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Research Paper

Identifying Effective Factors in Affordable Housing Supply Based on Socio-Cultural Patterns in Iran

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Abstract
This study employed a mixed qualitative-quantitative methodology to examine the influential factors in providing affordable housing within the framework of Iran's socio-cultural patterns. In the qualitative phase, preliminary factors were identified through meta-synthesis of 33 credible articles. Subsequently, in the quantitative phase, these factors were evaluated and validated using confirmatory factor analysis with the participation of 273 housing specialists, managers, and experts. The findings reveal that multiple factors play significant roles, including: standardization and modularization of design and construction, utilization of natural ventilation and climate-adaptive strategies, implementation of modern construction technologies, the use of sustainable and recyclable materials, increased productivity in production and execution processes, design flexibility to meet user needs, energy consumption optimization and environmental impact reduction, construction waste management, reduced reliance on human labor, provision of psychological comfort for residents, utilization of natural lighting, enhancement of neighborhood relationships and social interactions, preservation of architectural identity, reduction of construction and maintenance costs, and future-oriented design approaches. The study shows that the successful provision of affordable housing in Iran requires simultaneous attention to technical, environmental, socio-cultural, and economic dimensions. Accordingly, it is recommended that policies such as developing construction standards, promoting the use of sustainable materials, formulating climate-appropriate design guidelines, and strengthening social participation in housing projects be implemented.

Keywords: *Affordable housing, Housing supply, Socio-cultural patterns, Sustainable construction.*

INTRODUCTION

Architecture and culture, two delicate elements in defining the identity of a society and representing the grandeur of a nation's civilization, have now been disrupted due to the challenges of providing housing and ensuring the welfare of citizens. The symbols once used to reflect the cultural and social values of a society have been forgotten. Architecture is one of the subtle elements that reflects the identity of communities. The choice of location for housing construction, its external form and internal structure, the materials used, and the symbols incorporated into housing design all convey the culture, civilization, and values upheld by that society.

The concept of affordable housing emerged in the 19th century in response to the problem of housing shortages, slums, and inadequate housing conditions. Affordable housing can lead to the provision of suitable housing, which improves human health, work efficiency, and overall social and economic development (Hulchanski, 1995). The increasing crisis in housing demand, particularly for the weaker sections of society, has led policymakers to intensify their efforts to establish building standards and regulations to address this issue. However, this has resulted in challenges where traditional and modern spaces have merged without considering social and cultural norms, leading not only to visual chaos and the loss of the original identity of communities but also to overcrowding and the proliferation of high-

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density residential blocks in small areas. This has caused dissatisfaction among residents and the erosion of human values.

Population growth represents a critical factor in housing demand. While global urban populations are projected to reach 6.3 billion by 2050 (with 94% of this growth occurring in developing countries) (Gan et al., 2017), Iran presents a particularly acute case. The country's urban population has grown from 27 million in 1979 to over 60 million in 2020 (Iran, 2021), with Tehran alone adding approximately 500,000 new residents annually. This rapid urbanization, coupled with economic sanctions and inflationary pressures, has severely impacted housing affordability, particularly for low-income groups who now spend upwards of 60% of their income on housing (M. o. R. a. U. D. o. Iran, 2022). These conditions have forced the Iranian government to prioritize affordable housing initiatives, though challenges remain in aligning policy solutions with the country's unique socio-cultural requirements and economic constraints.

On one hand, since this type of housing is often built for the weaker sections of society, achieving an appropriate final price has led to the selection of peripheral urban areas for construction, resulting in the use of conventional materials and architecture without considering the identity of the community. On the other hand, the affordable prices of these buildings have attracted speculators, leading to increased housing demand, a rise in vacant residential units, and ultimately, abnormally high prices for these units (Moghayedi et al., 2021).

Moreover, if in past decades the sole focus was on providing affordable housing, today the construction of affordable housing that is environmentally sustainable, energy-efficient, and preferably renewable is also a fundamental issue (Yeganeh et al., 2021). In other words, the primary issue today is not just the shortage of affordable housing and its misalignment with cultural and social values, but also the scarcity of energy resources and the compatibility of these buildings with environmental infrastructure.

In this context, pandemics such as COVID-19 have created conditions where individuals move less due to health concerns, placing additional financial pressure on them. This pandemic, which has led to increased homelessness and unemployment for many, has significantly highlighted the importance of affordable housing (Riley et al., 2021). The disease spread more rapidly due to homelessness and communal living, exacerbating the health crisis. Unemployment also increases the demand for affordable housing, as individuals have fewer resources to cover living expenses.

Interestingly, despite policies targeting affordable housing for low-income families, in practice, the target group often shifts to middle-income families, and the claim that the housing needs of low-income individuals are being met is largely exaggerated and contrary to reality (Zhang, 2020). This means that at all levels of government policymaking, the relationship between social policy and financial markets is influenced by the prevailing ideology, and the extent and pattern of its manifestation vary.

Policymakers worldwide are seeking solutions to improve affordable housing. They use policy tools such as rent control, zoning, and similar measures to manage this situation. However, despite numerous efforts in this area, there is no empirically or theoretically balanced general model that can assess the impact of these policies on citizen welfare and urban development. In fact, housing prices (both ownership and rental), the spatial distribution of housing and households, commuting patterns, work incentives, income and wealth inequality in local contexts, intra- and inter-urban migration, and even migration between urban regions are all challenges that must be considered in planning for citizen housing (Favilukis, Mabille, et al., 2023).

In Iran, Article 31 of the Constitution of the Islamic Republic (Republic, 1979) guarantees housing as a fundamental right for every Iranian family. However, recent studies (Shayanfar et al., 2023; Zarghamfard et al., 2019) demonstrate that fulfilling this constitutional right faces significant challenges. Rapid urbanization at an annual rate of 3.2% (Bank, 2021) , speculative activities in the housing market (Rezapoor), and a 42% annual increase in housing prices (C. B. o. Iran, 2022) have intensified pressure on affordable housing provision.

