answer its goals in terms of post-earthquake reconstruction policies, influences and research.

6.1 Introducing Kandilli Rasathanesi (Observatory) and Earthquake Research Institute (BOUN)

Let us begin our analysis of Turkish academia institutes by analyzing the Istanbul located Kandili Observatory, or more formally Kandilli Observatory and Earthquake Research Institute (KOERI, "Kandilli Rasathanesi ve Deprem Araştırma Enstitüsü"), which specializes in earthquake research.

Figure 1: Location of Kandilli Observatory, (Source: Wikipedia)

The Kandilli Observatory in Istanbul has a rich history that has contributed to transform it into the reference institute for earthquake studies in the Turkish landscape. Its history dates back as far as 1868 when the sultan decided to found the Imperial Observatory of Constantinople focused on the study of astronomy. Its creation was mostly influenced by the French that were, at the time, leading the academic international world in the field of metrological studies with the Paris Observatory under the leadership of Urbain Le Verrier that had merged all meteorological data across the entire European continent. Thus, the Imperial Observatory of Constantinople followed the recommendations of Urbain Le Verrier and have remained close to the Paris Observatory ever since. However, the Turks would not consider enlarging the expertise of the institute until the year 1894 where the observatory was heavily damaged following an earthquake. Indeed, following the event of a disasterous earthquake in the Istanbul region, it would be decided that for its reconstruction, several buildings shall be dedicated to the study of geodynamics as well as magnetic studies alongside the study of astronomy and meteorology. Unfortunately, these projects would never come to fruition until 1911 when it was decided following the Young Turk revolution that the institute would be relocated to Kandilli on the Asian side of the Bosphorus, with buildings dedicated to seismological studies with proper tools. The architectural style of the buildings reflect the Ottoman revivalist style of the early 20th century. Since 1982, Kandili Observatory became affiliated to the Bosphorus University and became an official “Earthquake Research Institute ". (Benoist, 2009)

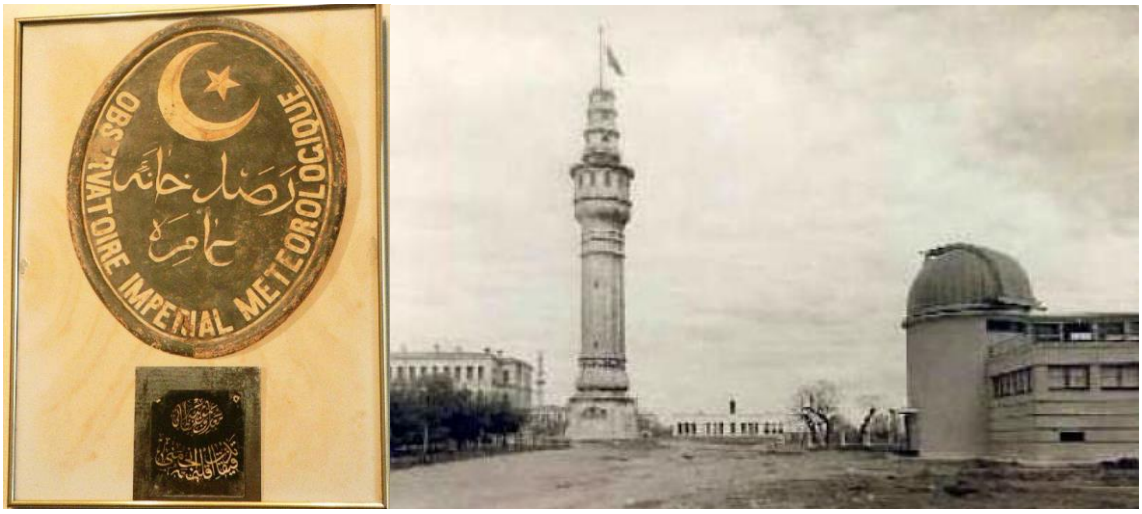


Figure 2: On the left the sign of the Imperial Observatory (19th century) now visible at Kandilli observatory, on the right the onstruction of the Istanbul University Observatory in 1934 (Source: Benoist, 2009)

Still to this day, the Observatory boasts a potent astronomical heritage, large instruments, clocks and other scientific instruments. Furthermore, Kandilli Observatory hosts in its library a very rich collection of manuscripts. This collection was selected to be one.
of the ten pilot projects for the Memory of the world programme launched by UNESCO in 1992, aiming at the preservation, cataloging and digitization of more than 1300 astronomical manuscripts written in Turkish, Persian and Arabic. In a way, one may say that the institute is much younger in terms of “earthquake related science” than in regard to its meteorological and astronomical heritage.

Figure 3: Kandili Observatory in Istanbul (Source: Benoist, 2009)

6.1.1 Introduction to Kandilli Rasathanesi (Observatory) and Earthquake Research Institute (BOUN)

Kandili Rasathanesi Observatory and Earthquake Research Institute is an infrastructure that is composed of a total of three research departments:

- Department of Earthquake Engineering
- Geodesy Department
- Department of Geophysics

Alongside these three departments that all focus on earthquake scientific research and affiliated physics disciplines, the institutes host four laboratories:

- Astronomy laboratory
- Geomagnetism laboratory
- Meteorology laboratory
- disaster preparedness laboratory

Finally, the institute also hosts three research centers:

- Belbasi Nuclear tests monitoring center
- Regional Earthquake Tsunami monitoring center
- Iznik Earthquake Hazard monitoring center

In summary, from the official website (Kandilli Observatory and Earthquake Research Institute. (n.d.)) we can deduce that the institute has three research departments that are working on scientific research in fields directly linked to earthquake studies, one laboratory that specializes in disaster management and two research centers that focus on earthquake monitoring and data production for earthquake studies.

6.1.2 Kandili Observatory as a research center linked to Turkish academia: Boğaziçi University (Istanbul)

6.1.2.1 Kandili Observatory as a research center linked to Turkish academia: Boğaziçi University (Istanbul)

Kandilli Observatory is linked from an academic point of view to the university of Boğaziçi University in Istanbul. Thus, from an academic point of view, most of the influence Kandilli Observatory can hope to promote is through the networks enabled by the university of Istanbul. According to international rankings, the university is amongst the 500 to 800 best universities in the world. In particular:

- according to the QS World University Rankings 2024 it is ranked #514.
- according to the Times Higher Education (THE) World University Rankings 2024, it is ranked in the 601–800 range.
- according to the U.S. News Best Global Universities it is Ranked 492

Furthermore, according to the SCIMAGO Institution rankings, Boğaziçi University in Istanbul is ranked 21st in Turkey, amongst a total of 140 ranked universities in the country. Thus, it is a university that is solidly implemented in the best quartile of universities in the country alongside the country's best performing institutes like Hacetteppe university.

				Best quartile
1 (1600)	Hacettepe University	TUR		Q1
2 (1771)	Bilkent University	TUR		Q1
3 (1978)	Ankara University	TUR		Q1
4 (2183)	Istanbul Technical University	TUR		Q1
5 (2303)	Istanbul University *	TUR		Q1
6 (2361)	Koc University	TUR		Q1
7 (2835)	Sabanci University	TUR		Q1
8 (2989)	Ege University	TUR		Q1
9 (3008)	Gazi University	TUR		Q1
10 (3063)	Middle East Technical University	TUR		Q1
10 (3063)	Middle East Technical University	TUR		Q1
11 (3096)	Ataturk University	TUR		Q1
12 (3177)	Marmara University *	TUR		Q1
13 (3452)	Anadolu University	TUR		Q1
14 (3663)	Dokuz Eylul University *	TUR		Q1
15 (3667)	Yildiz Technical University	TUR		Q1
16 (3780)	Istanbul Medipol University *	TUR		Q1
17 (3938)	Akdeniz University	TUR		Q1
18 (3991)	Selcuk University *	TUR		Q1
19 (4066)	Erciyes University	TUR		Q1
20 (4136)	Ondokuz Mayis University *	TUR		Q1
21 (4223)	Bogazici University	TUR		Q1

Figure 4: Turkish university rankings according to SCIMAGO Institution rankings (Lab, S. (n.d.-a). Scimago Institutions Rankings. SCImago Institutions Rankings)

Furthermore, we can see that according to SCIMAGO Institution rankings, that while the university seems to be solidly implemented amongst Turkey's best performing universities, it has been going down in international rankings in the last years in particular in the categories linked to research and innovation:

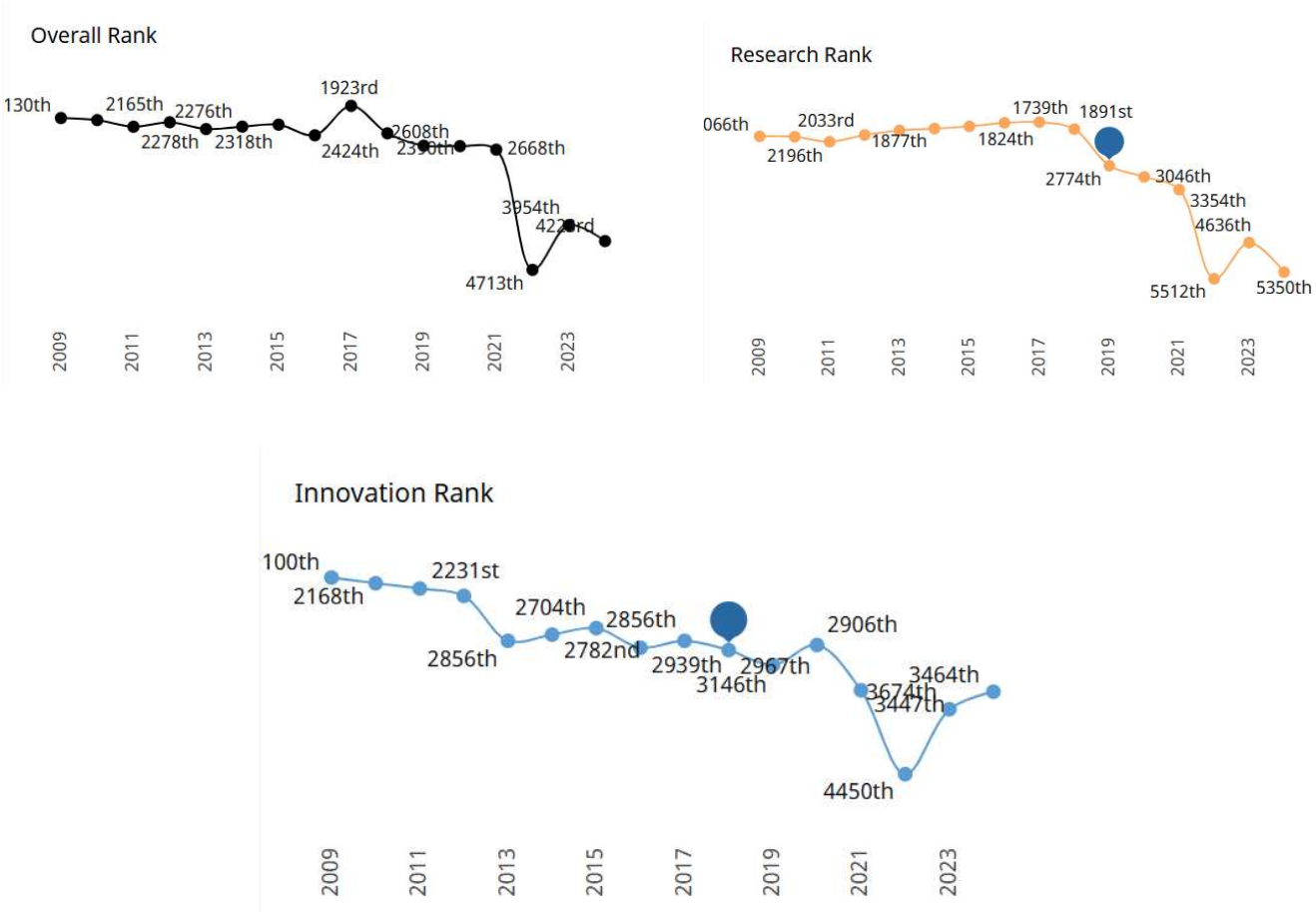


Figure 5: Evolution of Boğaziçi University's rank worldwide according to SCIMAGO Institution rankings (Lab, S. (n.d.-a). Scimago Institutions Rankings. SCImago Institutions Rankings)

Area	World	Middle East	OECD	Turkey
Agricultural and Biological Sciences	2619th	264th	1373rd	85th
Arts and Humanities +	1175th	46th	895th	19th
Biochemistry, Genetics and Molecular Biology	895th	21st	653rd	2nd
Business, Management and Accounting	1113th	51st	750th	14th
Chemistry	816th	34th	554th	3rd
Computer Science	1032nd	54th	710th	8th
Earth and Planetary Sciences	1992nd	122nd	1055th	29th
Economics, Econometrics and Finance	1027th	58th	669th	14th
Energy	2171st	236th	1092nd	67th
Engineering +	1413th	94th	917th	27th
Environmental Science	1876th	143rd	1030th	39th
Mathematics	998th	74th	656th	22nd
Medicine +	1584th	88th	1008th	19th
Pharmacology, Toxicology and Pharmaceutics	798th	41st	538th	5th
Physics and Astronomy	1993rd	186th	1081st	49th
Psychology	1540th	90th	1162nd	39th
Social Sciences +	1066th	47th	768th	12th

Figure 6: Evolution of Boğaziçi University's rank worldwide according to SCIMAGO Institution rankings (Lab, S. (n.d.-a). Scimago Institutions Rankings. SCImago Institutions Rankings)

Moreover, we can notice from the previous figure that while Boğaziçi University in Istanbul maintains prestigious ranked at at national level in different disciplines like chemistry, computer science, finance or even engineering, the university doesn't figure in the top 500 universities of any categories in any OECD country, or in the top 800 universities worldwide in any category. In sum, Boğaziçi University is a leader in the Middle East but its influence in other parts of the world seems limited.

Furthermore, we can compare Boğaziçi University's evolution in comparison to other Turkish top institutes. For example, we will compare Boğaziçi University with the following universities that figure amongst the top ten universities within the same ranking system:

- Hacettepe University (1st in Turkey according to SCIMAGO Institution rankings (Lab, S. (n.d.-a). *Scimago Institutions Rankings*. SCImago Institutions Rankings))
- Ankara University (3rd in Turkey according to SCIMAGO Institution rankings (Lab, S. (n.d.-a). *Scimago Institutions Rankings*. SCImago Institutions Rankings))
- Istanbul Technical university (4th in Turkey according to SCIMAGO Institution rankings (Lab, S. (n.d.-a). *Scimago Institutions Rankings*. SCImago Institutions Rankings))

- Middle East Technical University (5th in Turkey according to SCIMAGO Institution rankings (Lab, S. (n.d.-a). *Scimago Institutions Rankings*. SCImago Institutions Rankings))

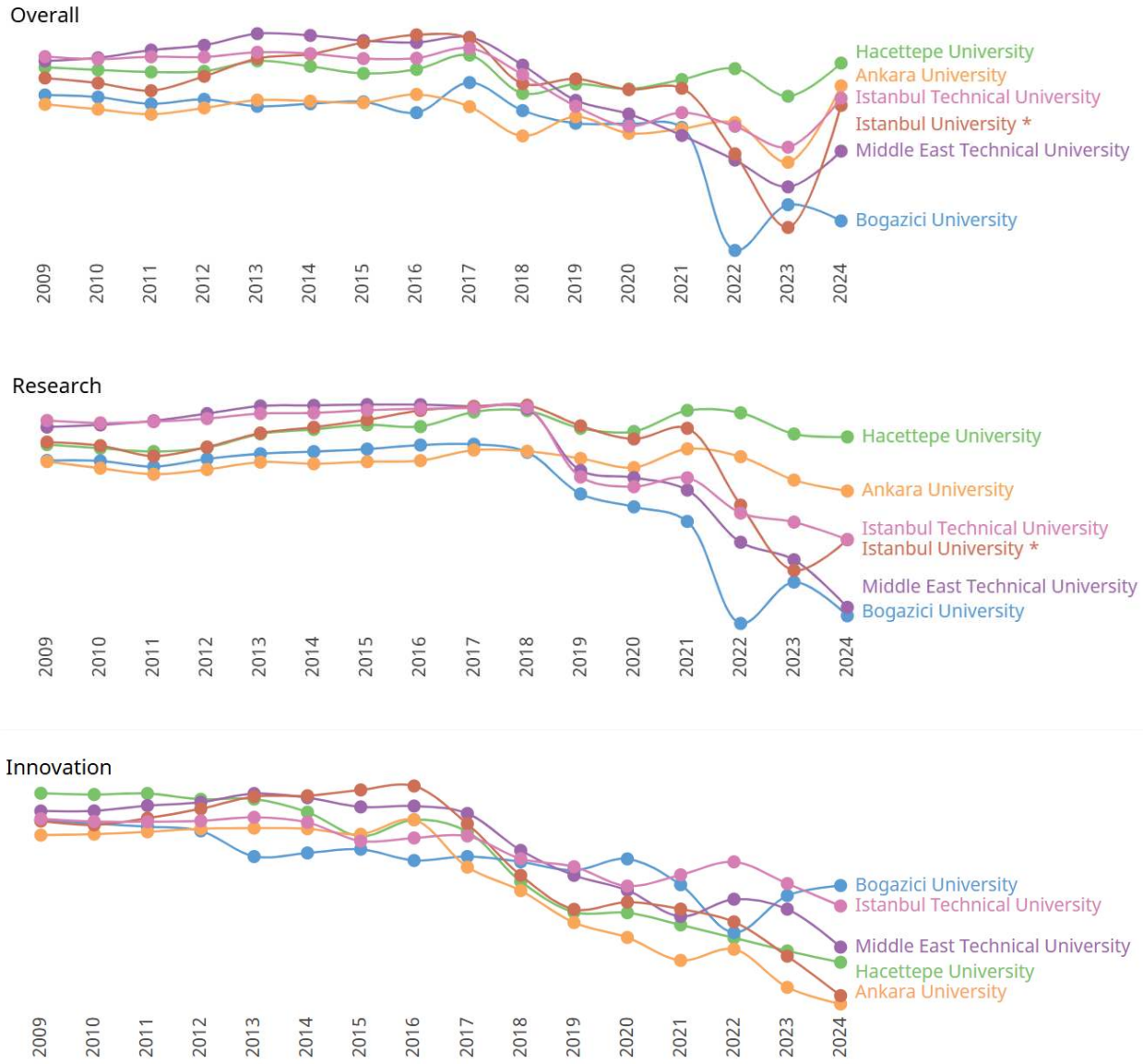


Figure 7: Evolution of Boğaziçi University's rank worldwide in comparison to the competing top Turkish universities according to SCIMAGO Institution rankings (Lab, S. (n.d.-a). Scimago Institutions Rankings. SCImago Institutions Rankings)

From the previous charts we can see that in the past 15 years, the top five Turkish institutes have a tendency to maintain the rank worldwide, with perhaps a drop in prestige that affected all institutes around 2018 which is usually followed by an increase in prestige and rank increase in 2023 and 204. However, Boğaziçi University has dropped more in its overall rank and across the research category than its counterparts and seems to be still dropping in prestige even in 2024. However, for the innovation category, Boğaziçi University's rank is ahead of its counterpart indicating that it retains an increased capability to innovate in comparison to the competing Turkish top universities.

