A PRACTICAL FRAMEWORK FOR RANKING-BASED ANALYSIS OF LIVABILITY IN URBAN-RURAL CONTEXTS: A CASE STUDY OF QAZVIN CITY-REGION, IRAN

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ABSTRACT

The burgeoning world population has transformed the interplay of space, human beings, and activity, leading to a decline in quality of life and livability in many places. This study aimed to identify the factors affecting livability within a new integrated urban-rural scale using both qualitative and quantitative approaches. Based on the research background and context, objective and subjective indices of livability in the economic, social, and environmental dimensions were developed for both urban and rural settlements in Qazvin, Iran. Data on these indices were collected through secondary resources and questionnaires, and then analyzed using the Analytic Hierarchy Process (AHP) along with Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE), both of which are multi-criteria decision-making methods. The compatibility between these two methods—used for comparing, weighting and evaluating quantitative and qualitative criteria—sets them apart from similar approaches. The results show no complete preference both in the cities and the rural districts. Furthermore, the importance of using three dimensions is highlighted in livable communities by the fact that Qazvin city unexpectedly could not acquire complete superiority due to poor environmental function even though it is the major settlement of the region. An examination of the effective factors and indices also demonstrated that the social dimension of livability is less desirable in the whole city-region; therefore, it should be given more attention when adopting strategies and decisions. Finally, this study can offer substantial assistance to authorities and the decision-makers by employing a flexible and adjustable framework.

Keywords: livability; sustainability; urban-rural context; Qazvin city-region; PROMETHEE

1. Introduction

The population of the world is increasing as economic development grows. This is leading to rapid urbanization and growth of cities which consequently affects livability and life conditions (Eeckhout & Hedtrich, 2021; Di Clemente et al., 2021; Couch, 2016). Every individual, regardless of their urban or rural context, aspires to lead a fulfilling life by positively interacting with their surrounding environment. Achieving a meaningful and satisfactory existence necessitates certain factors that contribute to long-term well-being for both the individual and society (Jome epour et al., 2018). Generally, such conditions, as some argue (Mulligan et al., 2004; Campbell et al., 1976; Marans & Stimson, 2011), are synonymous with livability or good conditions for life which make a place somewhere that is fit for people to live in now or in the future (Sheikh & van Ameijde, 2022).

According to the UN-Habitat (2020) report, rapid urbanization; concentrated urban population in big cities; urban sprawl in broader geographical areas and rapid metropolitan growth are currently the most important changes in human settlements. Urban sprawl, the term often used to describe inefficient urbanization patterns and processes, has affected both urban and rural areas. It has a direct influence on the sustainability of urban areas and leads to land use changes by converting rural croplands and natural landscapes into areas of unplanned urban growth. These changes may lead to increased transportation costs and time (e.g., higher fuel costs, increased vehicle maintenance and more time spent commuting) as well as increased infrastructure and environmental costs in urban areas. Moreover, it alters the socio-economic, environmental, and physical construction of rural areas (Wang & Miao, 2022; Couch, 2016). Therefore, due to the growing importance of multidimensional concepts, the conventional outlook of planning utilizes more inclusive objectives such as sustainable development. Sustainable development presents an integrated solution for these issues considering environmental, economic, and social dimensions (Kermanshahi, 2018). Sustainability is the goal for which we must build a strong base now in order to achieve. Livability is the first step towards accomplishing sustainability and can even be said to be a prerequisite and basis for sustainable development. In other words, livability corresponds to the present, and sustainability to the future (Huang & Liu, 2022; Ebraheem, 2018).

Generally, city-regions are relatively new phenomena in Iran. Qazvin city-region is one of the youngest in the country. It is in stage three of its evolution, which means it should be controlled and directed by planning interventions. In this stage, by increasing the concentration of the population and activity, the cost of living and activities will become more economically efficient in the central city of Qazvin, which will redirect the population flow toward the periphery. This stage is associated with stabilization of the population growth rate in Qazvin; on the other hand, it causes a sharp increase in the population of surrounding cities and villages. Summarizing the findings of the Qazvin city-region plan and based on the comments of the plan's steering council, the following values and ideals should be considered: 1) social and spatial justice at all levels of the city-region; 2) respect for nature and environment; 3) assurance of sustainable development (social, economic, environmental); 4) reduction of poverty and expansion of prosperity (Management and Planning Organization of Qazvin, 2018). All these items could be included in the indices of livability and sustainability. Therefore, a

comprehensive framework is required to fulfill these values and ideals. To date, there has been no effort to analyze livability on such a scale regarding both subjective and objective indices globally in the literature, so this study can offer substantial assistance to authorities and decision-makers by employing a flexible and adjustable framework.

Planning, especially regional planning that is responsible for social goals beyond urban spaces, should seek to improve livability conditions in urban and rural areas as a social desire. This leads to sustainable human settlements as a social goal. Three questions need to be answered on a typically overlooked scale regarding both urban and rural areas:

1. How should livability be measured in cities and rural districts?
2. Is there any relationship between population and livability? And is the central city the most livable?
3. What are the most effective indices to measure the livability of a region?

Accordingly, the present research attempts to assess livability, using a practical framework, within a city-region to fulfill the possible sustainability of human settlements in urban-rural contexts.

2. Literature review

2.1 Livability and correlating concepts

Livability is a general and controversial concept due to its flexibility. It has no precise or comprehensive definition. Despite the contradictions in definition, it is an appealing buzzword in planning (Tolfo & Doucet, 2022; Saitluanga, 2014). One definition given for livability is “good conditions for human life” (Sheikh & van Ameijde, 2022). It should be noted that good conditions rely on the particular context and values of each community such as the prevailing economic, social, and cultural background, since the livability of a place is determined by its inhabitants (Ahmed et al., 2019).

The concept of livability became popular in the early 1990s and was officially proposed at the second UN-Habitat conference in 1992 (Yin et al., 2018; Ahmed et al., 2019). Although the concept is flexible, definitions of livability have some common objective and subjective features about what makes a place attractive and desirable (Soleimani Mehrenjani et al., 2016). Livability is a dynamic concept that must be tailored to the local context and considers the needs of different community members (National Research Council, et al., 2002). Therefore, it’s related to the characteristics of a place that contribute to the well-being and quality of life of its inhabitants. The scale of the place considered can range from a house or neighborhood to a city or region (Newton, 2012).

The literature on livability demonstrates uncertainty about its precise notion as terms like “sustainability”, “well-being”, “satisfaction”, “quality of life", and “happiness" are used interchangeably (Ahmed et al., 2019). Therefore, when studying livability, selecting one of these terms as a complement and choosing a specific context helps clarify the definition of livability.

Sustainability is the generalized state of livability according to various aspects (American Planning Association, 2017); therefore, the comparison of these various aspects is the easiest way to create a more precise definition of livability (Gough, 2015). Sustainability

and livability are two very interesting concepts in urbanism and public debate (Baobeid et al., 2021). They share similar definitions, objectives, and approaches (Litman, 2010). Despite the similarities, they also have significant differences. Sustainability is a long-term goal concerned with the global balance between social, economic, and environmental issues as well as the preservation of intergenerational resources. Livability, by contrast, is concerned with this on a narrower scale by supplying the present, immediate needs (Huang & Liu, 2022; Baobeid et al., 2021).

Even though these two concepts have similarities and differences, they are still complementary approaches. The flexible and dynamic nature of livability and its practical strategies make the ideal of sustainability achievable gradually. Therefore, the reconciliation of these two concepts can lead to a happier, comfortable quality life (Gough, 2015; Baobeid et al., 2021).

2.2 Research framework

A sampling of some studies from the last few decades is presented in Table 1 which presents the results from about 30 selected studies investigated during this research.

Table 1
Extract of selected literature review from the last decade

Location	Context	Scale	Correlative concepts	Extra information
Iran	Urban and rural	• Urban neighborhoods • Rural districts	• Quality of life • Sustainability • Resilience	• Urban and rural livability were not studied within a region simultaneously
Rest of the world	Urban and rural	• Urban neighborhoods • Rural districts • Regional	• Sustainability • Quality of life • Satisfaction • Social health	• Urban and rural livability were not studied within a region simultaneously • Most of the studies in Asia and Australia have used livability indices in settlements while research from the U.S. has focused on the transportation sector

The review of recent studies highlights the necessity of a framework design for livability assessment in a village, city, or region. The framework consists of overall dimensions or principles which form a set of indices. The extent of livability is determined by the qualitative and quantitative measurement of the indices. This adoption of the best approaches leads to an improvement in the status quo. For example, Gough (2015)

introduced 36 indices based on six federal government principles to study the relationship between sustainability and livability in regional master plans. Leach et al. (2017) designed a five-level framework including dimensions, goals, actions, measures, and indices to improve the livable sustainability of the city of Birmingham, UK. Jome epour et al. (2018) and Soleimani Mehrenjani et al. (2016) analyzed rural livability and suggested a set of livability indices; both conducted their research based on sustainability dimensions. Pang et al. (2024) put forth a comprehensive framework comprising 27 indicators across six dimensions to assess residents' satisfaction with rural livability. However, their investigations were confined to questionnaires and subjective assessments provided by residents. Similarly, Ghozi et al. (2023) concentrated their research on social participation and subjective perceptions of livability. Additionally, they illuminated local contextual factors that influence the formulation of livability indicators. Quan et al. (2024), recognizing the significance of urban livability assessment in achieving sustainable urban development, formulated a three-dimensional model for spatially evaluating urban livability. Their approach relied on secondary data sources.

