Bagh-e Nazar
DOI: [10.22034/bagh.2025.502960.5754](https://doi.org/10.22034/bagh.2025.502960.5754)

Bagh-e Nazar, *22*(149), 17-30 / 2025
Persian translation of this paper entitled:
ارزیابی تطبیقی تاب‌آوری و خوداتکایی در خانه‌های
سنتی و معاصر بندرعباس با روش TOPSIS فازی
is also published in this issue of journal.

Original Research Article

A Comparative Assessment of Resilience and Self-Reliance in Traditional and Contemporary Houses of Bandar Abbas Using the Fuzzy TOPSIS Method*

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Received: 01/02/2025 Accepted: 09/08/2025 Available online: 23/10/2025

Abstract

Problem statement: Traditional houses in Bandar Abbas—owing to the use of local materials and climate-responsive mechanisms suited to the region's hot-humid conditions—have long served as exemplars of resilience and self-reliance. By contrast, contemporary constructions predominantly rely on modern technologies and, in some cases, due to misalignment with climatic and socio-cultural contexts, exhibit lower levels of resilience and self-reliance. The application of resilient architectural principles in the design of residential complexes in Bandar Abbas significantly increases residents' self-reliance.

Research objective: To conduct a comparative evaluation of the levels of resilience and self-reliance in traditional and contemporary houses in Bandar Abbas and to identify the key factors influencing these outcomes.

Research method: First, through semi-structured interviews with experts, the principal components of resilience (urban, physical, environmental, social, and economic) and self-reliance (sustainable, social, and managerial) were identified. Based on these components, questionnaires employing fuzzy scales were designed and distributed among a population of residents and specialists. The collected data were then analyzed using the Fuzzy TOPSIS method to determine each house's closeness to the ideal solution in terms of resilience and self-reliance.

Conclusion: Owing to climate-responsive design, the use of local materials, more effective water resource management, and the formation of supportive social spaces, traditional houses generally outperform contemporary houses across most dimensions of resilience and self-reliance. Conversely, some contemporary houses that depend on new technologies face challenges—particularly in social and managerial domains—which is reflected in lower Fuzzy TOPSIS scores. The findings indicate that combining traditional architectural principles with modern innovations not only reduces energy consumption and maintenance costs but also enhances residents' resilience and self-reliance. Accordingly, it is recommended that future designs incorporate vernacular strategies while placing greater emphasis on participatory and managerial aspects.

Keywords: *Resilience, Self-Reliance, Fuzzy TOPSIS Method, Traditional Houses of Bandar Abbas, Contemporary Houses of Bandar Abbas, Vernacular Architecture of Southern Iran.*

*This article extracted from Ph.D. thesis of "Soha Zakeri" entitled "Explanation of Resilient Architectural Design Principles for Residential Complexes with the Aim of Increasing Self-reliance of Residents; Case Study: Bandar Abbas" that under supervision of Dr. "Mahnaz Mahmoudi Zarandi" and in consultation of Dr. "Mohammad Reza Farzad Behtash" which has been done at Islamic Azad University, North Tehran Branch, Faculty of Architecture, Tehran, Iran in 2021.

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Introduction and Problem Statement

Resilience and self-reliance in residential architecture are two pivotal concepts in addressing climatic and social crises. Bandar Abbas, as one of Iran's strategic coastal cities, is highly vulnerable to both natural and human-induced hazards due to its geographical position and hot-humid climate. Environmental challenges such as climate change, sea-level rise, monsoon storms, and high humidity threaten housing resilience and the quality of life of local residents (Mansour et al., 2023; Haque et al., 2022). Architectural design under such conditions must draw upon vernacular principles and sustainable strategies to overcome these challenges and provide a safe, adaptive, and sustainable living environment.

Resilience is defined as the capacity of a system to absorb disturbances, maintain essential functions, and recover to its original state (Holling, 1973; Cutter et al., 2008). In architecture, this concept refers to the ability of spaces and structures to withstand hazards while maintaining vital functions (Renschler et al., 2010; Norris et al., 2008). Self-reliance, on the other hand, denotes the ability of individuals or communities to meet their essential needs without dependence on external resources (UNHCR, 2017). These two concepts work synergistically, enhancing the sustainability and adaptability of habitats (Astill & Miller, 2018). Traditional houses in Bandar Abbas, by employing vernacular design principles and using local materials such as gypsum, wood, and stone, exemplify successful adaptation to the region's climate (Gehl, 1971; Haque et al., 2022). Elements such as windcatchers, central courtyards, and natural ventilation systems not only provide desirable thermal balance but also foster residents' self-reliance in meeting daily needs (Newman, 1972; Spalioviero et al., 2015). In contrast, contemporary houses, which often rely on modern technologies and industrial materials, tend to show greater vulnerability to environmental hazards due to their incompatibility with climatic conditions and cultural needs (Charlesworth & Ahmed, 2015; Nicol & Nouphel, 2014).

