Journal of Architectural Sciences and Applications
JASA 2023, 8 (Special Issue), 84-102
Research article
e-ISSN: 2548-0170
https://dergipark.org.tr/en/pub/mbud

Investigation of Sustainable Disaster Management with Fishbone Method; Hatay Province Example

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Abstract

Disasters cause great losses to people and the environment around the world. It's possible to prevent or reduce these losses with disaster management. An effective disaster management system should be implemented in order to reduce all these damages of disasters. It is especially important that this disaster management is sustainable. The earthquakes that took place in Türkiye on February 6 reminded us once again the importance of disaster management. In this study, the stages of disaster management are mentioned. It's explained how sustainable disaster management can be. Hatay province was chosen as the study area. The fishbone method was used as the method. After the earthquakes, the current situation in Hatay province was determined and the current situation was analyzed with the fishbone method to provide sustainable disaster management. Thanks to the fishbone method, what can be done for sustainable disaster management in Hatay was discussed and suggestions were presented.

Keywords: *Sustainable disaster management, earthquake, fishbone method.*

Balık Kılçığı Yöntemi ile Sürdürülebilir Afet Yönetiminin İncelenmesi; Hatay İli Örneği

Öz

Afetler tüm dünyada insanlar ve çevre için büyük kayıplara neden olmaktadır. Afet yönetimi ile bu kayıpları önlemek veya azaltmak mümkündür. Afetlerin tüm bu zararlarını azaltmak için etkin bir afet yönetim sistemi uygulanmalıdır. Özellikle afet yönetiminin sürdürülebilir olması çok önemlidir. 6 Şubat tarihinde Türkiye'de meydana gelen depremler afet yönetiminin önemini bir kez daha hatırlatmıştır. Bu çalışmada afet yönetiminin aşamalarına değinilmiştir. Sürdürülebilir afet yönetiminin nasıl olacağı anlatılmıştır. Çalışma alanı olarak Hatay ili seçilmiştir. Yöntem olarak balık kılçığı yöntemi kullanılmıştır. Depremlerin ardından sürdürülebilir afet yönetimi sağlamak için Hatay İlindeki mevcut durum tespit edilerek kılçık yöntemiyle mevcut durum analiz edilmiştir. Balık kılçığı yöntemi sayesinde Hatay'da sürdürülebilir afet yönetimi için neler yapılabileceği tartışıldı ve öneriler sunuldu.

Anahtar Kelimeler: *Sürdürülebilir afet yönetimi, deprem, balık kılçığı metodu.*

Citation: Demirhan Arda, Y. & Soyluk, A. (2023). Investigation of sustainable disaster management with fishbone method; Hatay Province example. *Journal of Architectural Sciences and Applications*, 8 (Special Issue), 84-102.
DOI: https://doi.org/10.30785/mbud.1317734

Received: *20/06/2023 – **Accepted:** 12/10/2023*

1. Introduction

Millions of people's lives are impacted annually by the increasing frequency of catastrophes in the world as well as the rise in losses and damage. Due to the inadequate planning that preceded the disasters that occurred in the previous years, significant issues were encountered during the crisis management that followed each disaster, particularly in Türkiye. While developing short-, medium-, and long-term recovery strategies following the disaster, this condition persisted (Taş & Erdal, 2015).

Instead of a structure that spends the majority of the resources during and after the disaster, there should be an understanding that focuses resources before disasters, or prioritizes preparation and risk reduction. This understanding should also be ongoing and sustainable in order to reduce disasters and damage. In other words, disaster management should be based on the shift from a reactive (ineffective) strategy to a proactive (effective) one (Taş & Erdal, 2015).

After the 6 February earthquakes in Türkiye, the importance of disaster management was better understood. In this study, it is aimed to draw attention to the sustainability of disaster management. The current situations in the province of Hatay, which was affected by the earthquake, will be examined. Afterwards, sustainable disaster management in Hatay will be analyzed with the fishbone method. The reason for using the fishbone method is this: To be able to see many different factors for sustainable disaster management and to clearly see the table where I can discuss the branches of science that affect them. As a result of the analysis, many factors affecting sustainable disaster management will be determined. The deficiencies in sustainable disaster management will be mentioned, and the responsibilities of architects in this regard will be expressed. It will be discussed how measures can be taken against the social, psychological and economic effects of the earthquake. It will be concluded that the most devastating effects of the earthquakes experienced on 6 February are unplanned construction, lack of access to qualified architectural and engineering services, and use of poor quality materials.

1.1. Disaster Management

Disaster management; It is defined as the whole of the efforts to ensure coordination in a way that includes all segments of the society in order to plan and implement the works to be done to prevent the events that may result in disasters or to reduce their damages, to complete the necessary legal regulations and institutional structures, and to manage all resources in this direction in order to ensure an effective implementation (Güler, 2018).

The main purpose of disaster management is to reduce all kinds of risks, including natural and technological disasters. In other words, it is aimed to minimize the negative damages of disasters. Disaster management is handled in four phases: mitigation/avoidance, preparedness (sometimes referred to as planning), response, and recovery (Odabaş, 2010). Figure 1 shows diasaster management cycle.

