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Evaluation of Post-Disaster Temporary Shelter Quality Criteria in the Context of Sustainability

Afet Sonrası Geçici Barınma Kalite Kriterlerinin Sürdürülebilirlik Bağlamında Değerlendirilmesi

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ABSTRACT

Disasters, regardless of their type, create similar socio-economic and physical challenges on a global scale. Among these, the provision of shelter stands out as one of the most critical components in meeting the basic needs of affected populations. Post-disaster temporary shelter solutions vary depending on the type of disaster, the demographic structure of the affected population, specific user needs, available resources, and the priorities of decision-makers. This diversity complicates the development of a standardized framework for assessing the quality of temporary shelter units. The absence of reliable and comparable data sets that stakeholders can refer to during decision-making processes limits the adoption of sustainability-based approaches in shelter planning and creates various challenges during implementation. This study aims to reassess the quality criteria of temporary shelter units from a sustainability perspective. For this purpose, academic publications on post-disaster temporary sheltering published over the last decade were systematically reviewed, and the findings were analyzed using a meta-analysis method. The identified quality criteria were categorized under four dimensions of sustainability: environmental, social, economic, and technical. Based on these categories, a comprehensive pool of criteria was developed, and the interrelations among them were examined to propose a structural framework for quality assessment. The study concludes with recommendations for quantification methods and mathematical models that can guide future evaluations of temporary shelter units. By providing sustainability-oriented insights into the quality analysis of post-disaster shelter solutions, this research serves as a preliminary guide for future studies in the field.

Keywords: Post-disaster temporary shelter, Quality assessment, Sustainability, Meta-analysis

ÖZ

Afetler, türsel farklılıklar gösterse de küresel ölçekte benzer sosyo-ekonomik ve fiziksel zorluklar yaratmaktadır. Bu zorlukların başında, afetzedelerin temel ihtiyaçlarının karşılanması sürecinde en kritik konulardan biri olan barınma gelmektedir. Afet sonrası geçici barınma çözümleri; afetin türü, etkilenen nüfusun demografik yapısı, kullanıcıların özel ihtiyaçları, mevcut kaynaklar ve karar verici aktörlerin öncelikleri doğrultusunda çeşitlilik göstermektedir. Bu çeşitlilik, geçici barınma birimlerinin kalitesinin değerlendirilmesine ilişkin standart bir veri altyapısının oluşturulmasını zorlaştırmaktadır. Paydaşların karar alma süreçlerinde başvurabilecekleri güvenilir ve karşılaştırılabilir veri havuzlarının yetersizliği, afet sonrası barınma planlamalarında sürdürülebilirlik temelli bir yaklaşımın benimsenmesini sınırlamakta ve uygulamaya geçiş süreçlerinde çeşitli problemler ortaya çıkmaktadır. Bu çalışma, söz konusu sorunsalı temel alarak, geçici barınma birimlerinin kalite kriterlerini sürdürülebilirlik ekseninde yeniden değerlendirmeyi amaçlamaktadır. Çalışma kapsamında, son on yıl içerisinde yayımlanmış afet sonrası geçici barınmaya ilişkin akademik yayınlar incelenmiş ve elde edilen bulgular meta-analiz yöntemiyle değerlendirilmiştir. Analiz, kalite kriterlerini çevresel, sosyal, ekonomik ve teknik sürdürülebilirlik boyutları altında gruplandırarak kapsamlı bir kriter havuzu oluşturmuştur. Ayrıca, bu kriterler arasındaki ilişkiler değerlendirilmiş ve kalite analizine temel oluşturabilecek yapısal bir çerçeve önerilmiştir. Sonuç bölümünde, gelecekte yürütülecek çalışmalarda kullanılmak üzere geçici barınma birimlerinin kalite değerlendirmesine yönelik sayısallaştırma ve matematiksel model önerilerine yer verilmiştir. Çalışma, afet sonrası barınma çözümlerinin kalite analizine yönelik sürdürülebilirlik ekseninde öneriler sunmakta olup, bu alandaki araştırmalar için başlangıç niteliğinde bir rehber olarak değerlendirilmektedir.