Previous studies have demonstrated that resilience and self-reliance in residential architecture are influenced by a combination of environmental, social, and physical factors. For example, the PEOPLES conceptual model developed by Renschler et al. (2010) identifies seven key dimensions of community resilience, including physical infrastructure, socio-cultural capital, and economic development. Similarly, Mileti and Chang (2006) emphasized the importance of infrastructure functionality recovery after crises. In the context of vernacular architecture, studies such as Haque et al. (2022) and Anne et al. (2014) highlight the role of climate-responsive design and community participation in enhancing resilience and self-reliance. Despite these advances, notable research gaps remain regarding the integration of resilience and self-reliance principles in the contemporary architecture of Bandar Abbas. First, few studies have comparatively assessed traditional and contemporary houses in this region to identify their respective strengths and weaknesses (Tambran & Sachs, 2022; Omata, 2023). Second, the application of advanced analytical methods, such as Fuzzy TOPSIS, for precise evaluation of these principles has received limited attention (Zadeh, 1965).

This study seeks to address these gaps by conducting a comparative evaluation of resilience and self-reliance in traditional and contemporary houses in Bandar Abbas. To this end, the Fuzzy TOPSIS method is employed to analyze data collected through semi-structured interviews and fuzzy questionnaires. This method, due to its ability to measure distance from positive and negative ideal solutions, is recognized as an effective tool for multi-criteria decision-making under uncertainty (Chen, 2000; Kahraman et al., 2004). Beyond offering a practical framework for designing resilient and self-reliant housing, the findings of this study can contribute to the formulation of design guidelines that are both climate- and culture-responsive. Such guidelines may assist architects and policymakers in developing more sustainable and adaptive residential infrastructures in coastal cities such as Bandar Abbas (Astill & Miller, 2018; Nicol & Nouphel, 2014).

The objective of this research is to comparatively assess the performance of traditional and contemporary houses in Bandar Abbas with respect to resilience (physical, social, environmental) and self-reliance (sustainable, social, managerial) components. Considering the region's specific climatic conditions and the importance of climate-responsive design in improving quality of life, this study aims to determine which housing type performs more effectively in facing environmental hazards and meeting residents' needs. Accordingly, the central research question is whether traditional houses in Bandar Abbas perform better than contemporary counterparts in terms of resilience and self-reliance indicators, and which components play the most significant role in enhancing housing self-reliance. The research hypothesis suggests that traditional houses, due to the use of vernacular strategies and climate-responsive design, will demonstrate stronger performance in physical and social resilience indicators as well as in sustainable self-reliance compared to contemporary examples. Data analysis is conducted through the Fuzzy TOPSIS multi-criteria decision-making method to determine the proximity of each housing type to the ideal condition. The paper first reviews the literature and theoretical background, then presents the research methodology and findings of the comparative evaluation, followed by discussion and conclusions that offer practical recommendations for resilient housing design. Ultimately, this study seeks to answer key questions concerning the main components of resilience and self-reliance, the differences between traditional and contemporary houses, and the applicability of the Fuzzy TOPSIS method in analyzing these components.

Theoretical Foundations and Literature Review

- **Resilience**

In architectural and urban studies, resilience is an interdisciplinary concept referring to the capacity of built environments to adapt, withstand disturbances, and recover their functions after crises (Holling, 1973; Adger, 2000). Although the concept was first introduced in ecological sciences, it gradually extended to urban and architectural contexts, particularly in response to climate change, natural hazards, and social instabilities (Meerow et al., 2016). In the architectural domain, resilience encompasses three main dimensions. Physical resistance to sudden shocks such as earthquakes and storms (Renschler et al., 2010); Rapid recovery of spatial functions (Miles & Chang, 2006); and Structural and functional adaptability to new conditions (Cutter et al., 2010).

Social and cultural dimensions are also integral to housing resilience, as the way residents interact with their environment—both during crises and in reconstruction phases—largely depends on social and participatory resilience (Pickett et al., 2004; Satterthwaite et al., 2020). From a design perspective, the use of local materials, consideration of climate, and the integration of innovative technologies are three essential components of enhancing architectural resilience (Charlesworth & Ahmed, 2015; Nicol & Knoepfel, 2014). For instance, in hot-humid regions, materials such as gypsum and wood are suitable for sustainable construction due to their insulating properties and breathability (Irulegi et al., 2014). Moreover, climate-responsive design elements—including windcatchers, shading devices, and natural ventilation—play a critical role in reducing energy dependency and improving resilience (Hasse et al., 2013). Additionally, spatial flexibility during crises and the provision of emergency infrastructure, such as water storage tanks and renewable energy systems, are strongly recommended (Astill & Miller, 2018).

- **Self-reliance and sustainability in housing**

In the context of residential architecture, self-sufficiency refers to the ability of a dwelling to meet the essential needs of its residents with minimal reliance on external resources, particularly under crisis conditions (Clapp, 2017). This concept is closely linked to sustainability and is rooted in principles such as energy independence, resource efficiency, and environmental adaptability (Satterthwaite et al., 2020). Unlike consumption-driven models, self-sufficient housing not only mitigates environmental impacts but also enhances survival capacity and social resilience in the face of crises (Nicol & Knoepfel, 2014). Theoretically, self-sufficiency in architecture can be defined across two primary dimensions:

Physical-functional dimension: designing buildings to minimize dependence on energy, water, and urban services.