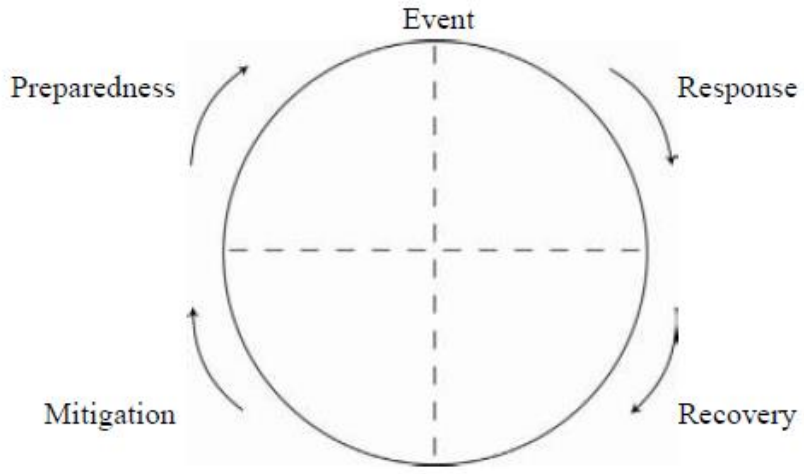

Figure 1. Disaster management cycle (O'Brien et al., 2010)

1.1.1. Mitigation

The goal of mitigation, the first stage of the disaster management process, is to lessen the impact of the disaster on the most vulnerable individuals and to minimize its socioeconomic effects on the impacted community (Owolabi & Ekechi, 2014). According to the World Development Reports (1998), there are many ways to mitigate. These include zoning and management of land use, implementation of preventive health measures, updating vulnerability analyzes and revision of safety standards. In addition, PAHO (2000) noted that catastrophe risk reduction requires educating the business community on steps for take to diversify a company's product offerings.

1.1.2. Preparedness

According to the World Health Organisation (2007), the term "preparedness" refers to a broad range of pre-disaster programs that build personnel capacity and improve managerial and technical efforts of governments, non-governmental and international organizations, scientific bodies, the private sector, the media, and the communities most vulnerable to disasters. Planning, emergency personnel training, emergency communication systems warning systems, evacuation plans and training, public information, emergency personnel contact lists, and resource inventories are just a few of the preparation processes (Owolabi & Ekechi, 2014).

1.1.3. Response

After the disaster occurs, emergency response activities are put into practice immediately. Emergency response begins with ensuring the safety of the population immediately after the disaster (Odabaş, 2010).

1.1.4. Recovery

After the immediate needs of the victims are fulfilled, the post-disaster recovery phase starts. This phase's activities include providing medical and psychological support, paying insurance claims and government obligations, repairing damaged private property, public property, and infrastructure, and clearing the disaster region of debris. The length of the recovery process will depend on how severe the tragedy was. Activities aimed at mitigating or avoiding future disasters should be incorporated into the recovery process to the greatest extent practicable (Odabaş, 2010).

1.2. Sustainable Disaster Management

In order for disaster management to become sustainable, a transformation is needed in the cultural structure (values, attitudes and behaviors) of the community or society. For this change, according to Mileti (1999), providing an environmental quality that takes into account the complex relationship between physical, social and built systems, requires taking responsibility in disasters, and prevents short-term thinking and making plans, and It is of great importance to implement the goals of sustainable development, such as increasing the quality of life of people, increasing local responsibility and resilience, creating a vibrant local economy, ensuring equality within and between generations, and reaching agreement between all public and private parties. Thus, sustainability is enabled in the reduction of disaster damages. However, in the implementation of these objectives, including the disaster phenomenon in the plans, ensuring communication and coordination between all units that make up the society and the community, conducting disaster assessments throughout the country and establishing a data bank, implementing local and country-level training programs for the creation of disaster awareness, the criteria by which all studies can be evaluated. It is necessary to establish criteria (scale) and to share the knowledge and experience gained at the international level (Odabaş, 2010).

Another suggestion for making disaster management sustainable comes from Sakulski (2006). According to the author, it is possible to talk about four parallel areas for this to happen: Legislation, inter-agency coordination (both horizontally and vertically), sensitive and sustainable technology, and finally education (which will raise awareness of all segments of society) and research on disaster management. However, the limitation of this approach is that it ignores the necessity of actively involving all segments of society in decision-making and policy-making processes (Odabaş, 2010).

2. Literature Review

Disaster management, whose main purpose is to reduce all kinds of risks, including natural and technological disasters, in other words, to minimize the negative damages of the above-mentioned disasters, is discussed in many studies. (Benson & Twig, 2004; Linnerooth-Bayer et al., 2002)

The fundamental principles of disaster management, which include prevention, management, reduction, and recovery, are frequently the same. But it appears that Henstra and McBean's (2005) method is based on activities, whereas Poser & Dransch's (2010) approach is based on processes. Pearce (2003) also notes that catastrophe management has a relatively recent academic and practical background. According to Moe & Pathranarakul (2006), the phrases "disaster management" and "emergency management" are frequently used interchangeably. They also claim that public project management and disaster management share several characteristics.

Numerous studies examined the networks of regional institutional players for disaster management. For instance, Vasavada (2013) evaluated the governance setup of a network for disaster management in Gujarat, India. Putra & Matsuyuki (2019) examined the vertical and horizontal interactions between Indonesian government actors to study the changes to the country's disaster management system. Jovita et al., (2018) assessed the Philippines' disaster management network structure. These studies are primarily restricted to analyzing network structure for either the preparedness stage or the recovery stage of disaster cycles.

Very few studies looked at the dynamics and procedures of post-disaster recovery and reconstruction prior to the 1970s. Many academics have noted that the majority of studies on post-disaster recovery and reconstruction are case-specific and frequently lack systematic comparative studies and have trouble extrapolating to other disasters (Rubin, Saperstein & Barbee, 1985; Olshansky, 2005). Nevertheless, after several years of research and growth in this new subject, there is a sizable amount of agreement regarding a range of recovery-related topics in the literature (Olshansky, 2005), which has aided in the direction of further investigations.