6.1.2.2: Kandilli Observatory specific academic output analysis

Let's now observe the academic output of Kandilli Observatory. For this, we will look at the number of papers that each department has published in the recent decades according to their official website.

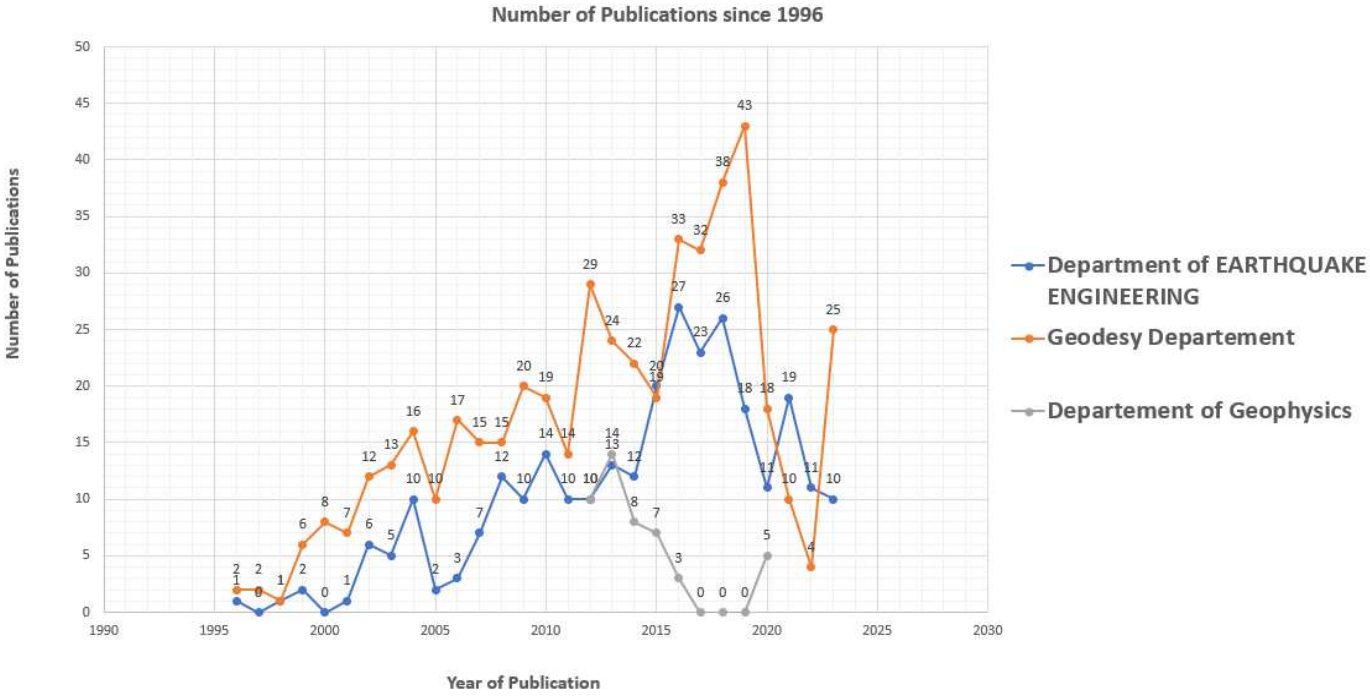


Figure 8: Evolution of the amount of Publications from the three different departments of Kandilli Observatory according to the official website (provided the by author)

We can observe on the previous chart that both the department of earthquake engineering and the Geodesy department publish many more papers than their Geophysics counterpart. Both the earthquake engineering department and the Geodesy department have seen a strong increase in its academic output since 1996 reaching a peak in the years 2015-2016. After 2016, the academic outputs of both departments have decreased. It will be interesting to observe in the following decades how the frequency of publication of this institute changes after the 2023 earthquake in Turkey. Indeed, it is possible that both departments published much more the following decade after 1999 since 1999 saw a devastating earthquake in the Istanbul region. Moreover, it can also be pointed out that according to the official website, ost of the previous articles are published in English, implying that they can reach academics beyond the national territory.

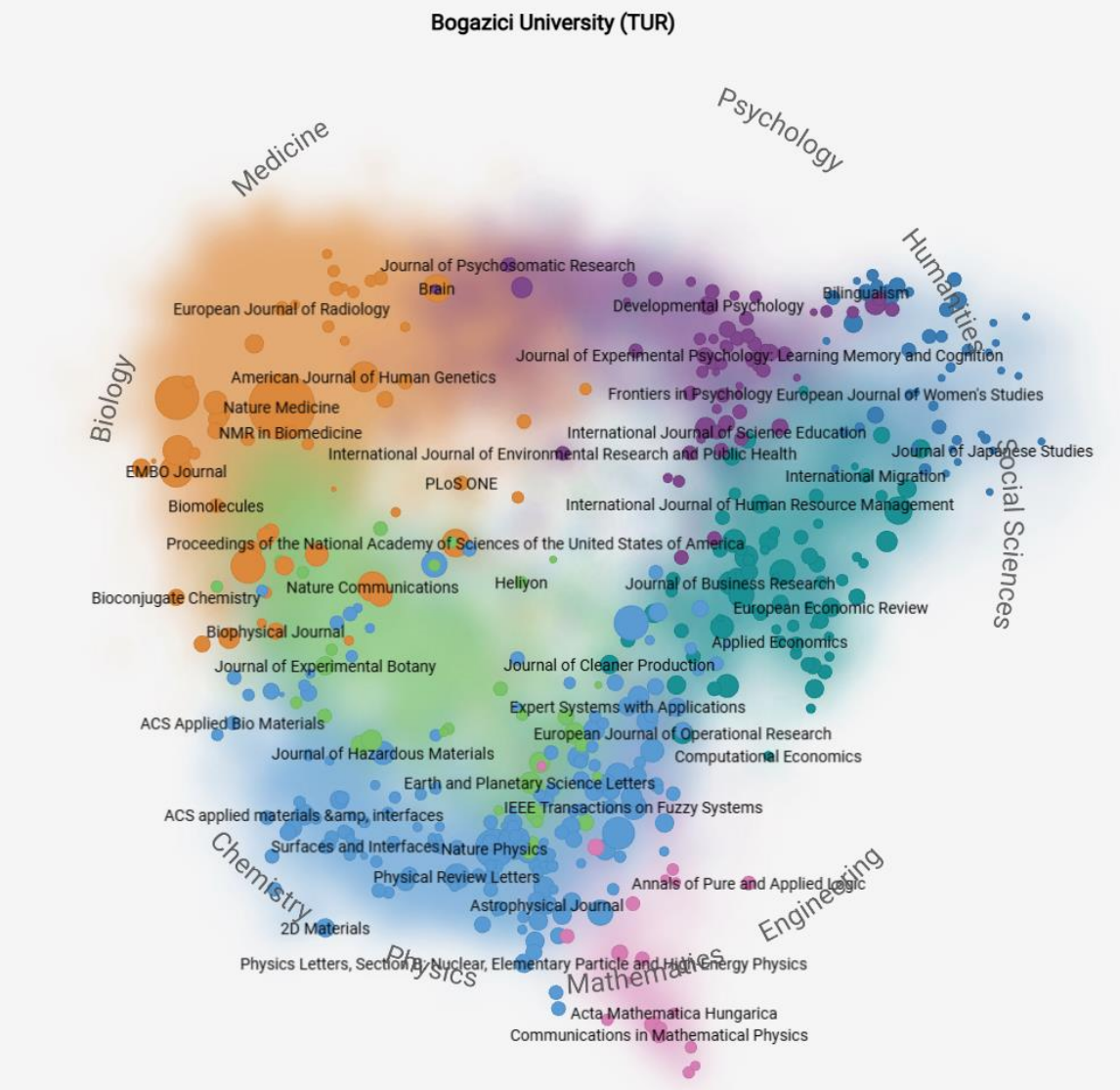


Figure 9: Publishing profile of Boğaziçi University according to (Lab, S. (n.d.-a). Scimago Institutions Rankings. SCImago Institutions Rankings)

On the previous image we can see Boğaziçi University's publishing profile: the different dots represent the main journals in which academics from the university publish the most, the larger dots being the most influential journals. Thus, we can see that in the Physics category which is relevant to our topic, academics publish in internationally known journals such as:

- Earth and Planetary Science Letters
- Physical Review Letters
- Nature Physics
- …..

The fact that such articles from Kandilli Observatory have the opportunity to be published in such journals indicates that Kandilli Observatory has an opportunity to reach a broader audience.

6.1.2.3 A look at the Disaster preparedness laboratory from Kandilli Observatory

Let us now assess the contribution to the Disaster preparedness laboratory from Kandili Observatory. According to the official website, the laboratory was created after the 1999 Kocaeli earthquake and was initially named "Disaster Preparedness Education Project" (Kandilli Observatory and Earthquake Research Institute. (n.d.)). For five years, it implemented a program funded by the United States Agency for International Development's Office of Foreign Disaster Assistance (USAID-OFDA) to help prepare Istanbul for future earthquakes by targeting different aspects including:

- Basic Disaster Awareness
- Non-Structural Mitigation
- Structural Awareness for Earthquakes
- Community Disaster Volunteer and Public Disaster Preparedness Program

From this, the laboratory produced a series of CDs, school presentations and handbooks that tackle these four themes, also available in English:

Figure 10: Handbooks on earthquake disaster prevention published by Disaster preparedness laboratory from Kandilli Observatory in 2004 (Kandilli Observatory and Earthquake Research Institute. (n.d.))

According to the official website, these programmes and hanbooks are distributed along different organizations within Turkey but also abroad. Indeed, they are promoted by the Turkish Ministry of the Interior Civil Defense Directorate, the Turkish Ministry of Health, the Turkish Red Crescent and the American Red Cross (Kandilli Observatory and Earthquake Research Institute. (n.d.))

In addition to these four handbooks, the laboratory continues to promote disaster prevention culture across Turkey and other nations like the USA and Russia. Indeed, the laboratory has also developed Turkish, English, and Russian-language educational material on the topics of disaster preparedness and business continuity planning for hospitals, museums, schools, and people with disabilities (Kandilli Observatory and Earthquake Research Institute. (n.d.)). Today, the laboratory's areas of expertise include:

- Developing, supervising, and evaluating educational programs
- Preparing educational materials such as reports, books, pamphlets, CD-ROMs, DVDs, and videos
- Developing distance-learning internet resources by publishing and updating educational materials in an online environment
- Building educational capacity throughout the institute and creating an on-site staff of educational personnel
- Assessing institutional and individual demand for existing educational programs and coordinating training
- Developing protocols for cooperation through cooperative work with national and international institutions and related sub-projects
- Contributing to the creation of national strategy and policy through coordination with public institutions and civil society organizations
- Arranging national and international seminars, workshops, and conferences.
- Coordinating training for the students who visit the Earthquake Park.

Indeed, according to the official website (Kandilli Observatory and Earthquake Research Institute. (n.d.)), the laboratory has provided, through the Earthquake Park, Disaster Awareness training to 4087 students and 226 accompanying teachers from 122 schools in Turkey.

Moreover, a "Mobile Earthquake Simulation Training Truck " was developed in 2007 by the laboratory, aiming to create a stage for community awareness for the earthquake preparedness, and to change the common wrong perception and ignorance on earthquakes. It also aims to be a model-project for other cities in Turkey and countries which have the same risks. (Kandilli Observatory and Earthquake Research Institute. (n.d.))

Figure 11: Mobile Earthquake Simulation Training Truck developed by the laboratory (Kandilli Observatory and Earthquake Research Institute. (n.d.))

6.1.2.4 A look at the research center's main seismic tool

One of the major scientific tools that the observatory offers for the study of earthquake science and disaster prevention is their regional tsunami and earthquake monitoring tool that is available online. The tool is able to record seismic activity in and around Turkey in real time and the official website allows for users to request data from the catalog directly from the institute. Furthermore, the website allows any user to easily determine the last seismic activities in the past 24 hours in the Turkey region with information on the magnitudes of the events recorded.

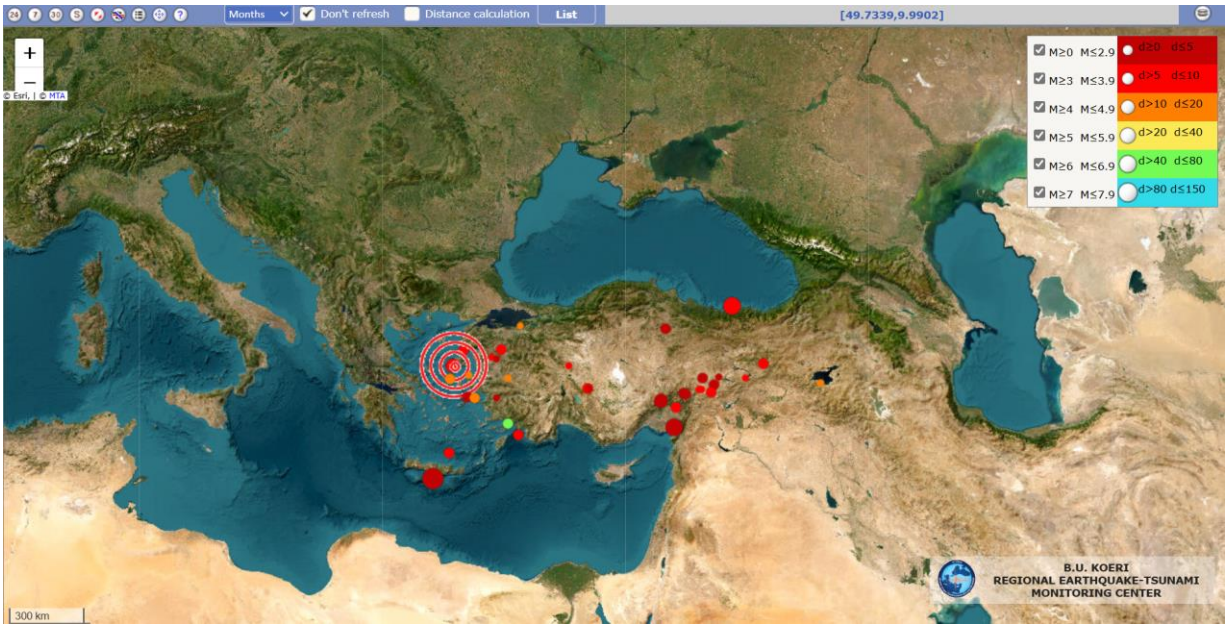


Figure 12: Kandilli observatory regional earthquake and tsunami monitoring tool (Kandilli Observatory and Earthquake Research Institute. (n.d.))

The tool is used by the institute itself to conduct earthquake research and disaster prevention and is updated regularly. For example, in 2019, the observatory published a review on its own catalog and seismic networks for which the data can be requested for online on their own website.

According to (Cambaz et al., 2019), the observatory's seismic network and earthquake catalog has been evolving, with the progress in the science of seismology. As of today, the seismic network consists of 242 stations that record approximately 1500 earthquakes per month during periods of regular seismicity. (Cambaz et al., 2019)

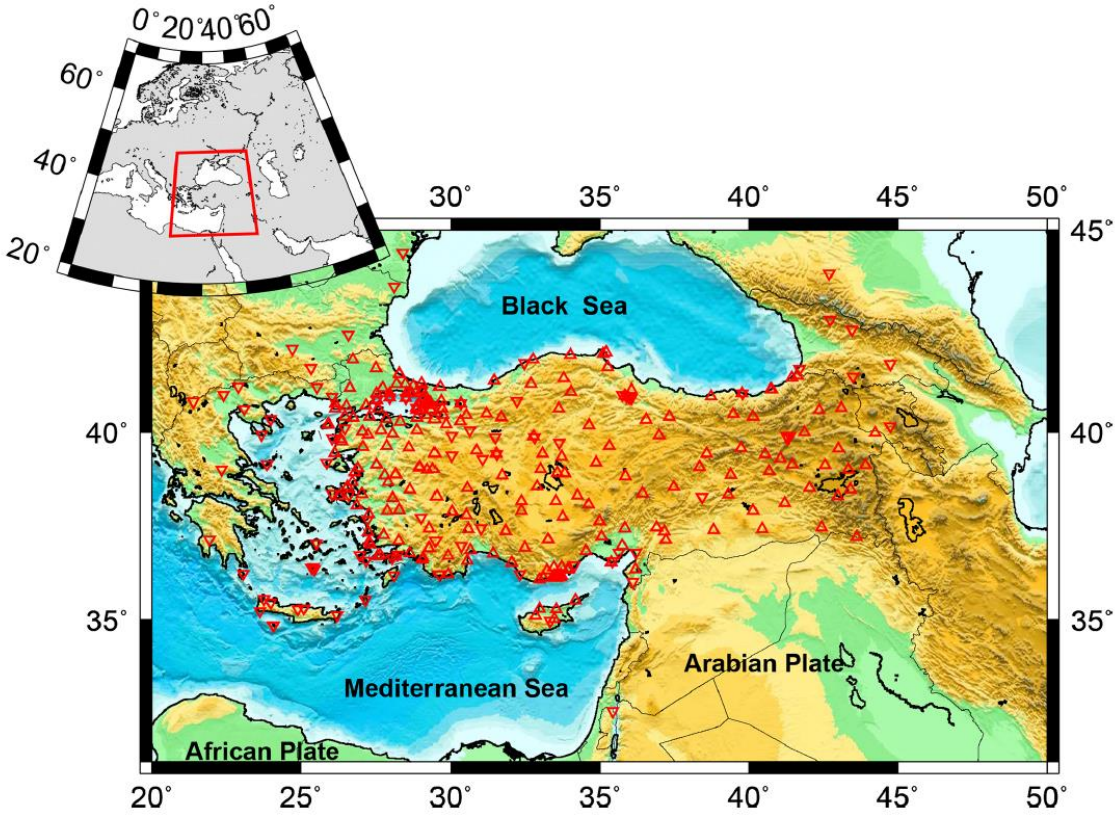


Figure 13: Station distribution used in earthquake location from network (triangles) and other stations from neighborhood countries (reverse triangles). (Source: Cambaz et al., 2019)

This tool is very important for the country's capability to anticipate disasters and promote earthquake culture and science. Indeed, Earthquake catalogs are one of the most important products of seismological agencies. Quality, consistency and the homogeneity of the seismic catalogs must be well defined in order for the data to be of any quality. Hence, as cited in (Cambaz et al., 2019), it is important to be able to collect as much data as possible, even from different magnitude levels in order to homogenize the data and improve its accuracy. This highlights the important role the observatory can have in providing data and contributing to collective efforts by sharing its values with other national and international seismic agencies.