Beyond the scholarly community and researchers, international organizations also exert a robust and impactful influence in this domain. The United Nations publishes a global report on sustainable development goals (SDGs) annually. This report (United Nations, 2021) is based on the economic, social, and environmental dimensions which can be used to determine the livability indices. The report investigates the world's progress in achieving SDGs by 2030 using the latest datasets. Another principal reference for indices in most studies is the Economist Intelligence Unit (EIU) whose framework and procedure are also globally accepted for analyzing livability. The Economist Intelligence Unit (2021) allocates a relative ranking to each city concerning 30 qualitative and quantitative factors.

As we delved deeper into the research literature, certain factors emerged as pivotal in shaping the construction of livability assessment frameworks. These factors encompass the interplay between sustainability and livability analysis, the selection of urban or rural contexts, the choice between objective and subjective evaluation methods, and the design of comprehensive, context-based indices. However, a critical gap persists in the existing literature which is the absence of a comprehensive framework grounded in local indices that can seamlessly address both urban and rural environments, facilitating a holistic assessment encompassing both subjective and objective dimensions. Therefore, due to the universality of sustainability and its supplementary relation to livability, its three pillars were used to determine indices of this study. Finally, context-based indices were selected by screening the literature, SDGs, and the EIU report and adding new applicable indices on both urban and rural scales (see Table 3 for the full list of indices and their relative weights). The final practical framework for livability assessment is provided in Figure 1.

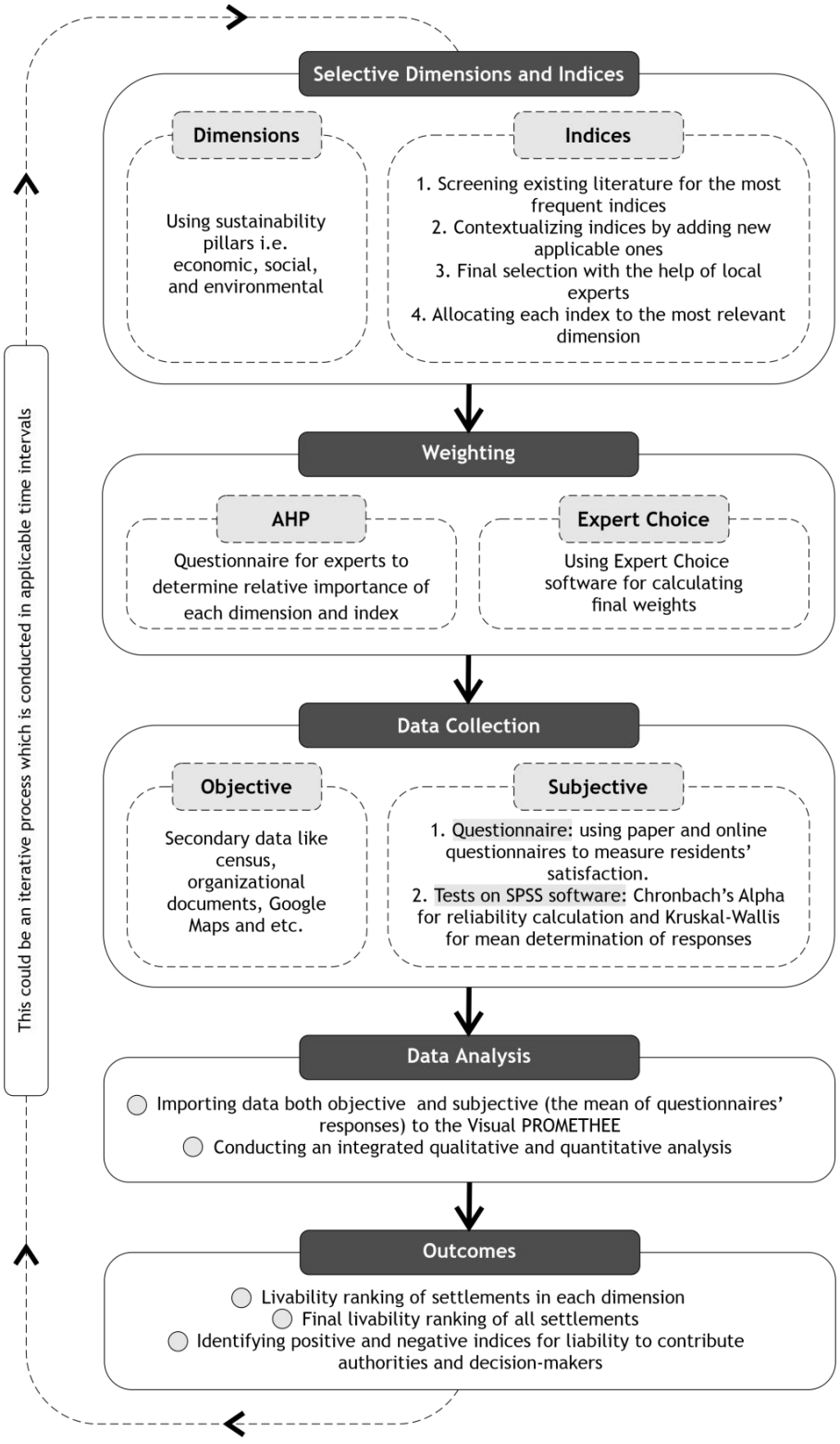


Figure 1 Practical framework for ranking-based analysis of livability

3. Methodology

In order to accomplish the purpose of the research a suitable methodology must be used. A scientific method should be adopted to achieve the accepted scientific results (Khaki, 1999). The novelty of this study is the livability assessment on a relatively new scale, i.e. regional. In contrast to most of the recent studies, objective and subjective data were also investigated in urban and rural contexts simultaneously. These factors highlighted the necessity of using a set of complementary methods. Therefore, the selection of the appropriate methods and tools was the most vital part of the study to correlate the discrete and distinct factors of the research. This facilitates problem-solving.

This study is an applied and evaluation research in terms of purpose. The base theories and principles of livability have been applied to be developed and assessed in a more practical context, i.e., the Qazvin city-region, Iran.

3.1 Scope of research

Time period

This study investigates the livability of the Qazvin city-region under the status quo. The latest data sources were used; however, these data belong to different periods of time. The subjective data was a result of a survey conducted in January 2022 while the objective data was collected from the sources from 2011- 2022.

Spatial boundaries

The study area is located in Qazvin province, Iran. It coincides with the first region of the Qazvin spatial plan which is called Qazvin city-region. The area is about 1471 square kilometers. It is divided into northern submontane and southern plain portions by freeway number 2 which is the busiest freeway in Iran. Seven cities and 111 villages with a population of about 702,000 (74% of the urban population of the province) and 58,000 (18% of the rural population of the province), respectively are located in the area (i.e., 60% of the population of the province live on only 10% of the land). Therefore, the vital role of this area in the province and even the country is irrefutable (Management and Planning Organization of Qazvin, 2018).

Table 2
Population (divided by cities and rural districts) and spatial situation of Qazvin city-region

Settlements		**Urban population**	**Rural population**	**Spatial situation**
Cities	Qazvin	402,000	-	Iran (source: Wikipedia (2015)) 
	Alvand	93,836	-	
	Mohammadiyeh	90,513	-	
	Eqbaliyeh	55,066	-	
	Mahmudabad-e Nemuneh	21,982	-	
	Sharifiyeh	20,347	-	Qazvin province (source: Authors) 
	Bidestan	18,060	-	
Rural districts	Eqbal-e Qarbi	-	27,796	
	Eqbal-e Sharqi	-	10,360	
	Hasar Kharvan	-	9,962	
	Nosrat Abad	-	5,805	Qazvin city-region (source: Authors) 
	Pir Yousefian	-	4,321	
	Sharif Abad	-	321	
Total		702,552	58,265	
		760,817		

Figure 2 depicts the process of demographic change in the city-regions. In this model, the three stages of change in the population of peripheral settlements are presented. According to this model, except for the central city, none of the other settlements show a significant change in population in the first stage. Based on the population thresholds and advantages arising from population concentration, upper-level services and activities will be concentrated in the central city during the second stage which will lead to a sharp increase in its population. In the third stage, by increasing the concentration of population and activity, the costs of living and activities will create economic efficiency in the central city, so the direction of the population flow will change toward the periphery. This stage is associated with stabilization of the population growth rate in the central city;

on the other hand, it causes a sharp increase in the population of surrounding cities and villages (Management and Planning Organization of Qazvin, 2018).

Assuming that the Qazvin city-region is at the beginning of the third stage of evolution, it is time for interventions that will make it the driver of regional development. If this opportunity is not seized and the developments of the city-region are not managed wisely, Qazvin will experience problems that other city-regions are currently facing in the country. Therefore, regarding the values and ideals of the Qazvin city-region, a comprehensive analysis of the livability condition is required to pave the way for sustainability as its most inclusive ideal and to determine directions of development by adopting appropriate strategies and policies.