3. Material and Method

In February 2023, a series of catastrophic earthquakes struck Turkey. The calamity was exceptional in its breadth and the amount of damage it left behind, even for an earthquake-prone region. Urban and rural constructions are in ruins over a huge area of territory that includes 11 provinces in southern and southeast Turkey: Kahramanmaraş, Gaziantep, Anlurfa, Diyarbakır, Adana, Adyaman, Osmaniye, Hatay, Kilis, Malatya and Elazığ (UNDP, 2023).

Hatay province was chosen as the study area. Hatay, the southernmost province of Turkey, is located on the eastern shores of the Iskenderun Bay between 36° 15-37° 00 North latitudes and 35° 46-36° 42 East longitudes in the eastern part of the Mediterranean Sea (Figure 2). There is Syria in the east and south of the province, the Mediterranean Sea in the west, Adana in the northwest, Osmaniye in the north and Gaziantep in the northeast. Its area is 5524 km2 and 46.1% of its territory is mountains, 33.5% is plains and 20.4% is plateaus. It is the 62nd largest city in Turkey by surface area and the 13th largest city by population (AFAD, 2022). Figure 3 shows Hatay provience map.

Figure 2. Hatay province location map (AFAD, 2022)

Figure 3. Hatay Province map (AFAD, 2022)

The biggest natural disaster that puts the province of Hatay at risk is an earthquake. The merging of the East Anatolian Fault Zone and the Dead Sea Fault Zone in the Amik Plain, the fault branches extending to Antakya, Yayladağı and Samandağ, the faults in the Mediterranean are the most important earthquake sources of the province. The central districts of the province, primarily Antakya and Defne, and the districts of Hassa, Kırıkhan, Reyhanlı, Dörtyol, Erzin are located on active fault lines or zones. The settlement of Antakya district, which has a high population, sits on fault lines/zones, and its location on alluvial ground indicates that liquefaction events may occur in a major earthquake. Active fault zones passing in the northeast-southwest direction can be clearly observed with the sudden steepness created in the topography of the skirts of Habib-i Neccar Mountain and the fault mirrors in the limestones forming the mountain, forming the border between the Asi River alluvium and Habib-i Neccar Mountain (AFAD, 2022).

It is very important to provide an effective sustainable disaster management after earthquakes. For this reason, the current situation in Hatay province will be determined after the earthquakes and the current situation will be analyzed with the Fishbone Method in order to provide sustainable disaster management. Thanks to the Fishbone Method, what can be done for sustainable disaster management in Hatay will be discussed and suggestions will be presented.

The fishbone method is employed to determine potential root causes of a certain issue or condition. Using statistical techniques and depending on the findings of the study, it can visually portray the sources of the issue in a way that reveals the cross-relationship between the outcomes and the reasons that led to them (Eraydın et al., 2019). Fishbone charts, also known as Ishikawa diagrams or cause-effect charts, were developed by Dr. It is stated as one of the problem solving tools created by Kaoru Ishikawa (Clary & Wandersee, 2010). Since the image of the drawn graph resembles a fishbone, it is called a fishbone graph. The head of the fish shows the main problem. The fishbone plot is typically rendered from right to left, showing smaller bones as more detail is drilled so that each larger fish bone can be branched. Detailed analysis of the problem is carried out in four steps. These steps are to clarify the main problem, develop a fishbone diagram by defining the sub-dimensions, incorporate stakeholder analysis into the evaluation, and create an unbiased perspective based on the analysis of the problem (Li & Lee, 2011).

Thanks to this type of diagram (Atalay & Kılıç, 2015);

- Streamlining the problem-solving process,

- Revealing all that is known about the problem, a systematic approach from the known to the unknown,
- It may be possible to benefit from the expertise of people who have direct experience with the problem.

The steps to be followed while creating the cause-effect diagrams are listed below; In the distribution analysis, first the problem to be developed must be determined. After the problem is determined, the main line of the cause-effect diagram is created as given in Figure 4 and the main problem to be solved is written (Atalay & Kılıç, 2015).

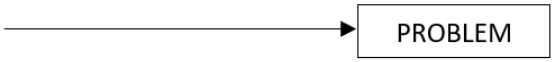

Figure 4. Cause - effect diagram phase 1 (Atalay & Kılıç, 2015)

The possible causes of the problem should be determined and gathered under the main headings. In order to convey all the reasons, the opinion of everyone involved in the problem should be sought. These main reasons, which are generally determined in the production sector, are grouped as method, machine, manpower and material. However, these reasons may differ according to the analyzes made (Atalay & Kılıç, 2015). The main reasons identified are added to the graph as shown in Figure 5.

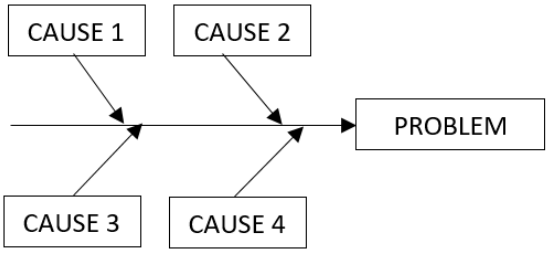

Figure 5. Cause - effect diagram phase 2 (Atalay & Kılıç, 2015)

All members within the scope of the project determine the sub-reasons of these main reasons found by brainstorming method. The important point at this stage is that the people participating in the brainstorming have information about the project and the problem. In this way, real reasons can be reached (Atalay & Kılıç, 2015). In Figure 6, the state of the graph after this phase is given.