6.2 The Turkish academia landscape: actors, influences, and capabilities in shaping earthquake policies and research

In this second part, we shall paint a picture of the main actors in the Turkish university landscape tackling the theme of earthquakes and earthquake related policies, assessing the influence of their work on the final decisions that are made by the Turkish governments when dealing with such tragic issues. Furthermore, we will attempt to quantify the capabilities and resources that are available to these institutes.

6.2.1 The main actors of the Turkish Academy and their involvement in seismic and earthquake studies

As of summer 2024, we can denote a total of 209 universities in Turkey, amongst which, 129 are state universities. Furthermore, amongst these state-owned universities, we can find a total of eleven technical universities, one institute of technology, two fine arts universities and one special national defense university. Furthermore, we also denote 76 private universities.

Amongst these, ten of these 209 universities are ranked within the 1000 most prestigious universities in the world according to "THE-QS World University Ranking" for 2024, the best performing university showing up on this ranking being the Ankara based university "Middle Eastern Technical" obtaining the rank of 336 in the world. Other honorable mentions include institutions like Istanbul Technical or Koc university which are within the 500 most honorable universities in the world.

QS World University Rankings 2024 - World

	World Rank	Institution	Country
1	336	Middle East Technical University	
2	404	Istanbul Technical University	
3	431	Koc University	
4	502	Bilkent University	
5	514	Bogazici University	
6	526	Sabanci University	
7	711-720	Istanbul University	
8	761-770	Hacettepe University	
9	901-950	Ankara University	
10	951-1000	Yildiz Technical University	
11	1001-1200	Ege University	

Figure 14: Turkish University rankings in 2024 according to the THE-QS ranking (Source: official website, 2024)

Even Though Turkish institutes retain strong rankings worldwide, according to some global rankings, the top institutes seem to have been losing positions in the rankings according to some Ranking institutions:

Figure 15: Evolution of the Turkish university rankings in the past 20 years (Source: the THE-QS official website)

In the 2010's, Turkish academic Zehra TASKIN from Hacettepe University based in Ankara studied in (Taşkın, 2010) the evolution of the Turkish academic scene after the devastating Turkish earthquakes of 1999 in MArmara that killed more than 1500 people. She proceeded to an evaluation of the Turkish publication outputs, analyzing the evolution of indicators such as frequency of outputs, how many times they were quoted by other academics and evaluating how many of them were linked to seismic studies or earthquake policies and management.

Z. Taskin has reported in (Taşkın, 2010) that in between the years 1990 and 2009, Turkish scholars have published exactly 1098 papers on the topics of earthquakes as seen on the figure below:

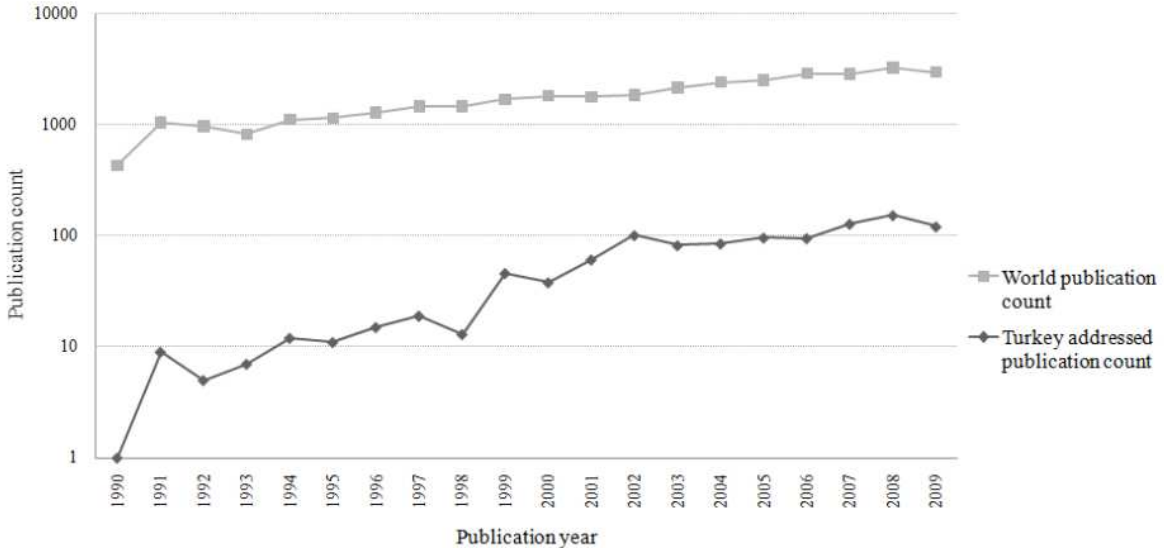


Figure 16: Evolution of papers tackling earthquakes that are published by academics in Turkey and in the rest of the world (Taşkın, 2010)

We can see that the number of publications on the topic of earthquakes has been multiplied by almost ten between the years of 1998 before the MArmara earthquake and the year of 2002. In fact, the year of 1998 represented Turkey's minimum publication count on the topic for the third consecutive year, but in 1999 the publication count was approximately multiplied by five and continued increasing until 2002, where the publication count stabilized around roughly 100 publications on earthquakes per year. Although, we can observe that the increase in earthquake related topics at the end of the 1990s and beginning of the 2000s is something that is noticeable on academics in the entire world, the increase in 1999 in Turkey is more significant than the world average.

The previous trend is nothing surprising. However, what is perhaps more interesting is the trend between the publication count of papers that are explicitly about the Marmara earthquake of 1999 in Turkey and in the rest of the world:

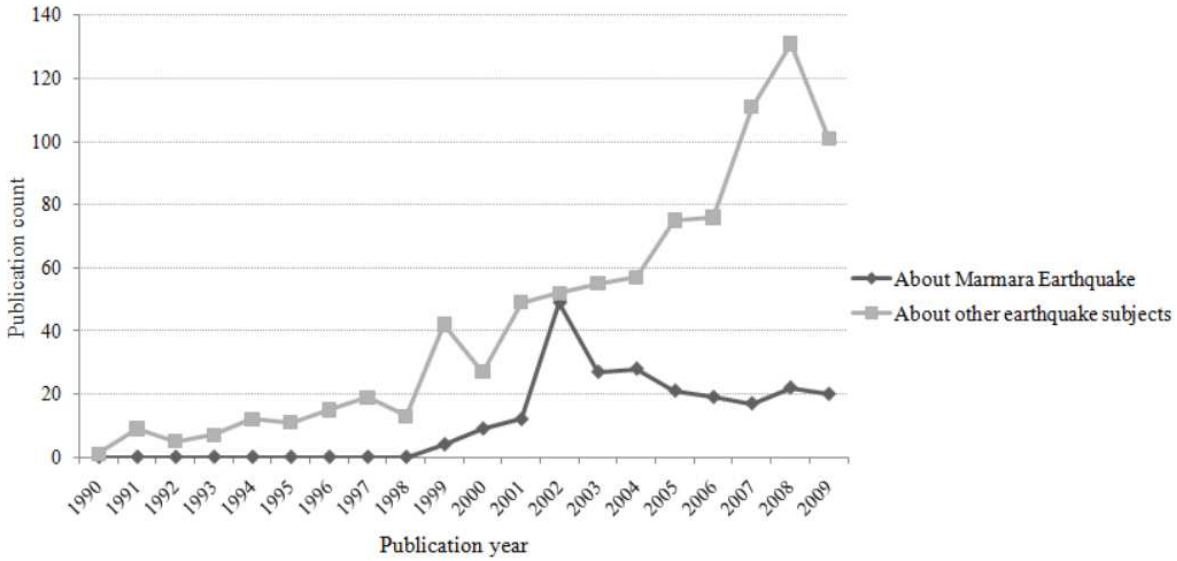


Figure 17: Evolution of the publication count according to topic in the academic world (Taşkın, 2010)

What we see is that there is an obvious positive increase starting in 1999 when the event happened concerning the publication of papers that Tackle specifically the subject of the Marmara earthquake. This positive trend leads to an increase until reaching a peak in 2002, mostly when most research concerning this topic has had time to be matured. Then after 2002 - 2003, there is a decrease of the publication count regarding the Marmara earthquake which stabilizes around 20 per year for the foreseeable decade. This is interesting as it suggests that the Marmara has stimulated publications at a stable pace, even several years after the main event. Furthermore, we see that even when the peak of publications on the Marmara earthquake has passed, the number of publications tackling themes linked to earthquakes continue to grow until 2008. Between the years 1999 and 2008, the publication count on earthquakes as a whole has been multiplied by 3.25 approximately, meaning that the tragedy has stimulated the research and academic world for at least one decade.

Finally, we can notice that unsurprisingly, the institutes that publish the most papers on the topics of earthquakes correspond in a major part to Turkey's top universities.

Institution Name	***N***	***%***
Bogazici University	117	14,21
Istanbul Technical University	114	13,85
Middle East Technical University	107	13
Istanbul University	59	7,16
Karadeniz Technical University	57	6,92

Table I: Number and percentages of articles published by Turkish Institutes in between 1990 and 2009 (Taşkın, 2010)

We can see that the Bogazici University which is linked to the Kandilli Rasathanesi (Observatory), and Earthquake Research Institute represented to itself over 14% of the national contributions to the country's publications, showing that it has great influence in the country and abroad.

6.2.2 The Influence of Turkish Academia on Earthquake Research and Policy in World Academia

Let us now try to tackle the impact of Turkish academia on the world of earthquake research, management policy and international academia. One manner to quantify the impact of the country's academia on international earthquake research and management policy is by analyzing the impact of its publications.

6.2.2.1 From 1990 to 2009

We will begin by evaluating Turkish academia's influence by looking at Z. Taskin's report for the period 1990 to 2009 and extend that research to today after the 2023 Syrian-Turkish earthquake. In order to do so, we can look at how much the different Turkish publications on the topic of earthquakes were quoted:

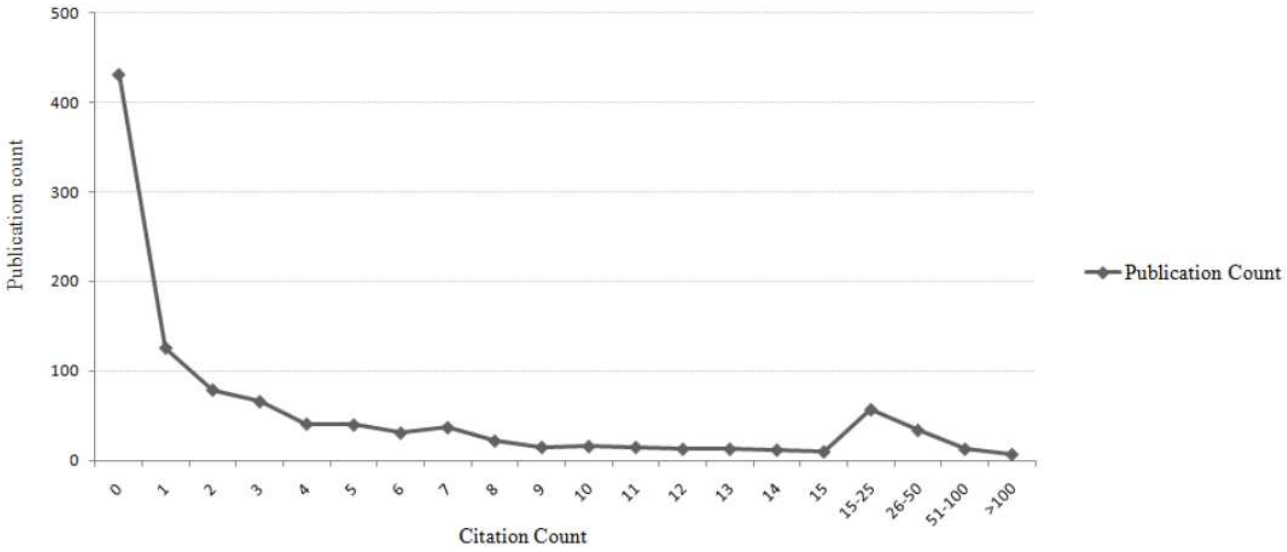


Figure 18: Publication count as a function of citation counts (Taşkın, 2010)

What we can notice on the previous chart is that over 400 of these Turkish earthquake related publications were not quoted once by external academics of the publications. However, some of the publications have received quotations and a small number of them have been quoted a large amount of time (over 50 times) suggesting that some of the most popular papers emitted by the most credible institutes of the country have had an impact. Furthermore, what is lacking on this chart is information about the date of publication: newer publications tend to have fewer quotations because fellow academics have been been able to integrate them in their own work yet. In that regard, Z. Taksin has joined the following graph in her 2009 article (Taşkın, 2010):

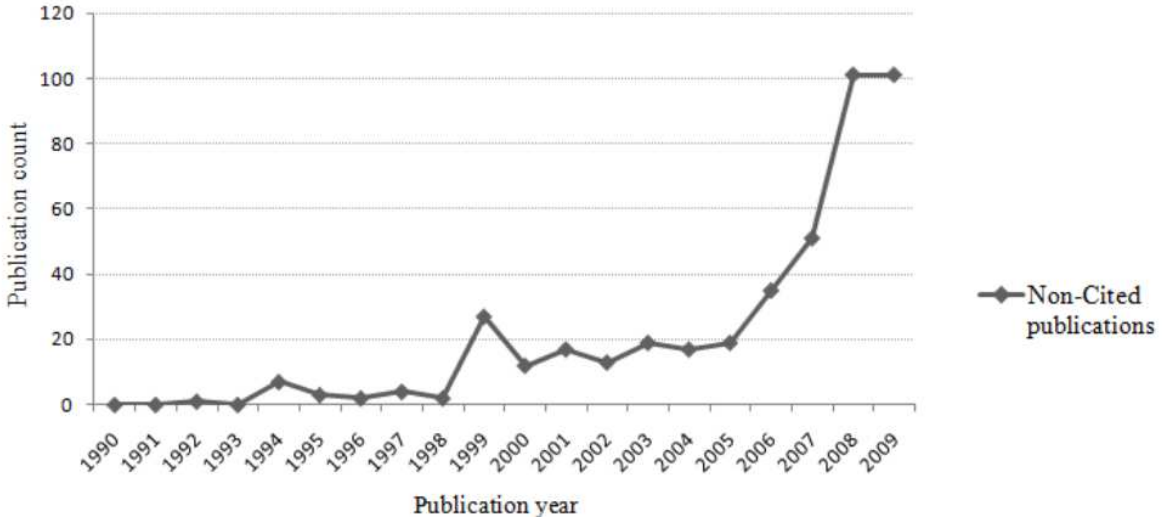


Figure 19: Turkish publications regarding earthquakes that have not been quoted as a function of publication year (Taşkın, 2010)

From the precedent chart it is clear that a large part of the non-quoted graphs are the younger ones. Indeed, in between publication years of 2000 and 2005 the number of non-quoted publications stagnated below 20 and the number rapidly rose in 2008 corresponding to new papers. This means that after a couple of years, many of the more recent un-quoted papers are likely to be quoted confirming Turkey's influence on the academic world regarding earthquake related academia.

Furthermore, according to Z. Taksin in between the years of 1990 and 2009, worldwide about 34,721 academic articles were published about earthquakes. Before 1998, the Turkish contribution to these articles represented about 1% of the international output, but after 1998, and until 2009 Turkey's contribution represented more than 4% of the international output meaning that post-Marmara earthquake, Turkey has more than quadrupled its contribution.

Moreover, over this time period, the share of international journals that tackle themes linked to earthquakes (seismic studies, geo-physical sciences, earthquake management policy etc) has increased. Z. Taksin in (Taşkın, 2010) estimated that 60% of international journals had published in that time period at least one Turkish article and many had even published multiple Turkish articles within that time frame as shown on the chart below:

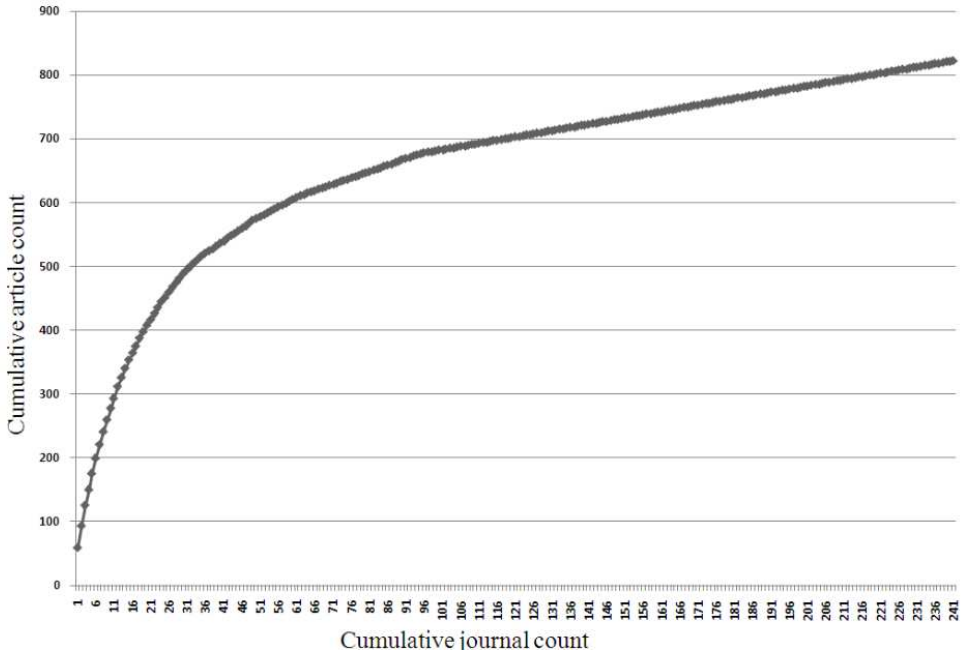


Figure 20: Distribution of journal counts that have published Turkish articles on earthquake related topics in between 1990 and 2009 (Taşkın, 2010)

We can also assess the impact of the Turkish academic publications by estimating the impact factor of the journals most Turkish articles are published in. The Journal Impact factor is calculated in the following manner:

"Journal Impact Factor = (Total number of citations from JCR year to items in "year -2" + citations from JCR year to items in "year -1") ÷ (total number of citable items in "year -2" + citable items in "year -1") "

In other words, the Journal Impact Factor is a number that quantifies the proportion of publications that have been quoted for the two previous years of a given year in respect to the total of all articles that could have been quoted.