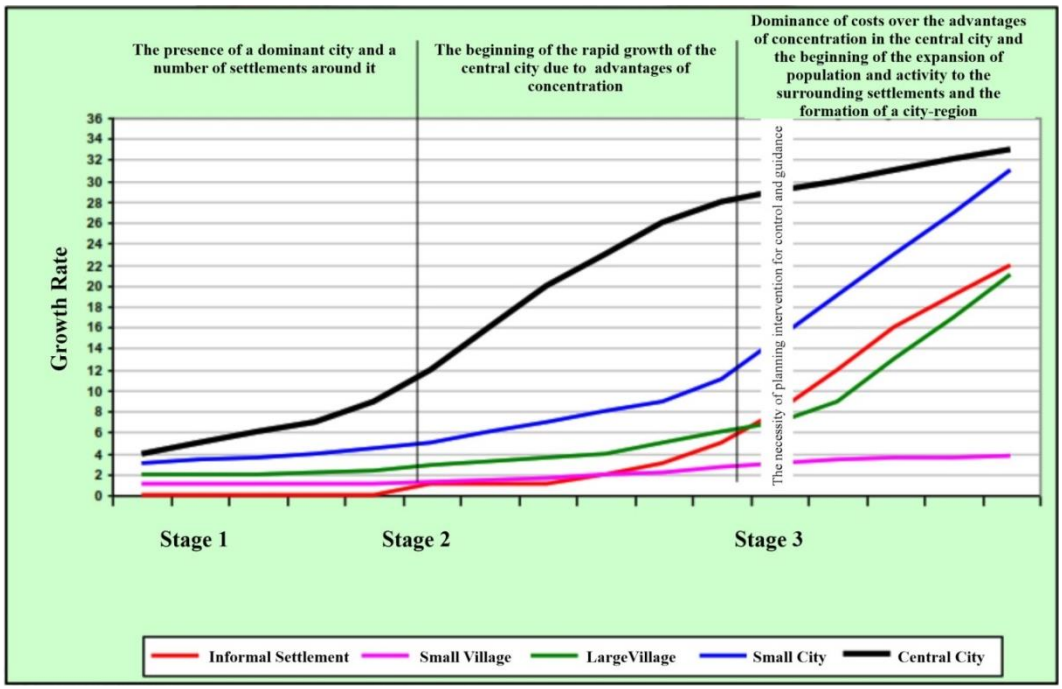


Figure 2 Conceptual model of demographic changes in city-regions by Management and Planning Organization of Qazvin (2018)

3.2 Data collection methods

Research data was obtained from secondary data and questionnaires. Secondary data were obtained from literature review, primary data, and objective data while subjective data were collected by questionnaire.

Secondary data

First, different secondary data including official and unofficial statistics, organizational reports, and plans on various scales were investigated for problem identification. Then, recent books and research literature were reviewed. Secondary data were also obtained by objective data collection. These objective sources included the population and housing census, Qazvin province statistical yearbook, organizational documents (e.g., Qazvin province electric power distribution company, Qazvin University of medical sciences,

etc.), a spatial plan of Qazvin province, the Qazvin city-region plan, and other sources like Google Maps.

Questionnaire

A questionnaire was used to obtain subjective data for the study. After initial studies and index selection for the study area, the validity of the questions and items were approved and the urban and rural questionnaires were designed (See Appendix 1). The urban and rural questionnaires were slightly different due to their respective contexts. The questionnaires had 20 questions and used a five-point Likert scale. They were available online and as paper copies.

1. Sampling

Stratified sampling was used due to distinct categories of the population structure in the city-region. The minimum sample size was determined to be 384 according to Krejcie and Morgan (1970); however, 430 questionnaires were completed for more precise and reliable results considering the time limitation.

2. Validity

Validity refers to the accuracy and correctness of the researcher's measurements (Khaki, 1999) and evaluates the measurement possibility of tools (Fathi Ashtiani, 2016). The measurement tools were identified by studying various global experiences which led to the selection of the most appropriate indices for the context considering what has been used frequently in the literature. Therefore, questions and items on the questionnaires were designed subsequently. The coordination of questions with the answers was such that one or two questions could be enough to perceive subjective judgments of the respondents toward each index. Then, the validity of the questions and items was approved by several academic experts.

3. Reliability

Traditionally, people who behave similarly and predictably are called stable and reliable. Reliability means that the score on a test would not change if the test was repeated in another situation. Another meaning of reliability is the internal similarity of the test which means to what extent the questions are consistent (Khaki, 1999; Fathi Ashtiani, 2016). Cronbach's alpha is one of the most popular parameters to measure validity in questionnaires and was used in this study with the aid of SPSS. Cronbach's alpha is a number from 0 to 1, with a higher number indicating greater reliability. The degree of consistency is considered to be suitable when $\alpha>0.700$ (Paul, 2020). Figure 3 shows Cronbach's alpha for urban and rural questionnaires which are 0.749 and 0.712, respectively.

Reliability Statistics

Cronbach's Alpha	N of Items
.749	17

(a)

Reliability Statistics

Cronbach's Alpha	N of Items
.712	17

(b)

Figure 3 Cronbach's alpha of urban (a) and rural (b) questionnaires

3.3 Analytical methods and tools

Due to the variety of scales and the dual nature of data (subjective and objective), applying an appropriate responsive tool for research questions was very important. Therefore, the PROMETHEE method, which is a multiple-criteria decision-analysis (MCDA) method, was applied. It was first introduced by Professor Jean-Pierre Brans in 1982 and was later developed by Brans and Bertrand Mareschal (Ebrahimzadeh & Sahraei Jouybari, 2018). The main reason for the success of this method is its mathematical features and ease of use. The visual PROMETHEE software is the tool used to implement this method. PROMETHEE was formed based on a pairwise comparison that ranks the proposed alternatives in decision-making problems (Fazli, 2014). It is compatible with this study as different (qualitative and quantitative) and often contradictory criteria were analyzed. Of course, complementary methods and tools were applied before data entry to PROMETHEE for final analysis.

4. Findings

Finally, the data needed to be analyzed by selected tools and methods in order to provide appropriate solutions to the research problem. Using a clear and logical process leads to a livability analysis in the Qazvin city-region.

4.1 Weighting of dimensions and indices

Allocating a specific weight to each dimension and index is essential for the final analysis in visual PROMETHEE. For this purpose, the Analytic Hierarchy Process (AHP) method was used. The AHP is a versatile decision-making approach. It combines rational analysis with intuitive judgment to select the best option from a set of alternatives, each evaluated against multiple criteria. In the AHP, decision-makers make pairwise comparisons to establish priorities, which are then used to rank the alternatives (Saaty & Vargas, 2012). This method proves especially useful when dealing with complex problems involving conflicting and subjective criteria (Ishizaka & Labib, 2009). Throughout time, people have grappled with measuring both physical and psychological phenomena. The physical realm encompasses tangible aspects—those objective realities outside the individual conducting the measurement. In contrast, the psychological realm deals with intangibles such as subjective ideas, feelings, and societal beliefs. The question arises: Can we develop a coherent theory that addresses both of these realities without compromising either? The AHP is a method capable of establishing measures in both the physical and social domains (Saaty & Vargas, 2012). The AHP's strength lies in its ability to evaluate both quantitative and qualitative criteria and alternatives using the same nine-level preference scale (Ishizaka & Labib, 2009). Saaty (1980, 1991) advocates the nine-level preference scale as the best scale to represent weight ratios, and is the only scale implemented in the Expert Choice software (Ishizaka & Labib, 2009).

An AHP questionnaire was designed for weighting the economic, social, and environmental dimensions and their respective indices for both urban and rural contexts (See Appendix 2). Numerical judgments were used to fill the pairwise comparison matrices by experts in each thematic area. The expert team consisted of six researchers and university professors specializing in urban and regional planning. They were chosen because they had extensive knowledge of the study area and a robust research background in the economic, social, and environmental fields, particularly in the context of urban-rural studies. Therefore, they were divided into two subgroups, with each pair

focusing on economic, social, or environmental areas. Finally, the results of the nine-level pairwise comparisons were imported into the Expert Choice software for the final weight calculation. Expert Choice uses the AHP to handle pairwise comparisons and synthesize the results. It typically uses the geometric mean to aggregate the pairwise comparison matrices from multiple experts. This method ensures that the combined judgments reflect the consensus of the experts. The software then calculated the priority weights for each index by normalizing the eigenvector corresponding to the largest eigenvector of the aggregated pairwise comparison matrix. It also performed a consistency check (CR) to ensure that the judgments are logically consistent. Given that the CR was less than 0.1, the judgments were considered consistent and acceptable. The final weight for each dimension and index is presented in Table 3.

Table 3
Selected indices of livability and their relative weights

Indices	**Dimensions**					
Urban Areas	*Economic (0.265)*		*Social (0.482)*		*Environmental (0.253)*	
Subjective	C1	Job opportunities (0.076)	C11	Public safety (0.112)	C20	Green spaces (0.043)
	C2	Land and housing price (0.071)	C12	Identity and sense of place (0.020)	C21	Sewerage system (0.036)
	C3	Shopping supply (0.029)				
	C4	Healthy drinking water (0.016)	C13	Recreation and leisure (0.018)	C22	Rubbish and waste collection (0.022)
	C5	Inter-urban public transportation (0.015)	C14	Women participation (0.018)		
	C6	Mobile networks (0.013)	C15	Housing quality (0.090)	C23	Urban landscape (0.020)
Objective	C7	Access to the transportation network (0.018)	C16	Health facilities (0.079)	C24	Natural disasters (0.083)
	C8	E-taxi accessibility (0.008)	C17	Sports and cultural facilities (0.020)	C25	Carbon footprint (0.024)
	C9	Gas supply network (0.007)	C18	Educational facilities (0.081)	C26	Renewable energies (0.024)
	C10	Power supply quality (0.013)	C19	Housing size (0.044)		
Rural Districts	*Economic (0.240)*		*Social (0.436)*		*Environmental (0.324)*	
Subjective	C1	Job opportunities (0.063)	C12	Public safety (0.049)	C22	Green spaces (0.014)
	C2	Land and housing price (0.016)	C13	Identity and sense of place (0.058)	C23	Sewerage system (0.030)
			C14	Recreation and leisure (0.013)	C24	Destruction of horticultural and agricultural lands (0.068)
	C3	Shopping supply (0.024)	C15	Women participation (0.047)		
	C4	Mobile networks (0.012)	C16	Housing quality (0.062)	C25	Rural landscapes (0.015)
			C17	Cooperation and solidarity (0.049)	C26	Water resources for agriculture and horticulture (0.070)

Indices	Dimensions					
Objective	C5	Power supply network (0.006)	C18	Health facilities (0.039) (0.020)	C27	Natural disasters (0.061)
	C6	Gas supply network (0.027)				
	C7	Tap water (0.027)	C19	Sports and cultural facilities	C28	Carbon footprint (0.019)
	C8	Sanitation system (0.024)			C29	Renewable energies (0.020)
	C9	Rural road type (0.012)	C20	Educational facilities (0.066)		
	C10	Access to public transportation (0.020)			C30	Rubbish and waste collection (0.026)
	C11	Information and communications technology (ICT) (0.009)	C21	Housing size (0.034)		

Note: The definitions of each indicator are listed in Appendix 3 with their respective sources.