Anahtar Kelimeler: Afet sonrası geçici barınma, Kalite değerlendirmesi, Sürdürülebilirlik, Meta-analiz

Introduction

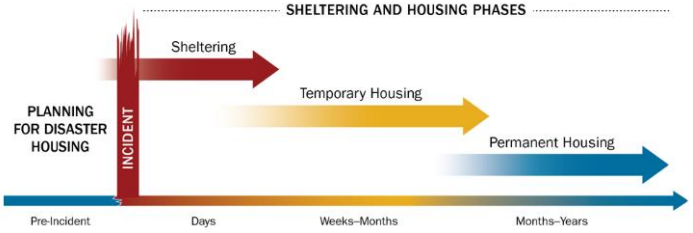
Earthquakes, fires, floods, tsunamis and man-made disasters, which are included in the scope of natural disasters, have the potential to disrupt the existing order, displace disaster victims, and affect infrastructure and buildings (Rakes et al., 2014; Moreno-Sierra et al., 2020). Because of more than 10,000 natural disasters that have occurred in the world since the 21st century, more than 4.6 billion people have been affected and these disasters have caused more than 1.6 million deaths (URL-1). After the disaster occurs, disaster victims need to remain resilient against physical destruction and receive psychological support. The post-disaster sheltering process (Song et al., 2016) supports this situation. Along with the sheltering process, one of the most important steps is to provide a habitable space for disaster victims to make them feel safe again (Ayvaz & Arpacıoglu, 2024; Savaşır, 2008). This situation is directly related to Article 25 of the Universal Declaration of Human Rights, which states, “Article 25: The Right to an Adequate Standard of Living: This right includes the right to food, clothing, housing, medical care and necessary social services, and to security in the event of unemployment, illness, disability, widowhood, old age, or lack of livelihood due to circumstances beyond [one's] control.” (UDHR, 1948).

Post-disaster sheltering processes are also examined in different stages in terminology. While Quarantelli (1995) distinguishes the types of shelter as emergency gathering areas, temporary shelter, temporary housing, and permanent housing; Limoncu and Bayülgen (2005) associate the types of shelter with the disaster phases and associate the emergency relief phase as tent, shelter in social facility; rehabilitation phase as temporary shelter in other regions, collective temporary shelter or temporary housing; and reconstruction phase as permanent housing. Can and Saka (2022) determined that emergency shelters include gyms, collective shelters such as dormitories, or tent cities; and temporary shelters as pre-planned areas suitable for comfort conditions. FEMA (2020) defines post-disaster sheltering types in three groups: sheltering, which takes place immediately after the disaster and represents safe areas, temporary housing, which represents all types of settlements between sheltering and the construction of permanent housing, and permanent housing built during the reconstruction process (Figure 1).

This study focuses on temporary shelter. Temporary shelter is also accepted as units where disaster victims meet their shelter needs until permanent housing is built after an earthquake (Avlar et al., 2023). Temporary shelter covers the types of shelters used during the period between the completion of shelter needs in reliable existing structures (dormitories, sports centres, etc.) after the disaster occurs and the completion of the construction of permanent housing during the reconstruction process and the delivery of these to disaster victims. Temporary sheltering describes the gap between the construction of permanent housing and the next phase (Johnson et al., 2006).

Within this logic, it is a process that encourages the continuation of normal life after a disaster and provides a basic perspective on reconstruction (Felix et al., 2013; Johnson, 2007). The existence of different perspectives on temporary shelter units designed and implemented to ensure a normal life process fosters uncertainty about which shelter unit is of better quality. The need for quality assessment to be carried out within the framework of certain criteria constitutes the main subject of the study. In this context, the study first analyzed the related studies within the scope of design, sustainability and quality. In the next section, information about the problem description, research questions and the applied method was given. Section 4, the meta-analysis method was detailed and the studies obtained as a result of the analysis are grouped under certain headings. Section 5, the quality criteria of the studies were determined in the context of sustainability and each title was discussed. In the last chapter presents the result and implications of the study. This section provides insights on the quality assessment of temporary accommodation units for future studies.

Figure 1.
Types and processes of sheltering after a disaster FEMA (2020)



Background and Related Works

Design of post-disaster shelter

Rakes and his team (2014) presented a model proposal that meets the needs of the existing temporary shelter alternatives. As seen in the relevant literature, although there is a temporary shelter design approach after the disaster, Perrucci and his team (2016) renewed the study and there is still no solution. The author, who considers that the factor that complicates the problem is the clear determination of the purpose of shelter use, stated that the duration of temporary shelter varies - months or years.

The design and implementation of temporary shelter units is a very common approach in the literature. Presenting the design, production and process stages of shelter units against a possible disaster in detail (Avlar et al., 2023), a new shelter design to offer flexible and transformable spaces with a kinetic architectural perspective (Ayanoglu & Erbaş, 2023; Kawuwa, 2017; Maden, 2023; Sarıcıoğlu, 2017), local materials and techniques (Barbosa, 2014), dismountable, simple, fast, lightweight digital production (Can and Saka, 2022), comfort-oriented better living standards (Nasution, 2017).