As of 2008, Z. Taksin reports that Turkish academia articles (all topics included) have been mostly published in the following journals:

Journal's Name	*Number of articles*	*Impact Factor*
Bulletin of The Seismological Society of America	60	2,199
Geophysical Journal International	33	2,219
Engineering Structures	32	1,102
Soil Dynamics And Earthquake Engineering	26	1,182
Engineering Geology	25	1,197
Structural Engineering And Mechanics	23	0,500
Earthquake Engineering & Structural Dynamics	21	1,240
Natural Hazards	21	1,142
Journal of Seismology	18	1,091
Tectonophysics	18	1,670

Figure 21: Journals in which most Turkish academia papers appear alongside the Journal Impact Factor of the journal (Taşkın, 2010)

We can see that amongst the international journals that publish the most articles from Turkish academics, figures include the journals "Geophysical Journal International", "Engineering Structures", and most importantly "Soil Dynamics and Earthquake Engineering". There are also other relevant journals such the "Journal of Seismology" with smaller impact factors. All of these journals have an impact factor superior to one, implying that the articles are on average quoted at least once within two years of its publication. Moreover, the journal in which Turkish academics publish the most is the "Bulletin of The Seismological Society of America" which has a very high Impact factor that is superior to two. This implies that Turkish articles published in these journals have a high probability of being read and quoted by fellow international academics.

6.2.2.2 From 2009 to today post February 2023 Turkish-Syrian earthquake

In this second sub-part, we will extend Z. Taksin's work in (Taşkın, 2010) and extend it to the period comprising the years of 2009 to mid-2024. Furthermore, we will look to see if we can notice a change in the academic Turkish influence or behavior after the February 2023 earthquake. However, because the thesis is being written merely one year after the earthquake, we cannot hope to have the same hindsight regarding the effect of the 2023 earthquakes on the Turkish academia as Z. Taksin has for the decade following the 1999 Marmara event.

Let us begin our analysis of Turkish academia today by observing Turkey's position as a country on the global academic scene. As of 2024, the official website (Lab, S. (n.d.). *SJR: Scientific Journal Rankings*. SCImago Journal & Country Rank.) that ranks countries and institutes according to their academic outputs and contributions to journals according to the Journal Impact Factor ranks Turkey at the 18th position worldwide in terms of academic impact across all academic topics:

	Country	↓ Documents	Citable documents	Citations	Self-Citations	Citations per Document	H index
1	United States	16047770	13969135	515339352	211154763	32.11	3051
2	China	10372322	10180089	145875947	86501833	14.06	1333
3	United Kingdom	4778980	3984194	142963939	29272921	29.92	1928
4	Germany	4104599	3741033	110076588	24142498	26.82	1690
5	Japan	3482279	3308467	70350390	16354163	20.20	1301
6	India	2970196	2700702	37700885	13122873	12.69	858
7	France	2784321	2561817	74641013	13665511	26.81	1514
8	Italy	2525870	2269098	61745641	13429245	24.45	1333
9	Canada	2426840	2156112	74088684	11485690	30.53	1562
10	Australia	2009795	1756807	57290179	10215117	28.51	1377
11	Spain	1986724	1818207	46573860	9115285	23.44	1215
12	Russian Federation	1722547	1672245	15529380	5205946	9.02	753
13	South Korea	1604519	1552810	30870039	5238570	19.24	934
14	Brazil	1427852	1344526	22432570	6643169	15.71	789
15	Netherlands	1343844	1201139	48221503	6306535	35.88	1373
16	Switzerland	1001958	906005	36539683	4064816	36.47	1291
17	Poland	964968	914009	13933794	3051764	14.44	738
18	Turkey	919863	852300	13171771	2603646	14.32	601
19	Sweden	908607	830620	30189093	3771615	33.23	1159
20	Iran	886359	857630	13089835	3851805	14.77	490
21	Taiwan	880380	845632	16709430	2560215	18.98	688
22	Belgium	739211	670141	23167907	2507783	31.34	1067
23	Denmark	571552	516164	19890735	2300633	34.80	1014

Figure 22: Most academically impactful countries in the worlds in terms of articles and papers published in journals alongside their quotation numbers and human index according to Scimaga & Journal Country Rank as of june 2024 (Lab, S. (n.d.). SJR: Scientific J

We can see that the top countries are much larger countries like the USA or China, but also more "comparable" countries like the UK, or European countries like Italy and France. However, Turkey is also ahead of some significant European countries like Sweden or Belgium in terms of academic international influence.

Moreover, Turkey finds most of its influence in the Middle-East area, but has also seen a growing influence in the past decade within the entire world and specifically OECD countries, with an increasing amount of international collaborations, especially since the beginning of the 2000 which has been accompanied by a growth in quotable publications which is still going today.

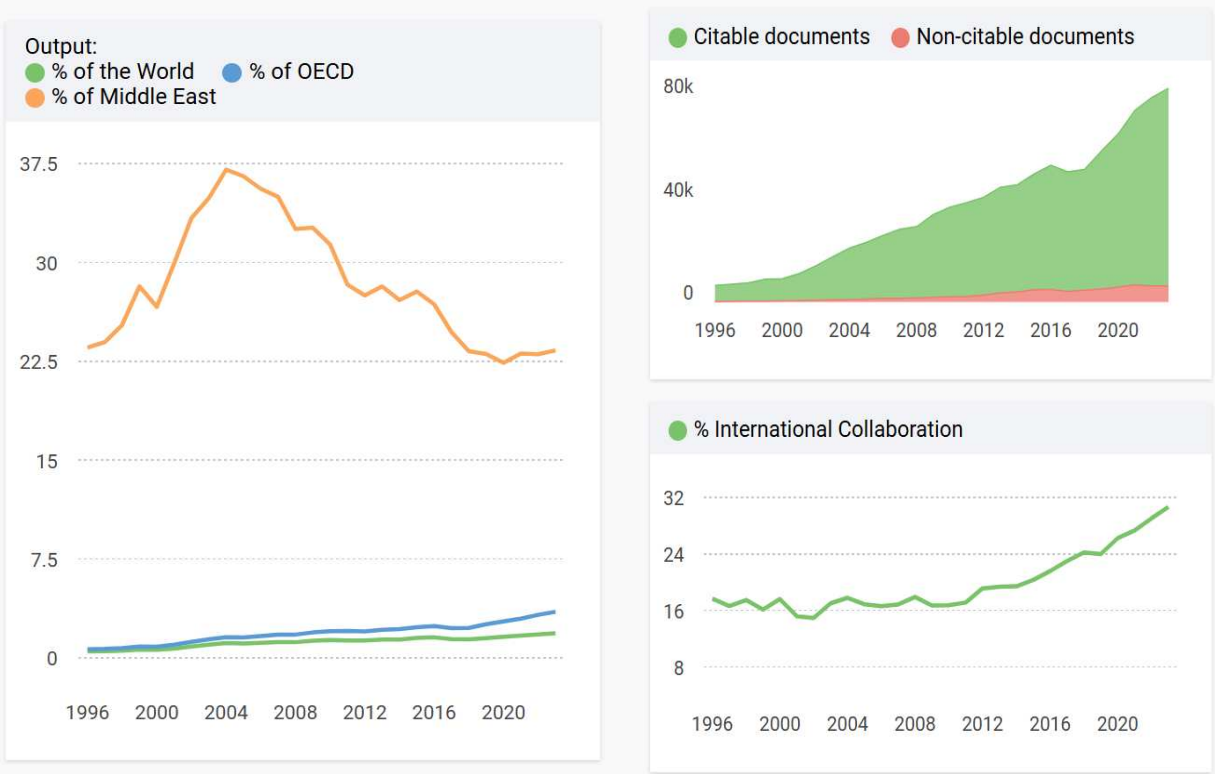


Figure 23: Academic output figures concerning Turkey's academic influence in the world according to Scimaga & Journal Country Rank as of june 2024 (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

Let us now look at which sectors and types of journals Turkey's influence on the international academic scene is the biggest:

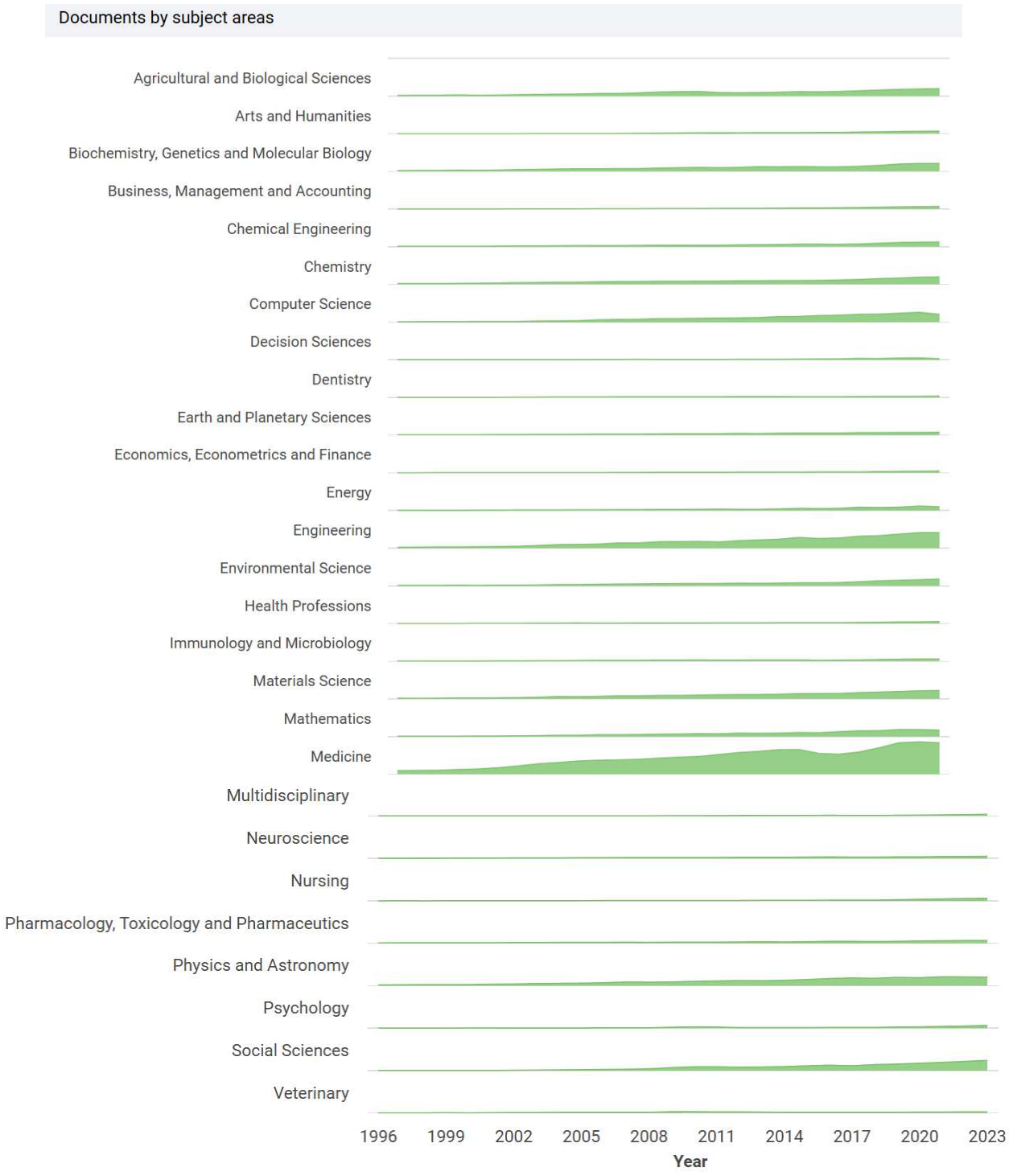


Figure 24: Domains of publication alongside their relative importance for Turkey as of 2024 according to Scimaga & Journal Country Rank as of june 2024 (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

From the previous chart we can notice that domains where earthquake studies would be composed like "Engineering" are not the most significant aspect of the Turkish academic scene. Indeed, for example medicine seems to be a bigger priority for the Turkish academia.

Furthermore, we can take a look at the most influential Turkish journals Turkish academics have been publishing in until 2024:

	Title	Type	SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Journal of Metaverse	journal	2.516 Q1	10	20	15	966	318	15	21.20	48.30	41.30	
2	Borsa Istanbul Review	journal	1.040 Q1	42	113	203	7508	1438	203	7.12	66.44	27.47	
3	Journal of Sports Science and Medicine	journal	0.979 Q1	81	85	246	3557	790	238	2.57	41.85	24.59	
4	All Azimuth	journal	0.734 Q1	9	10	34	460	46	34	1.15	46.00	25.00	
5	International Journal of Engineering and Geosciences	journal	0.700 Q2	12	30	66	1193	179	66	2.69	39.77	29.58	
6	Joint Diseases and Related Surgery	journal	0.607 Q2	22	116	337	2473	568	330	1.86	21.32	18.24	
7	European Journal of Dentistry	journal	0.600 Q2	48	211	412	7800	1056	406	2.19	36.97	53.59	
8	JCRPE Journal of Clinical Research in Pediatric Endocrinology	journal	0.568 Q2	46	65	199	1678	401	187	1.43	25.82	65.19	

Figure 25: Most influential Turkish journals in which Turkish academics publish as of june 2024 according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

We observe that the first influential journal susceptible to publishing Turkish academia papers related to earthquake situations comes at the fifth place with an impact factor of less than 1 (0.7): "International Journal of Engineering and Geosciences". This implies that papers published in this journal have about a quotation chance of about 70% on average, well below the nation's heavyweights like "Journal of Metaverse" which has an impact factor of around 2.5, meaning papers are quoted on average 2.5 times. "International Journal of Engineering and Geosciences" boasts an international collaboration proportion of less than 10% these past years with a majority of its papers being quoted (almost 80%) and the number is growing, implying that the journal is still growing in influence.

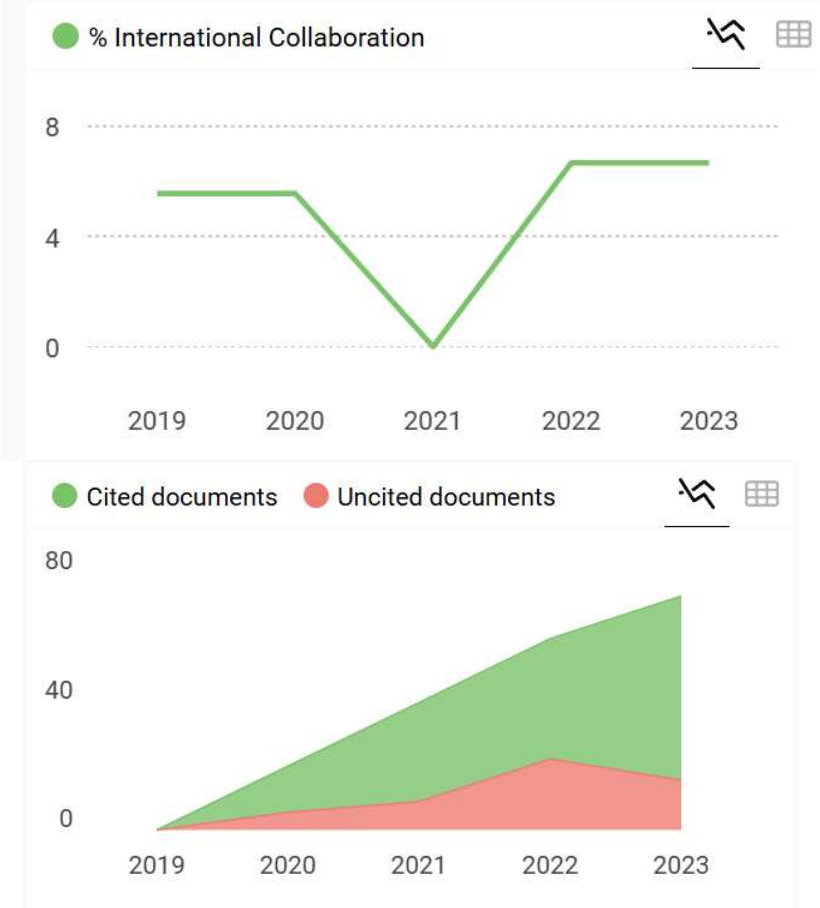


Figure 26: Share of international collaborations & quotations of "International Journal of Engineering and Geosciences" as of june 2024 according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.

Let us now search the most influential academia journals as of june 2024 according to specific keywords that would imply earthquake and earthquake related policiy studies be published in:

- Geography, planning and development
- Geophysics
- Building and construction
- Civil and structural Engineering

6.2.2.2.1 Keyword: Geography, planning and development

For the Geography, planning and development category of journals, where articles tackling themes such as urban planning in post-earthquake zone or urban planning in risk vulnerable zones we obtain the following results:

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Nature Sustainability	journal	7.366 Q1	115	250	516	9291	10802	379	18.52	37.16	34.58	
2	ISPRS Journal of Photogrammetry and Remote Sensing	journal	3.760 Q1	187	289	777	21339	10766	772	11.83	73.84	28.50	
3	Business Strategy and the Environment	journal	3.666 Q1	147	398	720	37890	13489	713	17.88	95.20	36.54	
4	Journal of Travel Research	journal	3.408 Q1	172	187	319	17090	4506	310	13.38	91.39	42.08	
5	Progress in Human Geography	journal	3.357 Q1	178	72	245	7916	2495	242	8.61	109.94	43.52	
6	Wiley Interdisciplinary Reviews: Climate Change	journal	3.236 Q1	113	58	164	5906	2022	160	11.50	101.83	44.51	
7	Global Environmental Change	journal	2.996 Q1	225	111	436	10235	4540	425	9.01	92.21	42.81	
8	Long Range Planning	journal	2.928 Q1	126	55	175	6323	1727	167	8.15	114.96	36.77	
9	Journal of Sustainable Tourism	journal	2.822 Q1	140	230	381	19102	5278	380	10.40	83.05	43.38	

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Yillik: Annual of Istanbul Studies	journal	0.113 Q4	3	19	42	473	14	40	0.28	24.89	55.56	
2	Bogazici Journal	journal	0.111 Q4	6	12	21	542	4	21	0.20	45.17	4.55	

Figure 27: Most influential Journals for the category "Geography, planning and development" in the world (top) and in Turkey(bottom) as of June 2024, according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal

We can see that the most influential journals for this category in the world are dominated by british journals with the most influential international journal promoting an Impact Factor of over 7, while the most influential Turkish journal for this category ("Yillik Annual of Istanbul Studies") promotes an Impact Factor of about 0.11. Consequently, papers about earthquake zones and urban planning that would be published in "Yillik: Annual of Istanbul Studies" would be approximately 70 times less likely to be quoted than its counterpart in "Nature Sustainability".