4.2 Questionnaire data description

A total of 430 questionnaires were completed. Each questionnaire included 20 questions with the first three requesting personal information from the respondents (i.e., gender, age, and city/village of residence). In the rural districts, the number of women participants was approximately 50% of the men, unlike in the cities where the proportion of men and women was fairly equal. Respondents were classified into five age groups with the age range of 26-35 years having the most participation in both urban and rural areas. Qazvin city-region includes seven cities and six rural districts and most of the questionnaires were completed in Qazvin city according to stratified sampling.

The median of responses was calculated before data entry into the visual PROMETHEE. Therefore, the non-parametric Kruskal-Wallis test was conducted in SPSS regarding ordinal data of the research. These medians were calculated in SPSS based on a five-point Likert scale.

4.3 Livability analysis

The final step was data entry into visual PROMETHEE. In this step, each index obtained a specific mean or score based on responses and other data sources. Therefore, ranking of urban and rural areas was determined for each index separately as were the dimensions and overall ranking. The PROMETHEE partial (PROMETHEE I) and complete (PROMETHEE II) ranking methods were both applied. PROMETHEE II was used for the overall ranking. It is based on the Phi net flow which is the balance between Phi+ and Phi-. Phi+ is a measure of strength while Phi- is a measure of weakness. The Phi score is a number in the -1 to +1 range.

PROMETHEE Diamond and Rainbow were used for data visualization. PROMETHEE Diamond is an alternative two-dimensional joint presentation of both PROMETHEE I and II rankings. In PROMETHEE Diamond, the square corresponds to the (Phi+, Phi-) plane where each settlement is represented by a point. The plane is angled 45° so that the vertical dimension gives the Phi net flow. For each settlement, a cone is drawn from the settlement position in the plane. If a cone overlaps all the other cones, its corresponding settlement is preferable to all other ones in the PROMETHEE I ranking.

PROMETHEE Rainbow is a disaggregated view of the PROMETHEE II complete ranking. Settlements are displayed from left to right according to the PROMETHEE II ranking. For each settlement, a bar is drawn. The positive part of the bar minus the negative part is equal to the Phi net flow score of the settlement. The short bars indicate a very average profile, with no real weakness but no real advantage. If the whole bar is over zero, all indices contribute positively to its net flow score. This settlement presents no weakness concerning the others. This is contrary to bars under zero.

Urban livability

1. Economic dimension

The economic indices show that Qazvin city ranked first with a score of 100 (according to the PROMETHEE scoring algorithm, the settlement with the best performance in comparison to the others automatically gains 100). Bidestan was the worst city with a score of 53.29. However, there was no gross difference between the economic conditions of the cities due to the constant downward slope of the scores. As seen in the Diamond diagram, none of the neighboring cities in the ranking are completely preferable to each other.

2. Social dimension

The social indices show that Qazvin and Bidestan obtained the best and the worst positions, respectively, but with a gross difference this time. This difference led to a more concentrated social Diamond diagram. Qazvin and Mohammadiyeh are socially preferable to all of their following cities in the ranking.

3. Environmental dimension

The environmental indices show that Alvand ranked first, followed closely by Mohammadiyeh. Sharifiyeh was ranked last with a score of 15.05. There is a gross difference between the first two cities and the others; therefore, the Diamond diagram shows the complete excellence of Alvand and Mohammadiyeh.

Rural livability

1. Economic dimension

Nosrat Abad ranked first and Sharif Abad ranked last in the economic dimension. There is no gross difference between the rural districts; however, Nosrat Abad is completely preferable to the others. It should be noted that Sharif Abad ranked last even with a high Phi+ because it had equally both positive and negative indices together.

2. Social dimension

Hasar Kharvan ranked first in contrast to Sharif Abad which ranked last in the social dimension. Hasar Kharvan and Eqbal-e Sharqi have complete excellence relative to the other rural districts while Sharif Abad is far behind due to a vast difference from the others.

3. Environmental dimension

Eqbal-e Sharqi and Pir Yousefian ranked the best and the worst, respectively; however, all districts obtained scores close to each other which means that their environmental profiles are similar to some extent and no settlement has complete excellence over all the others.

Table 4
Livability rankings and scores by dimension

Urban livability					
Economic dimension		Social dimension		Environmental dimension	
City	Score	City	Score	City	Score
1. Qazvin	100	1. Qazvin	100	1. Alvand	100
2. Mohammadiyeh	89.84	2. Mohammadiyeh	48.68	2. Mohammadiyeh	79.13
3. Eqbaliyeh	73.32	3. Alvand	28.56	3. Mahmudabad…	33.92
4. Alvand	67	4. Eqbaliyeh	28.28	4. Qazvin	32.99
5. Sharifiyeh	61.41	5. Sharifiyeh	26.33	5. Bidestan	27.84
6. Mahmudabad	58.63	6. Mahmudabad…	21.02	6. Eqbaliyeh	23.70
7. Bidestan	53.29	7. Bidestan	14.31	7. Sharifiyeh	15.05
Rural livability					
Economic dimension		Social dimension		Environmental dimension	
Rural district	Score	Rural district	Score	Rural district	Score
1. Nosrat Abad	100	1. Hasar Kharvan	100	1. Eqbal-e Sharqi	100
2. Eqbal-e Sharqi	76.53	2. Eqbal-e Sharqi	71.87	2. Hasar Kharvan	82.99
3. Eqbal-e Qqarbi	66	3. Eqbal-e Qqarbi	45.91	3. Sharif Abad	75.12
4. Hasar Kharvan	61.58	4. Nosrat Abad	40.87	4. Nosrat Abad	74
5. Pir Yousefian	51.25	5. Pir Yousefian	36.16	5. Eqbal-e Qqarbi	62.02
6. Sharif Abad	44.75	6. Sharif Abad	15.60	6. Pir Yousefian	60.25

Overall livability ranking

The final ranking is based on the Phi value and is the sum of all dimensions; therefore, settlements with a positive value are likely desirable in terms of livability and those with a low score are likely undesirable.

In the urban context, Qazvin, Mohammadieh, and Alvand were grouped as livable cities while Eqbaliyeh, Mahmudabad-e Nemuneh, Sharifieh, and Bidestan did not gain high enough scores for livability conditions. None of the livable cities were completely preferable to the others, similar to cities with undesirable conditions except Eqbaliyeh. The noteworthy point is that the population had a direct relationship with livability in urban areas of the Qazvin city-region.

Table 5
Final ranking of urban livability based on scores of pairwise comparison of indices

City	**Phi**	**Phi+**	**Phi-**
1. Qazvin	0.2920	0.3696	0.0777
2. Mohammadiyeh	0.2296	0.2803	0.0507
3. Alvand	0.0849	0.2453	0.1604
4. Eqbaliyeh	-0.0689	0.1245	0.1934
5. Mahmudabad-e Nemuneh	-0.1278	0.0846	0.2124
6. Sharifiyeh	-0.1593	0.1212	0.2806
7. Bidestan	-0.2503	0.0974	0.3477

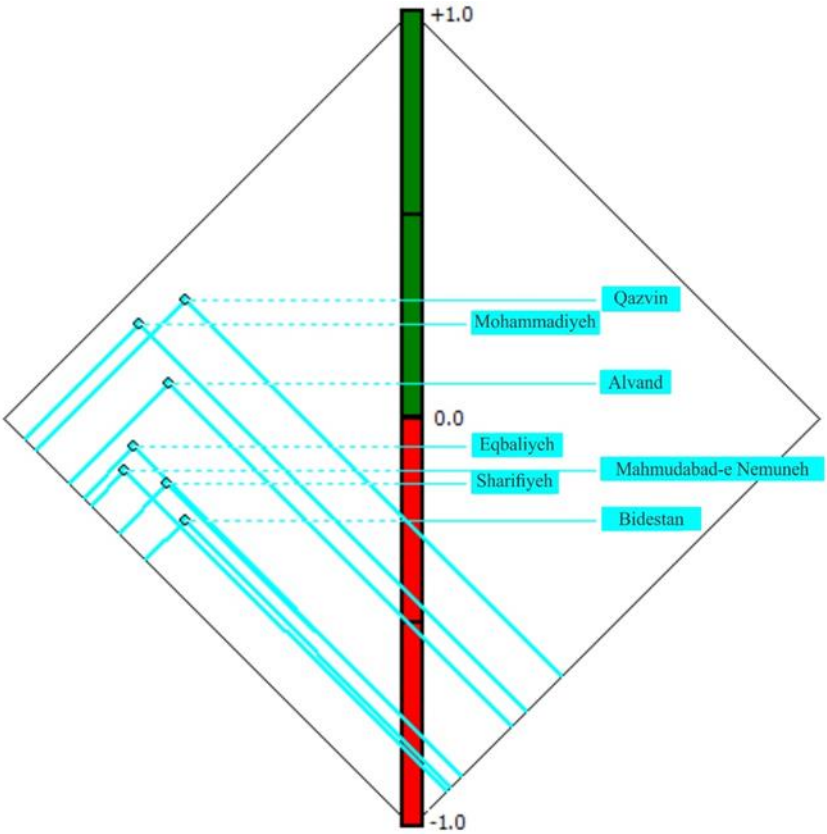


Figure 4 Diamond diagram of urban livability ranking

On the other hand, the rural districts, Hasar Kharvan, Eqbal-e Sharqi, and Nosrat Abad were recognized as livable rural districts, but the others presented poor results. The final scores were more concentrated compared to cities due to partial differences in livability indices.