Socio-economic dimension: promoting residents' participation in production, maintenance, and resource recycling processes (Irulegi et al., 2014).

From a design standpoint, the use of local materials such as gypsum, stone, and wood—particularly in the hot-humid regions of southern Iran—reduces costs and increases climatic compatibility (Hasse et al., 2013). These materials, due to their insulating and natural ventilation properties, played a vital role in traditional construction in Bandar Abbas (GhaffarianHoseini et al., 2015). One cornerstone of self-sufficiency is energy independence through innovative technologies. Solar panels, natural ventilation systems, energy storage batteries, and greywater recycling systems are among the most important technologies employed in self-sufficient housing (Engelken et al., 2016). For example, in Germany's self-sufficient housing projects, photovoltaic systems provide a complete electricity supply for homes without reliance on urban grids (Ramirez et al., 2018).

Water resource management is another crucial element of self-sufficient housing. Strategies such as rainwater harvesting, greywater treatment, and the design of efficient internal networks are central in this domain (Saito et al., 2015). Furthermore, the creation of small-scale productive spaces, such as household gardens, contributes significantly to food provision, cost reduction, and the strengthening of social interactions (Haque et al., 2022). Spatial flexibility, especially under crisis conditions, represents another important aspect of self-sufficiency. Designing multifunctional spaces that can serve as storage facilities, temporary accommodation, or emergency gathering areas substantially enhances the sustainable performance of housing (Newman, 1972).

A Review of Traditional and Contemporary Architecture in Bandar Abbas

The vernacular architecture of southern Iran, particularly in the hot-humid climate of Bandar Abbas, represents one of the most prominent examples of climate-responsive design, shaped through the integration of indigenous knowledge, local materials, and a profound understanding of environmental conditions (Bahadori, 1985; Givoni, 1998). In this approach, climatic adaptability, social interaction, and resource efficiency were regarded as fundamental principles in the physical design of houses. Given its high humidity, extremely hot summers, and prevailing winds, Bandar Abbas required effective vernacular solutions to achieve thermal comfort (Kasmaei, 2005; Khakzand & Rafieian, 2015). One of the defining features of traditional architecture in Bandar Abbas is the use of local materials such as stone, gypsum, palm wood, adobe, and mudbrick. These materials are not only easily accessible and cost-effective but also provide efficient performance in the regional climate due to their physical properties such as high thermal capacity, insulation, and breathability (Irulegi et al., 2014; Hasse et al., 2013; Haque et al., 2022). Thick earthen walls, domed coverings, and light-colored facades were also effective strategies to reduce the thermal load of interior spaces (Fathy, 1986; Edwards, 2006).

From a design perspective, elements such as windcatchers, central courtyards, deep verandas, and shading devices provided cross-ventilation and facilitated natural cooling (Nicolopoulou et al., 2003; Baniassadi et al., 2020). For instance, windcatchers—among the most common architectural elements in the south—channel airflow from higher altitudes into indoor spaces, lowering the interior temperature by several degrees (Bahadori, 1978; GhaffarianHoseini et al., 2015). Courtyards, as the nucleus of family life, not only enhanced ventilation but also played a significant role in social interaction and humidity regulation (Foruzanmehr & Vellinga, 2011; Mahmoudi et al., 2015).

Socially, traditional architecture in Bandar Abbas was designed in accordance with Islamic culture and collective lifestyles. Semi-open and enclosed spaces with defined spatial hierarchies-maintained privacy while simultaneously providing shared spaces for daily interactions (Oliver, 2003; Newman, 1972). Functional flexibility was another key feature: rooms could be easily repurposed according to daily needs, representing an intelligent example of vernacular adaptability (Clapp, 2017; Sassi, 2006). In recent decades, however, rapid urban development and the penetration of modern architectural models have given rise to a new form of architecture in Bandar Abbas, commonly referred to as contemporary architecture. Although this type of architecture benefits from durable materials, industrial technologies, and new structural models, it has largely departed from climate-responsive principles (Charlesworth & Ahmed, 2015; Ramirez et al., 2018). For example, the widespread use of concrete, glass, industrial bricks, and lightweight metals—without consideration of local climatic conditions—has led to higher indoor temperatures and heavy reliance on mechanical cooling systems (Satterthwaite et al., 2020; Engelken et al., 2016).

From a design standpoint, elements such as windcatchers, shading devices, and central courtyards have often been eliminated or reduced to a minimal role. Enclosed plans, expansive glass facades, and poor natural ventilation have rendered many new buildings vulnerable to heat and humidity (GhaffarianHoseini et al., 2015; Nicolopoulou et al., 2003).