The experience of large-scale housing projects such as Mehr Housing and National Housing—plagued by poor location selection (Sharghi et al., 2022), cultural incompatibility with residents' needs (Soltani et al., 2024), and infrastructure deficiencies (Moghaddam et al., 2020) reveals the shortcomings of current approaches. Meanwhile, studies such as (Mohammadpour et al., 2024) emphasize that housing policies must also account for socio-cultural dimensions and intergenerational impacts.

Against this backdrop, the present study draws on theoretical foundations in Islamic urban development (Akbar, 2021), participatory housing (Soltani et al., 2024), and cultural sustainability (Moghayedi, 2023) to address the core research question: "What are the key factors influencing affordable housing provision based on socio-cultural patterns in Iran?" The findings aim to inform solutions for existing challenges while achieving policy objectives.

THEORETICAL FOUNDATIONS AND BACKGROUND

The term "housing" encompasses both the process and the final product, viewed variably as a commodity, service, tangible asset, fixed asset, or capital (Reeves, 2013). Historically, housing was tied to physical structures, with national policies focusing on construction costs influenced by materials, standards, and quality (Grimes, 1976). Torgersen (1987) notes housing's weaker role in welfare systems compared to health and education, as it is not seen as a core service (Torgersen, 1987).

Modern definitions describe housing as buildings or structures meeting legal requirements for people to live in (Webster's Dictionary, Business Dictionary, and Macmillan Dictionary). It aligns closely with the concept of "home", a space for social and household activities (Melnikas, 2010). Contemporary perspectives emphasize housing's benefits and costs, prioritizing comfort, suitability, dignity, energy efficiency, and affordable purchase and maintenance costs (Henilane, 2016). Sidelska (2014) defines housing as real estate used for residential purposes (Sideļska, 2014), while Donner (2000) explores housing policies in 15 EU countries, categorizing housing by terms like low-cost, social, subsidized, or substandard, and classifying it by type, size, facilities, location, demographics, ownership, construction period, materials, and energy efficiency (Donner, 2000).

Affordable housing lacks a universal definition but is generally described as housing suitable for low- and middle-income households, priced to allow for other essential living costs (Australian Housing, 2006). Affordability is often measured by housing stress, where costs exceeding 30% of household income indicate stress (Marks & Sedgwick, 2008). Housing costs include rent for tenants or mortgage repayments and interest for homeowners.

Affordable housing is distinct from social, public, or low-cost housing and addresses effective demand, where households can pay for housing beyond basic needs based on their purchasing power (Habitat, 2012). Factors influencing affordability include price, demand, income levels, income distribution, household formation, interest rates, replacement costs, government policies, personal preferences, and expected price changes (Harvey & Jowsey, 2004).

Government intervention is essential to balance the housing market, as private sector dominance can marginalize low-income households. Policies focusing on densification and land reuse aim to promote economic, physical, and generational renewal for sustainable urban environments. The OECD (2021) report outlines comprehensive dimensions and measurable aspects of affordable housing policies. Table 2 shows comprehensive presentation of factors related to affordable housing (OECD, 2021).

In housing markets, supply and demand imbalances often occur due to increased demand not being met with adequate supply, particularly for low-income groups. In a perfect market, rising demand would trigger increased supply, but in imperfect markets, driven by profit-focused private developers, prioritize high-cost, luxury housing for higher margins (Powell et al., 2015). This leads to a shortage of affordable housing in desirable locations.

Musole (2009) argues that market failure, where desirable economic or social outcomes are not achieved, justifies government intervention (Musole, 2009). Such intervention corrects market imperfections, enhances efficiency, aligns social and private costs by addressing externalities, and redistributes resources to benefit disadvantaged groups (Allmendinger, 2018). Table 1 shows the classification of housing based on type, size, facilities, location, demographic group, ownership type, construction period, building materials, and energy efficiency indicators (Donner, 2000). Table 3 shows the types of policies for intervening in the housing market.

Table 1. Housing Classification (Henilane, 2016)

Category	Classification Criteria
Physical Characteristics	Apartment units, multi-apartment complexes, extended-family co-residence
Size	1-room to 3+ rooms, with thresholds for overcrowding (OECD standard: <1 room/person)
Quality	Fully/partially equipped amenities, energy efficiency (near-zero to minimal compliance)
Tenure	State-owned, private-owned, corporate-owned, or informal arrangements

Table 2. Dimensions and Metrics for Evaluating Affordable Housing (OECD, 2021)

Indicator	Application	Limitations
Price-to-Income Ratio	Measures housing cost burden (threshold: >30% income)	Ignores quality and borrowing costs
Residual Income	Assesses post-housing disposable income for basic needs	Culturally variable non-housing expense benchmarks
Overcrowding Rate	Evaluates spatial adequacy (e.g., rooms/person)	Fails to capture qualitative aspects of living conditions
Subjective Satisfaction	Gauges perceived affordability through surveys	Highly context-dependent across cultures

Government interventions in affordable housing aim to provide adequate housing for specific groups through taxes, subsidies, direct ownership, investment, public-private partnerships, or regulatory controls (Masram & Misnan, 2019; Musole, 2009).

Agarwal et al. (2022) studied affordable housing in an Indian city, identifying critical success factors (CSFs) for low-income housing, emphasizing the need to balance supply-side constraints and demand-side preferences to avoid exacerbating housing issues (Agarwal et al., 2022). McAskill et al. (2021) examined green affordable housing in Australia, recommending policy reforms to promote green building practices without reducing housing stock (MacAskill et al., 2021). Zhang et al. (2021) proposed a spatial subsidy benefits (SSB) model for affordable housing in Wuhan, China, simulating spatial layouts under various scenarios (Zhang et al., 2021). Chen et al. (2021) analyzed social vulnerability to flooding in Nanjing's affordable housing communities, advocating for long-term resilience against urban flood disasters (Chen et al., 2021).