Table 6
Final ranking of rural livability based on scores of pairwise comparison of indices

City	Phi	Phi+	Phi-
1. Hasar Kharvan	0.1792	0.2812	0.1020
2. Eqbal-e Sharqi	0.1699	0.2569	0.0871
3. Nosrat Abad	0.0315	0.1768	0.1453
4. Eqbal-e Qqarbi	-0.0206	0.1521	0.1727
5. Pir Yousefian	-0.1074	0.1443	0.2516
6. Sharif Abad	-0.2526	0.1605	0.4131

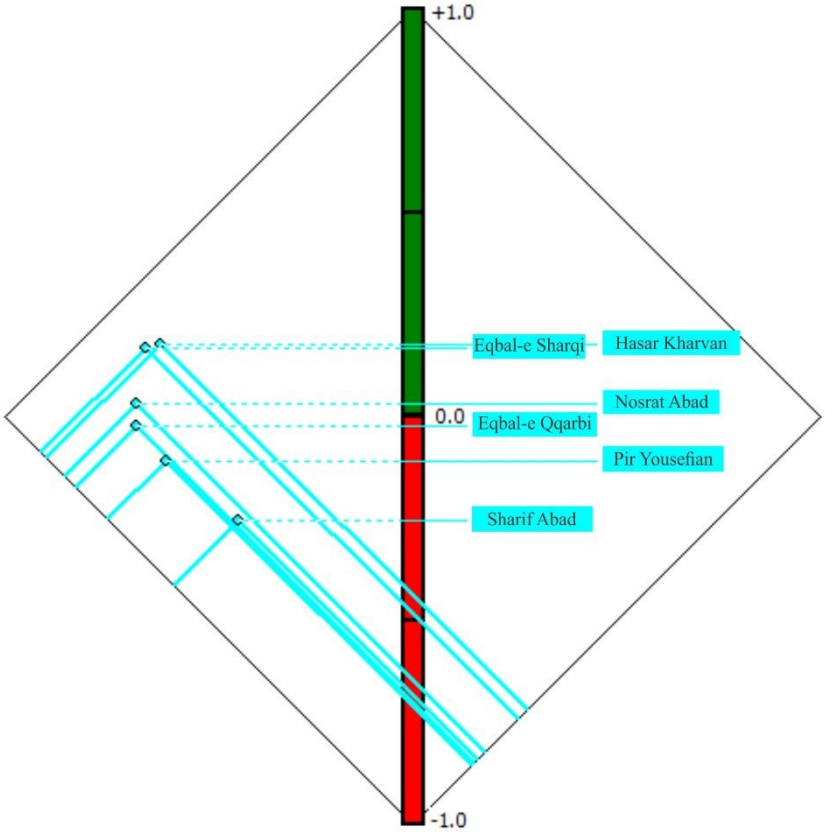


Figure 5 Diamond diagram of rural livability ranking

5. Discussion and conclusion

The concentration of population in Qazvin city-region where 60% of the population occupies 10% of the land, has led to economic problems, social anomalies, destruction of traditional gardens and fertile lands, environmental pollution, etc. Therefore, concerns about livability, sustainability, and quality of life have been raised.

Therefore, this research was conducted to analyze the livability of the city-region and recognize effective factors for livability. For this reason, the literature was reviewed and indices were extracted based on the context of the study area. All collected data, both subjective and objective, were analyzed using the PROMETHEE method to provide the final ranking and recognize the effective factors related to livability. This should result in policies that enhance livability in urban and rural regions.

The first goal of the research was to determine an appropriate method to measure livability in the Qazvin city-region. After following the steps of the proposed framework, Qazvin and Hasar Kharvan were determined to be the most livable city and rural district, respectively. The findings showed more differences between cities than in the rural districts in terms of livability scores. However, Qazvin did not achieve the best position through complete excellence over all other cities. In contrast to its role as the central city, Qazvin performed poorly in some areas. This demonstrates that population is a

prerequisite for creating facilities and services to make a settlement more livable but it is not everything.

Finally, the research sought to determine effective factors on the livability and sustainability of the city-region, so the Rainbow diagram for each dimension was analyzed separately to obtain the overall situation of the indices whether they were positive or negative. The indices at the bottom of are negative and the ones at the top are positive (see Figures 6 and 7). Negative indices were extracted through pairwise comparison in PROMETHEE and their overall profile by dimension is shown in Figure 8.

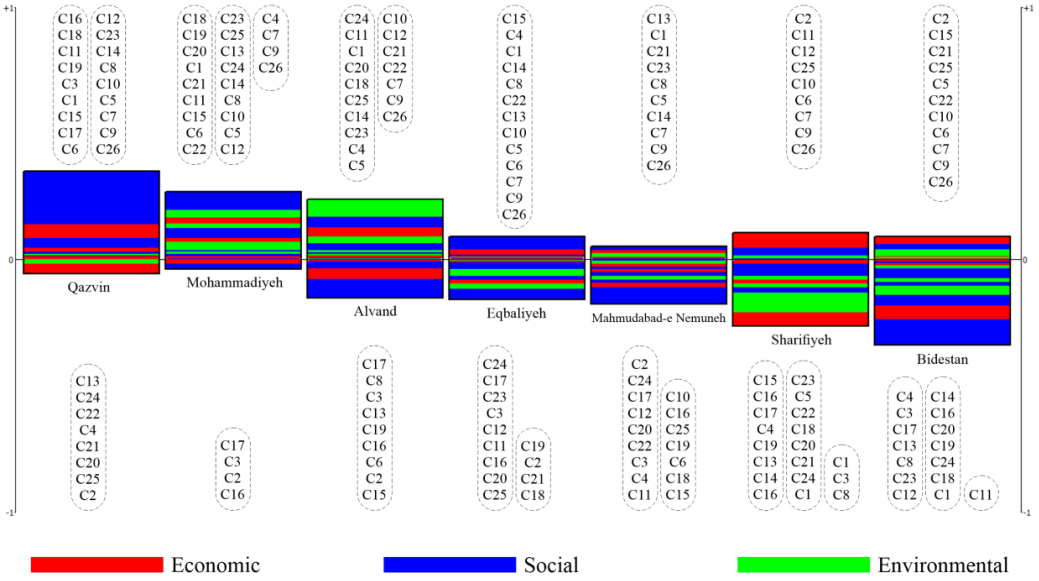


Figure 6 Rainbow diagrams of urban indices by dimension

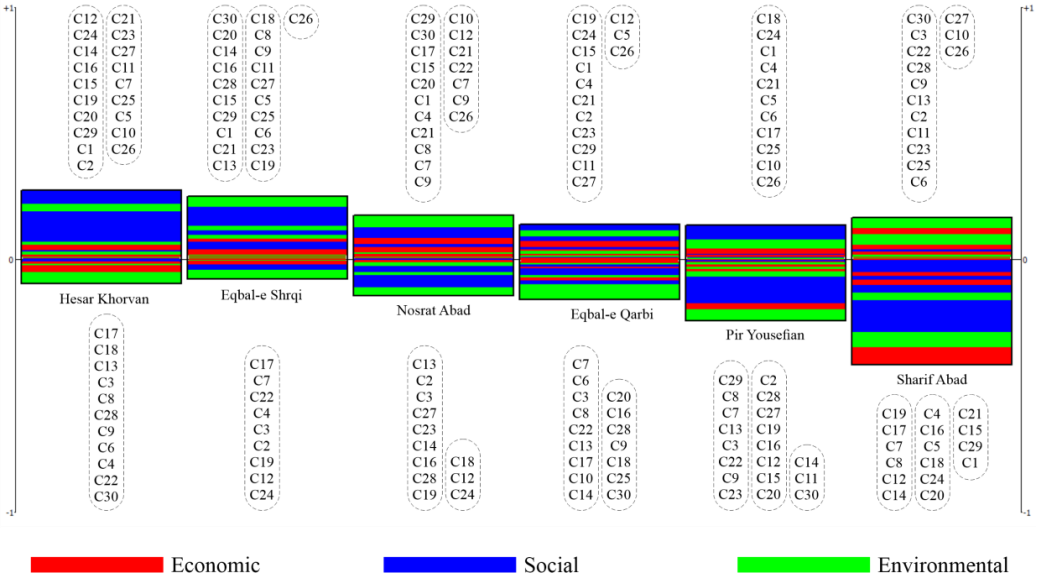
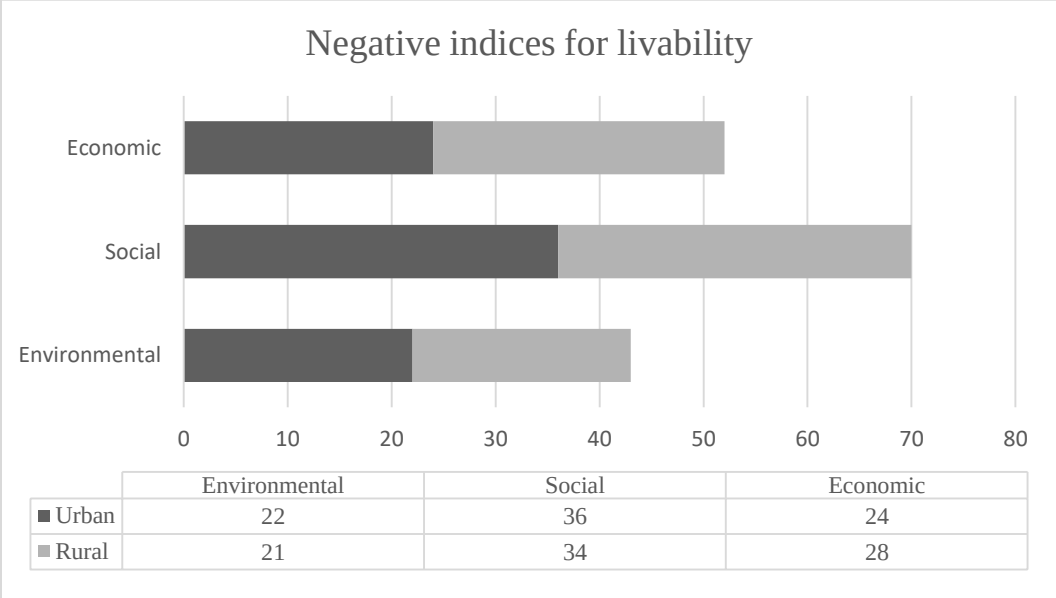


Figure 7 Rainbow diagrams of rural indices by dimension



	Environmental	Social	Economic
Urban	22	36	24
Rural	21	34	28

Figure 8 Overall profile of negative indices (out of 182 and 180 indices in urban and rural contexts, respectively)

This research is the first of its kind to examine the livability of the selected area. Therefore, it is necessary to contrast the framework of this study with other analogous investigations conducted in different contexts. There are several main findings and contributions of this study in relation to previous studies.