Socially, the decline of communal and interactive spaces has reshaped lifestyles, promoting individualistic patterns and social isolation in new residential developments (Newman, 1972; Haque et al., 2022). From an environmental perspective, contemporary architecture in Bandar Abbas conflicts with sustainability principles through excessive energy consumption, the use of non-recyclable materials, and the neglect of natural resource management (Sassi, 2006; Charlesworth & Ahmed, 2015). Moreover, the rapid and unregulated growth of high-rise and dense residential complexes—disconnected from local climatic and cultural models—has diminished the quality of life in urban areas (Kuittinen et al., 2016; Khakzand & Rafieian, 2015).

Research Background

The concepts of resilience and self-sufficiency in residential environments—particularly in specific climates such as Bandar Abbas—are among the major topics in contemporary architectural and urban studies. Numerous international and domestic studies have examined various aspects of these concepts (Table 1). In the field of resilience, the comprehensive PEOPLES model developed by Renschler et al. (2010) incorporated key dimensions such as population, infrastructure, governance, emergency services, and social capital in analyzing resilience in urban and residential areas. Miles and Chang (2006), focusing on the post-crisis period, investigated the interactions between infrastructure, households, and urban services as determinants of housing recoverability. In Asian studies, Olshansky and Johnson (2010) analyzed the reconstruction process following the tsunami in Japan, emphasizing that disaster-resistant design, social participation, and intelligent management of public spaces are critical to strengthening resilience. Similarly, Anh et al. (2014), in their study on housing in Vietnam, demonstrated that resident participation in planning and reconstruction significantly enhances local resilience. At the national level, Sohrabi and Zolfizadeh (2023) and Afifi (2022) revealed that informal settlements in southern Iran, particularly in Bandar Abbas, suffer from low physical resilience. Factors such as the use of non-local materials, neglect of climatic conditions, and deviation from traditional models were identified as resilience-weakening agents. Nevertheless, most of these studies have either remained at a conceptual level or focused only on one dimension—whether physical, social, or infrastructural—

Table 1. Background of the studies. Source: Authors.

Row	Researcher / Year	Research Domain	Approach / Method	Key Findings
1	Renschler et al. (2010)	Resilience	PEOPLES conceptual model	Identification of key dimensions of urban resilience
2	Miles & Chang (2006)	Resilience	Interactive analysis	Role of households and services in recoverability
3	Olshansky & Johnson (2010)	Post-crisis resilience	Case study – Japan	Importance of disaster-resistant design and social participation
4	Anh et al. (2014)	Local resilience	Field survey – Vietnam	Resident participation = enhanced resilience
5	Ameri Siahoui & Moradi, 2022	Physical resilience	Case study – Bandar Abbas	Weak resilience in informal settlements
6	Charlesworth & Ahmed (2015)	Self-sufficiency	Comparative analysis	Challenges of sustainable housing in the Global South
7	Kuittinen et al. (2016)	Energy self-sufficiency	Case study – Finland	Climate-responsive design + solar energy = energy independence
8	Haque et al. (2022)	Social self-sufficiency	Neighborhood study	Participatory design and green space improve self-sufficiency
9	Ahmadpour et al., 2018	Thermal self-sufficiency	Conceptual modeling	Focus on energy parameters in hot climates
10	Ahmadi et al. 2025	Food self-sufficiency	Social analysis	Impact of home gardens on household livelihood
11	Bahadori (1985), Givoni (1998)	Climatic architecture	Technical analysis	Role of windcatchers and courtyards in hot-humid climates
12	Foruzanmehr & Vellinga (2011)	Tradition & sustainability	Qualitative analysis	Link between vernacular architecture and cultural sustainability
13	Ramirez et al. (2018)	Contemporary architecture	Critical analysis	Incompatibility of modern materials with the southern climate
14	Nazari et al. (2018)	Traditional settlements	Descriptive study	Analysis of residential quality without comparative assessment

without conducting a systematic comparison between traditional and contemporary housing in real contexts.

In the domain of self-sufficiency, studies such as Charlesworth and Ahmed (2015) examined the challenges of achieving sustainable and self-reliant housing in developing countries. Kuittinen et al. (2016), in Finland, showed that the integration of solar energy with climate-responsive design can lead to energy independence at the residential scale. Haque et al. (2022) also highlighted the role of participatory design and green spaces in promoting social self-sufficiency. In Iran, Abedi et al. (2019) presented a conceptual design for solar self-sufficient housing in hot climates; however, their study was limited to thermal analysis and overlooked aspects such as social participation and resource efficiency. Similarly, Ghanbari and Mahdavi (2021) investigated the impact of home gardens on household livelihoods, but failed to address their integration with residential spatial design.

Another strand of research has focused on vernacular architecture in hot-humid climates. Bahadori (1985) and Givoni (1998) were pioneers in analyzing climate-responsive design in Iran, addressing the role of traditional elements such as windcatchers and central courtyards in achieving thermal comfort. Foruzanmehr and Vellinga (2011) examined the relationship between vernacular patterns and cultural sustainability. Similarly, Fathy (1986), Nicolopoulou et al. (2003), and Mahmoudi et al. (2015) showed that climate-based design in traditional houses reduces dependence on external resources and enhances self-sufficiency. In contrast, Ramirez et al. (2018) critiqued contemporary architecture for its inadequacy in addressing climatic conditions. Domestically, Nazari et al. (2018) investigated residential quality in traditional southern settlements, but their work lacked a comprehensive comparative analysis between traditional and contemporary housing.