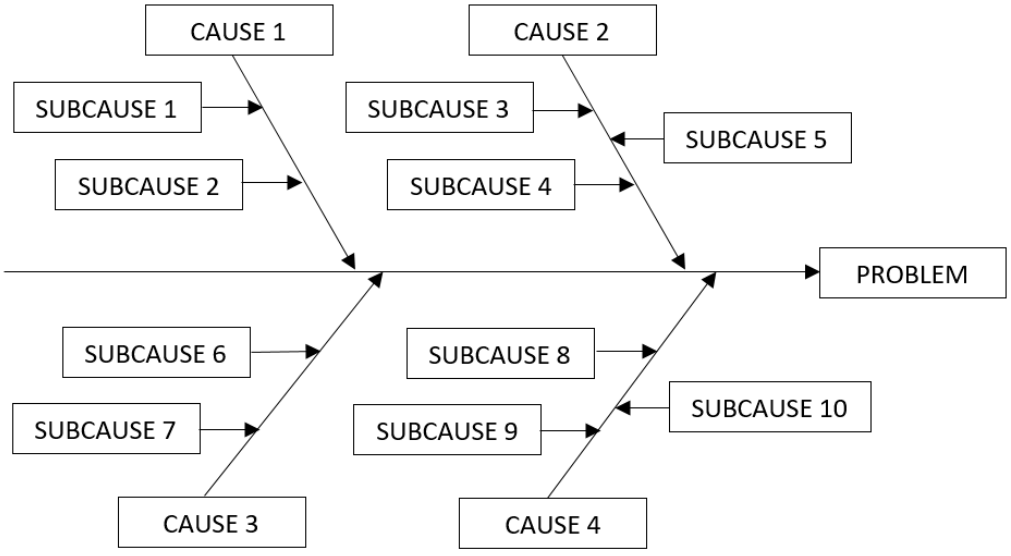

Figure 6. Cause - effect diagram phase 3 (Atalay & Kılıç, 2015)

In the final stage of drawing the cause-effect diagrams; The sub-reasons written in accordance with the determined main reasons are evaluated by the people participating in the brainstorming. Individuals give points according to their order of importance, one by one. As a result of the scoring, the total score determined by the individuals is given to each sub-reason. The sub-reason that gets the most votes is determined, according to the root cause analysis, the source point of the problem is the sub-reason that gets the most votes. After this sub-reason, which received the most votes, efforts should be made to improve and eliminate the cause. Over time, the resulting diagram needs to be updated (Atalay & Kılıç, 2015).

4. Findings and Discussion

The Pazarcık (Mw 7.7; focal depth: 8,6 km) and Elbistan (Mw 7.6; focal depth: 7 km) districts of Kahramanmaraş were the epicentres of two significant earthquakes that struck Turkey on February 6, 2023, at 04:17 and 13:24, respectively. Another 6.4-magnitude earthquake with its epicentre at Yayladağı, Hatay, occurred on February 20, 2023, at 20:04 local time (SBB, 2023). In this section, the situation of Hatay province after the earthquakes is discussed.

4.1. Emergency Response Processes After Earthquake in Hatay

It has been observed that the citizens affected by the earthquake meet their vital needs such as shelter and nutrition through their relatives and relatives in the region. It has been observed that search and rescue activities are carried out by volunteer teams from international organizations as well as miners, voluntary organizations and AFAD. It has been observed that tents and AFAD coordination points in Hatay are not created in a regular and planned manner, but are scattered in marketplaces, parks or city squares. It has been observed that vital needs such as nutrition and cleaning are not adequately met in these areas (TMOBB, 2023).

It has been discussed that there are security problems, especially in certain areas of the city, and that security forces keep watch, but it is not sufficient. It was observed that the materials inside the building were emptied, and the cash registers of some banks were removed from the buildings, most of which were observed to be heavily damaged. It has been learned that non-governmental organizations and volunteer teams participating in search and rescue efforts in Antakya and Samandag have gradually withdrawn from the field due to security problems (TMOBB, 2023).

Aid materials sent to the city are distributed with the coordination of voluntary organizations and professional chambers. Unlike the systems implemented in the past, aids; After they are prepared in packages according to the lists received from the needy, they are delivered to the relevant people (TMOBB, 2023).

4.1.1. Hatay - Payas

AFAD did not carry out search and rescue activities due to the lack of teams in the district and the magnitude of the destruction in the region. As of February 16, 2023, search and rescue, removal of the missing and debris removal works in the district are carried out by the Municipality and District Governorship (TMOBB, 2023).

4.1.2. Hatay-İskenderun

It has been reported that search and rescue efforts could not be carried out actively in the first three days of the earthquake in Iskenderun, as in the city center of Antakya (TMOBB, 2023). Figure 7 shows İskenderun – General Directorate of Highways, former Construction Site / Disaster and Emergency Assembly Area.

Figure 7. İskenderun – General Directorate of Highways, former Construction Site / Disaster and Emergency Assembly Area (TMOBB, 2023)

4.2. Planning Decisions, Structural Damages and Losses in Hatay

According to Law No. 6306, a total of 37 problematic zones (1,237 hectares) were identified in the earthquake-affected provinces, and 17,686 of the 83,634 risky structures there were removed. In terms of the determination of unsafe structures on a plot basis, 64,033 buildings in total were deemed risky and destroyed (Türkiye Earthquakes Recovery And Reconstructıon Assessment, 2023). Table 1 shows Distribution of Risky Areas and Buildings in Hatay.