First, regarding the evaluation framework, some studies have purported to offer a comprehensive framework for the appraisal of livability. However, there is a lack of necessary balance among their indices and these studies often disregard one dimension such as the social (Wei et al., 2022) or environmental dimensions (Sheikh & van Ameijde, 2022), and their corresponding indices. Moreover, subjective indices are frequently overlooked in these studies. Another issue is that previous studies have employed the same indicators for urban and rural areas (Munir et al., 2022), whereas their nature is distinct and they cannot be assessed equally in all dimensions. In contrast, in the present study, considering the limitations, a practical framework for the evaluation of livability was proposed with different indices for urban and rural areas, which is fully compatible with the context and comprises a complete set of objective and subjective indices in three dimensions: social, economic and environmental.

Second, in other studies based on a definitive livability ranking system, larger and more populated urban settlements, except in some cases (Wei et al., 2022), are usually in better condition (Munir et al., 2022; Saeed et al., 2022); However, in this study, after a contextual and relative ranking by the PROMETHEE method, even though Qazvin city ranked first as the central city as expected, it was not entirely preferable to the second city in terms of livability. This interpretation is lacking in previous studies. Moreover, it is noteworthy that no specific pattern was observed for rural districts that relates to

livability; whereas in urban areas, livability is directly associated with the population and their land size.

In conclusion, this study has provided a novel and practical framework for evaluating livability in urban and rural areas, as well as a contextual and relative ranking method that reveals the strengths and weaknesses of each settlement. This study hopes to contribute to the existing knowledge and literature on livability and provide a useful tool for authorities and decision-makers to create more livable areas.

6. Recommendations

Overcoming existing obstacles leads researchers to more practical and richer results. One significant benefit of our practical framework lies in its scalability. With adequate computer resources and support, it is feasible to internationalize the approach, even overcoming key data barriers. Another benefit of this approach is its ability to simultaneously analyze both objective and subjective data. By maximizing the collection of objective data and encouraging greater citizen participation, we can achieve more accurate results. Therefore, policymakers and planners should expand livability indices, increase social participation, and use more updated materials, using the existing resources and facilities to collect comprehensive and inclusive data for analyzing livability. We also suggest setting up a system based on the framework to monitor the livability situation of the city-region online. The system can be developed as a mobile application that creates a real-time map of the target area, reflecting the livability status. This status would be based on data provided by developers and information recorded by citizens at any time. This would allow permanent control over the region as well as application of the results to long-term and short-term decisions. Therefore, the process of transforming the Qazvin city-region into a successful case in livability and sustainability will be accelerated.

REFERENCES

Ahmed, N. O., El-Halafawy, A. M., & Amin, A. M. (2019). A critical review of urban livability. *European Journal of Sustainable Development, 8*(1), 165–165. http://dx.doi.org/10.14207/ejsd.2019.v8n1p165

American Planning Association (2017). *Emerging trends in regional planning*. Chicago: PAS Publications.

Baobeid, A., Koç, M., & Al-Ghamdi, S. G. (2021). Walkability and its relationships with health, sustainability, and livability: elements of physical environment and evaluation frameworks. *Frontiers in Built Environment, 7*, 721218. http://dx.doi.org/10.3389/fbuil.2021.721218

Campbell, A., Converse, P. E., & Rodgers, W. L. (1976). *The quality of American life: Perceptions, evaluations, and satisfactions*. New York, NY: Russell Sage Foundation. http://dx.doi.org/10.1093/sf/56.1.283

Couch, C. (2016). *Urban planning: An introduction*. London: Palgrave.

Di Clemente, R., Strano, E., & Batty, M. (2021). Urbanization and economic complexity. *Scientific Reports, 11*(1), 3952. http://dx.doi.org/10.1038/s41598-021-83238-5

Ebraheem, M. (2018). Using geospatial analysis to determine livability in Najaf city by GWR. *MATEC Web of Conferences, 162*, 03031. https://doi.org/10.1051/matecconf/201816203031

Ebrahimzadeh, I., & Sahraei Jouybari, A. (2018). Using the PROMETHEE method as a constructive approach in regional decision-making and planning, case study: The small towns of Jouybar. *Human Geography Research*, 391–410. [In Persian]

Economist Intelligence Unit. (2021). *The Global Liveability Index 2021: A free overview*. The Economist Intelligence Unit Limited. http://dx.doi.org/10.18235/0006452

Eeckhout, J., & Hedtrich, C. (2021). Green urbanization. *PloS ONE, 16*(11), e0260393. http://dx.doi.org/10.1371/journal.pone.0260393

Fathi Ashtiani, A. (2016). *Psychological tests: evaluation of personality and mental health*. Tehran: Besat. [In Persian]

Fazli, R. (2014). *Evaluation of the development of the districts of Ardebil city from the perspective of spatial justice.* [Master's Thesis, University of Mohaghegh Ardabili]. [In Persian]

Ghozi, S., Dharmawan, I. B., Sari, D. H., Bijaksana, T. M., & Devi, S. M. (2023). An analysis of the perceived liveability index with the use of adjusted and weighted aspects based on a multi-stakeholder perspective in the Indonesian city of Balikpapan. *Acta Scientiarum Polonorum Administratio Locorum, 22*(2), 131–151. http://dx.doi.org/10.31648/aspal.7829

Gough, M. Z. (2015). Reconciling livability and sustainability: Conceptual and practical implications for planning. *Journal of Planning Education and Research, 35*(2), 145–160. http://dx.doi.org/10.1177/0739456x15570320

Huang, X., & Liu, Y. (2022). Livability assessment of 101,630 communities in China's major cities: A remote sensing perspective. *Science China Earth Sciences, 65*(6), 1073–1087. http://dx.doi.org/10.1007/s11430-021-9896-4

Ishizaka, A., & Labib, A. (2009). Analytic Hhierarchy Process and expert Choice: Benefits and limitations. *OR insight, 22*(4), 201–220. http://dx.doi.org/10.1057/ori.2009.10

Jome epour, M., Motiee Langerudi, S. H., Hajihosseini, S., & Salami Beirami, A. (2018). A survey of the environmental effects on the livability of rural areas (Case study: Villages of Buin Zahra County). *Journal of Research & Rural Planning*, *7*(1) 39–56. [In Persian] https://doi.org/10.22067/jrrp.v5i4.62494

Kermanshahi, H. (2018). *Spatial analysis of quality of life in Qazvin city complex during the period from 2001 to 2015.* [Master's Thesis, University of Guilan]. [In Persian]

Khaki, G. (1999). *Research method with an approach to thesis writing*. Tehran: Derayat press. [In Persian]

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*(3), 607–610. http://dx.doi.org/10.1177/001316447003000308

Leach, J. M., Lee, S. E., Hunt, D. V., & Rogers, C. D. (2017). Improving city-scale measures of livable sustainability: A study of urban measurement and assessment through application to the city of Birmingham, UK. *Cities, 71*, 80–87. http://dx.doi.org/10.1016/j.cities.2017.06.016

Litman, T. (2010). *Sustainability and livability: Summary of definitions, goals, objectives and performance indicators*. New York: Victoria Transport Policy Institute.

Marans, R. W., & Stimson, R. J. (2011). Objective measurement of quality of life using secondary data analysis. In R.J. Stimson, R.W. Marams, *Investigating quality of urban life: theory, methods and empirical research* Social Indicators Research Series 45 (pp. 33–53). Springer Science+Business Media. http://dx.doi.org/10.1007/978-94-007-1742-8_2

Management and Planning Organization of Qazvin. (2018). *Qazvin spatial plan*. Retrieved from Qazvin MPORG: https://ghazvin.mporg.ir/Portal/View/Page.aspx?PageId=67442811-d69d-4ea2-8d1a-ca307b27323f&t=44%20 [In Persian]

Mulligan, G., Carruthers, J., & Cahill, M. (2004). Urban quality of life and public policy: A survey. *Contributions to Economic Analysis, 266*, 729–802. http://dx.doi.org/10.1016/s0573-8555(04)66023-8

Munir, F., Sharjeel, M. Y., Sibt-e-Ali, M., Aslam, M., & Ali, N. (2022). Measuring spatial inequality in livability index using microdata in Pakistan. *Webology, 19*(2), 5677–5689.

National Research Council, Division on Earth, Life Studies, Board on Earth Sciences, Committee on Geography, & Committee on Identifying Data Needs for Place-Based Decision Making. (2002). *Community and quality of life: Data needs for informed decision making*. National Academies Press.