Despite the existence of these studies, a significant gap remains in systematically comparing the performance of the two housing models—traditional and contemporary—in specific climates such as Bandar Abbas. Most research has either taken a descriptive approach or addressed only one aspect of resilience or self-sufficiency. The present study seeks to fill this gap by employing the Fuzzy TOPSIS multi-criteria analysis method to conduct a comprehensive comparison of traditional and contemporary architecture in Bandar Abbas, evaluating indicators such as energy consumption, materials, spatial flexibility, and social participation.

Research Methodology

This study adopted a mixed-methods approach (qualitative–quantitative) to conduct a comparative analysis of resilience and self-sufficiency in traditional and contemporary architectural models in Bandar Abbas. In the first phase, semi-structured interviews were conducted with 20 experts in architecture, urban planning, and environmental studies to accurately identify the key components. A snowball sampling method was applied to ensure diversity of perspectives across the expert chain. The interview questions covered multiple dimensions of resilience (urban, physical, social, economic, environmental) and self-sufficiency (sustainable, social, managerial). Qualitative analysis of the interviews was performed through a three-stage coding process (open, axial, selective), ultimately yielding eight main components for evaluation. In the second phase, based on the extracted components, a questionnaire using a five-point fuzzy scale (ranging from very low to very high) was designed and distributed among residents of 20 selected residential units. The statistical population included residents above 18 years of age with at least one year of residency. Out of 50 distributed questionnaires, 45 valid responses were collected and used for analysis. A systematic sampling method was applied to account for diversity in age, gender, and educational background among respondents.

- **Fuzzy topsis method**

For quantitative data analysis, the Fuzzy TOPSIS multi-criteria decision-making method was employed. This method, by accounting for uncertainty inherent in human perception and judgment, provides an effective tool for prioritizing alternatives across diverse components (Hwang & Yoon, 1981; Zhang & Yang, 2021). The rationale for choosing this method lies in its compatibility with fuzzy linguistic data and its ability to simultaneously analyze multiple key indicators under uncertainty. The analytical steps are as follows:

- Construction of a fuzzy decision matrix, incorporating fuzzy scores derived from questionnaire responses for the 20 sample houses.
- Normalization of data to enable comparability;
- Weight assignment based on results from expert interview content analysis; - Calculation of the distance from the positive and negative ideal solutions;
- Computation of the closeness coefficient (C) for each alternative, leading to the final ranking.

By ranking the alternatives according to their closeness to the ideal solution, this method provides an objective framework for comparing the performance of traditional and contemporary houses.

- **Case studies**

To achieve the goal of a comparative evaluation of traditional and contemporary houses, 20 houses (10 traditional and 10 contemporary) in Bandar Abbas and its surrounding areas were selected. The main selection criteria included:

Diversity of location: some are located within the old urban fabric (e.g., Hodi neighborhood and historical districts), and others in newer or suburban areas (e.g., Golshahr-e Jonoubi, Nakhl-e Nakhoda).

Construction year: traditional houses with more than 50 years of age (e.g., Sharif House), and contemporary houses built within the past two decades.

Data accessibility and fieldwork feasibility: only houses with sufficient documentation (maps, historical records, architectural files) and permission for site visits were included. Finally, data collected for each of these 20 houses were entered into the fuzzy decision matrix, and the Fuzzy TOPSIS procedure was applied. The results of this process are presented and interpreted in the Findings section. This approach not only provides deeper insights into the strengths and weaknesses of traditional and contemporary architecture in Bandar Abbas but also establishes a foundation for discussing strategies to enhance resilience and self-sufficiency in future housing designs.

Findings

This section presents the data obtained from the semi-structured interviews and the fuzzy questionnaires analyzed through the Fuzzy TOPSIS method. First, a summary of the interview analysis and coding results is provided, followed by the outcomes of the fuzzy evaluation of resilience and self-sufficiency components in traditional and contemporary case samples. Finally, a comparative assessment between the two groups of houses is discussed.

- **Interview analysis and coding results**

Through the semi-structured interviews and the three-stage coding process (open, axial, and selective), a total of eight key components were identified and categorized under the two main domains of Resilience and Self-Sufficiency:

- **Resilience**

Urban Resilience | Physical Resilience | Environmental Resilience | Social Resilience | Economic Resilience

- **Self-sufficiency**

Sustainable Self-Sufficiency | Social Self-Sufficiency Managerial Self-Sufficiency

Table 2 presents the relative frequency of codes extracted from the interviews during the open coding stage. This frequency reflects the recurrence and emphasis of experts on each of the main categories related to resilience and self-sufficiency. In addition to the eight main components, several other codes—such as “socio-economic challenges” and “the role of government participation”—were also mentioned by participants. However, these were not grouped into the main categories during axial coding and were instead categorized under Other Codes.