Table 1. Distribution of risky areas and buildings in Hatay (SBB, 2023)

Province	Number of Risky Buildings	Risky Areas		
		Number of Areas	Number of Detached Units	Number of Demolished Units
Hatay	9.612	2	6.215	250

As part of efforts to improve urban neighborhoods, dangerous buildings were partially renovated in places where the financing was reliant on price rises from prior projects. As a result, there are now brand-new residential districts with densely packed buildings (SBB, 2023).

Although the number of destroyed buildings in Belen and Defne districts of Hatay is low, it has been observed that all structures are at least moderately or heavily damaged. It has been observed that low-rise buildings and small industrial sites that have not received qualified architectural and engineering services in Defne district and Antakya have been severely damaged or destroyed. However, in the recent past, after the 2007 and 2018 updates of the Turkish Building Earthquake Code, intense damage has also been observed in the structures built. It has been observed that the soft floor effect is intense on the floors where residential and commercial functions are used together and commercial activities are carried out in most buildings (TMOBB, 2023). Figure 8 shows Hatay – city center heavily damaged and destroyed buildings.

Figure 8. Hatay – city center heavily damaged and destroyed buildings (TMOBB, 2023)

In the city center of Antakya, public buildings, religious buildings, civil buildings and residences have been destroyed or damaged. Figure 9 shows Hatay Cultural Center damaged after 6 February 2023 earthquakes.

Figure 9. Hatay Cultural Center damaged after 6 February 2023 Earthquakes (TMOBB, 2023)

The lodging issue is made worse by the continued negative effects of earthquakes as well as the circumstances and uncertainties in the earthquake-affected region (SBB, 2023).

Table 2. Damage Control Report by Province as of 06 March 2023 (SBB, 2023)

Province	Total Number of Urgent + Severely Damaged + Collapsed Houses	Number of Moderately Damaged Houses	Number of Lightly Damaged Houses
Hatay	215,255	25,957	189,317

After damage control measures and the beneficiary identification process are finished, the number of homes to be built and the institutions through which such homes will be built will be made clear (SBB, 2023). The number of housing units planned for construction in the Hatay, applicable as of 3 March 2023, is provided in the table 3 below.

Table 3. The number of housing units planned for construction in the Hatay, applicable as of 3 March 2023 (SBB, 2023).

Province	Number of Planned Houses	Number of Planned Village Houses
Hatay	146,650	14,997

4.2.1. Hatay-Payas

In the district center, the ground-floor floors of the buildings used for commercial activities have been severely damaged and destroyed due to collapses in these parts. It was reported that the columns were cut and structural changes were made during the interventions made for commercial functions (TMOBB, 2023).

4.2.2. Hatay-İskenderun

Many buildings on the beach and in the center of the city were destroyed and severely damaged, and many lives were lost. In the city center of Iskenderun, liquefaction, subsidence and swellings were observed in the ground on Cengiz Topel Street and Atatürk Boulevard on the coastline. It was observed that the structures on the boulevard collapsed to the ground by 1 meter. On the second day of the earthquake, the sea level rose and the structures and roads on the beach were submerged (TMOBB, 2023). Figure 10 shows İskenderun Cengiz Topel Street.

Figure 10. İskenderun Cengiz Topel Street (TMOBB, 2023)

The construction on Cengiz Topel Street, which was limited to 2 floors in the past, was then allowed up to 4 floors. While the buildings built in accordance with these regulations on the coastline were not destroyed in the earthquake, the buildings with illegal floors in violation of the zoning rules were demolished. The 8-storey Eda Apartment, located on the beach, was demolished as a result of the construction of 4 more floors on top of the 4 floors allowed in the zoning rules. It has been learned that the other two buildings on the beach, which were demolished, had illegal floors over 4 floors (TMOBB, 2023). Figure 11 shows İskenderun – Eda apartment.

Figure 11. İskenderun – Eda Apartment (TMOBB, 2023)

In the area known as Adana Road in the city, the multi-storey buildings built in 1980 and later were demolished. Many structures at the intersection known as Pac Square were destroyed or badly damaged (TMOBB, 2023).

4.2. Structural Damages in Public Buildings, Public Services, Transportation and Infrastructure Problems

It has been observed that the public buildings in the city were also heavily damaged, and the reinforced concrete building of the Government House as well as the registered structure of the Hatay Governorate was heavily damaged. It was learned that an examination was made in 2012 that the reinforced concrete structure carries risks (TMOBB, 2023).

Due to the lack of cleanliness and hygiene conditions in the city, there is a risk of spreading epidemics. It has been observed that there are breaks due to collapse and elevation due to the earthquake on the divided road between Hatay and Gaziantep, which continues over Kırıkhan. Flights are not possible in the city due to the break in the airport runway and structural damage to the ground of the terminal building. It has been observed that the roofs of TOKİ houses located in Hatay Altınçay Neighborhood have slipped and structural damage has been observed in the buildings (TMOBB, 2023).

It was observed that the District Directorate of National Education building, which is one of the public buildings in Belen, Hatay - Belen, Defne and İskenderun Districts, was heavily damaged. It has been learned that as of February 12, 2023, education, housing and administrative public buildings in Defne District are at least moderately or heavily damaged. No significant damage has been observed in the Bus Terminal in the district, and the terminal actively serves in the evacuation of the city. Approximately 150 patients in the İskenderun State Hospital, along with their healthcare workers and patient attendants, were destroyed. It is stated that 250-300 people lost their lives in the building. It was learned that an examination was made in 2011 that the hospital structure carries risks (TMOBB, 2023).

In the 17 universities in the earthquake-affected provinces, a total of (SBB, 2023);

- 9 service buildings, with a total indoor area of 7,714 m2, collapsed,
- 111 service buildings, with a total indoor area of 273,293 m2, were severely damaged,
- 51 service buildings, with a total indoor area of 338,805 m2, were moderately damaged,
- 358 service buildings, with a total indoor area of 1,894,152 m2, were lightly damaged.