The common aims of the studies are that the temporary shelter design is not sustainable, and since it is produced outside the disaster area, it does not provide comfortable living conditions for the victims (Avlar et al., 2023). From the strengthening perspective, it is also clear that the temporary shelter units designed after the disaster are seen as a product rather than a process and are not evaluated within the scope of sustainability (Pomponi et al., 2019). In addition, short-term shelter solutions are based on universal prototypes, do not take into account the local culture and climate, and are aimed at providing quick assistance rather than contributing to the long-term reconstruction process after the disaster (Ayanoğlu & Erbaş, 2023; Wagemann, 2015).

Sustainability of post-disaster shelter

The rapid provision of temporary shelter units to the victims after the disaster occurs and the lack of design perspectives suitable for the real scenario before the disaster are criticized in the literature for the fact that temporary accommodation solutions are essentially unsustainable (Faragallah, 2021; Felix et

al., 2013). On the other hand, studies emphasizing the importance of sustainability have also been developed. By meeting the shelter needs, post-disaster sustainability can contribute to the environmental resilience process built with development principles (Guarnacci, 2012; Mayunga, 2009; Yi and Yang, 2014).

The main theme of post-disaster sustainability is defined under three main headings: environmental, social and economic (Halliday, 2008). For example, Hosseini et al. (2016) proposed a new model based on the sustainability concept of temporary shelter and determined the most sustainable technology to be used. The sustainability criteria at this stage were determined by the researchers themselves. These are economic (implementation cost and reuse cost), social (safety and customization) and environmental (resource consumption and emission) (Hosseini et al., 2016). Ahmed and Charlesworth (2015) proposed a model that evaluates resilience in post-disaster housing construction by adhering to the built-back better approach. Abrahams (2014), on the other hand, aimed to fill the gap in the literature on environmental sustainability efforts in post-disaster operations, although not specifically for post-disaster shelters, and to examine the post-disaster benefits and practices of sustainability. Pomponi et al. (2019) aimed to advance the global discussion within the scope of the sustainability of post-disaster shelters. In this context, they analysed sustainability indicators in social: Social status, Social Involvement of local people, Familiarity with intended users; Environmental: Local availability of materials required, Environmentally Healthy, Low environmental impacts; Economic: Low construction costs, long potential lifespan, Low life cycle costs. In addition, Technical: Easy to maintain, Safe, High construction speed indicator. Potangaroa (2015) presented the Qsand approach for sustainability criteria in the post-disaster reconstruction process in his study; in this approach, shelter and community, settlement, material and waste, energy, water and sanitation, natural environment, communication and cross-cutting issues are the main topics. Faragallah (2021) examined seven headings for a sustainable temporary shelter design in his study: economic, cultural, social and environmental concerns, construction, infrastructure and site organization. The researcher created these headings through examples. Montalbano and Santi (2023), on the other hand, analysed the sustainable approaches in the literature and presented three areas in their study, each with sub-requirements: environmental, economic and social.

Quality assessment of post-disaster shelter

Within the scope of disaster management, quality is associated with providing the necessary support quickly in the short term and providing high returns on humanitarian investment in the long term. In addition, it is assumed that the higher the user satisfaction rate in the recovery process after the disaster, the higher the quality of disaster management (Kirsch et al., 2012).

Quality management in disaster management is addressed in multiple aspects. Madu and Kuei (2014) proposed a new methodology for disaster relief supply chain quality management (DRSCQM) and argued that more sustainable and quality disaster relief practices can be developed from this perspective. Modgil et al. (2022), who conducted a disaster-specific quality assessment within the scope of humanitarian aid management, stated that many gaps need to be addressed as well as transparency of practitioners, policies, and financial challenges as a result of their comprehensive analysis. Seppänen and Virrantaus (2015) present a methodology that combines different aspects of the quality of basic information systems in disaster response and provides the necessary critical information. However, in addition to the studies clearly stating that there is a lack of information about quality in the context of disaster (Fritz Institue, 2006; Hallam, 1998; Watson, 2008), it is seen that the relationship between quality in post-disaster sheltering is addressed on a case-by-case basis. The assessment of post-disaster shelter quality is a complex process that requires a multidisciplinary approach. Many factors such as indoor quality (Mirza, 2020), temporary shelter policies (Lines et al., 2022), the needs of local communities (Tran, 2015) and architectural and engineering construction processes (Ayanoğlu & Erbaş, 2023) are among the factors affecting the success of this process. There is no common language among the perspectives used in the process of assessing sheltering quality.

