Viability index in urban environments (case study: the central part of holy city of Qom)

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Abstract: Improvement of living conditions in urban environments not only increases their attractiveness, but it also prepares an appropriate context for achieving to major goals of sustainable development. However, rapid growth of urbanization and other related issues with urban development have caused the problems of these habitants be increased. The situation is well understood in many Iran's cities suffering from the consequences of rapid growth of urbanization and lack of adequate financial and human resources in the process of management. Thus, this research tries to identify the characteristics of viable urban societies, assess the viability of central part of Qom city, and find the situation of the city regarding viability indexes. Research method is descriptive-analytical as well as documentary, survey, and field studies such as adopted techniques and measures in this research. According to the research findings, policies for decentralization of activities, change in development policy based on automobile, attempt to stabilize old residents of the region (renovation, improve the quality of neighborhood services), and such issues should be adopted in order to improve the quality of life in this part of the city.

Key words: viability, viability criteria, city management, central part of the city
JEL Classification: L39, G39, O47, I25

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1- Introduction

Cities are great centers for absorbing entrepreneurs, innovators, investors, intellectuals, and human population. Cities provide appropriately economic opportunities with more choice for the future. Contrarily, such centers have been severely blamed and criticized because of their environmental damage that have brought so that some experts consider today's cities as centers with full of damage and some others believe that such centers are subject to a variety of risks of industrial pollution, environmental disasters and global warming (Cities, 2007). Now we can ask the question whether cities are undesirable place for life or we can benefit from its advantages by identifying and reducing its negative aspects. The answer of this question can be found in the current situation of cities such as Vancouver, Toronto, Sydney, Melbourne, etc. that they are considered as the world's best viable cities and in contrast with Karachi and Dakar that they are among the 10 cities with the worst viability conditions in the world because of failing to overcome their problems. (Ling & Yuen, 2010; Economist intelligence unit Limited, 2011). Observing such different situation of citizen's quality of life all over the world caused the issue of societies' viability in all levels (macro to local) be in the center of urban planners and related experts' attention and do several researches in this field. City of Qom is one of the cities that has experienced extremely rapid growth because of its geographical location and immigration conditions during the last half century. Thus, this research tries to identify the most important factors of viable societies, assess quality of living conditions in the central part of Qom city, and discuss viability issues in the city.

2- Literature Review

Several researches have been done about the conditions of urban viability. A few examples have been presented in the following:

Wheeler believes that the word "viability" is used for describing conditions that they have direct relationship with quality of life and it is of great importance for people and societies' long-term welfare. This concept includes issues such as environment quality, security, affordability, pleasure, comfort, local facilities including parks, open spaces, sidewalk, restaurants, and shops. In his view, such situation helps to create pleasant environments for living in the neighborhood and lack of this condition makes life more difficult (Wheeler, 2001).

Lotfi and Saberi (2012) examined the quality of urban life by using multi criteria decision-making method in the areas of Yasuj city.

Poorahmad and Zareei (2015) studied quality of life in urban distressed areas of Tehran district 9. The results indicate that the situation of satisfaction from physical, social, economic, and environmental characteristics is significant. It also shows that these indexes have relatively unpleasant quality so that factors such as transport, housing, urban governance, and recreational access have the most impact on satisfaction level from Tehran district 9.

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Akhundi et.al. (2014) studied the quality of life assessment in Tehran city. The findings showed that main effective factors on quality of life in Tehran Metropolis have 19 main factors.

3- Theoretical Principles

Kennedy & Buys believe that viability concept is defined with phrases such as society welfare and it represents features that changes a place to one people always want to live in it (Kennedy & Buys, 2011).

Victoria Transport Policy Institute (VTPI) has described viability as an existing environmental and social quality in an area that is understood by residents, employees, customers and the viewers. It includes security and sanitary (traffic security, personal security, public sanitary), environmental conditions (cleanliness, noise, dust, air and water quality), status of social interactions (pleasant neighborhood, fairness, respect, identity and community pride), opportunities for recreation and entertainment, aesthetics and unique cultural and environmental resources (historic structures, old trees, traditionally architectural styles) (VTPI, 2011).

Federal Highway Administration (FHWA) defines viability as the concept of viability that has been formed over the years is often used to describe a range of actions that is intended to improve the quality of community life and support the broader goals of sustainability as well. Viability includes multi-dimensional issues in connection with designing with community, land use, environmental protection, mobility and accessibility, public health and sanitation and economic welfare. Thus, viability refers to a set of requirements for people living within a certain range that provides inhabitants' comfort, welfare and satisfaction for a long time.

Understanding the Concept of Viability and Its Features

Clear and single definition of viability concept has not been provided so far (Leby & Hashim, 2010). According to Kennedy and Buys, this is due to the lack of consensus and some ambiguities in the field, but Heylen believes that the difference is common among researchers since their scientific fields are different and each of them has presented a certain definition in proportion to their specialty (Heylen, 2006). We have tried to achieve a better understanding of the idea by reviewing some of the definitions and views in this section.

Livability has been used in Robert Cowan's Dictionary of Urban Development to understand better, which means "appropriate for life", "providing good quality of life" and "a good place to live." (Cowan, 2005). Therefore, "viability" term can be interpreted with synonymous concept of "living conditions" trying to explain biology conditions and capabilities in one place.