Table 4 shows damage assessment for university structures in Hatay.

Table 4. Damage assessment for university structures in Hatay (SBB, 2023)

University	Number of Collapsed Buildings	Number of Severely Damaged Buildings	Number of Moderately Damaged Buildings	Number of Lightly Damaged Buildings	Unusable Buildings (m^2)	Buildings Requiring Reinforcement (m^2)
Hatay M. Kemal University	7	24	2	1	35,982	2,211
Iskenderun Technical University	-	2	2	10	12,287	96,833

It is essential to repair the damage of moderately and slightly damaged structures and to make them earthquake resistant.

In terms of the dormitories in the provinces affected by the earthquake (SBB, 2023):

- 5 dormitory buildings with a total indoor area of 28,279 m2 were severely damaged,
- 19 dormitory buildings with a total indoor area of 128,684 m2 were moderately damaged,
- 52 dormitory buildings with a total indoor area of 320,802 m2 were lightly damaged.

Table 5 shows damage status of dormitories in Hatay.

Table 5. Damage status of dormitories in Hatay (SBB, 2023)

Province	Collapsed (m2) (Needs to be reconstructed)	Severely Damaged (m2) (Needs to be reconstructed)	Moderately Damaged (m2) (can continue operating only through being strengthened)	Lightly Damaged (m2) (can continue operating through minor repairs)	Total Estimated Cost (TRY)
Hatay	-	11,639	44,940	12,669	370,586,856

4.3. Cultural Heritage, Urban and Rural Heritage

In Hatay, the Government House (Governor's Office), Habib-i Neccar Mosque, Ulu Mosque, Sarımiye Mosque, Antakya Synagogue, St. Paul's Orthodox Church, Hatay Assembly were severely damaged or largely destroyed. Today, Kurtuluş Street, which is the first illuminated street of Anatolia and located within the boundaries of urban and / or archaeological sites, and the historical texture around it have been largely destroyed and it has been determined that the registered civil architectural works have been heavily damaged (TMOBB, 2023).

After the earthquake that took place in Hatay on February 20, 2023, it was learned that the Government Mansion (Governorship) building, which was heavily damaged, was demolished. In addition, heavily damaged structures and registered civil architectural works in Kurtuluş Street and its surrounding historical texture were destroyed (TMOBB, 2023).

4.4. Evaluation

According to TMOBB (2023), within the scope of the observations and examinations made in the region, the main causes of structural damage in urban areas are similar to the earthquake damage experienced in the past;

- Zoning plans and plan amendments made without considering disaster data,
- Encouraging illegal construction through zoning amnesty, projects and practices contrary to zoning rules, illegal constructions,

- Opening of agricultural lands and soils with low carrying capacity for construction,
- Exclusion of qualified architectural, engineering and planning services from the building production and inspection process,
- Lack of technical staff and lack of supervision in the fields of professional expertise,
- Failure to establish a structure-ground relationship, construction on floors that are not suitable for the load of the building,
- Deterioration of the ground-structure relationship by increasing the building load with high-rise buildings,
- Soil liquefaction,
- Damages caused by not choosing the appropriate foundation,
- Making architectural and structural system designs that do not take into account seismic loads,
- Incorrect material selection, workmanship and applications,
- Low concrete quality,
- Use of flat reinforcement and insufficient number of reinforcements,
- Using hollow blocks and beamless floors without taking the necessary precautions,
- Damages caused by interventions made during the usage process,
- Soft floor and short column effect due to renovations, wide openings, mezzanines and different floor heights due to commercial functions (market, gallery, office, etc.) on the ground floors of the buildings,
- The hammering effect appears as a result of not making the necessary arrangements in the adjacent building layout.

The devastating effects of earthquake disasters occur mostly in unstructured areas. These areas are generally poor and poorly built neighborhoods. Considering this situation, it is understood that the destructive effect of the disaster is not a work of nature, but a result of the system established by man. For this reason, the system should be considered as a whole in order to reduce the destructive effects of disasters, and legal, administrative, social and economic developments should be provided together (Kepenek & Gençel, 2016). This situation, which was caused by unplanned construction, was also observed in the province of Hatay. Therefore, the earthquake had devastating effects.

Türkiye Earthquakes Recovery and Reconstruction Assessment (TERRA) identifies five principles to guide the reconstruction efforts:

- Rebuild resilient communities, institutions, and structures better.
- Use eco-friendly strategies to ensure a sustainable future.
- Accountable choices that involve those who will be impacted.
- The aim of education, policy, and practices is disaster risk reduction.
- Accountable choices that involve those who will be impacted.
- In all relief, restoration, and construction operations, leave no one behind.

The TERRA also identifies sectoral priorities for recovery and reconstruction, including:

Society

- Improve public services both inside and outside earthquake zones.
- Rebuild the educational and health systems.
- Social support and defense of vulnerable groups.
- Provide all impacted parties with psychosocial help.

Economy

- Restore agriculture and make it climate-proof.

- A common vision for regional economic growth and recovery.
- Draw in, keep, and upskill the workers to fend off a labor outflow.
- Digitalize and modernize your firm, and "buy local"

Infrastructure

- Repair and update transportation and communication systems.
- Protecting cultural heritage is essential to preserving local identity and boosting tourism.
- Spatial planning and regulation based on science for urban renewal and housing rebuilding.

Environment

- Restore energy supply in line with the net-zero goal.
- Natural remedies, such as ecosystem restoration.
- Improving disaster management and education.
- Responsible waste management using repurposed materials.