6.2.2.2.2 Keyword: Geophysics

For the "Geophysics" category of journals, where articles tackling themes such as seismic activity analysis, earthquake fundamental science and physics or geological risk prevention, we obtain the following results:

	Title	Type	SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Reviews of Geophysics	journal	8.853 Q1	191	16	67	6100	1852	65	25.02	381.25	32.29	
2	Economic Geology	journal	2.372 Q1	141	84	257	8173	1445	252	5.25	97.30	24.87	
3	Earth and Planetary Science Letters	journal	2.294 Q1	287	390	1428	25118	7191	1409	4.87	64.41	26.69	
4	Journal of Petrology	journal	1.976 Q1	195	86	336	9378	1241	330	3.13	109.05	24.37	
5	Mineralium Deposita	journal	1.913 Q1	110	87	241	8673	1250	224	4.80	99.69	21.40	
6	Contributions to Mineralogy and Petrology	journal	1.865 Q1	170	96	327	8532	1152	326	3.25	88.88	21.36	
7	Geophysical Research Letters	journal	1.850 Q1	322	1498	5231	78148	26394	4596	4.55	52.17	28.82	
8	Journal of Geophysical Research: Atmospheres	journal	1.710 Q1	126	734	2255	52126	9812	2243	3.91	71.02	33.07	
9	Journal of Geophysical Research: Solid Earth	journal	1.690 Q1	271	518	2060	43485	8465	2051	3.86	83.95	25.33	

	Title	Type	SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Turk Deprem Arastirma Dergisi	journal	0.197 Q4	4	20	36	780	17	36	0.46	39.00	29.55	

Figure 28: Most influential Journals for the category "Geophysics" in the world (top) and in Turkey(bottom) as of June 2024, according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

We see that only one significant journal appears to be existing in the Turkish landscape for this category of academia. The journal is entitled "Turk Deprem Arastirma Dergisi" and boasts an Impact Factor of around 0.198 , which is about 44 times less impactful than the major international journal "Reviews of Geophysics" from the USA, and about 8.5 times less impactful than journals like "Journal of Geophysical Research : Solid Earth" from the international bottom top ten.

6.2.2.2.3 Keyword: Building and construction

For the "Building and construction" category of journals, where articles tackling themes such as building structures that are resilient to seismic activity, urban renovation in a seismically active zone or reconstruction of infrastructures and buildings after an earthquake we obtain, we obtain the following results:

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)
1	Cement and Concrete Research	journal	4.781 Q1	288	231	806	16404	10372	793	11.68	71.01	26.75
2	Cement and Concrete Composites	journal	3.650 Q1	212	398	1124	27325	13892	1124	11.88	68.66	29.51
3	Applied Energy	journal	2.820 Q1	292	1569	4818	86374	58188	4806	11.46	55.05	25.80
4	Automation in Construction	journal	2.626 Q1	176	428	1376	28882	17235	1375	11.37	67.48	25.12
5	Tunnelling and Underground Space Technology	journal	2.174 Q1	139	575	1279	27308	10279	1273	7.49	47.49	27.09
6	Energy	journal	2.110 Q1	251	4008	8133	209116	82524	8115	10.29	52.17	28.46
7	Construction and Building Materials	journal	1.999 Q1	259	4133	11225	244264	98512	11220	8.20	59.10	28.98
8	Sustainable Structures	journal	1.930 Q1	14	12	20	504	284	20	14.20	42.00	19.05

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)
1	Journal of Thermal Engineering	journal	0.303 Q3	20	110	312	4759	481	312	1.73	43.26	10.79
2	Teknik Dergi/Technical Journal of Turkish Chamber of Civil Engineers	journal	0.201 Q4	11	0	152	0	137	152	0.84	0.00	0.00

Figure 29: Most influential Journals for the category "Building and construction" in the world (top) and in Turkey(bottom) as of June 2024 , according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country

This time, two major Turkish journals emerge:

- "Journal of Thermal Engineering" with an impact factor of 0.303
- "Teknik Dergi/Technical Journal of Turkish Chamber of Civil Engineers" with an impact factor of about 0.2

Both of these journals boast high impact factors in comparison to other Turkish academia journals that were mentioned in the previous part. However, Turkey's most impactful journal "Journal of

Thermal Engineering" remains still about 16 times less impactful than the international leader from the UK "Cement and concrete research" and about 6 times less impactful than Tunisia's "Sustainable Structures" journal that is from a more comparable country in terms of economic and cultural capabilities.

6.2.2.2.4 Keyword: Civil and structural Engineering

Finally, for an analogous category to the previous one entitled "Civil and structural Engineering" we obtain the following results:

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Water Research	journal	3.596 Q1	376	1287	3577	79587	47268	3559	12.46	61.84	38.46	
2	Computer-Aided Civil and Infrastructure Engineering	journal	2.972 Q1	109	177	330	10794	3645	282	11.16	60.98	25.98	
3	Transportation Research, Part E: Logistics and Transportation Review	journal	2.884 Q1	144	280	796	17394	9136	789	9.59	62.12	29.57	
4	Transportation Research Part C: Emerging Technologies	journal	2.860 Q1	180	345	1080	20105	11151	1072	8.78	58.28	27.46	
5	Transportation Research Part B: Methodological	journal	2.660 Q1	171	114	447	6418	3410	444	6.54	56.30	23.30	
6	Automation in Construction	journal	2.626 Q1	176	428	1376	28882	17235	1375	11.37	67.48	25.12	
7	Sustainable Cities and Society	journal	2.545 Q1	130	725	2349	52191	29362	2346	12.07	71.99	32.87	
8	Transportation Science	journal	2.475 Q1	128	80	240	3959	1355	237	5.18	49.49	17.79	

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Research on Engineering Structures and Materials	journal	0.262 Q3	9	90	124	3695	175	124	1.57	41.06	24.85	
2	Teknik Dergi/Technical Journal of Turkish Chamber of Civil Engineers	journal	0.201 Q4	11	0	152	0	137	152	0.84	0.00	0.00	
3	AIZ ITU Journal of Faculty of Architecture	journal	0.165 Q4	10	45	143	2003	55	134	0.40	44.51	76.06	

Figure 30: Most influential Journals for the category "Civil and Structural Engineering" in the world (top) and in Turkey(bottom) as of June 2024 , according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal &

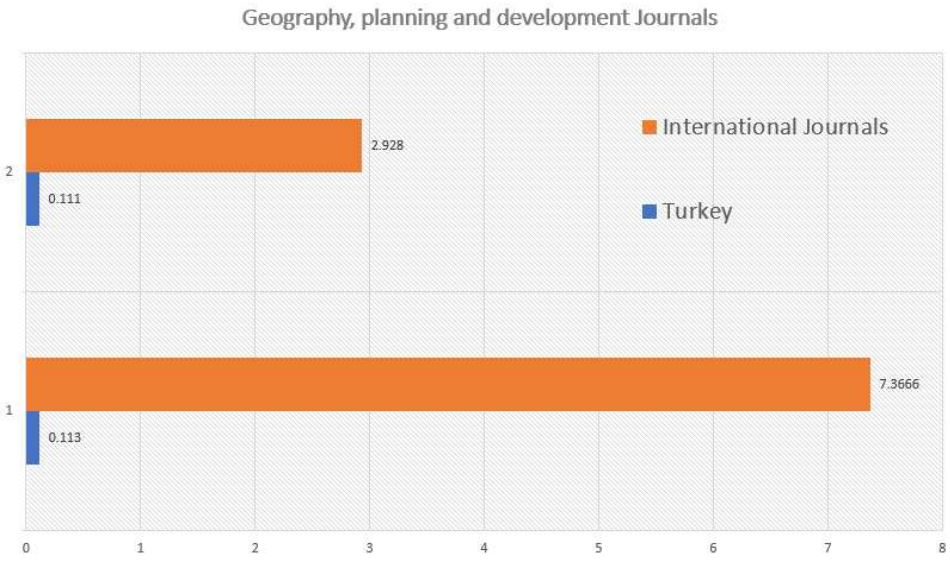
Alongside the journal "Teknik Dergi/Technical Journal of Turkish Chamber of Civil Engineers" with an impact factor of about 0.2 that was cited previously we also have the following two journals:

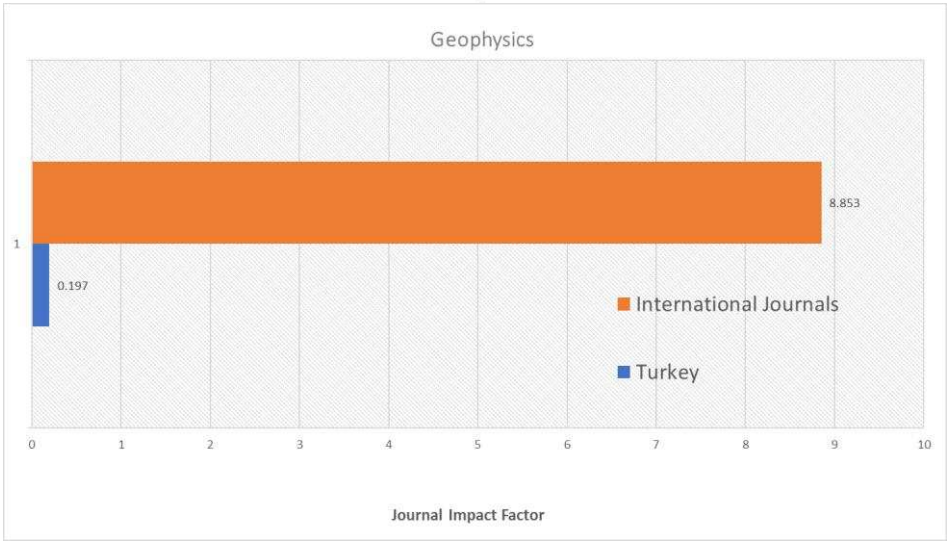
- "Research on Engineering Structures and Materials" with an impact factor of about 0.201
- "AIZ ITU Journal of Faculty of Architecture" with an impact factor of 0.165

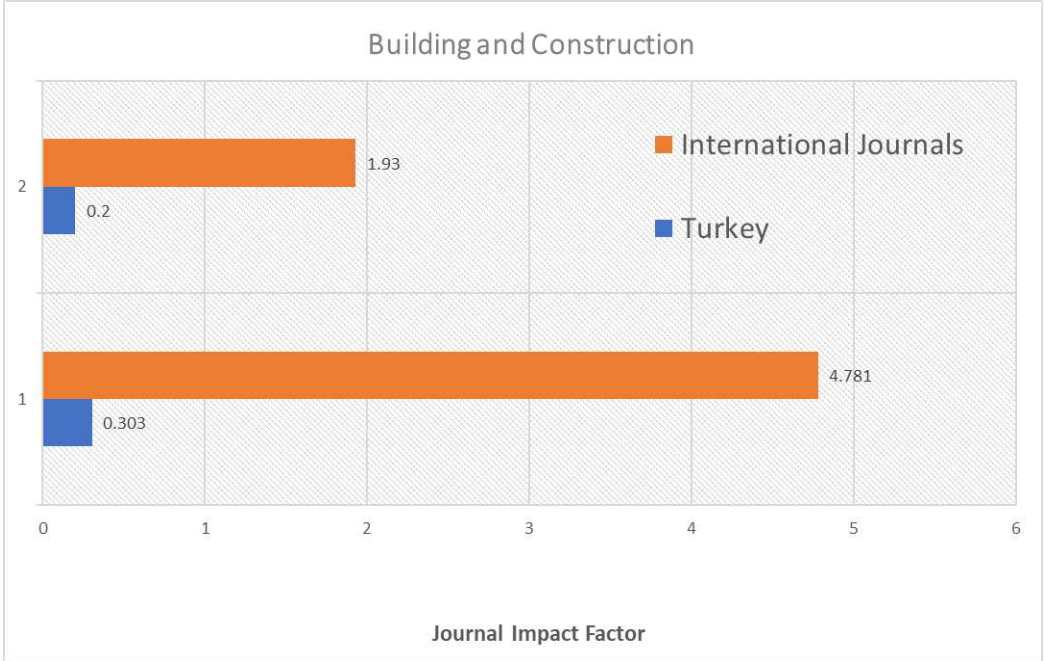
Internationally, the UK journal "Water research" is the most impactful with an impact factor of about 3.6, which is around 18 times more impactful than Turkey's "Research on Engineering Structures and Materials."

6.2.2.2.5 Summary

In summary, we can recapitulate Turkey s academic influence with the following series of charts where for each category of relevant research to the earthquake study, we represent the Turkish journal s influence factor in comparison to the influence factor of the most influential journals internationally:


Geography, planning and development Journals
International Journals
Turkey
2.928
0.111
7.3666
0.113
2
1
0
1
2
3
4
5
6
7
8
Journal Impact Factor


Geophysics
8.853
0.197
International Journals
Turkey
1
0
1
2
3
4
5
6
7
8
9
10
Journal Impact Factor



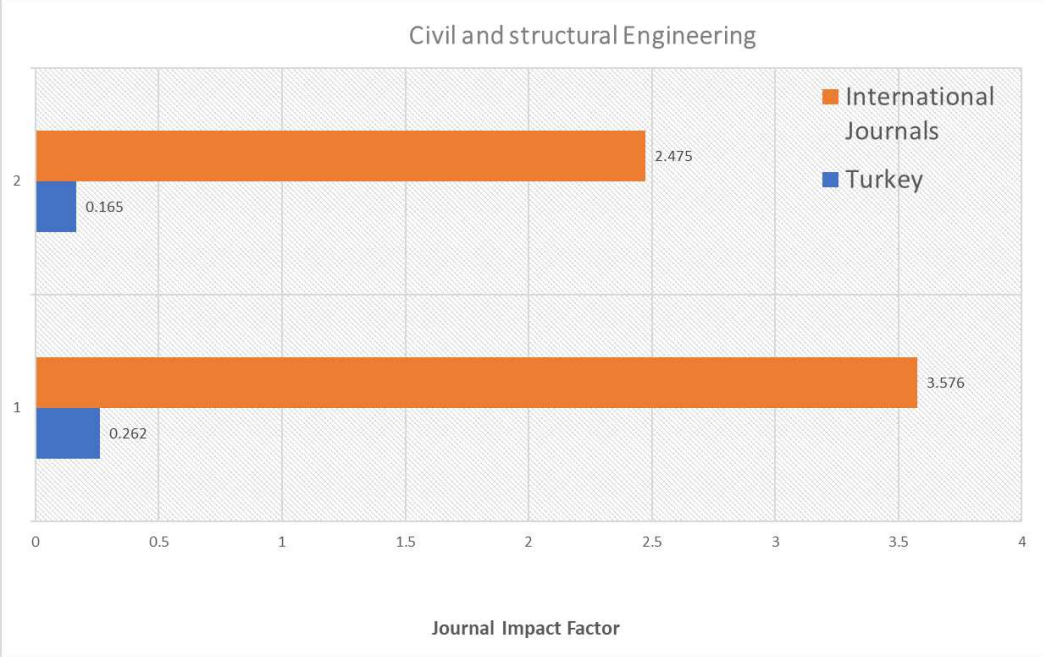


Chart I: Journal Impact Factors in related fields (provided by the author)

What the charts highlight is the major difference in influence articles published by Turkish academics in national Turkish journals can have with articles Turkish academics can have if they publish their articles in international journals. Indeed, if Turkish academics publish in national journals, on average they have a 10% chance of being quoted by fellow academics meaning that on average, around 90% of Turkish academia will potentially have no influence on the global scene. However, if Turkish academics publish within well-known international journals, they can have an impact on the global community where on average they would be quoted system atically

more than once. The former observation highlights the importance of maintaining the Turkish academics with the world of international academia in order to enable them to have influence.

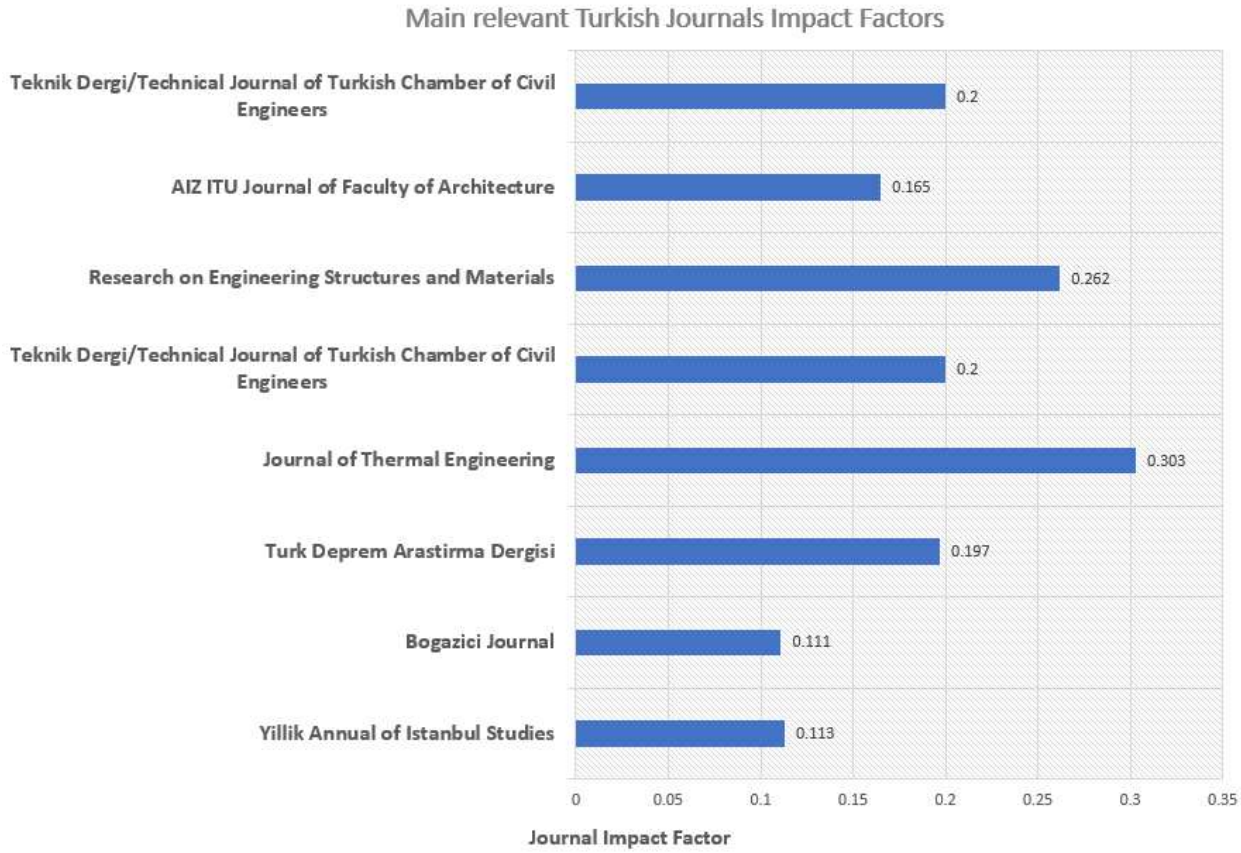


Chart II: Main Relevant Turkish Journals Impact Factors (provided by the author)

The above graph denotes the major Turkish journals that are likely to promote Turkish academia papers and articles relevant to the study of earthquakes. As we can observe, the most influential journals are the Journal of Thermal Engineering and Research on Engineering Structures and Materials with respective influence factors of 0.303 and 0.262. These numbers suggest that at best, Turkish papers published in national journals will be quoted only 30 percent of the time, hence reflecting a poor influence potential of Turkish journals on the international scene. One possible explanation for this could be the fact that some of the articles published by these journals are published in Turkish language meaning outside of Turkey, they don't really have any potential for impact. In fact, some journals have both Turkish and English names like Teknik Dergi and some are only in Turkish like Turk Deprem Arastirma Dergisi.