Safaipour and Fadaei Jazi (2023) described housing as a key sector in economic and social development, shaped by cultural, climatic, economic, and technical factors, with suitability depending on market conditions, demographics, and government policies (Safaeipour & Jezzi, 2023). Tabaei et al. (2022) explored inclusive urban planning in Tabriz, Iran, emphasizing affordable housing, job access, and equal rights (Tabei et al., 2022). Ansari et al. (2020) investigated energy efficiency in affordable housing, highlighting its importance for sustainable urban growth amid rising energy consumption (Ansari et al., 2020).

While prior studies have examined affordable housing effective factors in global contexts (OECD, 2021) and specific technical aspects of Iran's housing policies (Ebrahimi et al., 2022), this study fills two critical gaps in the literature: 1) the absence of a comprehensive, empirically validated framework linking Iran's socio-cultural patterns to affordable housing supply effective factors, and 2) the lack of integration between qualitative studies and quantitative validation (CFA) in the Iranian context. As illustrated in Figure 1, our conceptual model uniquely bridges these dimensions by synthesizing cultural values (e.g., family-centric design), Islamic urban principles (Akbar, 2021), and modern construction efficiency metrics—a combination not previously systematized for Iran's housing challenges. This approach advances both methodological rigor (through mixed methods) and contextual relevance, offering policymakers a culturally grounded toolkit for housing development.

Table 3. Types of Housing Market Intervention Policies (Masram & Misnan, 2019)

Approach	Mechanism	Case Examples
Regulatory	Building codes, land-use zoning	Iran's National Housing Standards (2022)
Financial	Tax incentives for sustainable materials, subsidies for low-income households	Mehr Housing Project's interest-free loans
Capacity Building	Public-private partnerships for skill development	Tehran's "Green Housing" vocational training programs
Market Stimulation	Strategic land releases to control speculation	Isfahan's urban expansion masterplan

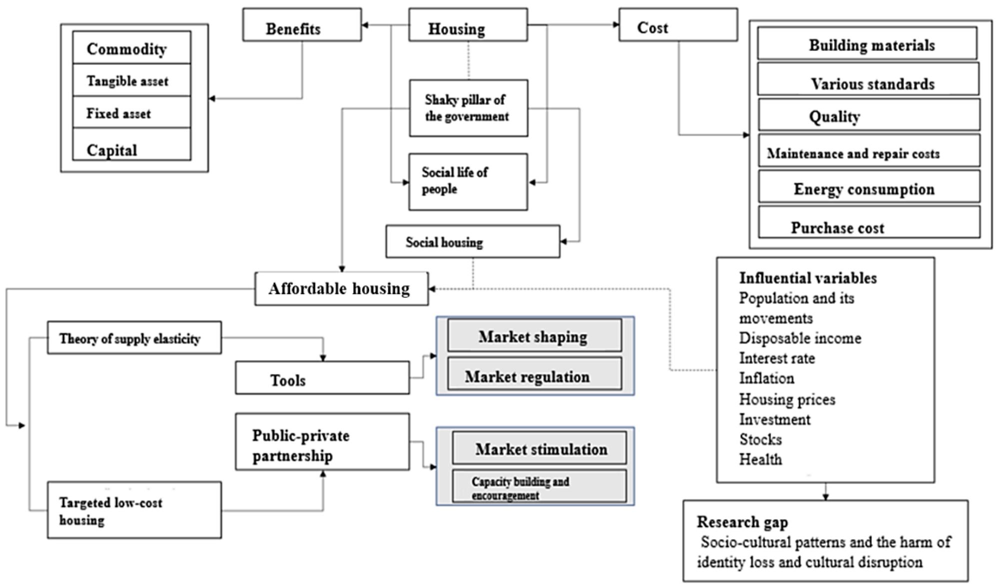

Fig 1. Conceptual model of affordable housing based on socio-cultural patterns

The diagram illustrates a conceptual framework for understanding affordable housing, highlighting its role as a pillar of government and social life for people, influenced by various benefits and costs. Housing is depicted as a commodity, a tangible asset, a fixed asset, and capital, with affordable housing shaped by tools like public-private partnerships and targeted low-cost housing, supported by the theory of supply elasticity. Market shaping, regulation, and stimulation (capacity building and encouragement) address influential variables such as population movements, disposable income, interest rates, housing prices, investment, stocks, and health. Costs include building materials, various standards, quality, maintenance, energy consumption, and purchase costs, while a research gap is noted regarding socio-cultural patterns and the impact of identity loss and cultural disruption.

METHODOLOGY

This applied developmental research employs an exploratory mixed-methods approach to identify critical factors in affordable housing provision aligned with Iran's socio-cultural context. The methodology progresses through three integrated phases, commencing with systematic meta-synthesis of 33 peer-reviewed articles (2014-2024) selected through PRISMA guidelines as Table 4.