- **Results of fuzzy questionnaires**

Based on the components identified in the interviews, fuzzy questionnaires were designed and distributed among 50 residents of Bandar Abbas ([45] valid responses were collected). Each component was measured using a five-point fuzzy scale (from very low to very high). For example, very low was represented as (0, 0, 0.25), while very high was represented as (0.75, 1, 1).

Table 3 shows the fuzzy average of each component along with its defuzzified (crisp) values. These results illustrate the relative importance of each component from the perspective of respondents.

- **Framework for evaluating resilience and self-sufficiency**

Following the semi-structured interviews and coding analysis, combined with the quantitative results from the fuzzy questionnaires, a final framework was developed for

Table 2. Frequency of Key Codes in Semi-Structured Interviews. Source: Authers.

Component	Frequency in Interviews	Relative Frequency (%)
Physical Resilience	25	14%
Urban Resilience	20	11%
Environmental Resilience	18	10%
Social Resilience	14	8%
Economic Resilience	12	7%
Sustainable Self-Sufficiency	10	6%
Social Self-Sufficiency	8	4%
Managerial Self-Sufficiency	6	3%
Other Codes	87	47%
Total	200	100%

Table 3. Fuzzy Averages of Components and Defuzzified Values. Source: Authers.

Component	Fuzzy Mean Value	Defuzzified Value (Average)	Rank of Importance
Physical Resilience	(0.4, 0.6, 0.8)	60%	1
Environmental Resilience	(0.3, 0.55, 0.75)	53%	3
Urban Resilience	(0.35, 0.5, 0.7)	52%	4
Social Resilience	(0.3, 0.5, 0.7)	50%	5
Economic Resilience	(0.4, 0.55, 0.7)	55%	2
Sustainable Self-Sufficiency	(0.35, 0.5, 0.65)	50%	5
Social Self-Sufficiency	(0.25, 0.45, 0.65)	45%	7
Managerial Self-Sufficiency	(0.25, 0.4, 0.6)	42%	8

assessing resilience and self-sufficiency in the residential complexes of Bandar Abbas. This framework encompasses five main components of resilience (urban, physical, environmental, social, and economic) and three main components of self-sufficiency (sustainable, social, and managerial). Each component is further broken down into measurable subcomponents and indicators, as summarized in Table 4. Steps in Developing the Framework:

- **Collection of initial concepts:** through expert interviews and literature review.
- **Organization of indicators:** integrating open codes into the resilience (urban, physical, environmental, social, economic) and self-sufficiency (sustainable, social, managerial) categories.
- **Validation via fuzzy questionnaires:** measuring the relative importance of each component according to residents' perspectives and aligning results with expert interviews.
- **Integration into the final model:** creating a framework applicable in any housing assessment project to identify strengths, weaknesses, and ranking of case studies.

This framework was applied to all traditional and contemporary housing samples in Bandar Abbas, enabling comparative analysis and identification of improvement priorities. Based on the results, indicators related to physical resilience, environmental resilience, and sustainable self-sufficiency demonstrated stronger performance in traditional houses, while social and managerial subcomponents require significant reinforcement in contemporary housing.

• **Evaluation of traditional and contemporary samples**

Using the Fuzzy TOPSIS method, 20 case studies (10 traditional and 10 contemporary houses) were assessed. A decision matrix was constructed based on the fuzzy scores of each component for each house, and through steps such as normalization, weighting, and distance calculation from positive/negative ideals, the final closeness coefficient (C*) was computed for each house. The Sharif House, due to its climate-responsive design, use of local materials, and incorporation of social spaces, received the highest scores across most resilience and self-sufficiency components, ranking first in this evaluation Table 5. In many contemporary houses, certain attention has been paid to the use of local materials and energy efficiency. However, social resilience and managerial self-sufficiency were consistently rated below the desirable

Table 4. Final framework for assessing resilience and self-reliance in Bandar Abbas residential complexes. Source: Authors.

Main Component	Subcomponents / Indicators	Dimensions of Assessment
Urban Resilience	– Location in the city – Building orientation – Geometry and form	Access to urban services, compatibility with urban fabric, and energy efficiency through orientation
Physical Resilience	– Local materials – Construction techniques – Durability and maintenance	Resistance to erosion and natural hazards, maintenance costs, and structural flexibility
Environmental Resilience	– Climate responsiveness – Natural ventilation – Energy efficiency	Adaptation to climate (temperature, humidity, wind), reduced dependency on mechanical systems
Social Resilience	– Social interactions – Communal spaces – Identity and belonging	Availability of communal spaces, level of neighborhood participation, reinforcement of identity, and local ties
Economic Resilience	– Economic accessibility – Support for the local economy – Economic sustainability	Affordability of construction/maintenance, use of local labor and materials
Sustainable Self-Sufficiency	– Use of local materials – Water resource management – Energy efficiency	Reduced dependence on external resources, conservation of natural resources, and energy savings
Social Self-Sufficiency	– Resident participation – Social governance	Resident involvement in building management and maintenance, local decision-making structures
Managerial Self-Sufficiency	– Interaction with local government – Managerial practices	Support from urban institutions, effective policies throughout the building lifecycle

level, underscoring critical areas for improvement (Table 6).