Material and Methods

A selective overview of current literature shows that post-disaster temporary shelter has a strong relationship with sustainability. The fact that the guidelines and the sustainability topics were created from the researchers' perspectives proves that each study addresses different aspects of sustainability. It has been observed that the current research proposals have the following shortcomings:

- There is no clear perspective to determine the quality of shelter after a disaster.
- Sustainability criteria for temporary shelter after disasters are not dependent on detailed literature.
- The criteria derived from the literature study are not systematically analysed.

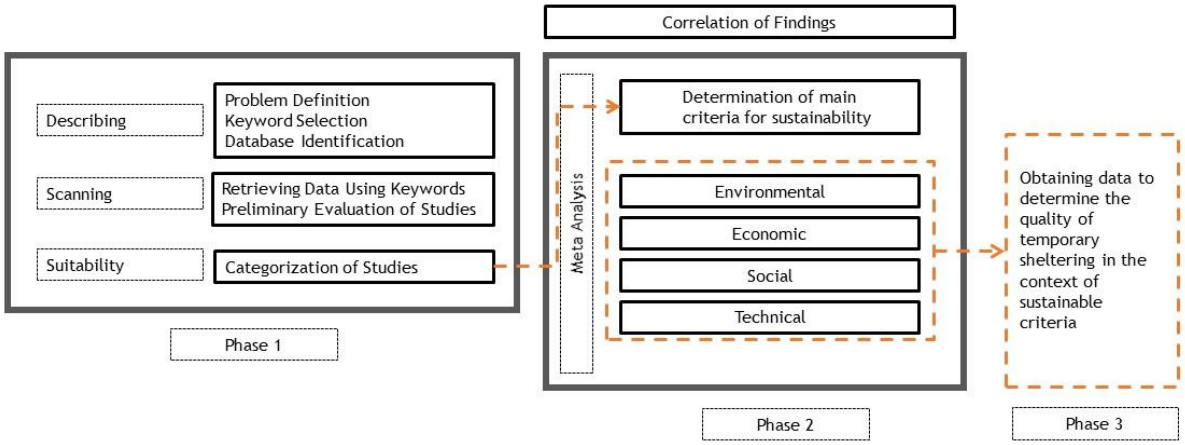
Two research questions were developed within the scope of the study to overcome these gaps in the literature and to complete these gaps:

1. How should the data required for quality assessment of post-disaster temporary shelter be obtained?

2. How should temporary shelter criteria be distributed within the scope of sustainability?

The flow chart used in the study is presented in Figure 2. The process was carried out in three main phases. The first phase includes the processes of describing, scanning, and suitability. In the describing phase, the problem was defined, keywords were determined, and the database to be used was selected. In this context, a total of 329 publications were accessed through a search using the keywords “post-disaster temporary shelter design” and “post-disaster temporary housing design” via the Web of Science search engine. In the first step of the scanning phase, publications that were not open access were excluded from the study. Then, a year range criterion was determined, and only studies published in the last ten years (2014–2024) were considered. Additionally, only publications in the field of architecture and in the form of journal articles were included in the analysis. In the suitability phase, 99 publications were subjected to a preliminary evaluation; 31 publications were included in the meta-analysis by re-analyzing them in terms of content suitability.

Figure 2.
Flowchart of the research Diagram (author's drawing).



Analysis

The meta-analysis method was first applied to these 31 publications. Meta-analysis, developed by Glass (1976), is defined as "the analysis of statistical analysis results." Considering the variability and frequency of data in the literature on a particular topic, making decisions solely by reading the studies may seem impossible (Harrison, 2011). Focusing on this deficiency, the aim of meta-analysis is to ensure the methodological rigor expected from empirical research in the literature review (DeCoster, 2009). This method is preferred in systematic data research within the framework of certain rules. The criteria obtained from this analysis constitute the second phase of the study. In this phase, the identified criteria were re-evaluated under the categories of environmental, economic, social, and technical within the framework of sustainability. As a result of the study, data were obtained to determine sustainability-based criteria related to the quality of temporary shelters. The full texts of the articles identified using the specified keywords and year range filters were analyzed. Most of the reviewed studies cover sheltering processes conducted after disasters such as earthquakes, tsunamis, and hurricanes. In addition, studies that are not disaster-focused and only concern shelter design were also identified. The publications vary according to countries and disaster types, and the topic of shelter has been addressed in the disaster management literature in both pre-disaster and post-disaster periods. The list of publications included in the meta-analysis is presented in Table 1. This table includes information on the author name, title, year, country of publication, and the type of disaster addressed. However, since the main objective of the study is to conduct a quality analysis of post-disaster temporary shelter units in the context of sustainability, the analysis of the study was structured to focus on the content analysis of the selected literature. Accordingly, findings corresponding to the shelter criteria identified in the texts were extracted, and the obtained data were classified and evaluated under sustainability headings.