6.3 Turkish academia and its position in the world compared to other countries on these topics

6.3.1: An overview of Italy's academic scene and influence in the earthquake study world

In order to assess Turkey's influence in the earthquake academic world, we will compare the Impact factors of Turkey's top relevant journals to those of a fellow Mediterranean country that is also earthquake-prone, Italy. We choose Italy as a reference point in this paragraph as Italy will also serve as a reference in the upcoming paragraphs. Furthermore, Italy is a country that is comparable in size, of the Mediterranean Sea that has also known devastating earthquakes in its history. As we have already seen previously, Italy is considered the 8th most impactful country in terms of journals and academic publications in the world according to Scimaga & Journal Country Rank, which is about ten ranks above Turkey. Furthermore, we notice that the top Italian journals are the following,

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)
1	Haematologica	journal	2.490 Q1	165	427	1327	12783	6221	803	4.26	29.94	45.30
2	Journal of Headache and Pain	journal	1.791 Q1	90	165	438	9758	3146	428	6.54	59.14	47.33
3	Annali della Scuola normale superiore di Pisa - Classe di scienze	journal	1.461 Q1	54	69	207	2252	248	207	1.20	32.64	21.58
4	La Rivista del Nuovo Cimento	journal	1.344 Q1	50	9	36	2384	186	36	5.13	264.89	10.00
5	Cortex	journal	1.330 Q1	138	197	856	14465	3022	778	3.17	73.43	52.86
6	Radiologia Medica	journal	1.251 Q1	61	157	476	6128	3442	452	8.46	39.03	43.97
7	Journal of Nutrition, Health and Aging	journal	1.197 Q1	105	190	544	6885	2447	470	3.97	36.24	45.99
8	Clinical Neuropsychiatry	journal	1.140 Q1	35	50	134	2773	578	117	2.15	55.46	57.14
9	Minerva Urology and Nephrology	journal	1.102 Q1	37	125	347	3007	1086	251	3.05	24.06	24.67
10	Clinical and Experimental Medicine	journal	1.038 Q1	55	447	190	25216	874	187	4.96	56.41	47.38

Figure 31: Most influential Italian journals in which Italian academics publish as of june 2024 according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

Interestingly, like Turkey Italy has a clear emphasis on medical sciences in its academic world. Let us now compare the impact factor between the most influential Turkish journals and Italian journals for academia over all categories.

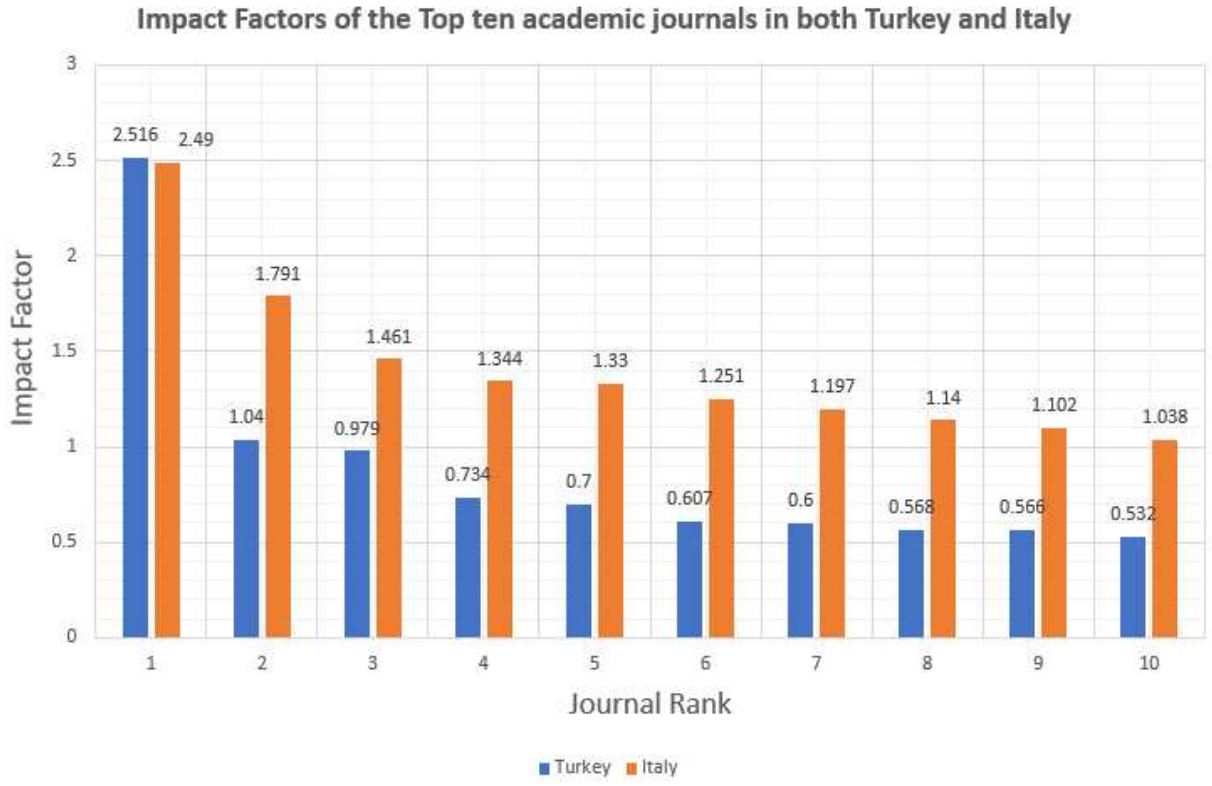


Chart III: Impact factors of top ten academic journals in Italy and Turkey (provided by the author)

We can see that Italy usually boasts a higher impact factor for its national academic journals than Turkey except for the most successful journal which Turkey has actually more quotations for. On average, the ten most impactful Italian academic journals have impact factors that are 1.7 times higher than what Turkish journals boast. Moreover, as seen on the charts below extracted from Scimaga & Journal Country Rank (Lab, S. (n.d.). *SJR: Scientific Journal Rankings*. SCImago Journal & Country Rank.), we can see that while Turkey's influence in the middle East is about five times greater than Italy, Italy has a strongly growing impact on the OECD and European academic world with Italian collaborations with OECD countries being more than 2.5 times that of Turkey's. In sum, Turkey's sphere of influence in the academic world is primarily the; middle east while Italy's sphere of influence in the academic world is primarily Europe and the OECD countries.

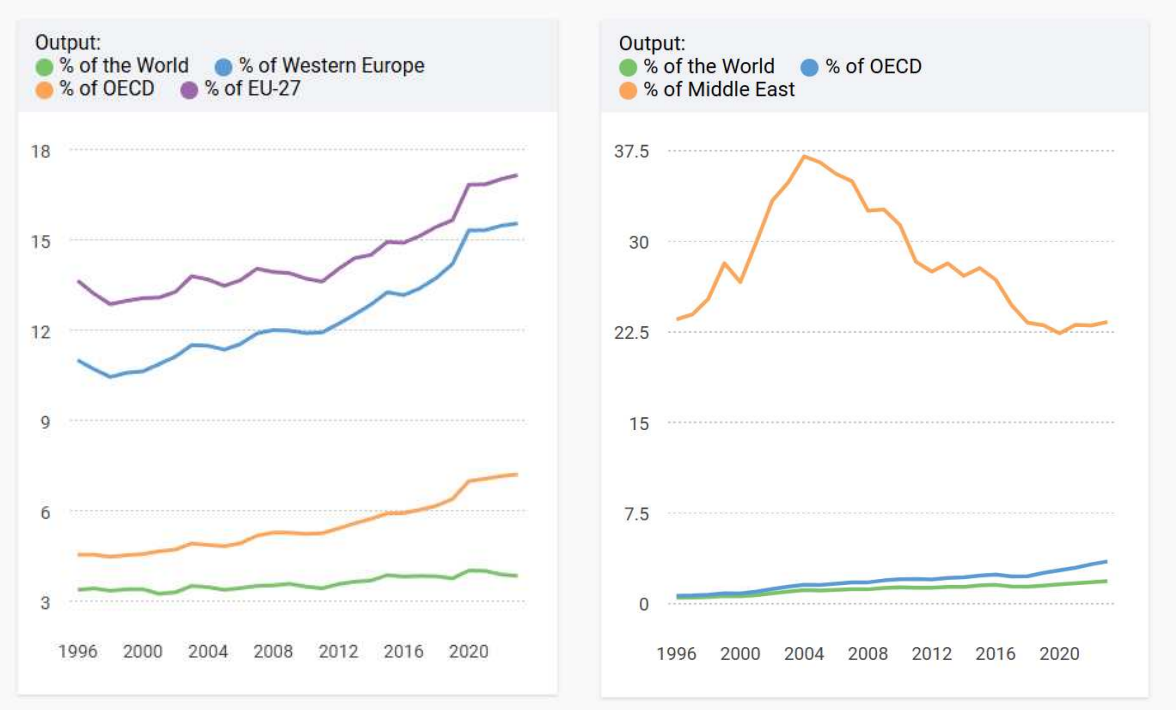


Figure 32: Academic output figures concerning Turkey's (right picture) and Italy's (left picture) academic influence in the world according to Scimaga & Journal Country Rank as of june 2024 (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

Furthermore, we can also notice a much greater international collaboration percentage with Italy in comparison to Turkey (almost 7 times more) which results in much higher citation numbers and underlines Italy's stronger overall influence internationally on the academic world.

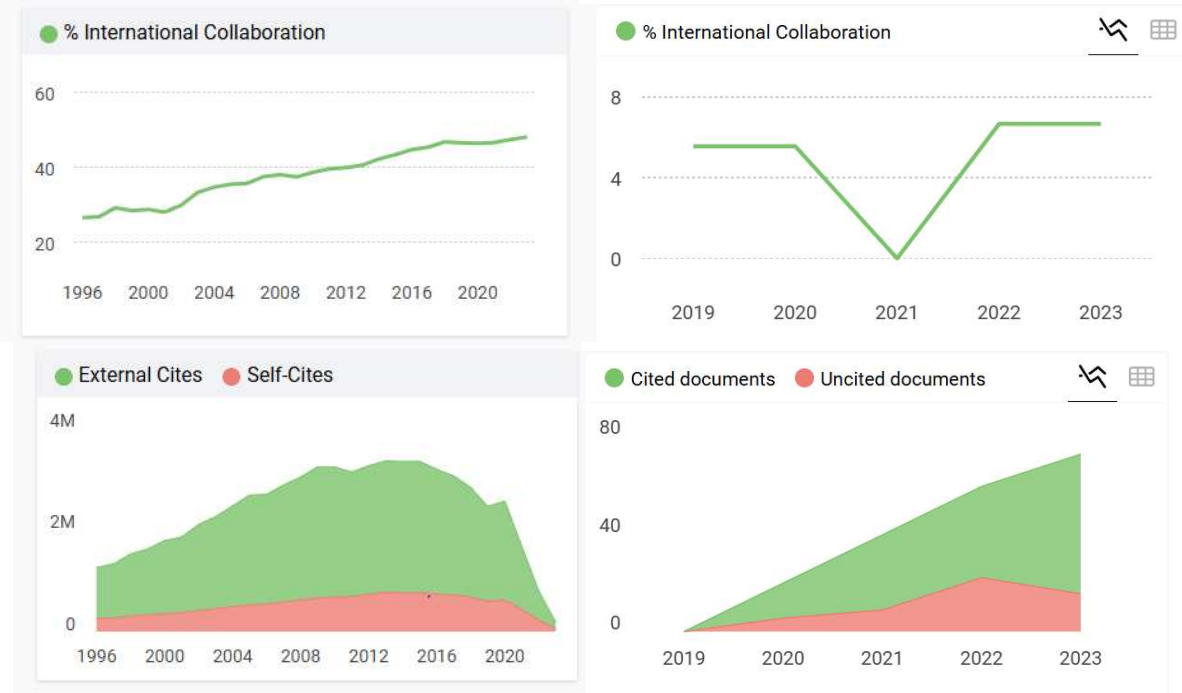


Figure 33: Share of international collaborations & quotations of "International Journal of Engineering and Geosciences" as of june 2024 for Italy(left side) and Turkey(right side) according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Jour

We will now list the most successful Italian journals for academics to publish in within Italy following the same four categories as those chosen in 6.2.2.

6.3.1.1 Geography, planning and development

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Scienze Regionali	journal	0.440 Q2	16	18	81	993	74	66	0.79	55.17	55.88	
2	Geospatial health	journal	0.326 Q3	42	44	158	914	178	152	1.05	20.77	39.64	
3	New Medit	journal	0.289 Q3	23	33	131	1814	163	125	1.25	54.97	29.41	
4	Revista Interdisciplinar da Mobilidade Humana	journal	0.287 Q3	6	48	132	1917	65	120	0.43	39.94	58.90	
5	Italian Review of Agricultural Economics	journal	0.281 Q3	6	17	57	922	64	52	0.95	54.24	31.75	

Figure 34: Most influential Journals for the category "Geography, planning and development" in in Italy (bottom) as of June 2024, according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

We see that in this category, the best journal Italy can promote is one that holds an italian name entitled "Science Regionali" boasting a journal influence factor of about 0.44. The major journal is followed closely by "Geospatial health" with an impact factor of 0.326 with an English title. Both journals thus boast on average articles that are quoted less than 50% of the time, which is better than its Turkish competitors but still far away from the international leading journals.

6.3.1.2 Keyword: Geophysics

Italy's leading journal in the Geophysics category boasts a mere impact factor of 0.276 with an English title "Annals of Geophysics", meaning that it's major journal has less than 30% probability of getting its articles quoted on average.

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Annals of Geophysics	journal	0.276 Q3	69	35	173	1986	181	166	1.24	56.74	36.17	
2	Periodico di Mineralogia	journal	0.251 Q3	32	18	54	1108	41	52	0.92	61.56	58.62	
3	Acque Sotterranee - Italian Journal of Groundwater	journal	0.238 Q3	9	25	69	1014	52	56	0.82	40.56	29.41	
4	Bollettino di Geofisica Teorica ed Applicata	journal	0.233 Q4	31	0	36	0	36	33	0.00	0.00	0.00	
5	Quaderni di Geofisica	journal	0.229 Q4	8	7	12	883	7	12	0.58	126.14	48.15	
6	Bulletin of Geophysics and Oceanography	journal	0.228 Q4	7	26	113	1112	81	93	0.72	42.77	28.85	

Figure 35: Most influential Journals for the category "Geophysics" in Italy as of June 2024, according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

6.3.1.3: Keyword: Building and construction

Italy's leading journal in the "Building and construction" is an Italian titled journal called "Ingegneria Sismica" which boasts an impact factor of 0.486 followed closely by "International Review of Civil Engineering" with an impact factor of 0.376. Thus, in this category, on average, italian journals can at best get quoted a maximum of 49% on their articles.

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Ingegneria Sismica	journal	0.486 Q2	28	7	55	200	131	54	1.97	28.57	48.00	
2	International Review of Civil Engineering	journal	0.376 Q3	13	46	136	1657	225	136	1.60	36.02	21.30	
3	TECHNE	journal	0.162 Q4	13	74	245	984	98	234	0.40	13.30	52.71	
4	Sustainable Mediterranean Construction	journal	0.127 Q4	4	20	194	450	49	182	0.30	22.50	37.84	
5	In_Bo	journal	0.102 Q4	1	18	83	710	2	77	0.02	39.44	50.00	

Figure 36: Most influential Journals for the category "Building and construction" in Italy as of June 2024, according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

6.3.1.4 Keyword: Civil and structural Engineering

Finally, in the "Civil and structural Engineering" category, the most successful journal is also an italian titled journal "Frattura ed Integrità Strutturale" with an impact factor of 0.419 followed by the previously mentioned "International Review of Civil Engineering".

	Title	Type	↓ SJR	H index	Total Docs. (2023)	Total Docs. (3years)	Total Refs. (2023)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2023)	%Female (2023)	
1	Frattura ed Integrita Strutturale	journal	0.419 Q2	28	82	379	3113	636	379	1.56	37.96	21.70	
2	International Review of Civil Engineering	journal	0.376 Q3	13	46	136	1657	225	136	1.60	36.02	21.30	
3	Advances in Transportation Studies	journal	0.173 Q4	20	107	245	2943	132	244	0.51	27.50	33.99	
4	Energia Elettrica	journal	0.111 Q4	6	4	89	53	4	59	0.03	13.25	30.00	

Figure 37: Most influential Journals for the category "Civil and Structural Engineering" in Italy as of June 2024, according to Scimaga & Journal Country Rank (Lab, S. (n.d.). SJR: Scientific Journal Rankings. SCImago Journal & Country Rank.)

6.3.1.5: Summary

In summary, we see that in categories relevant to the study of earthquakes and their management policies and science, Italy's most influential journal is an Italian titled journal "Ingenieria Sismica" which is a purely engineering focused journal, followed closely but another italian titled journal "Scienze Regionale" which is more focused towards management sciences and soft science disciplines like administration and urbanization. Moreover, the most successful Italian journal has an Impact Factor of 0.486 meaning that even papers that are published in Italy's top journal can hopefully get quoted on average about 49% of the time.