Newton, P. W. (2012). Liveable and sustainable? Socio-technical challenges for twenty-first-century cities. *Journal of Urban Technology, 19*(1), 81–102. http://dx.doi.org/10.1080/10630732.2012.626703

Pang, Y., Zhang, W., & Jiang, H. (2024). A socio-spatial exploration of rural livability satisfaction in megacity Beijing, China. *Ecological Indicators, 158*, 111368. http://dx.doi.org/10.1016/j.ecolind.2023.111368

Paul, A. (2020). Developing a methodology for assessing livability potential: An evidence from a metropolitan urban agglomeration (MUA) in Kolkata, India. *Habitat International, 105*, 102263. http://dx.doi.org/10.1016/j.habitatint.2020.102263

Quan, Z., Huijuan, N., & Xiaoying, L. (2024). Evaluation of urban space livability in the urban area of Hefei based on production-living-rcological dpace. *Journal of Resources and Ecology, 15*(2), 338–350. http://dx.doi.org/10.5814/j.issn.1674-764x.2024.02.009

Saaty, T. L. (1980). The Analytic Hierarchy Process (AHP). *Journal of the Operational Research Society, 41*(11), 1073–1076.

Saaty, T. L. (1991). Response to Holder's comments on the Analytic Hierarchy Process. *Journal of the Operational Research Society, 42*(10), 909–914. http://dx.doi.org/10.1057/jors.1991.176

Saaty, T. L., & Vargas, L. G. (2012). *Models, methods, concepts and applications of the Analytic Hierarchy Process*. 2nd ed. New York: Springer.

Saeed, U., Ahmad, S. R., Mohey-ud-din, G., Butt, H. J., & Ashraf, U. (2022). An integrated approach for developing an urban livability composite index—a cities' ranking road map to achieve urban sustainability. *Sustainability, 14*(14), 8755. http://dx.doi.org/10.3390/su14148755

Saitluanga, B. L. (2014). Spatial pattern of urban livability in Himalayan Region: A case of Aizawl City, India. *Social Indicators Research, 117*, 541–559. http://dx.doi.org/10.1007/s11205-013-0362-3

Soleimani Mehrenjani , M., Tavalayi, S., Rafieian, M., Zanganeh, A., & Khazaei Nezhad, F. (2016). Urban livability: the concept, principles, aspects and parameters. *Geographical Urban Planning Research (GUPR), 4*(1), 27–50. [In Persian]

Sheikh, W. T., & van Ameijde, J. (2022). Promoting livability through urban planning: A comprehensive framework based on the "theory of human needs". *Cities, 131*, 103972.

Tolfo, G., & Doucet, B. (2022). Livability for whom?: Planning for livability and the gentrification of memory in Vancouver. *Cities, 123*, 103564. http://dx.doi.org/10.1016/j.cities.2022.103564

UN-Habitat. (2020). *World Cities Report 2020: The Value of Sustainable Urbanization*. Retrieved from UN-Habitat: https://unhabitat.org/world-cities-report-2020-the-value-of-sustainable-urbanization

United Nations. (2021). *The Sustainable Development Goals Report 2021*. New York: United Nations Publications.

Wang, Y., & Miao, Z. (2022). Towards the analysis of urban livability in China: spatial–temporal changes, regional types, and influencing factors. *Environmental Science and Pollution Research, 29*(40), 60153–60172. http://dx.doi.org/10.1007/s11356-022-20092-6

Wikipedia. (2015*). Iran (orthographic projection).svg*. Retrieved from Wikipedia: https://en.wikipedia.org/wiki/File:Iran_(orthographic_projection).svg

Wei, Y., Wang, H., Tan, B., Xue, M., & Yin, Y. (2022). Analysis of the spatial differentiation and development optimization of towns' livable quality in Aksu, China. *Sustainability, 14*(13), 7728. http://dx.doi.org/10.3390/su14137728

Yin, Z., Wu, Y., Jin, Z., & Zhang, X. (2018, January). Research on livable community evaluation based on GIS. *IOP Conference Series: Earth and Environmental Science*, *108*, 042075. http://dx.doi.org/10.1088/1755-1315/108/4/042075

Appendix I

Urban livability questionnaire

1) Specify your gender: • Female • Male
2) Specify your age: • 0-15 • 16-25 • 26-35 • 36-45 • More than 45 years old
3) Specify your city of residence:
• Qazvin • Alvand • Mohammadiyeh and Mehrgan • Eqbaliyeh • Bidistan • Sharifiyeh • Mahmudabad-e Nemuneh
4) How do you evaluate the availability of job opportunities in your city of residence?
• Very high • High • Medium • Low • Very low
5) How do you evaluate the price of land and housing in your city?
• Very high • High • Medium • Low • Very low
6) How much of your shopping can you do in your city?
• Very high • High • Medium • Low • Very low
7) How frequently do you go to nearby cities (such as Qazvin or Tehran) for shopping?
• Very high • High • Medium • Low • Very low
8) To what extent are you satisfied with the quality of drinking water in your city (in terms of purification, pressure, interruption, etc.)?
• Very high • High • Medium • Low • Very low
9) How satisfied are you with public transportation services in your city (taxi and bus)?
Very high • High • Medium • Low • Very low
10) How do you evaluate the quality of the mobile phone network in your city (in terms of antenna coverage, internet speed, etc.)?
• Very good • Good • Average • Poor • Very poor
11) How safe do you think your city is?
• Very high • High • Medium • Low • Very low
12) How much do you feel connected to your city?
• Very high • High • Medium • Low • Very low
13) How willing are you to leave your city if similar living conditions are provided in another city?
• Very high • High • Medium • Low • Very low
14) How do you evaluate the state of recreation and leisure facilities in your city?
• Very Good • Good • Average • Poor • Very Poor
15) In your opinion, how receptive is the city to the active presence and participation of women?
• Very high • High • Medium • Low • Very low
16) How do you evaluate the quality of your housing according to the ideal you have in mind?
• Very Good • Good • Average • Poor • Very Poor
17) What is the extent of greenery within the city, including gardens, tree plantations, urban green spaces, and the periphery?
• Very Good • Good • Average • Poor • Very Poor
18) How is the state of urban sewage system?
• Very Good • Good • Average • Poor • Very Poor
19) How satisfied are you with the waste collection services?
• Very high • High • Medium • Low • Very low
20) How beautiful are the city landscapes?
• Very Good • Good • Average • Poor • Very Poor

Rural livability questionnaire

1) Specify your gender: • Female • Male
2) Specify your age: • 0-15 • 16-25 • 26-35 • 36-45 • More than 45 years old
3) Specify the district where you live:
• Eqbal-e Qarbi • Eqbal-e Sharqi • Hasar Kharvan • Nosrat Abad • Pir Yousefian
• Sharif Abad
4) How do you evaluate the availability of job opportunities in your village?
• Very high • High • Medium • Low • Very low
5) How do you evaluate the price of land and housing in your village?
• Very high • High • Medium • Low • Very low
6) How much of your shopping can you do in your village?
• Very high • High • Medium • Low • Very low
7) How often do you go to nearby cities (for example, Qazvin) for shopping?
• Very high • High • Medium • Low • Very low
8) How do you evaluate the quality of the mobile phone network in your village (in terms of antenna coverage, internet speed, etc.)?
• Very good • Good • Average • Poor • Very poor
9) How safe do you think your village is?
• Very high • High • Medium • Low • Very low
10) How much do you feel connected to your village?
• Very high • High • Medium • Low • Very low
11) If jobs, housing, and facilities are available in the village, how willing are you to leave your village??
• Very high • High • Medium • Low • Very low
12) How do you evaluate the state of recreation and leisure facilities in your village?
• Very Good • Good • Average • Poor • Very Poor
13) How much cooperation exists among people in village affairs?
• Very high • High • Medium • Low • Very low
14) In your opinion, how receptive is the village to the active presence and participation of women?
• Very high • High • Medium • Low • Very low
15) How do you evaluate the quality of your housing according to the ideal you have in mind?
• Very Good • Good • Average • Poor • Very Poor
16) What is the extent of greenery within the village?
• Very Good • Good • Average • Poor • Very Poor
17) How is the greenery of the village?
• Very Good • Good • Average • Poor • Very Poor
18) How is the state of rural sewage system?
• Very Good • Good • Average • Poor • Very Poor
19) How much water resources are available for agriculture and horticulture?
• Very high • High • Medium • Low • Very low
20) How beautiful are the village landscapes?
• Very Good • Good • Average • Poor • Very Poor

Appendix II

At the outset of the questionnaire, following the guidance section for completing it, each expert was asked to prioritize the three dimensions through pairwise comparisons.

i						Priority of dimensions of urban livability												j
Ec	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	So
So	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	En
En	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Ec

Ec =Economic / So = Social / En = Environmental

Then, according to the table below, experts conducted pairwise comparisons of indices within their respective fields of expertise. Due to the extensive number of indices in both urban and rural sectors, only a subset of the urban economic indices are presented in the following table as an illustrative example.

i						Priority of economic indices of urban livability												j
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C2
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C3
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C4
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C5
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C6
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C7
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C8
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C9
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C10

Appendix III

Definitions and sources of urban indices:

Urban indices	Definition	Source
C1- Job opportunities	Assessing residents' subjective perception regarding the availability of job opportunities.	Adapted from Gough (2015)
C2- Land and housing price	Assessing residents' subjective perception regarding land and housing prices.	Adapted from Gough (2015); Soleimani Mehrenjani et al. (2016)
C3- Shopping supply	This index is determined through a dual inquiry posed to residents. First, it assesses the proportion of their purchases that can be fulfilled within their city of residence. Second, it gauges the frequency with which they travel to nearby cities for shopping.	Authors; Adapted from Soleimani Mehrenjani et al. (2016)
C4- Healthy drinking water	Assessing residents' satisfaction regarding the quality of drinking water.	Adapted from Economist Intelligence Unit (2021)
C5- Inter-urban public transportation	Assessing residents; satisfaction regarding the public transportation (buses and taxis) services.	Adapted from Economist Intelligence Unit (2021)
C6- Mobile networks	Assessing residents' satisfaction with the quality of the mobile phone network, encompassing aspects such as antenna coverage and internet speed.	Adapted from Economist Intelligence Unit (2021)