Table 1.
List of publications included in the meta-analysis

n.	Author	Year of Study	Title	Country	Event
1	Albadra et al.	2018	Toward healthy housing for the displaced	UK	Jordan-refugee camps
2	Asali et al.	2019	Living on the move, dwelling between temporality and permanence in Syria	UK	Syria-displaces person
3	Avlar et al.	2023	Post-earthquake temporary housing unit: CLT E-BOX	Türkiye	-
4	Barbosa	2014	Capacity building through design innovation with vegetable fibres for temporary shelters	Brazil	Brazil-floods
5	D'Orazio and Maracchini	2019	An experimental investigation on the indoor hygrothermal environment of a reinforced-EPS based temporary housing solution	Italy	-
6	Dash et al.	2022	To study the material feasibility and propose design prototype for temporary housing structures for emergency relief	India	Odisha-cyclone
7	Felix et al.	2013	The role of temporary accommodation buildings for post-disaster housing reconstruction	Portugal	-
8	Hosseini et al.	2022	Sustainability Model to Select Optimal Site Location for Temporary Housing Units: Combining GIS and the MIVES-Knapsack Model	Spain	-
9	Kawakami et al.	2020	Onset and remission of common mental disorders among adults living in temporary housing for three years after the triple disaster in Northeast Japan: comparisons with the general population	Japan	Japan-earthquake
10	Kotani et al.	2020	Transition of post-disaster housing of rural households: A case study of the 2015 Gorkha earthquake in Nepal	Japan	Nepal-Earthquake
11	Li et al.	2023	Using the EEG+ VR+ LEC evaluation method to explore the combined influence of temperature and spatial openness on the physiological recovery of post-disaster populations	China	-

Table 1.
List of publications included in the meta-analysis (continued)

n.	Author	Year of Study	Title	Country	Event
12	Maiteh and Zoltan	2023	Descriptive comparative analysis of post-disaster settlements		
13	McConell and Bertolin	2019	Quantifying environmental impacts of temporary housing at the urban scale: Intersection of vulnerability and post-hurricane relief in New Orleans	Norway	New Orleans-hurricane
14	Miyaji et al.	2020	A study on the use of cyclone shelters in Bangladesh	Japan	Bangladesh-cylone
15	Montalbano and Santi	2023	Sustainability of Temporary Housing in Post-Disaster Scenarios: A Requirement-Based Design Strategy	Italy	Turkey-earthquake/ USA- katrina Italy-earthquake/ Japan-earthquake Moroccco-earthquake
16	Moreno-Sierra et al.	2020	The use of recycled plastics for the design of a thermal resilient emergency shelter prototype	Saudi Arabia	-
17	Parva and Rahimian	2014	Transformability as a factor of sustainability in post-earthquake houses in Iran: the case study of Lar city	Iran	Iran-earthquake
18	Perrucci et al.	2016	Sustainable temporary housing: Global trends and outlook	USA	-
19	Pezzica et al.	2022	The making of cities after disasters: Strategic planning and the Central Italy temporary housing process	UK	Italy-earthquake
20	Pusceddu et al.	2017	The use of building technology to support disaster resilience: the case study of air shelter house	Italy	-
21	Rakes et al.	2014	A decision support system for post-disaster interim housing	USA	-
22	Rapone et al.	2024	Investigating Advanced Building Envelopes for Energy Efficiency in Prefab Temporary Post-Disaster Housing	Italy	-
23	Salvalai et al.	2017	Architecture for refugees, resilience shelter project: a case study using recycled skis	Italy	-
24	Schmitt et al.	2023	Move up or move over: mapping opportunities for climate adaptation in Pakistan's Indus plains	USA	Pakistan-floods
25	Song et al.	2016	Life-time performance of post-disaster temporary housing: A case study in Nanjing	China	Nanjing-
26	Suriastini et al.	2023	Measuring Disaster Recovery: Lessons Learned from Early Recovery in Post-Tsunami Area of Aceh, Indonesia	Indonesia	Indonesia-tsunami
27	Türker et al.	2024	Reimagining resilience: The transformative role of urban green areas in Türkiye's disaster preparedness	Türkiye	Türkiye-earthquake
28	Wang et al.	2021	A Study for the Influence of the Location of PCMs Assembly System on Improving Thermal Environment inside Disaster-Relief Temporary Houses	China	China-earthquake
29	Witt	2014	Mapping construction industry roles to the disaster management cycle	Estonia	-
30	Xin et al.	2022	A novel tension strap connection for rapid assembly of temporary timber structures	Australia	-
31	Zafra et al.	2021	Structural and thermal performance assessment of shipping container as post-disaster housing in tropical climates	Philippines	Philippines -Typhoon