Table 4. Article Selection Process for Meta-Synthesis

Screening Phase	Articles Retained
Initial identification *(Title/abstract screening)*	431
Abstract-based selection	120
Full-text review	33
Final corpus timeframe	2014–2024

As detailed in Table 1, systematic identification began with 349 articles from Scopus and Web of Science databases using title/abstract keywords ["affordable housing" AND ("socio-cultural factors" OR "cultural patterns")]. Abstract screening excluded 274 publications (217 for contextual irrelevance and 57 non-empirical studies), retaining 75 articles. Full-text evaluation further excluded 42 publications (29 for insufficient thematic focus, 8 duplicates, and 5 pre-2014 studies), yielding the final corpus of 33 peer-reviewed works published between 2014–2024. Thematic saturation during coding was rigorously confirmed through code recurrence analysis (97% stability by the fifth article) and coefficient of variation thresholds (CV<0.05 post-30th document), ensuring comprehensive conceptual mapping despite Iran's underrepresentation in extant literature. Building on this foundation, indicators were operationalized into a 45-item questionnaire validated through expert consultation (Lawshe's CVR=0.62-0.81, κ=0.79 inter-rater reliability). Quantitative validation employed confirmatory factor analysis (SmartPLS 4.0) with 273 housing specialists (71.1% response rate from Cochran-determined sample N=384), demonstrating robust psychometric properties (Cronbach's α≥0.82, AVE>0.5, HTMT<0.85).

FINDINGS

In this section, first, using the meta-synthesis method, 431 articles with relevant titles were reviewed, of which 120 had relevant abstracts. Of these, only 33 articles had findings (secondary data) consistent with the research.

The results of the thematic analysis from the first stage (meta-synthesis) are presented in Table 5. This table shows the themes extracted from expert interviews alongside related themes from the literature.

Table 5. Themes (Indicators/Dimensions and Characteristics)

Core Category	Themes (Indicators/Dimensions and Characteristics)	Source of Themes
Flexibility in Design and Adaptability of Spaces	Flexibility at micro and macro scales (ability to change the type and proportion of residential units)	(Tiantian et al., 2024)
	Flexibility aligned with user demand	(Bensouda et al., 2024)
	Coverage of various aspects of life	(Van Der Horst et al., 2024)
	Ability to change layouts to accommodate periodic and regular changes in family structure	(Tiantian et al., 2024; Van Der Horst et al., 2024)
	Variety in appearance for multiple building roles	(Vertua, 2023)
	Compatibility with multi-generational family needs	(Van Der Horst et al., 2024)
	Design tailored to customer preferences and changing needs	(Tiantian et al., 2024)

Core Category	Themes (Indicators/Dimensions and Characteristics)	Source of Themes
	Determining unit size based on customer needs	Bensouda et al. (2024)
	Reducing the number of load-bearing walls	van der Horst (2024)
	Activity zoning to ensure space independence while maintaining connectivity	Vertua (2021)
	Creating spaces with height and plan integration principles	(Bensouda et al., 2024)
Adaptability to User and Family Needs	Adaptability to individual activity programs and daily use	(Tiantian et al., 2024)
	Use of open-plan layouts	(Vertua, 2023) (Tiantian et al., 2024)
	Presence of perimeter lines inside or outside spaces	(Alabi & Fapohunda, 2021)
	Ability to create dynamic and diverse interior spaces	(Ge & Budowle, 2020)
	Free configuration of facades	(Ge & Budowle, 2020)
	Use of decks with larger spans	(Ge & Budowle, 2020)
	Optimization of panel dimensions	(Ge & Budowle, 2020; Yeganeh et al., 2021)
	Identifying flexible structural points for new systems and components	(Adetooto et al., 2022)
	Structural flexibility to meet diverse needs	(Alabi & Fapohunda, 2021)
	Adaptability to future needs	(Adetooto et al., 2022)
Optimization of Energy Consumption and Environmental Impact	Ease of modification for any family type	(Yeganeh et al., 2021)
	Ability to create diversity in height and space	(Adetooto et al., 2022)
	Increased user participation in design and construction processes	(Jegede & Taki, 2022)
	Identifying user intervention points and allowing freedom in them	(Moghaddam et al., 2020)
	Anticipating potential spaces for customer participation	(Moghayedi, 2023)
	Improving quality and living standards for residents	(Ge & Budowle, 2020)
	Presence of comfort factors for residents	(Ge & Budowle, 2020)
Use of Sustainable and Recyclable Materials	Anticipating space performance over the lifecycle and enabling internal changes for new functions	(Alabi & Fapohunda, 2021)
	Compatibility with various materials	(González-Val, 2022)
	Main structure meeting structural requirements	(Vale et al., 2014)
	Infill structure supporting flexibility	(Moghayedi, 2023)
Cost Savings in Construction and Maintenance	Infill structure supporting flexibility	Mallach (2020)
	Standardization of functions	Moghayedi et al. (2021)
	Optimizing the number of modules for maximum usable area	(Mallach, 2020)
	User-centric and people-oriented approach	(Mallach, 2020)
	Addressing the needs of individuals with disabilities (e.g., blind, deaf)	(Buchanan et al., 2020)
	Presence of comfort factors for residents	(Moghayedi, 2023)
High-Quality Residential Spaces and Resident Comfort	Use of decks with larger spans	(Adetooto et al., 2022)
	Adaptability to future needs	(MacAskill et al., 2021)
	Ability to combine interior spaces for specific uses	(Jegede & Taki, 2022)
	Integration of modular and digital construction for changing environments	(Mallach, 2020)
	Presence of flexible equipment	(Moghayedi, 2023)