4.4. Analysis of The Factors that Adversely Affect Sustainable Disaster Management Using Fishbone Method; Hatay Province Example

After the earthquakes in Hatay, the importance of sustainable disaster management was revealed. It is not always possible to successfully implement sustainable disaster management. In order to understand the reasons for this and to ensure sustainable disaster management, the fishbone method will be used in this section.

A new understanding is required in the steps to be taken so that the losses experienced are not repeated. This provides green recovey. WWF (2023) has put forward a number of principles for green recovery.

Analysis will be made by fishbone method, taking into account the latest situations in Hatay. First, ineffective sustainable disaster management is chosen as the main problem. Then, the main causes that may cause this situation to occur are determined. Principles set by WWF (2023), formed the main causes for the fishbone diagram. The main causes can be listed as follows:

- Environmental impact and precautions
- Energy
- Management
- Infrastructure
- Nature
- Water and cleaning
- Agriculture and Food.

Finally, a fishbone diagram is created by adding sub-causes to these causes (Figure 12). Then, the main causes will be discussed under headings and what can be done for effective sustainable disaster management will be discussed.

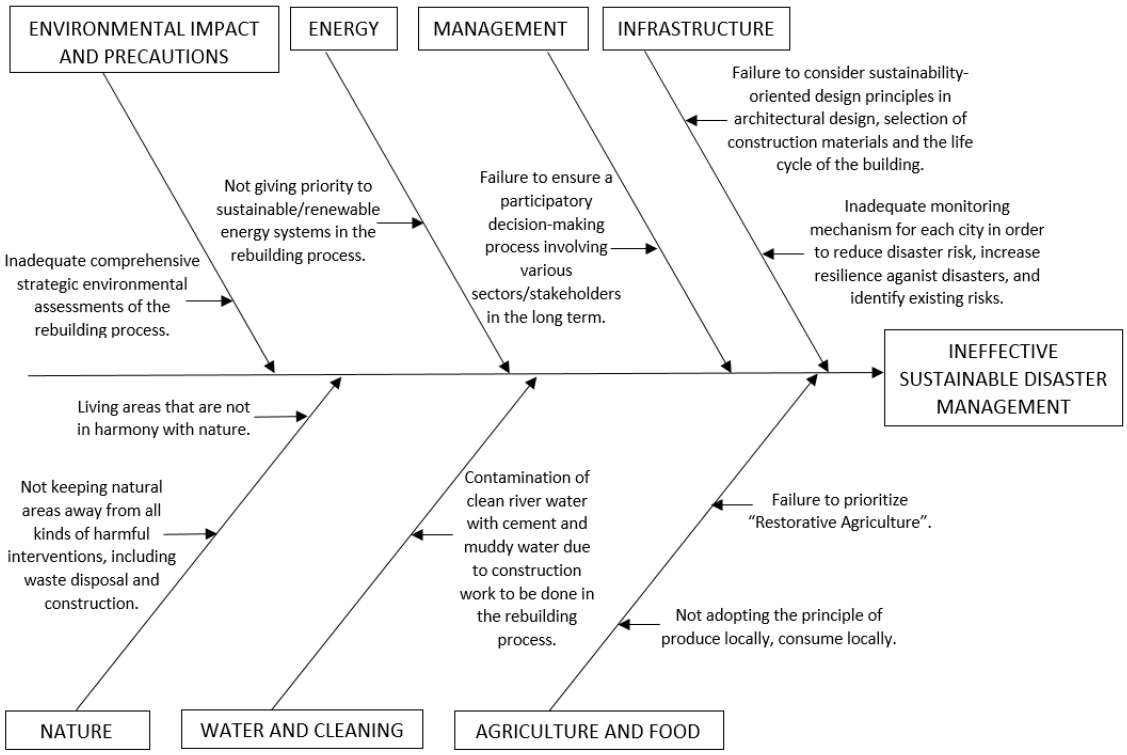

Figure 12. Analysis of the factors that adversely affect sustainable disaster management using Fishbone Method (Edited by the Author)

Environmental impact and precautions

- A comprehensive strategic environmental assessment of the rebuilding process should be undertaken. On the project basis, environmental impact assessment (EIA) should be included in the process, and post-disaster needs and environmental problems should be addressed by considering that human well-being and nature's health are a whole.
- For the environment and human health, scientific approaches should not be compromised in the disposal of materials containing harmful chemical content. In order to protect underground and surface water resources, soils that will not allow leakage should be preferred in the selection of sites where such wastes will be dumped.

Energy

- Sustainable/renewable energy systems should be given priority in the rebuilding process. In addition, the access of individuals to energy, especially the disadvantaged groups, should be secured. Planning of residential and production areas, design and construction of new buildings should aim to minimize energy consumption.

Management

- The restructuring process, if carried out in a sustainable way, can offer infrastructure improvement opportunities that can have positive results for the environment and people. In the long run, it is important to ensure a participatory decision-making process involving various sectors/stakeholders.
- Remediation activities should be appropriate to local conditions, remembering that each disaster has its own characteristics; Local knowledge, experience and capacity should be utilized as much as possible for public interest and support.

Infrastructure

- Architectural design, selection of construction materials and sustainability-oriented design principles in the life cycle of the building should be considered, and this approach should be taken

as a basis throughout the entire construction cycle. Flexibility of use, building and material life, local climatic conditions, energy efficiency, waste management and sustainable water and energy systems must be taken into account.