Discussion

The publications identified within the scope of the meta-analysis were obtained data to determine the quality criteria of post-disaster sheltering. The data were combined in common criteria and matched with environmental, economic, social and technical sustainability sub-headings. In this context, environmental sustainability includes thermal comfort, material, design standard and site selection; economic sustainability includes assembly, cost, supply and delivery; social sustainability includes support services, security, contribution to disaster resilience and policy; and technical sustainability includes energy use criteria (Table 2).

Environmental Sustainability

Thermal comfort, material, design standards and site selection criteria were determined in the environmentally sustainable criterion of temporary shelter after the disaster. The current climatic condition of the community where the disaster occurs is effective in the implementation of the shelter unit. With the changing climate, the frequency of disasters has also increased in the last century (Perrucci et al., 2016). Determining design criteria suitable for local geographical and climatic conditions is closely related to the effect of the current temperature environment on the thermal comfort of the disaster victim (Li et al., 2023). Designers and practitioners need to work on site-specific climatic assessment risk management to build fair climate adaptation to reconstruction (Schmitt et al., 2023). In addition, ensuring indoor comfort is possible from a climate-related perspective. In prefabricated houses, especially in the summer months, providing indoor thermal comfort suitable for the user affects the quality of shelter (Albadra et al., 2018; Wang et al., 2021). Standard design practices lead to the process of providing the thermal comfort conditions of disaster victims individually: such as building an extension in front of the shelter or keeping their clothes wet (Albadra et al., 2018). Additional energy sources are required to consider cold and hot energy storage alternatives instead of primitive solutions (Wang et al., 2021). In this context, heat transfer, conduction and radiation are provided by using materials that provide thermal insulation by controlling the surface temperature (D'Orazio & Maracchini, 2019; Pusceddu et al., 2017; Zafra et al., 2021). Energy and overheating performance are supported by building performance simulation tools to reduce thermal problems (Rapone et al., 2024). To balance energy performance, thermal conductivity,

thermal comfort and user satisfaction are provided with the selection of the material in the design process (Wang et al., 2021). For post-disaster shelter requirements, prefabricated products, including rapidly produced lightweight structural materials, are generally preferred (Salvalai et al., 2017; Song et al., 2016). Studies indicate that these materials are preferred in the design of common social areas other than shelter, while shelter units preferred with local materials provide thermal comfort, increase user satisfaction and have the potential for permanent housing (Asali et al., 2019).

Table 2.
Grouping of sheltering quality criteria in the context of sustainability

Environmental	Thermal comfort	Albadra et al., 2018; D'Orazio and Maracchini, 2019; Li et al., 2023; Perrucci et al., 2016; Pusceddu et al., 2017; Rapone et al., 2024; Schmitt et al., 2023; Wang et al., 2021; Zafra et al., 2021;
	Material	Asali et al., 2019; Barbosa, 2014; Dash et al., 2022; McConell and Bertolin, 2019; Montalbano and Santi, 2023; Moreno-Sierra et al., 2020; Pusceddu et al., 2017; Salvalai et al., 2017; Song et al., 2016; Wang et al., 2021
	Design standard	Avlar et al., 2023; D'Orazio and Maracchini, 2019; Felix et al., 2015; Maiteh and Zoltan, 2023; Miyaji et al., 2020; Parva and Rahimian, 2014
	Site selection	Asali et al., 2019; Hosseini et al., 2022; Kotani et al., 2020; McConell and Bertolin, 2019; Türker et al.,2023
Ekonomic	Assembly	Avlar et al., 2023; D'Orazio and Maracchini, 2019; Moreno-Sierra et al., 2020; Perrucci et al., 2016; Xin et al., 2022; Zafra et al., 2021
	Cost	Avlar et al., 2023; Perrucci et al., 2016
	Supply and delivery	Avlar et al., 2023; Dash et al., 2022; Pezzica et al., 2022
Social	Support services	Rakes et al., 2014
	Security	Hosseini et al., 2022; Lines at al., 2022; Maiteh and Zoltan, 2023; Montalbano and Santi, 2023
	Contribution to disaster resilience	McConell and Bertolin, 2019; Schmitt et al., 2023; Wang et al., 2021; Witt, 2014
	Policy	Asali et al., 2019; Dash et al., 2022; Felix et al., 2015; Kawakami et al., 2020; Kotani et al., 2020; Lines at al., 2022; Suriastini et al., 2023
Technical	Energy use	D'Orazio and Maracchini, 2019; Hosseini et al., 2022; McConell and Bertolin, 2019; Pusceddu et al., 2017; Rapone et al., 2024; Wang et al., 2021