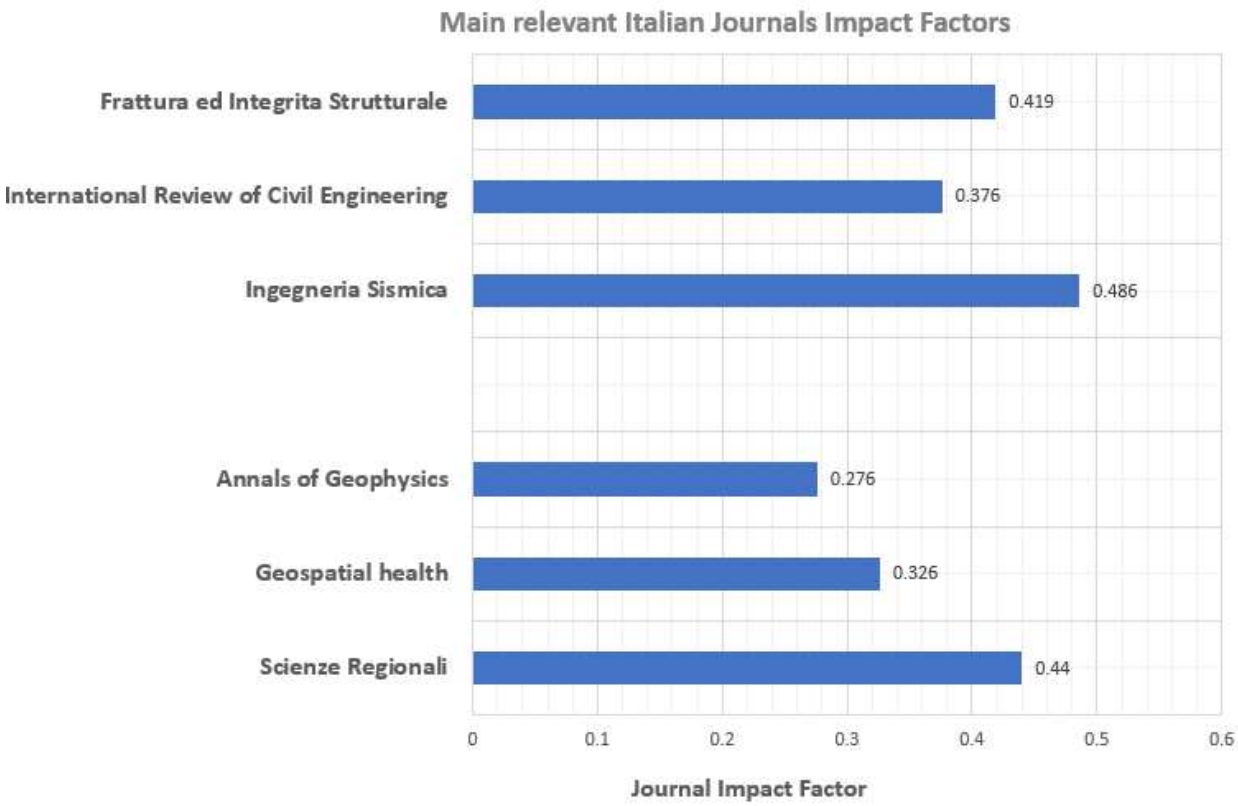
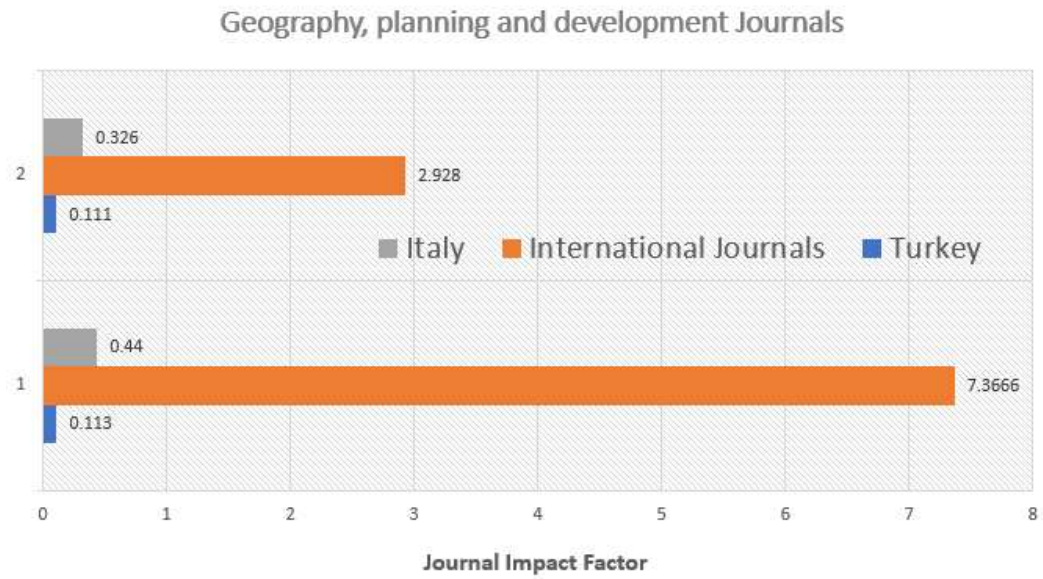


Chart IV: Main Relevant Italian Journals Impact Factors (provided by the author)

Furthermore, we can see that in the upcoming graphs, Italy's journals systematically have higher impact factors than its Turkish counterparts in each category analyzed. Indeed, across all four categories, on average, Italian journals have higher impact factors than Turkish journals by a factor of 2.06 but the leading International heavy weights, have on average impact factors that is 23.82 greater than the one boasted by Italian top journals and thus on average, 49.07 times greater than Turkish top journals.


Geography, planning and development Journals
0.326
2.928
0.111
0.44
7.3666
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International Journals
Turkey
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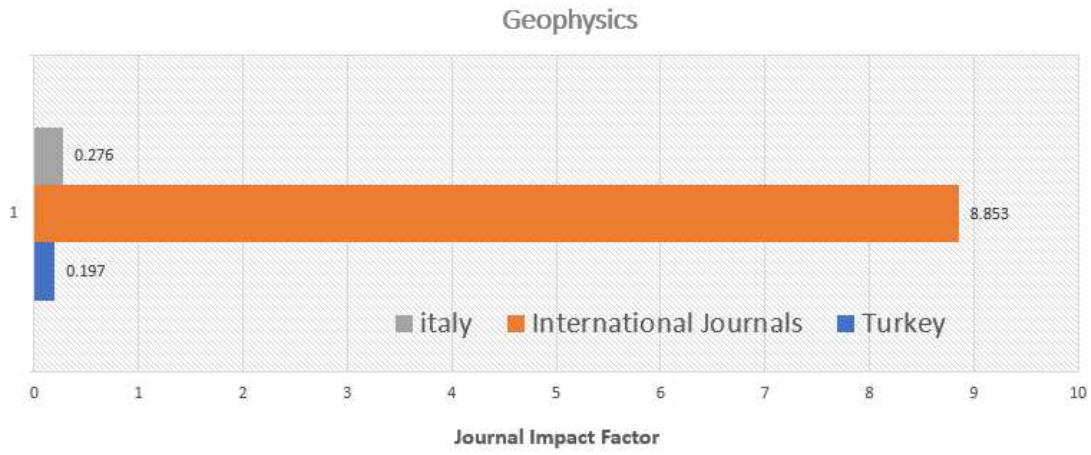
Journal Impact Factor


Geophysics
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Journal Impact Factor

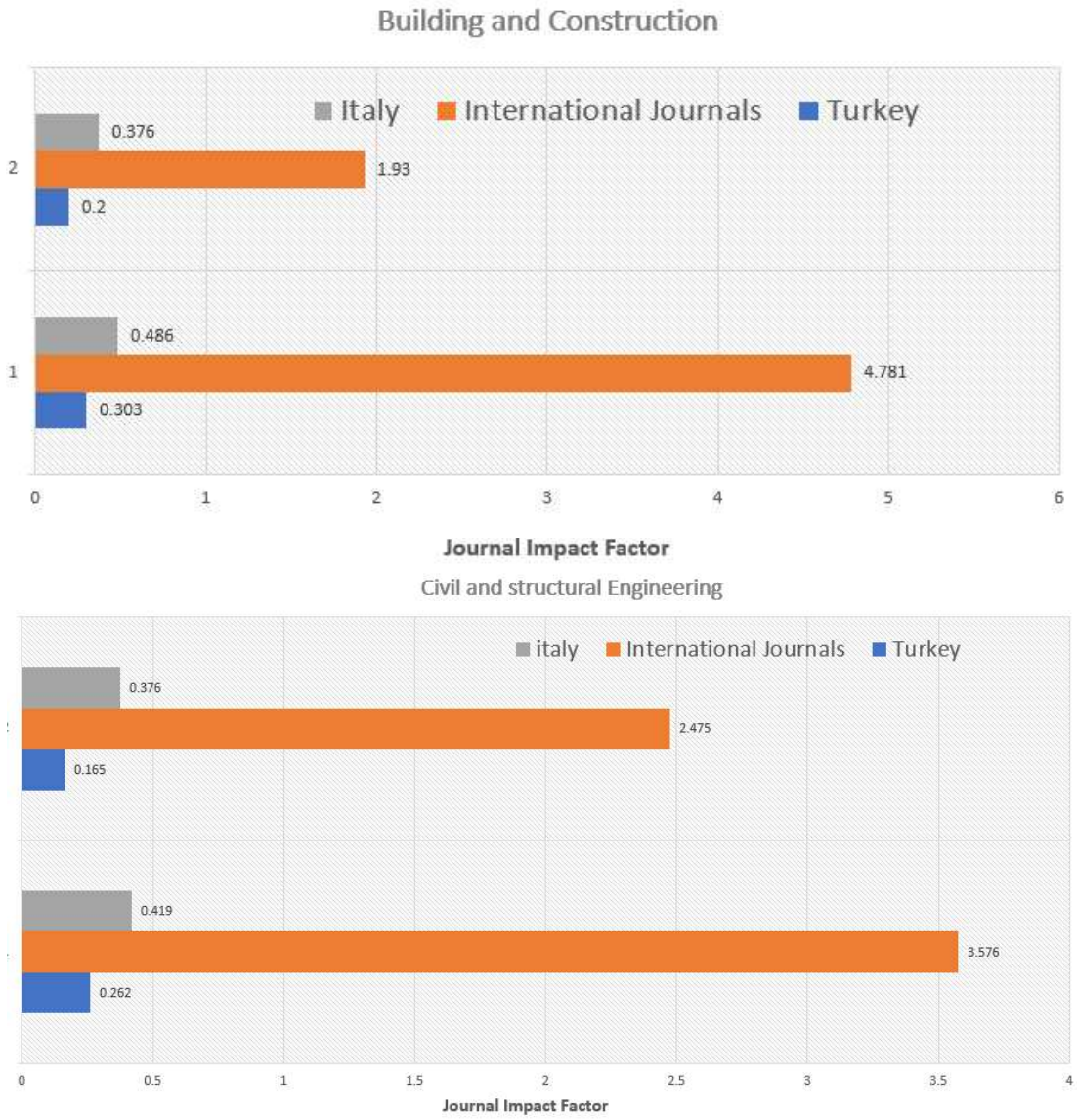

Figure 38: Journal impact factor between Turkey and Italy (source: provided by the author)

In addition, an interesting aspect of comparison lies between the amount of publication between Italy and Turkey that are in English language or in Italian or Turkish. In other words, what share of each nation's publications are eligible to be read by academics beyond their respective countries. What is interesting to notice is that even though Italian journals boast significantly more impactful journals than Turkish competitors, they have a higher percentage of journals that have non-English names.

Three main factors could explain this:

- Italian is a more well-known language in the world.
- Italy has a better inner-country academic community network meaning that Italian academics quote other Italian academics more often than Turkish academics quote other Turkish academics.
- The amount of english language papers that come out of these foreign titled journals is higher for Italy than Turkey.

	Turkey	Italy
Amount of journals with English Titles	6	3
Amount of journals with non-English Titles	2	3
Percentage of non-English titled journals	25%	50%

Table II: Comparison between top Italian and Turkish journals title languages (provided by the author)

6.4 Does Turkish academia have the tools to fulfill its mission?

In this final chapter, we will try to summarize the previous findings and attempt to assess whether Turkey's academia is capable, in its current form, to fulfill its mission when it comes to earthquake management and scientific research. In order to answer this question, we will summarize the previous considerations alongside some closing informational facts and some considerations about what future challenges Turkey's academia could face in the upcoming crisis.

6.4.1 Are the resources enough?

Previous considerations have suggested that while Turkey's academia is not as influential as some other Mediterranean counterparts like Italy, it has generally been growing in the past decades and has been stimulated by the earthquake. However, the question of whether the ressources, especially in academia and in affiliated technical fields is a more pragmatic one.

Indeed, as pointed out in (Karasözen et al., 202), one of the most pragmatic guidelines that is given to Turkey in order to allow it to become more earthquake resilient is to make sure that the country is producing enough geo-scientists or related scientists in such engineering fields. However, the data suggests that the number of undergraduate students in such disciplines is failing such as the disciplines of "geoscience" or civil engineering. In fact, the below chart suggests that Turkish universities are not filling their quotas of undergraduate students for these fields of students. This

trend is very worrying for the country because it means that experts in these fields will become more scarce in a country that desperately needs to improve its earthquake culture.

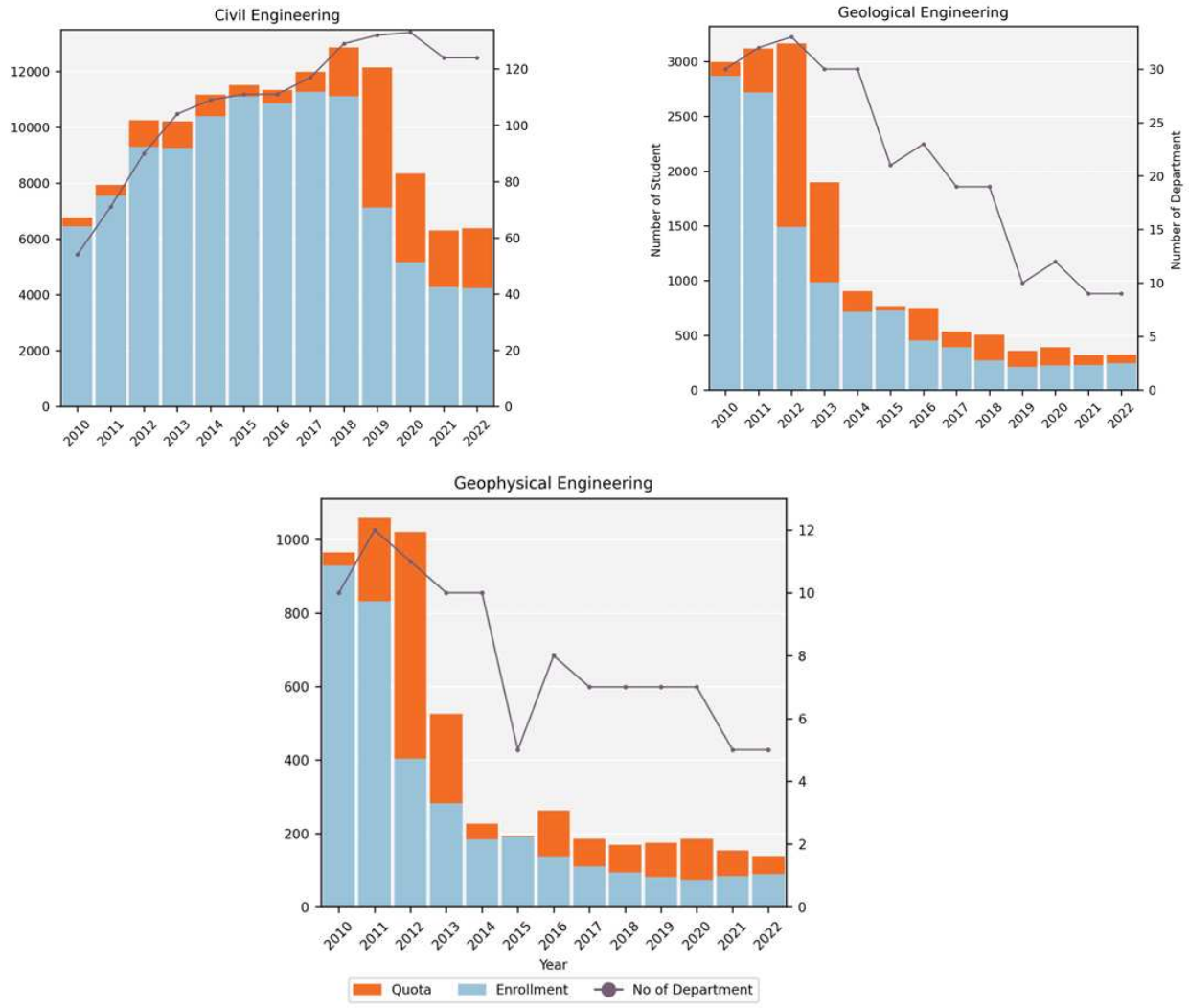

Figure 39: Undergraduate student quotas and enrollment for earthquake science departments in Türkiye since 2010 (Karasözen et al., 202)

As depicted below, universities in Turkey with "Geophysical Engineering", "Civil Engineering" and "Geological Engineering" departments are not filling all the positions available at undergraduate level.

6.4.2 Challenges of the new era: the impact of misinformation in a post-earthquake response

In addition, Turkish academia should also prepare to fight against new forms of challenges that are emerging in modern societies. Most notably, disinformation. Indeed, it is of capital importance that when a crisis happens, Turkish academics are able to maintain their voices against rising misinformation amongst its local population.

In (Méndez-Muros et al., 2024), the authors analyze the impact of misinformation during the Turkish-Syrian earthquake of 2023. More specifically, the paper demonstrates that during this earthquake, the social media platform X was not really efficient or dedicated to mediating and silencing rising fake news and conspiracy theories following the earthquake. In fact, sometimes the algorithms of X would promote them.

Indeed, the study of (Méndez-Muros et al., 2024) compares the tweets from the news agencies below from different countries and quantifies how much misinformation or fake news they spread using what kind of techniques:

Member	Country	Followers
@kompascom	Indonesia	8.5 M
@Indiatoday	India	6.2 M
@USATODAY	USA	4.9 M
@Liputan6dotcom	Indonesian	4.5 M
@pajaropolitico	Mexico	2.6 M
@20Minutes	France	2.5 M
@vtenws	Netherlands	628,800
@thejournal_ie	Ireland	737,300
@Aosfatos	Portugal	291,700
@FullFact	United Kingdom	230,000
@teyitorg	Turkey	841,000
@doğrulukpayicom	Turkey	219,100
@Doğrulaorg	Turkey	59,800
@malumatfurusorg	Turkey	51,700
@veSyria	Syria	32,100
@Newtral	Spain	197,700
@Maldita	Spain	132,700
@Snopes	USA	285,400
@FactCheck	USA	100,500
@PolitiFact	USA	641,200

Figure 40: New agencies analyzed by the study conducted in (Méndez-Muros et al., 2024)

The following results from the study of (Méndez-Muros et al., 2024) which associates a score to different forms of engagement (retweets (RW) , Likes and discussion) , based on criteria such as demonstrates that categories linked to conspiracy theories and facts exaggerations like manipulated content and the kinds of misinformation that are most likely to create the highest level of engagement.