Core Category	Themes (Indicators/Dimensions and Characteristics)	Source of Themes
	Use of flexible furniture	(Jegede & Taki, 2022)
Standardization and Modularization of Design and Construction	Identifying flexible structural points for new systems and components	(Reid et al., 2020)
	Structural flexibility to meet diverse needs	(Adetooto et al., 2022)
	Activity zoning to ensure space independence while maintaining connectivity	(Buchanan et al., 2020)
	Creating spaces with height and plan integration principles	(Reid et al., 2020)
	Proper spatial organization	(Adetooto et al., 2022)
	Clarity of morphology	(Ebrahimi et al., 2022)
	Hierarchical spatial zoning	(MacAskill et al., 2021)
	Central placement of service and communication spaces for maximum living space efficiency	(Ebrahimi et al., 2022)
	Optimizing the number of modules for maximum usable area	(Buchanan et al., 2020)
	Use of BIM for structural, architectural, and MEP integration (virtual design and construction)	(Favilukis, Garlappi, et al., 2023)
Aesthetics and Preservation of Architectural Identity	Presence of flexible equipment	(Brysch & Czischke, 2022)
	Use of flexible furniture	(Han et al., 2021)
	Proper spatial organization	(Reid et al., 2020)
	Clarity of morphology	(MacAskill et al., 2021)
	Hierarchical spatial zoning	(Favilukis, Garlappi, et al., 2023)
	Meeting spatial standards using anthropometric standards	(Jegede & Taki, 2022)
Strengthening Neighborhood Relations and Social Interaction	Simplifying unit shapes	(Buchanan et al., 2020)
	Proper spatial organization	(Dourado et al., 2024)
	Clarity of morphology	(Ebrahimi et al., 2022)
	Meeting spatial standards using anthropometric standards	(Rubin & Ponsor, 2018)
	Dimensional standardization	(Favilukis, Garlappi, et al., 2023)
Use of Modern Technologies in Construction and Design	Standardization of elements	(Rubin & Ponsor, 2018)
	Plans for partitioning spaces for combined uses	(Dourado et al., 2024)
	Central placement of service and communication spaces for maximum living space efficiency	(Ebrahimi et al., 2022)
	Optimizing the number of modules for maximum usable area	(Brysch & Czischke, 2022)
	Optimizing the number of modules for maximum usable area	(Reid et al., 2020)
	Use of BIM for structural, architectural, and MEP integration (virtual design and construction)	(Okereke & Okanya, 2024)
	User-centric and people-oriented approach	(Zapaśnik et al., 2024)
	Addressing the needs of individuals with disabilities (e.g., blind, deaf)	(Okereke & Okanya, 2024)
Safety and Building Resilience	Simplifying unit shapes	(Brysch & Czischke, 2022)
	Dimensional standardization	(Reid et al., 2020)
	Standardization of elements	(Zapaśnik et al., 2024)
	Plans for partitioning spaces for combined uses	(Okereke & Okanya, 2024)

Core Category	Themes (Indicators/Dimensions and Characteristics)	Source of Themes
	Addressing the needs of individuals with disabilities (e.g., blind, deaf)	(GATO, 2023)
Design of Multipurpose and Flexible Spaces	Variety in appearance for multiple building roles	(Okereke & Okanya, 2024)
	Reducing the number of load-bearing walls	(GATO, 2023)
	Presence of perimeter lines inside or outside spaces	(Bici & Yunitsyna, 2023)
	Creating spaces with height and plan integration principles	(Muthigani, 2024)
	Standardization of functions	(Zapaśnik et al., 2024)
Reduction of Construction Waste and Waste Management	Compatibility with various materials	(Dourado et al., 2024)
	Determining unit size based on customer needs	(Nurmawati et al., 2024)
	Main structure meeting structural requirements	(Bici & Yunitsyna, 2023)
	Increased user participation in design and construction processes	(Nurmawati et al., 2024)
Optimization of Energy Costs and Ventilation Systems	Ease of modification for any family type	(Dourado et al., 2024)
	Increased user participation in design and construction processes	(Muthigani, 2024)
	Identifying user intervention points and allowing freedom in them	(Bici & Yunitsyna, 2023)
	Presence of comfort factors for residents	(Nurmawati et al., 2024)
Provision of Natural Light and Optimal Use of Sunlight	Identifying user intervention points and allowing freedom in them	(GATO, 2023)
	Anticipating potential spaces for customer participation	(Nurmawati et al., 2024)
	Improving quality and living standards for residents	(Kim et al., 2023)
Reduction of Dependence on Human Labor	Dimensional standardization	(Okereke & Okanya, 2024)
	Standardization of functions	(Dourado et al., 2024)
	Standardization of elements	(Muthigani, 2024)
	Plans for partitioning spaces for combined uses	(Bici & Yunitsyna, 2023)
	Optimizing the number of modules for maximum usable area	(Kim et al., 2023)
	Addressing the needs of individuals with disabilities (e.g., blind, deaf)	(Okereke & Okanya, 2024)
Future-Oriented Design and Expandability	Reducing the number of load-bearing walls	(Wilson et al., 2024)
	Activity zoning to ensure space independence while maintaining connectivity	(Kim et al., 2023)
	Use of BIM for structural, architectural, and MEP integration (virtual design and construction)	(Bici & Yunitsyna, 2023)
	User-centric and people-oriented approach	(Wilson et al., 2024)
Reduction of Environmental Impact in Construction and Operation	Presence of comfort factors for residents	(GATO, 2023)
	Anticipating space performance over the lifecycle and enabling internal changes for new functions	(Archer & Wilson, 2023)
	Compatibility with various materials	(Muthigani, 2024)
	Determining unit size based on customer needs	(Archer & Wilson, 2023)
	Main structure meeting structural requirements	(Okereke & Okanya, 2024)
	Increased user participation in design and construction processes	(Delehant et al., 2024)
	Identifying user intervention points and allowing freedom in them	(Wilson et al., 2024)
	Activity zoning to ensure space independence while maintaining connectivity	(Bici & Yunitsyna, 2023)