On the other hand, studies also highlight design criteria compatible with local materials and the region (Barbosa, 2014; Moreno-Sierra et al., 2020). In the technical design process, it is essential to consider not only the availability of locally sourced materials but also their economic, social, and structural suitability in meeting shelter needs (Dash et al., 2022).

The necessity of deep research in post-disaster shelter design comes to the forefront. A numerical database containing a specific design standard is required to increase the social, economic and psychological impact on the living conditions of disaster victims (Maiteh & Zoltan, 2023). The relevant database includes allowing users to change by their own needs and requirements, making design decisions for long-term settlement rather than from a temporary perspective and by the existing households of local people (Avlar et al., 2023; Parva & Rahimian, 2014). In addition, infrastructure, public space and service spaces for normal life activities are emphasised beyond the just building logic of shelter (Felix et al., 2013). To include all requirements, the quality criteria include the resilience of temporary shelter areas against future disasters in the settlement area (Hosseini et al., 2022). In addition, the existence and capacity of reliable areas called open spaces for sheltering and protection needs after the disaster are of interest to disaster victims (Türker et al., 2023; Kotani et al., 2020). For the environmental sustainability performance of the area to be preferred, user satisfaction, accessibility potential and pre-disaster land delimitation are required (Asali et al., 2019).

Economic Sustainability

The economic sustainability of post-disaster temporary shelter includes assembly, cost, supply and delivery elements. The ability to disassemble the structure and fasteners to provide more flexibility for temporary shelter units (Moreno-Sierra et al., 2020; Perrucci et al., 2016) and pre-disaster packaged building materials for transportation makes it possible to improve the quality of shelter (Pezzica et al., 2022). In addition, the rapid assembly of prefabricated structural panel products (D'Orazio and Maracchini, 2019) and the low cost of the procurement process (Avlar et al., 2023) affect the quality of shelter. The delivery and supply of temporary shelter units should be included in pre-disaster strategic planning to ensure that disaster victims have access to basic needs promptly, and its feasibility should be measured after the disaster (Pezzica et al., 2022). Beyond unit-specific delivery, the supply of raw materials, labour, and on-site availability of materials support practical design phases (Dash et al., 2022).

Social Sustainability

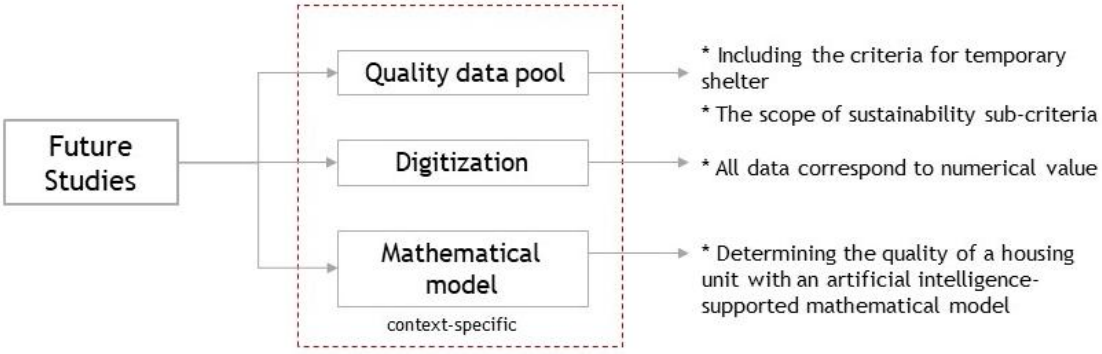
The social sustainability of temporary shelter after a disaster includes support services, security, contribution to disaster resilience and policy principles. Apart from the shelter needs of disaster victims, the adequacy and scope of education, health, food and beverage and psycho-social centres per person affect the quality of shelter (Rakes et al., 2014). This perspective is evaluated within the scope of user safety and ensures adequate access to services (Hosseini et al., 2022). In addition, in the context of physical safety, the opening of shelter units to settlements in safe and resilient areas and the time required to find these resilient places makes it possible to be resilient against possible disasters, enabling a quality shelter process (Hosseini et al., 2022; Lines et al., 2022). Mechanical strength and fire resistance in the interior design of shelter units in the context of building safety also include the design of neighbourhood units (Montalbano & Santi,2023). Resilience to disasters depends on identifying social vulnerability curves to adopt and reduce risk