- Sustainable materials should be used for post-disaster construction that will protect both people and the environment, their supply should be supported, designs that require relatively less material should be applied, local resources should be used as much as possible, disaster residues should be evaluated, and recycled materials should be preferred.
- Monitoring mechanisms should be developed for each city in order to reduce disaster risk, increase resilience against disasters, and identify existing risks.

Nature

- The aim of the reconstruction process should be to go beyond pre-disaster conditions in all aspects (life safety, urban fabric, natural environment, etc.).
- Reconstruction projects should be designed, implemented, monitored and evaluated in such a way as to identify environmental problems in the region, minimize negative environmental impacts and support positive environmental impacts. In this context, nature-based solutions should be taken as basis in the construction of new living spaces.
- In the redevelopment of post-disaster cities and new living spaces, open spaces and green spaces of sufficient size, number and scale should be created where people can breathe and need in times of disasters.
- For the sustainability of ecosystem services and human well-being, all kinds of protected areas such as national parks, wildlife protection areas, wetlands, natural sites, drinking water basins, rivers, coasts and important natural areas, forests and pastures, waste disposal and construction should be kept away from harmful interference.
- "Nature/environment" should be included as a value in social programs and projects to be initiated to improve post-disaster livelihoods and reduce disaster risk, and the relationship between the benefits of the project and the environment should be understood by the citizens and the project should be supported.

Water and Cleaning

- Construction work to be undertaken during the rebuilding process may pose a risk of contamination of clean river water with cement and muddy water. Negative effects on surface water and groundwater quality, especially in areas close to natural water bodies, should be avoided.
- This process should include innovative water and sanitation solutions that can make people more resilient to potential future disasters and reduce long-term impacts on ecosystems. Technology options such as domestic water treatment technologies, treatment wetlands, waste water management and solid waste management should be evaluated.
- Innovative solutions/models such as "sponge city", "rainwater harvesting" and "closed loop systems" should be included in the plans for the sustainability of water resources in the rebuilding process of destroyed settlements.

Agriculture and Food

- In the redevelopment of agriculture in rural areas, it should be essential to prioritize "regenerative agriculture" that protects, repairs and enriches the soil, improves water resources and improves ecosystem services, and adopts the principle of "produce locally, consume locally" for nature and human health.

In order to make sustainable disaster management effective, the process must be handled as a whole. In addition to post-disaster reconstruction studies, disaster prevention studies should also be given importance. Nature/environment should be considered as an integral component of the disaster

management strategy so that habitats can be rebuilt more safely and be stronger against similar shocks that may be encountered in the future (WWF, 2023).

The factors that negatively affect an effective sustainable disaster management for Hatay are handled with the fishbone method. These factors are discussed under the main headings and what can be done to make sustainable disaster management effective has been examined under these headings.

The analysis revealed the following: Preventive and risk-reducing studies should be given importance as much as the cyclical integrity of the process and the reconstruction efforts made after the disaster, in overcoming major disasters such as earthquakes with the least possible loss of life, property and nature by managing them correctly.

5. Conclusion and Recommendations

As stated in the evaluations and determinations shared with the public after the earthquakes in the past; The main factors of the destruction in the region are unplanned construction, the inability to provide access to qualified architecture and engineering services, the use of deficient and poor quality materials, the privatization of the building inspection process that should be carried out on behalf of the public, the failure of the local administrations and the central administration to fulfill their public inspection duties, the illegal and zoning amnesty. It has been seen that insecure construction is encouraged.

It is an urgent necessity to make the existing constructions in urban and rural areas safe and primarily to identify and demolish dangerous structures, to examine the existing building stock, and to report the damage situation by expert professionals. These structural determinations and assessments are an absolute necessity to prevent and reduce the risks that damaged structures may create.

In addition, it is important to take measures to quickly eliminate the social, social, psychological and economic negativities experienced by the earthquake, and to ensure the active participation of both professional chambers and non-governmental organizations in the duties to be fulfilled by public institutions.

Things to Consider in the Recovery Process

- Professional Chambers and local and central administrations; Ensuring that the region continues its investigations and studies in cooperation and coordination,
- Making disaster management and coordination qualified by taking into account the negativities and experiences in the region,
- Carrying out studies to transfer the experience and accumulation of all the disasters experienced in the past and the institutional memory of the relevant organizations to the next generations,
- Taking necessary precautions for the protection of traditional structures and social life in rural areas and village settlements,
- Taking measures to maintain social, social life and economic activities in the region,
- Important issues and titles such as the protection of the natural environment in the region, especially the Hatay Milleyha Bird Sanctuary and its surroundings, from the ruins and wastes of the collapsed structures, should be taken into consideration.

Architects have a lot of responsibility in sustainable disaster management. Architects need to design green buildings in harmony with nature. As an example of these; to use renewable energy sources like wind and solar energy to meet energy needs, to use energy-saving lighting and electronics, to prioritize non-toxic and recyclable building materials, to design excessively large spaces with smaller but more effective spaces, to avoid harming the environment, With the right site, it is feasible to use native vegetation in its landscape, allow rainwater to be recycled, and make the most of sunlight and wind.. In addition to all these, the way to build cities that can survive against the negative effects of climate change is to produce resistant structures. Architects should also adopt sustainability-oriented design principles, taking this into account.

It is no longer enough for buildings to be nature-friendly only. At this point, structures should be built to withstand natural disasters and man-made disasters. Architects should investigate the natural

disasters that may occur in the area where the building will be built. It should build structures that are resistant to disasters. The fight against disasters should be comprehensive from landscaping to building design. The measures to be taken must remain up-to-date and innovative solutions must be found.

Acknowledgements and Information Note

The arcticle complies with national and internationalresearch and publication ethics. Ethic Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. We hereby declare that there is no conflict of interest.

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