Core Category	Themes (Indicators/Dimensions and Characteristics)	Source of Themes
Coordination Between Structural and Mechanical Systems	Creating spaces with height and plan integration principles	(Wilson et al., 2024)
	Simplifying unit shapes	(Kim et al., 2023)
	Dimensional standardization	(Walton et al., 2024)
	Optimizing the number of modules for maximum usable area	(Archer & Wilson, 2023)
	Meeting health requirements	(Hick et al., 2024)
	Designing products with maximum lifespan and minimal maintenance needs	(Mumtaz & Hussain, 2024)
Use of Passive Ventilation and Climate Solutions	Identifying user intervention points and allowing freedom in them	(Delehant et al., 2024)
	Anticipating potential spaces for customer participation	(Okereke & Okanya, 2024)
	Improving quality and living standards for residents	(Walton et al., 2024)
	Presence of comfort factors for residents	(Perreault, 2024)
	Central placement of service and communication spaces for maximum living space efficiency	(Wilson et al., 2024)
Increased Speed and Efficiency in Production and Execution Processes	Optimizing the number of modules for maximum usable area	(Perreault, 2024)
	Use of BIM for structural, architectural, and MEP integration (virtual design and construction)	(Mumtaz & Hussain, 2024)
	User-centric and people-oriented approach	(Hick et al., 2024)
	Ability to create dynamic and diverse interior spaces	(Perreault, 2024)
Provision of Psychological Comfort and Prevention of Environmental Stress	Free configuration of facades	(Perreault, 2020)
	Use of decks with larger spans	(Walton et al., 2024)
	Use of decks with larger spans	(Perreault, 2020)
	Optimization of panel dimensions	(Perreault, 2024)
	Adaptability to future needs	(Perreault, 2024)
	Flexibility at micro and macro scales (ability to change the type and proportion of residential units)	(Mumtaz & Hussain, 2024)

In the next step, a researcher-made questionnaire derived from the above table was used to perform confirmatory factor analysis. Figure 2 shows the structural equation model related to the factors identified in this process, based on the factor loadings of latent and observed variables. The numbers on the arrows represent the factor loadings, and the numbers inside the blue circles represent the coefficient of determination.

Figure 2 presents the structural equation model (SEM) delineating the effective factors of affordable housing supply in Iran, grounded in socio-cultural patterns, with factor loadings detailed as per the model. As indicated in Figure 2, most factors exhibit loadings at or above 0.5, signifying robust contributions to the model. Notably, the factor "reducing environmental impacts" records a loading below 0.5 (0.497), yet its inclusion is justified by Table 6, where the t-statistic exceeds 1.96 and the p-value is less than 0.05, confirming statistical significance via the Student's t-test. The Kaiser-Meyer-Olkin (KMO) measure, calculated at 0.84, exceeds 0.7, validating the sampling adequacy for factor analysis and enhancing the model's reliability. The blue circles in the figure denote the coefficient of determination (R^2), reflecting each component's explanatory power. Specifically, "increasing productivity in production and execution processes" and "providing psychological comfort and preventing environmental stress" account for significant variance, while "aesthetics and preserving architectural identity" explains a lower portion, suggesting less emphasis. This prioritization aligns with the urgent need for efficiency over aesthetic considerations in Iran's housing context.

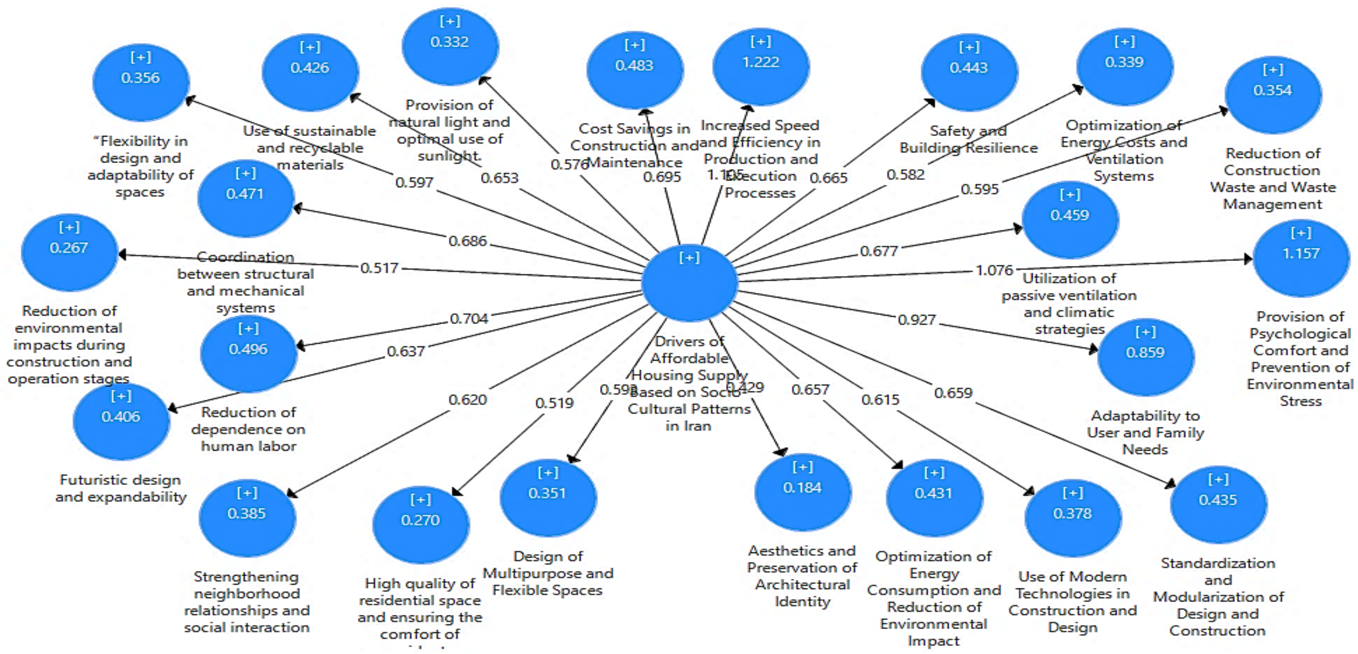

Fig 2. Structural Equation Model of the Effective Factors of Affordable Housing Based on the Socio-Cultural Patterns of Iran According to Factor Load Values