factors in communities in disaster-prone areas (McConnell & Bertolin, 2019). To include communities in post-disaster reconstruction adaptation and increase social resilience, it is necessary to utilise all opportunities, especially the need for shelter (Schmitt et al., 2023). In the process of meeting the need for shelter, it develops the decision mechanism to increase the resilience of the existing disaster management system. Determining the housing needs by identifying the existing building and infrastructure stocks contributes to the quality process (Witt et al., 2014). The problem of temporary sheltering is a process that should be politicised by identifying strategic basic problems beyond simply providing buildings (Felix et al., 2013). Studies recognise post-disaster shelter policies as a multidisciplinary approach that combines sustainability principles (Dash et al., 2022). Factors affecting settlement status and transitions, especially vulnerable rural communities, are investigated to formulate relevant policies for better replanning practices (Kotani et al., 2020). The existence of shelter-specific policies within the disaster zone contributes to the coordination of relevant institutions such as central government, local government and NGOs (Asali et al., 2019; Lines et al., 2022). For policies to be assessed under quality standards, periodic evaluation is required as existing policies are implemented at different times during the recovery process. The point of view here is that the difference in objectives between rebuilding better and rebuilding faster is left to the decision of the implementers (Suriastini et al., 2023).

Technical Sustainability

The evaluation of post-disaster temporary shelter quality criteria in the context of technical sustainability includes energy use. According to the life cycle, energy efficiency is in question for the whole cycle from the processing of the material to the completion of the post-disaster temporary shelter needs (Rapone et al., 2024). This process involves improving the energy efficiency of housing units and reducing energy consumption by users (Wang et al., 2021). The focus is on updating construction techniques with high-efficiency building materials (Rapone et al., 2024), keeping the changing room temperature constant by creating an energy storage system (Wang et al., 2021) and determining the indoor comfort level by developing low-cost and low-energy building materials (D'Orazio & Maracchini, 2019; Pusceddu et al., 2017) and the energy efficiency to be achieved in the continuous reuse of the housing unit considering the global warming potential (McConnell & Bertolin, 2019) are considered to support sustainable practice in this context.

Figure 3.
Future studies. Diagram (author's drawing)



Clearly defining the criteria related to the design, construction, use, and reuse cycle of each shelter unit is crucial in terms of sustainability. Quantifying these criteria based on measurable indicators can help eliminate subjectivity in quality assessments. Once these criteria are translated into numerical data, artificial intelligence–based decision-making algorithms can be employed to analyze them, enabling the objective, systematic, and rapid evaluation of shelter unit quality. In this context, the study presents an assessment of the quality of shelter units established to meet urgent housing needs following disasters. The findings can be re-evaluated and enriched through future research. Ultimately, this study contributes a foundational perspective on the evaluation of temporary shelter quality within the context of sustainability and is expected to serve as a critical step for future developments in the field.

Conclusion and Recommendations

This study represents the initial phase of the process for evaluating the quality criteria of post-disaster temporary shelter units within the framework of sustainability. This phase involves examining the fundamental prerequisites necessary for classifying temporary shelters in terms of sustainability and determining their quality. It is evident that the criteria obtained through the meta-analysis offer a framework open to further development. For instance, under the heading of environmental sustainability, subtopics such as thermal comfort, material, design standards, and site selection were addressed. However, it is also clear that aspects such as harmony with the natural environment, the preservation of cultural and historical structures, and the potential for recycling and reuse should be considered in evaluating the quality of post-disaster temporary shelters. In this context, the study reflects a perspective based on a specific publication timeframe, suggesting that the scope of evaluation can be further expanded.

Within the scope of the study, existing literature was systematically reviewed, and data derived from field-based findings were analyzed. The results revealed the essential criteria required to assess the quality of temporary shelters in post-disaster contexts. It is believed that evaluating these criteria within a sustainability framework will make a significant contribution to the field of disaster management. Future studies may benefit from developing a comprehensive data pool that includes not only the design and usage phases of temporary shelter units but also the entire crisis and risk management cycle within disaster governance (Figure 3).

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