- **Comparative analysis**

For the final comparison, Fig. 1 illustrates the average closeness coefficient for the two groups of houses—traditional and contemporary. As shown, the average scores for traditional houses fall within the range of 0. 76 to 0.84, while contemporary houses range from 0. 49 to 0.643.

- Reasons for the relative superiority of traditional houses include

High climatic adaptability (*stronger environmental and physical resilience*). Use of local materials with greater resistance to heat and humidity. Social spaces such as central courtyards and traditional resident

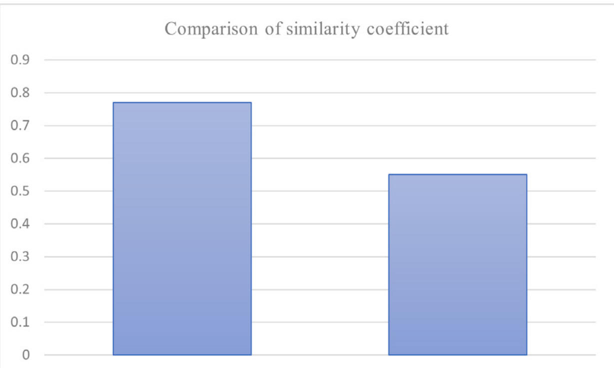


Fig. 1. Comparison of Average Closeness Coefficient in Traditional and Contemporary Samples. Source: Authers.

interactions which enhance social resilience and sustainable self-sufficiency.

- Challenges of contemporary houses include

Insufficient attention to social resilience and participatory space design. Weaknesses in managerial self-sufficiency and interaction with local government. In some cases, an overemphasis on modern materials without consideration of climatic factors.

- Key components requiring attention in Bandar Abbas housing are:

Water resource management: despite technological advancements in some contemporary houses, the use of traditional methods of rainwater collection and storage remains inadequate in this hot-humid climate.

Social design: Most contemporary houses lack spaces for resident interaction and participation.

Governance and social management: findings revealed low levels of resident participation in managing contemporary housing, thereby reducing self-sufficiency.

Overall, the findings of this section indicate that traditional houses in Bandar Abbas scored higher in various aspects of resilience (particularly physical and environmental) and certain dimensions of self-sufficiency. By contrast, contemporary houses, despite incorporating modern technologies, require significant revision in social,

Table 5. Final Ranking of Traditional Houses (Based on Fuzzy TOPSIS and Research Framework). Source: Authers.

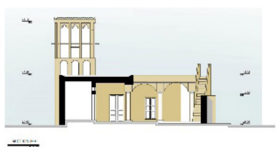
House Name	Closeness Coefficient (C*)	Rank	Pic
Sharif House	0.84	1	
Hodi House	0.805	2	
Galledari House	0.792	3	
Farough House	0.775	4	
Vahedi House	0.773	5	
Bastaki House	0.771	6	
Ghasemi House	0.749	7	
Gol House	0.736	8	
House No. 31	0.719	9	
House No. 42	0.710	10	

Table 6. Final Ranking of Contemporary Houses (Based on Fuzzy TOPSIS and Research Framework). Source: Authers.

House Name	Closeness Coefficient (C*)	Rank
House in 22 Bahman Neighborhood	0.643	1
House in Damahi Neighborhood	0.606	2
House in Kahtak Village	0.583	3
House 1 in Shah-Hosseini Area	0.562	4
House in Nakhl-e Nakhoda	0.529	5
House 2 in Shah-Hosseini Area	0.540	6
House in Southern Golshahr	0.522	7
House between Bandar Abbas–Minab	0.518	8
House 1 in Sarkhoon	0.510	9
House 2 in Sarkhoon	0.491	10

managerial, and even economic domains. These results suggest that integrating vernacular architectural principles with modern methods can enhance resilience and self-sufficiency in new constructions.

Discussion

The findings of this study, particularly the relative superiority of traditional houses in terms of physical and environmental resilience, are consistent with many previous studies on vernacular architecture and sustainable design in hot-humid climates. Specifically, the use of local materials and indigenous techniques of natural cooling and ventilation have both been widely reported as effective strategies (Fazeli et al., 2022; Ghorouei et al., 2020). Similarly, studies focusing on water resource management and the establishment of social structures in traditional Iranian architecture have confirmed comparable outcomes regarding environmental and social resilience (Sheikhi et al., 2021). In the domain of self-sufficiency, the present results align with studies suggesting that resident participation and collaborative maintenance are crucial factors in enhancing sustainability in older neighborhoods (Zhang & Yang, 2021). However, certain economic and managerial aspects of traditional houses in Bandar Abbas did not fully correspond with the expectations set by recent research on the economics of vernacular housing. For instance, in some traditional houses, the costs of restoration or access to modern infrastructure exceeded initial assumptions. Moreover, several recent studies have argued that, despite their climatic advantages, vernacular materials may not be universally applicable in large-scale industrialization and urban redevelopment projects (Fazeli et al., 2022).