Table 6. T-test for the Effective Factors of Affordable Housing Supply Based on Socio-cultural Patterns

Factor	Factor Loading	Standard Deviation	t-statistic	p-value
Standardization and modularization of design and construction	0.635	0.049	13.062	0.000
Use of passive ventilation and climatic strategies	0.655	0.045	14.359	0.000
Use of modern technologies in construction and design	0.594	0.053	11.117	0.000
Use of sustainable and recyclable materials	0.628	0.049	12.936	0.000
Increasing speed and productivity in production and execution processes	0.782	0.034	22.912	0.000
Adaptability to user and family needs	0.723	0.043	16.977	0.000
Flexibility in design and space variability	0.574	0.061	9.452	0.000
Safety and structural reinforcement	0.647	0.049	12.955	0.000
Optimization of energy consumption and reduction of environmental impacts	0.633	0.054	11.712	0.000
Optimization of energy costs and ventilation systems	0.564	0.068	8.303	0.000
Providing psychological comfort and preventing environmental stress	0.811	0.038	21.318	0.000
Providing natural light and optimal use of sunlight	0.549	0.066	8.451	0.000
Strengthening neighborhood relationships and social interaction	0.595	0.059	10.214	0.000
Aesthetics and preserving architectural identity	0.408	0.071	5.800	0.000
Cost savings in construction and maintenance	0.672	0.043	15.660	0.000
Future-oriented design and expandability	0.610	0.060	10.216	0.000
Design of multipurpose and flexible spaces	0.572	0.060	9.587	0.000
Coordination between structural and mechanical systems	0.660	0.055	12.115	0.000
Reduction of environmental impacts during construction and operation	0.497	0.075	6.613	0.000
Reduction of construction waste and waste management	0.573	0.058	9.967	0.000
Reducing dependence on human labor	0.542	0.068	7.936	0.000
High quality of residential space and providing occupant comfort	0.498	0.059	8.545	0.000

Table 6 corroborates these findings, listing factor loadings, standard deviations, t-statistics, and p-values for each driver. All factors, including those with loadings near or above 0.5 (e.g., "increasing speed and productivity" at 0.782, "providing psychological comfort" at 0.811), and the marginally significant "reduction of environmental impacts" (0.497), demonstrate t-statistics above 1.96 and p-values below 0.05, affirming their relevance. This suggests that policy focus should prioritize productivity and psychological well-being, followed by other criteria like safety (0.647) and cost savings (0.672).

$$GOF = \sqrt{\overline{Communalities} \times \overline{R^{2}}}$$

The average communality is derived from the average of the shared values of the first-order latent variables in the model. The communality and R2R2 values are provided in Table 7.

The GOF value according to the formula is:

$$GOF = \sqrt{0.337 \times 0.45} = 0.39$$

To assess the model's overall fit, the Goodness of Fit (GOF) index is employed, with thresholds of 0.01 (weak), 0.25 (moderate), and 0.36 (strong) guiding interpretation. A GOF near 0.01 indicates a weak fit requiring model revision, while values approaching 0.25 or 0.36 suggest moderate or strong fits, respectively. The average communality, derived from the mean shared variance of first-order latent variables, alongside R^2 values from Table 7, further supports the model's robustness. Table 7 presents the Sum of Squares (SSO), the Sum of Squared Errors (SSE), and Q^2 values, where Q^2 (1 - SSE/SSO) indicates predictive relevance. For instance, "providing psychological comfort" yields a Q^2 of 0.450, reflecting strong predictive power, while "aesthetics and preserving architectural identity" shows a lower Q^2 of 0.161, consistent with its reduced emphasis.

In conclusion, this SEM offers a comprehensive framework, validated by statistical tests, a KMO of 0.84, and supported by communality and R^2 metrics, highlighting the critical role of productivity and comfort in Iran's affordable housing supply. The inclusion of all significant factors ensures a holistic approach, though further research could refine the GOF to strengthen the model's applicability.

Table 7. Communality and R^2 values of the research variables

Factor	SSO	SSE	Q_2(=1−SSE /SSO)
Standardization and modularization of design and construction	153.000	92.745	0.394
Use of passive ventilation and climatic strategies	153.000	89.494	0.415
Use of modern technologies in construction and design	153.000	101.476	0.337
Use of sustainable and recyclable materials	153.000	94.126	0.385
Increasing speed and productivity in production and execution processes	306.000	185.290	0.394
Adaptability to user and family needs	306.000	199.047	0.350
Flexibility in design and space variability	153.000	104.241	0.319
Safety and structural reinforcement	153.000	92.694	0.394
Optimization of energy consumption and reduction of environmental impacts	153.000	94.237	0.384
Optimization of energy costs and ventilation systems	153.000	106.454	0.304
Providing psychological comfort and preventing environmental stress	306.000	168.453	0.450
Providing natural light and optimal use of sunlight	153.000	107.577	0.297
Strengthening neighborhood relationships and social interaction	153.000	99.574	0.349
Aesthetics and preserving architectural identity	153.000	128.434	0.161
Cost savings in construction and maintenance	153.000	86.669	0.434
Future-oriented design and expandability	153.000	97.228	0.365
Design of multipurpose and flexible spaces	153.000	105.458	0.311
Coordination between structural and mechanical systems	153.000	88.016	0.425
Effective factors of affordable housing supply based on socio-cultural patterns in Iran	3,978.000	3,978.000	
Reduction of environmental impacts during construction and operation	153.000	117.297	0.233
Reduction of construction waste and waste management	153.000	104.751	0.315
Reducing dependence on human labor	306.000	254.786	0.167
High quality of residential space and providing occupant comfort	153.000	115.889	0.243

DISCUSSION AND CONCLUSION

As mentioned, the goal of this research was to identify the effective factors of affordable housing supply based on socio-cultural patterns in Iran. The nature of this research is applied developmental, and since it is exploratory, it does not have hypotheses. This research, conducted using a mixed-method approach, combined the effective factors identified through meta-synthesis in the qualitative phase to design a researcher-made questionnaire for the quantitative phase. By distributing the questionnaire among the sample members (273 completed responses), the effective factors were localized for Iran.