Urban indices	Definition	Source
C7- Access to the transportation network	This index assesses the connectivity of cities to transportation networks, encompassing freeways, highways, main roads, minor roads, airports, and railways. It is extracted from the documents of Management and Planning Organization of Qazvin.	Adapted from Gough (2015)
C8- E-taxi accessibility	Analyzing the geographical coverage of internet taxi services based on data from mobile applications of the respective service providers.	Authors
C9- Gas supply network	The geographical area covered by the gas network provided by Statistical Center of Iran.	Adapted from Economist Intelligence Unit (2021)
C10- Power supply quality	This index is derived from two underlying sub-indices: blackout duration per subscriber per day and unsupplied energy. It is provided by Qazvin Distribution Electrical Co.	Adapted from Economist Intelligence Unit (2021)
C11- Public safety	Assessing residents' subjective perception regarding the safety of the city.	Adapted from Ahmed et al. (2019); Soleimani Mehrenjani et al. (2016)
C12- Identity and sense of place	This index is derived from a dual inquiry posed to citizens. First, it assesses the extent of their sense of belonging and dependence on their current city. Second, it explores the likelihood of residents relocating to another city if comparable conditions were present there.	Authors; Adapted from Soleimani Mehrenjani et al. (2016)
C13- Recreation and leisure	Assessing residents' subjective perception regarding the recreational and leisure facilities of the city.	Adapted from Soleimani Mehrenjani et al. (2016)
C14- Women participation	Assessing residents' subjective perception of the city's openness to the active presence and participation of women.	Authors
C15- Housing quality	Assessing residents' subjective perception of housing quality in relation to their ideal standards.	Adapted from Economist Intelligence Unit (2021)
C16- Health facilities	The chosen sub-indices encompass several facets of healthcare accessibility. These include the density of comprehensive health service centers, health centers, clinics, pharmacies, and medical diagnostic laboratories per 10,000 individuals. Additionally, the proximity to the nearest government hospital, measured in minutes by car, is a critical factor. While spatial analysis using Google Maps facilitates the assessment of the latter, the remaining sub-indices can be obtained from the data provided by Qazvin University of Medical Sciences and Health Services.	Adapted from Economist Intelligence Unit (2021)
C17- Sports and cultural facilities	To assess this index, nine distinct sub-indices have been established, each measured in relation to the city's population. These sub-indices draw upon data accessible from the	Adapted from Economist Intelligence Unit (2021)

Urban indices	Definition	Source
	Management and Planning Organization of Qazvin as well as the Department of Culture and Islamic Guidance. Specifically, the following factors are considered: sports facilities, cultural services, public parks, cinema seating capacity, library services, swimming pools, free art schools, single-purpose cultural institutions, and multi-purpose cultural institutions. By evaluating these sub-indices, a comprehensive picture of cultural and recreational amenities emerges within each city.	
C18- Educational facilities	In this index, the educational institutions per capita across all cities are determined through the utilization of Google Maps and field survey.	Adapted from Economist Intelligence Unit (2021)
C19- Housing size	The mean housing size for each city is derived from the Qazvin City-region Plan report.	Adapted from Ahmed et al. (2019); Soleimani Mehrenjani et al. (2016)
C20- Green spaces	Assessing residents' subjective perception regarding the urban greenery within the cityscape.	Adapted from Soleimani Mehrenjani et al. (2016)
C21- Sewerage system	Assessing residents' subjective perception regarding the state of urban sewage system.	Authors
C22- Rubbish and waste collection	Assessing residents' subjective perception regarding the state of garbage collection by the municipality.	Authors
C23- Urban landscape	Assessing residents' subjective perception regarding the urban landscape.	Adapted from Soleimani Mehrenjani et al. (2016)
C24- Natural disasters	The assessment of this index relies on data from Qazvin Spatial Plan, specifically considering sub-indices related to flood risk, landslide risk, soil erosion risk, and dust risk.	Authors
C25- Carbon footprint	This index is individually assessed for each city within the Qazvin Spatial Plan. It is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions.	Authors
C26- Renewable energies	The presence of operational renewable energy power plants.	Authors

Definitions and sources of rural indices:

Rural indices	Definition	Source
C1- Job opportunities	Assessing residents' subjective perception regarding the availability of job opportunities.	Adapted from Jome epour et al. (2018)
C2- Land and housing price	Assessing residents' subjective perception regarding land and housing prices.	Adapted from Jome epour et al. (2018)
C3- Shopping supply	This index is determined through a dual inquiry posed to residents. First, it assesses the proportion of their purchases that can be	Authors; Adapted from Jome epour et al. (2018)

Rural indices	Definition	Source
	fulfilled within their rural district. Second, it gauges the frequency with which they travel to nearby cities for shopping purposes.	
C4- Mobile networks	Assessing residents' satisfaction with the mobile phone network's quality, encompassing aspects such as antenna coverage and internet speed.	Adapted from Economist Intelligence Unit (2021)
C5- Power supply network	This index assesses the power network coverage of villages within each rural district, utilizing data from the Statistical Center of Iran.	Adapted from Economist Intelligence Unit (2021)
C6- Gas supply network	This index assesses the gas network coverage of villages within each rural district, utilizing data from the Statistical Center of Iran.	Adapted from Economist Intelligence Unit (2021)
C7- Tap water	This index assesses the tap water coverage of villages within each rural district, utilizing data from the Statistical Center of Iran.	Authors
C8- Sanitation system	In this index, utilizing data from the Statistical Center of Iran, the proportion of villages equipped with water sanitation systems within each rural district is delineated.	Authors
C9- Rural road type	The geographical area covered by the gas network provided by Statistical Center of Iran.	Authors; Adapted from Jome epour et al. (2018)
C10- Access to public transportation	In this index, utilizing data from the Statistical Center of Iran, the proportion of villages within each rural district that have access to public transportation has been ascertained.	Adapted from Jome epour et al. (2018)
C11- Information and communications technology (ICT)	In this index, utilizing data from the Statistical Center of Iran, the proportion of individuals within each rural district is assessed based on their access to public services such as the Internet, post office, telecommunication office, and ICT facilities.	Authors; Adapted from Economist Intelligence Unit (2021)
C12- Public safety	Assessing residents' subjective perception regarding the safety of the village.	Adapted from Jome epour et al. (2018)
C13- Identity and sense of place	This index is derived from a dual inquiry posed to residents. First, it assesses the extent of their sense of belonging and dependence on their current village. Second, it explores the likelihood of residents relocating to another city or village if comparable conditions were present there.	Adapted from Jome epour et al. (2018)
C14- Recreation and leisure	Assessing residents' subjective perception regarding the recreational and leisure facilities of the village.	Adapted from Jome epour et al. (2018)
C15- Women participation	Assessing residents' subjective perception of the village's openness to active women presence and participation.	Authors
C16- Housing quality	Assessing residents' subjective perception of housing quality in relation to their ideal standards.	Adapted from Economist Intelligence Unit (2021)
C17- Cooperation and solidarity	Assessing residents' subjective perceptions of their level of solidarity and cooperation in	Adapted from Jome epour et al. (2018)

Rural indices	Definition	Source
	managing village affairs.	
C18- Health facilities	To assess this index, utilizing data from the Statistical Center of Iran, the proportion of villages within each rural district equipped with hygiene and treatment centers, pharmacies, and health facilities is determined.	Adapted from Economist Intelligence Unit (2021)
C19- Sports and cultural facilities	To assess this index, utilizing data from the Statistical Center of Iran, the proportion of villages within each rural district equipped with parks, libraries, sports grounds and sports halls is determined.	Adapted from Economist Intelligence Unit (2021)
C20- Educational facilities	To assess this index, utilizing data from the Statistical Center of Iran, the proportion of villages within each rural district equipped with different educational institutions (e.g. kindergarten, elementary school, high school, etc.) is determined.	Adapted from Economist Intelligence Unit (2021)
C21- Housing size	The mean housing size for each rural district is derived from the Qazvin City-region Plan report.	Adapted from Jome epour et al. (2018)
C22- Green spaces	Assessing residents' subjective perception regarding the village's greenery.	Adapted from Jome epour et al. (2018)
C23- Sewerage system	Assessing residents' subjective perception regarding the state of rural sewage system.	Adapted from Jome epour et al. (2018)
C24- Destruction of horticultural and agricultural lands	Assessing residents' subjective perception regarding the recent trajectory and extent of degradation affecting gardens and agricultural lands.	Authors
C25- Rural landscapes	Assessing residents' subjective perception regarding the rural landscapes.	Authors
C26- Water resources for agriculture and horticulture	Assessing residents' subjective perception regarding the availability of water resources for horticulture and agriculture.	Authors
C27- Natural disasters	The assessment of this index relies on data from Qazvin Spatial Plan, specifically considering sub-indices related to flood risk, landslide risk, soil erosion risk, and dust risk.	Authors
C28- Carbon footprint	This index is individually assessed for each city within the Qazvin Spatial Plan. It is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions.	Authors
C29- Renewable energies	The presence of operational renewable energy power plants.	Authors
C30- Rubbish and waste collection	In this index, utilizing data from the Statistical Center of Iran, the proportion of villages within each rural district equipped with waste collection systems is delineated.	Adapted from Jome epour et al. (2018)