In terms of managerial self-sufficiency, the findings revealed that traditional houses typically maintain strong local structures but exhibit limited interaction with formal institutions. By contrast, some modern urban studies emphasize broader collaboration with governmental bodies to enhance resilience. This indicates a partial misalignment regarding the role of local governance, suggesting the need for further comparative investigation (Sheikhi et al., 2021). Overall, the results of this research largely confirm the theoretical foundations concerning the benefits of vernacular architecture in strengthening physical, environmental, and even social dimensions of resilience. At the same time, challenges in the managerial and economic domains indicate that the ideal solution may lie in the integration of traditional principles with modern technologies and policies. Thus, while the study broadly aligns with existing literature, in some areas—such as restoration costs and governance structures—it underscores the need for future studies to adopt more detailed approaches and to move toward a hybrid vernacular–modern model. In line with the research questions, the following key results were obtained. Physical and environmental resilience components carry the greatest weight in shaping housing resilience in Bandar Abbas, with local materials identified as a critical success factor in traditional houses. Traditional houses were generally found to be more resilient and more sustainably self-sufficient compared to contemporary houses. The Fuzzy TOPSIS method, by incorporating uncertain and multi-criteria data, provided precise prioritization of components and case samples, thereby confirming the main hypothesis: that a significant difference exists between traditional and contemporary housing with respect to physical and environmental resilience.

Traditional houses in Bandar Abbas, the product of generations of vernacular knowledge in coping with hot-humid climates, demonstrated multiple strengths. The use of local materials such as stone, wood, and gypsum reduced energy consumption and enhanced durability against humidity and heat (Fazeli et al., 2022). Furthermore, inward-oriented layouts with central courtyards and traditional windcatchers provided optimized natural ventilation and thermal comfort (Sheikhi et al., 2021). Socially, the preservation of communal spaces and neighborhood interactions significantly contributed to residents' self-sufficiency. Conversely, contemporary architecture—often shaped by modernist trends and technologies—showed insufficient adaptation to the climatic conditions of Bandar Abbas, facing challenges not only in environmental but also in economic aspects (Zhang & Yang, 2021). Socially, the prevalence of apartment living and the gradual removal of communal spaces reduced neighborhood participation. From a managerial perspective, contemporary housing models lack sustainable structures for engagement with local institutions, thereby limiting self-sufficiency (Ghorouei et al., 2020).

Conclusion

The findings of this research revealed that traditional houses in Bandar Abbas outperform contemporary houses across multiple dimensions of resilience and self-sufficiency, particularly in the physical, environmental, and social domains. The use of climate-adapted local materials, the spatial organization of indoor and outdoor areas based on natural ventilation, the presence of communal spaces such as central courtyards and verandas, and the integration of traditional elements like windcatchers collectively enhanced the ability of these houses to withstand environmental hazards while meeting residents' daily needs. By contrast, many contemporary houses—designed with industrial materials and modern architectural models—demonstrated weaker alignment with the hot-humid climate and neglected social and managerial dimensions, resulting in lower final rankings. The findings suggest that the intelligent integration of modern construction technologies with vernacular design principles can pave the way toward sustainable and resilient housing in similar climates. For example, combining advanced building systems with natural ventilation and climate-responsive layouts can simultaneously reduce energy consumption and improve thermal comfort. At the policy level, developing construction regulations adapted to climatic characteristics, alongside incentives for using local materials and vernacular design elements, can provide stronger foundations for enhancing urban resilience and self-sufficiency. Nevertheless, this study faced certain limitations, including restricted access to maps and documents for some case studies, as well as a sample limited to the city of Bandar Abbas. As such, the results should be generalized cautiously to other contexts. Future research is recommended to:

- Conduct studies on larger samples across other coastal cities in southern Iran or in regions with similar climates;
- Employ complementary multi-criteria decision-making methods, such as Fuzzy AHP or ANP, and compare their outcomes with those of Fuzzy TOPSIS to strengthen analytical accuracy;
- Focus on economic evaluation and cost–benefit analysis of self-sufficient and resilient housing to operationalize findings within housing markets and urban planning policies. In sum, this study highlights the potential of hybrid vernacular–modern models that integrate indigenous wisdom with advanced technologies, offering a practical pathway toward sustainable and resilient residential design in hot-humid climates.

Declaration of Conflicting Interests

The authors declare that there are no conflicts of interest regarding the conduct of this research.

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HOW TO CITE THIS ARTICLE

Zakeri, S., Mahmoudi Zarandi, M., & Farzad Behtash, M. R. (2025). A Comparative Assessment of Resilience and Self-Reliance in Traditional and Contemporary Houses of Bandar Abbas Using the Fuzzy TOPSIS Method. *Bagh-e Nazar*, *22*(149), 17-30.

DOI: 10.22034/bagh.2025.502960.5754
URL: https://www.bagh-sj.com/article_228162.html?lang=en