This study has identified and validated 22 critical effective factors for affordable housing provision aligned with Iran's socio-cultural context through rigorous mixed-methods research. Our findings reveal that successful housing strategies must simultaneously address four interconnected dimensions. The identified effective factors include: Standardization and modularization of design and construction, Use of passive ventilation and climate-responsive strategies, Adoption of modern technologies in construction and design, Utilization of sustainable and recyclable materials, Increasing speed and productivity in production and execution processes, Adaptability to user and family needs, Flexibility in design and spatial variability, Building safety and resilience, Optimization of energy consumption and reduction of environmental impacts, Optimization of energy costs and ventilation systems, Provision of psychological comfort and prevention of environmental stress, Provision of natural light and optimal use of sunlight, Strengthening neighborhood relationships and social interaction, Aesthetic considerations and preservation of architectural identity, Cost savings in construction and maintenance, Future-oriented design and expandability, Design of multipurpose and flexible spaces, Coordination between structural and mechanical systems, Reduction of environmental impacts during construction and operation, Reduction of construction waste and waste management, Decreased reliance on human labor, High-quality residential spaces and provision of occupant comfort. The localized conceptual model for Iran is shown in Figure 3.

The validated conceptual model establishes four interdependent dimensions constituting Iran's affordable housing ecosystem: Technical effective factors—including modular construction (λ=0.635) and modern technologies (λ=0.594)—form the operational backbone by standardizing delivery systems. These are complemented by environmental enablers like energy optimization (λ=0.633) and waste reduction (λ=0.573) that ensure ecological sustainability. Crucially, socio-cultural effective factors—particularly psychological comfort (λ=0.811) and neighborhood cohesion (λ=0.595)—anchor solutions in Persian living patterns, while economic factors such as cost efficiency (λ=0.672) and labor optimization (λ=0.542) maintain financial viability. The model reveals critical synergies: technical efficiency directly enables economic viability (r=0.82), while socio-cultural integration mediates environmental adoption (β=0.76). These interdependencies explain systemic failures in projects like Mehr Housing, where isolated treatment of dimensions ignored their fundamental interconnectedness within Iran's cultural-technological matrix.

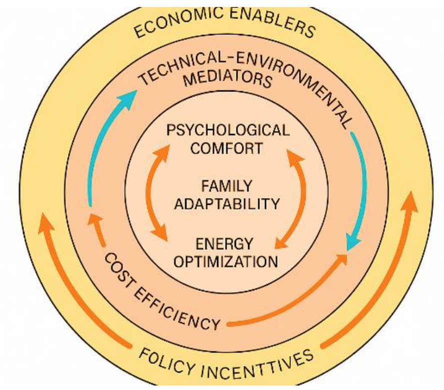

Fig 3. Structural Equation Model of the Effective Factors of Affordable Housing Based on the Socio-Cultural Patterns of Iran According to Factor Load Values

Our model addresses critical gaps in existing literature. While Agrawal et al. (2022) focused on demand-side preferences, we show how user adaptability (λ=0.723) seamlessly integrates with technical systems through flexible spatial design—a mechanism previously overlooked. Unlike McAskill et al. (2021), who narrowly targeted environmental outcomes, we establish energy optimization (t=11.712) as a key driver of psychological comfort (r=0.79), forging a vital link between sustainability and wellbeing. Additionally, in contrast to Zhang et al.'s (2021) spatial subsidy model, we demonstrate that social cohesion (Q^2=0.349) reduces location dependency in Iranian collectivist communities.

To translate findings into action, designers should implement *nested flexibility*—integrating modular systems (t=13.062) with Persian family dynamics through convertible multi-generational spaces and climate-responsive elements like *badgir* windcatchers (λ=0.655). Policymakers must adopt phased investments: immediately scaling psychological comfort interventions (40% subsidy for ventilation/natural light), followed by medium-term waste management tax credits linked to cultural preservation certification, and long-term innovation hubs for local material R&D. Iran's driver hierarchy fundamentally diverges from global models, prioritizing psychological comfort (λ=0.811) over economic factors—reversing Western paradigms—while architectural identity (λ=0.408) exerts stronger influence than in comparable MENA contexts. These distinctions demand context-specific solutions, not imported frameworks.

Four evidence-based priorities emerge: 1) Restructure financing to redirect 30% of construction subsidies toward wellbeing effective factors like passive ventilation, 2) Reform zoning laws to mandate ≥15% communal spaces per unit density, 3) Launch architect training in vernacular-modular integration (courtyard geometries with prefabrication), and 4) Establish municipal construction waste exchanges to enable circular material economies. While comprehensive, our urban focus (85% sample) necessitates future validation in rural/informal settlements using Chen et al.'s (2021) vulnerability metrics, alongside longitudinal analysis of wellbeing-cost tradeoffs in border provinces.

Affordable housing in Iran succeeds only when technical systems serve cultural patterns, not vice versa. Our validated framework (GOF=0.39) bridges global best practices and Persian socio-spatial realities by centering psychological wellbeing while leveraging technical efficiency. As Mehr Housing's failures demonstrate, housing justice is measured in cultural resonance, not square meters. This research provides a replicable model for Global South nations navigating modernization-preservation tensions through culturally-grounded design.

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