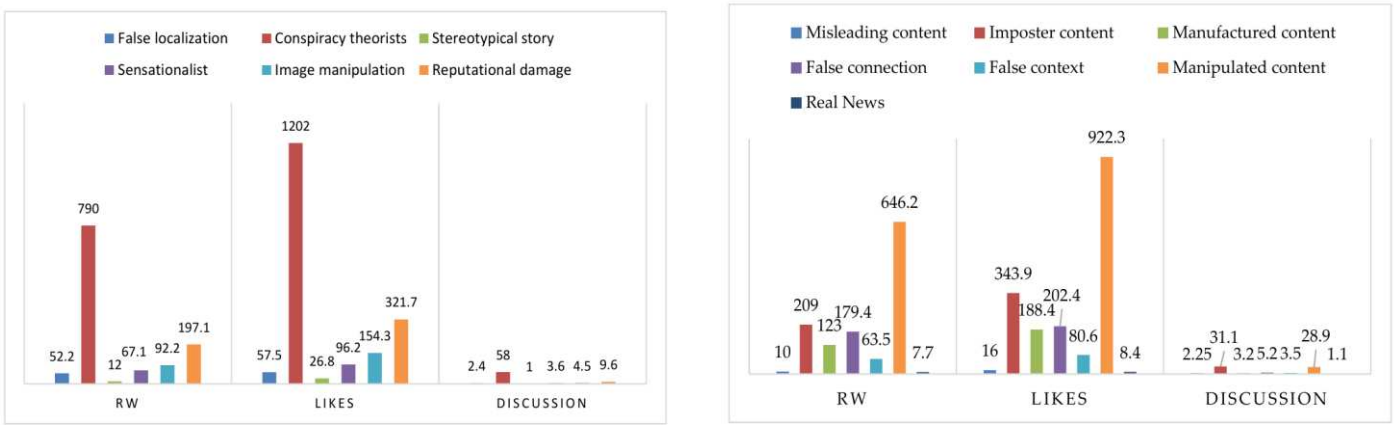

Figure 41: Figures taken form (Méndez-Muros et al., 2024) depicting the level of engagement generated on X during the 2023 Turkish Syrian Earthquake by fake-news dependent on its category

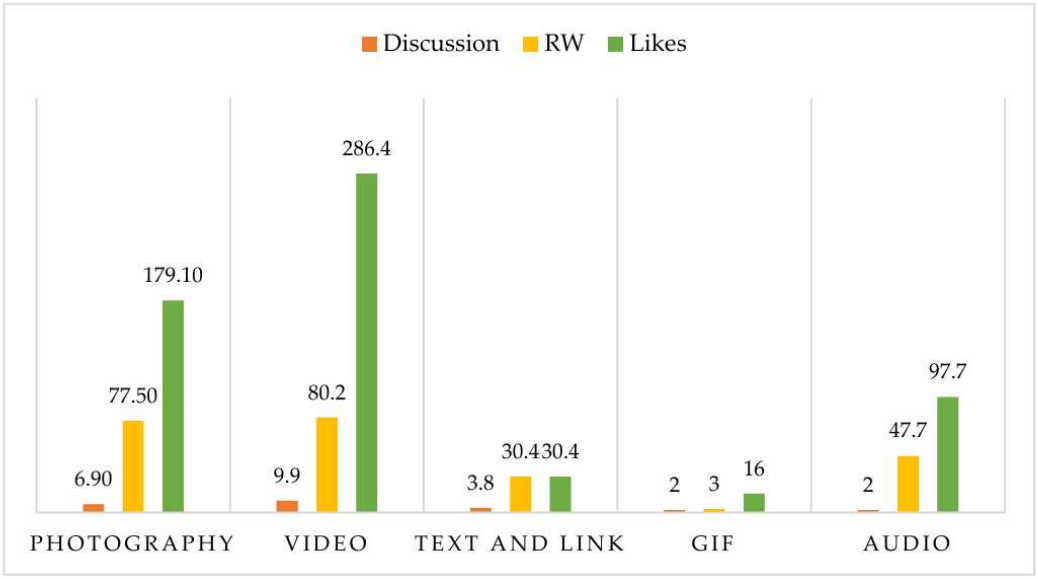

Figure 42: Figures taken form (Méndez-Muros et al., 2024) depicting the level of engagement generated on X during the 2023 Turkish-Syrian Earthquake by fake-news dependent on the nature of the media.

Furthermore, the previous graph also demonstrates that according to (Méndez-Muros et al., 2024), media that is image or video based has the most potential to cause the spread of misinformation during a crisis. Moreover, the study of (Méndez-Muros et al., 2024) also points out the different mis-information strategies which are used on websites such as X which include paradigms such as fact invention or wrong attribution of the responsibilities as shown below:

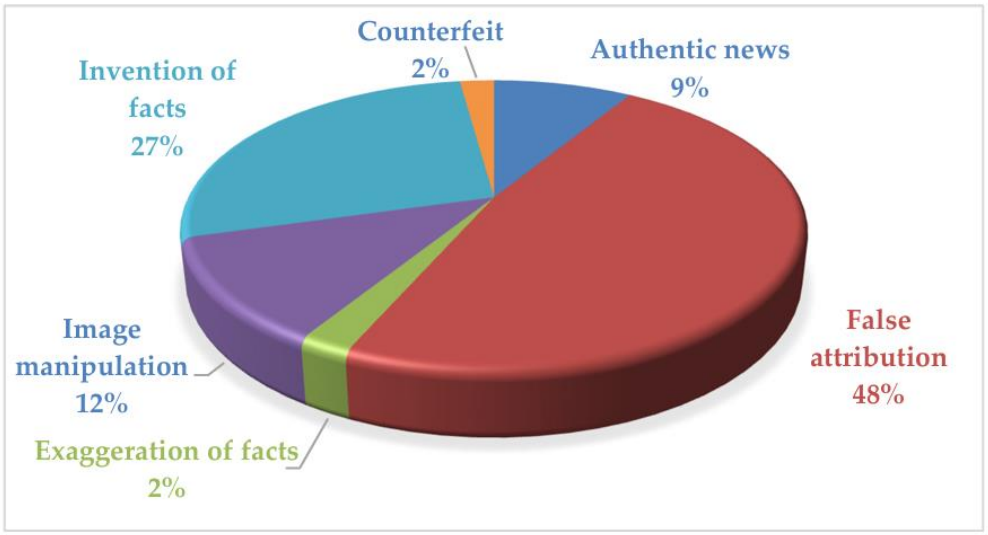

Figure 43: Proportion of the different strategies of misinformation found on X during the Turkish-Syrian earthquake of 2023 (Méndez-Muros et al., 2024)

Figure 44: two examples of misinformation that circulated on X during the 2023 Turkish-Syrian earthquake reported by (Méndez-Muros et al., 2024). On the left a conspiracy theory, on the right a false emotional tweet.

Perhaps, the most worrying trend that is detected by the studies in (Méndez-Muros et al., 2024) is that misinformation was pretty much detected in all the agencies that were inspected in the study, whether they were intentional or not. Indeed, even reputable sources like “20 Minutes” in France had propagated misinformation either willingly or unwillingly.

6.4.3 What can Turkey do to better itself and increase its international influence on earthquake science and policy management research?

Considering everything that was in this chapter, we can formulate the following advice to Turkish academia if it wishes to better it’s influence in the world, but also to better itself in terms of being able to tackle future challenges and ensure it has the sufficient resources to fulfill its mission :

1) **Develop the local and in particular, promote journals that have English titles with articles written in the English language**. This can help to diminish the gap in “quotation potential” with articles published by Turkish academics that are only written in Turkish meaning they cannot be quoted by international academics.

2) **Develop links with the international community in order to allow Turkish academics and intellectuals to share work in international journals which have much higher potential for influence** (sometimes more than 40 times in comparison to local journals). Indeed, it is absolutely primordial for Turkey to maintain and develop links with international journals and institutions as they can give an influence potential that national journals just can’t.

3) **Develop more links with the academic world of OECD countries and not just middle eastern countries** as the academia of OECD countries is in general much more influential than middle eastern based academia. Indeed, the fact that Turkey’s academia links are mostly with the middle east and not OECD countries is the main different for the influence gap between Turkey and Italy’s academia.

4) **Develop a true earthquake culture in schools starting at a young age through institutes like AFAD in order to reduce the ignorance of potential for unregulated dangerous constructions in the country**. Indeed, (Karasözen et al., 2023) points out the corruption amongst construction contractors but also building mismanagement by the population is responsible for many deaths in the country. In other words, even though the country is earthquake-prone, its population doesn’t have an earthquake culture. Indeed, the following graph shows that the death toll of earthquakes in Turkey is systematically much higher than in countries like Japan or Chile in the past decades, even though Japan and Chile have known at times more devastating earthquakes and Chile has a similar economy. This is attributed to corruption, illegal house building and general earthquake ignorance by the authors of (Karasözen et al., 2023):

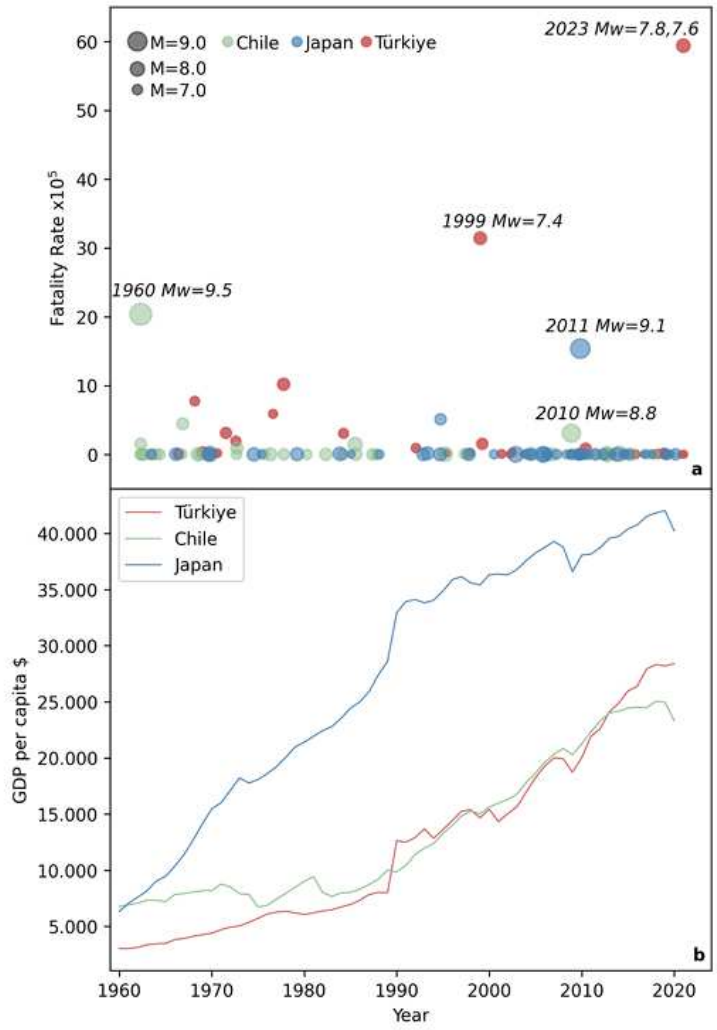

Figure 45: (a) Fatality rates (the number of fatalities divided by past country population for each earthquake) in Chile, Japan, and Türkiye. Circles are scaled with earthquake magnitude. (b) Gross domestic product (GDP) per capita in Chile, Japan, and Türkiye between 1960-2020. (Karasözen et al., 2023)

5) **Make the jobs linked to geoscience or civil engineering more appealing** in order to make sure that enough students choose this career path to ensure the country doesn't run out of experts on the topic. Indeed, Turkey must reverse its trend of not filling earthquake related study positions in undergraduate schools. This trend is explained by the fact that it is at times difficult for students of these studies to find a stable job after they finish university (on average more than 6 months according to (Karasözen et al., 2023)). In order to reverse it, (Karasözen et al., 2023) suggests developing career opportunities by linking these undergraduate studies with the AFAD network, for example to help young scientists develop a network and find rewarding positions.

6) **Develop a strategy to fight against the spreading of misinformation, especially during times of crisis**. Indeed, academia must retain its influence and credibility in the face of a crisis, and it should, therefore, think of new ways to counter the spread of

misinformation about such crises as they become more and more present on platforms like X that can, at times, even promote them.

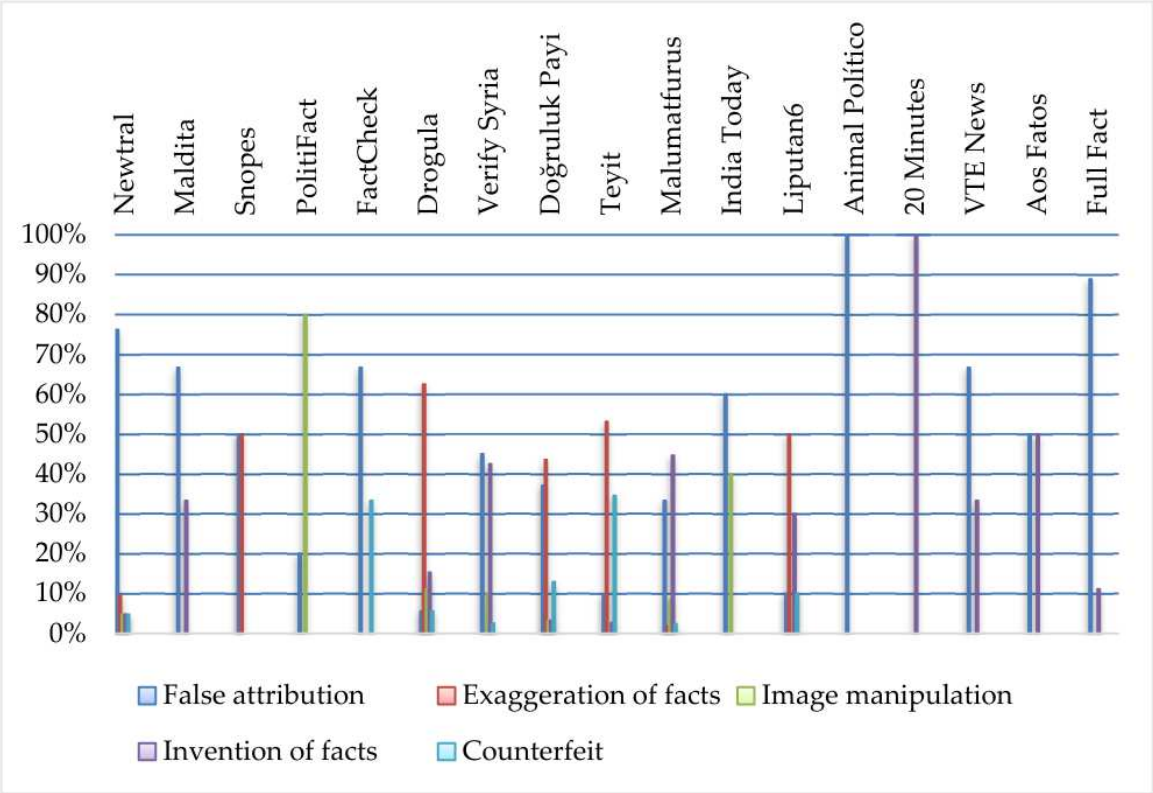

Figure 46: Strategies of misinformation detected by the study (Méndez-Muros et al., 2024) in the agencies that were part of the sample.

Conclusion

The research that was conducted in this thesis analyzes Turkish government policies for Hatay, while primarily focusing on disaster management and urban planning in the post-earthquake era, which is now pushed by the collaborative efforts of multiple governmental and non-governmental organisations. Firstly, the regulations for building codes were revised, and it's been said by the experts that while the building regulation codes for earthquake were sufficient, it was the execution part in construction phases that resulted in such damage in the region. The governmental collaboration for reconstruction is critical as various governmental bodies, including the Ministry of Environment, Urbanisation and Climate Change, as well as the Ministry of Culture and Tourism and AFAD (Disaster and Emergency Management Presidency) and TOKI (Turkish Housing Development Agency), are leading the reconstruction efforts. However, it's not only the governmental bodies that are focusing on the reconstruction, but also, they are NGOs such as TTV (Turkish Design Council) who are collaborating with architects such as Foster + Partners with one goal in mind, which is the rebuilding with disaster-resilience on the horizon. The urban planning is now being shaped with various restrictions like forbidding building near the riverbanks and expanding green spaces. The pilot projects made for Hatay include precise reconstruction policies which are now the main focus of developing twelve walkable districts whilst preserving the original neighbourhood fabric and limiting building heights to align with the building regulations. The pilot project in Antakya is important because not only it will become a model in Hatay region, but also in the rest of the earthquake-damaged regions in Turkey. The pilot project's main objective is to reconstruct the area in complying with disaster-resistant approaches while collaborating with local municipalities. However, all the reconstruction efforts come to face with some challenges, as professionals from the TMMOB Chamber of City planners argue that there's concerns regarding participatory planning. The tasks being handed out to starchitects and political conflicts have sparked concerns about the plans' effectiveness, transparency, and the scope of local community involvement.

Equally important, the essay focused on the role of Turkish academia, especially on its capability to better earthquake culture amongst the population in Turkey and abroad. In particular, the essay analyzed the main actors of Turkish academia: the Kandilli Observatory and Turkey's top universities. By analyzing the tools of these institutes, and by estimating its influence through quotation potential and journal rankings in comparison to friendly countries like Italy, several conclusions were drawn. It was found that Turkish academia was overall growing and its impact on earthquake-related science had been stimulated since the 1999 Marmara earthquake, perhaps hinting at the fact that the recent earthquake will have a positive impact on its influence in the coming years. However, because of its lack of ties in OECD countries in academia, it seems that Turkish academia's impact is limited beyond the middle east. Indeed, the essay concluded that

Turkey should diversify its partnerships with OECD countries, or else it will remain a less influential actor than other Mediterranean powers like Italy. Furthermore, the essay highlighted that Turkish academia faces several challenges in the future in the forms of a lack of young Turkish people wanting to follow undergraduate studies related to earthquake sciences, hinting at a lack of future academics in the country, but also the rise of misinformation that was propagating during the 2023 Turkish-Syrian earthquake. These two challenges are major obstacles Turkish academia must face in the coming decade if it wants to protect its citizens in the next crisis. In a way, these two challenges facing Turkish academia are linked: young people will be the ones facing the rise of misinformation in their lifetimes, meaning it is essential for Turkish academia to bring in the youth into these topics, and maintain legitimacy on such issues at home and internationally.

In order to manage post-earthquake reconstruction in Hatay, the administrators in charge should prioritize inclusive and participatory planning by engaging local communities in decision-making through proper consultations to make sure that their needs are reflected in the reconstruction part. Collaboration across governmental bodies, particularly, various ministries and local governments as municipalities, while involving experts like architects and urban planners, is important for having the desired outcome for Hatay and its residents. The political disputes and political polarization should be minimized within local and central governments to have the focus on completing the reconstruction goals. The reconstruction efforts must prioritize earthquake resilience to create an exemplary reconstruction on the Eastern Anatolian Fault Zone with stricter measures to reinforce the execution of the construction process with the updated building codes, expanded green spaces, and walkable zones for long-term sustainability. Transparency and accountability should be granted by the institutions to the people by keeping the public informed and implementing monitoring systems to make sure progress aligns with reconstruction goals. The funding resources should be distributed equitably, to empower local authorities and avoid over-centralization of planning. In addition, the preservation of Antakya's cultural and historical heritage should be integrated into rebuilding strategies to indicate that both the community's cultural landscapes and cultural heritage are protected.

Regarding Turkey’s academia, the essay’s conclusions suggest that it should seek out new partnerships with different countries beyond the middle east, in particular with OECD countries in order to not remain unimpactful to the international community. Turkey’s academia should also look into ways to combat the propagation of conspiracy theories and fake news during such crises and set up response plans accordingly. Finally, it should stimulate the youth involvement more in the academic sector, by working on ways to facilitate job insertions for new graduates and make such studies more appealing. As highlighted in Chapter 6, the academic institutions can significantly contribute to local public policies by providing support to specific government agencies, by promoting earthquake culture amongst Turkish public and decision-makers, as well as promote Turkey as an influential and reliable country on such topics within the international stage, increasing its partnership opportunities and knowledge transfers.

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