Despite many similarities between the two ideas of viability and quality of life (these two terms often used interchangeably in urban planning), the distinctions between these two concepts can be stated in the facilities of built and natural environments (viability) and experience and users' judgment (good, bad or indifferent) after using them (quality of life). This interpretation indicates

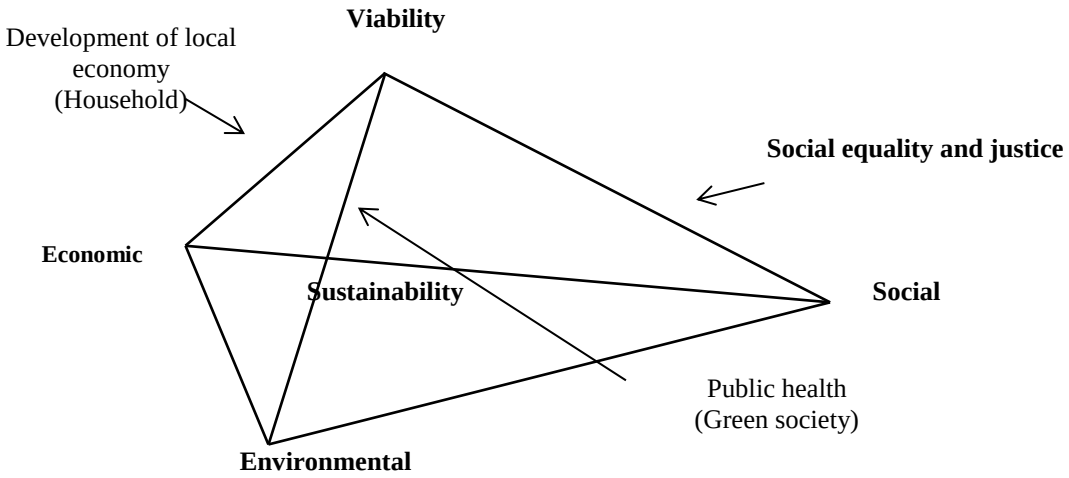
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that quality of life can only be achieved in the presence of appropriate conditions for life (viability) in a place.

The Relationship Between Sustainability and Viability

Sustainability and viability have recognized interdependence among social, economic, and environmental dimensions (Knox, 2011). Mutual relations between these two ideas and its dimensions can be designed as a prism that main dimensions of sustainability are at the confluence of three sides under the prism. Each of the three sides is joined together at the top by axes. These axes are those values that they are being respected in three dimensions of social, economic, and environmental framework. Top of the pyramid (or viability) is created at the confluence of the value axes, recognized as the ultimate goal of any society to achieve favorable conditions for life (shape1)



Shape1. The relationship between sustainability and viability
Source: (Isaloo, 2011)

In this regard, viability can be considered as a subset of more general idea of sustainability trying to achieve sustainability goals at the level of local societies. Despite both mentioned ideas emphasize on similar values, they also have differences in some areas. Table1 summarizes some of the most important similarities and differences between them.

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Table1. Similarities and differences between sustainability and viability

Similarities	Differences
Both of them emphasizes on: -justice and equality among different social groups -human health (environment quality including the quality of water, weather, etc.) -improvement of economic situation in all indexes -sustainability in travel options	- sustainability emphasizes on long-term and multi-generational goals regarding time dimension -Sustainability emphasizes on major and overall environmental goals such as reducing the effects of air pollution, increasing energy efficiency, and reducing dependence on foreign oil -Viability presents more detailed strategies about improving trip styles and accessibility -Viability focuses on short-term and specially environmental goals

Source: (Rue et al., 2011)

The definition of viability components

Viability is a complex and multi-dimensional concept (Knox, 2011); this has led to evaluate the viability of a region hard. In other words, the involvement of various social, economic, physical and environmental components on one hand; and people's different interpretations of the concept of viability on the other hand have caused the complexity and difficulty of this issue. The viability of a place can be identified and assessed with different criteria, despite such barriers and problems. A list of the most important features and characteristics of viable communities has been mentioned in the following that is able to modify via social studies (VTPI, 2011). It should be noted that existing restrictions on the way of research led us to avoid full explanation of each variables (items) affecting viability indexes.

Equality: Generally, equality is a criterion that profit and loss is distributed fairly among the members of a community through it (Lynch, 2005). This principle includes equality in resource allocation, equality in decision-making and participation, equality among groups, places, generations, etc. The estimation of this principle in urban planning is generally specified with following criteria (Saeidniya, 2004):

- Fairness in the sharing and distribution of urban resources

- Providing adequate access (social access) to educational, sanitary, recreational, and cultural services and facilities

- Proving facilities (opportunities) for all urban societies

- providing housing and employment fairly for all people and residents' of different urban areas

Public safety: safety refers to a situation that a person is supported in its framework against risks, threats, and losses resulting from social life. In the lack of security, satisfaction of life decreases that result in the loss of vitality of the place and spread of despair, hopelessness and loss of relationships among people and residents of a community (Sedighi Sarvestani and Nimroozi, 2010). The variables commonly used to measure these indicators in various areas usually have great diversity, but they can be classified into three categories including different types of crimes (murder, fighting, stealing, and rape), incidents or accidents, and sense of safety (Leby & Hashim, 2010).

Social solidarity: Although different theorists attribute many conceptual characteristics to this expression, most of them have accepted that social solidarity

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refers to quality and quantity among people within a society and they are evaluated by components such as residents' recognition from each other, their attention and interactions with each other, their participation in social activities etc. (Litman, 2011).

Real affordability of housing: The average ratio of housing costs to total household income has been considered by experts as a criterion for measuring housing accountability over the years so that spending less than 25 to 30 percent of total monthly household's income is counted as a main criterion in connection with the issue of housing affordability. However, today experts pay attention to movement costs as well as housing ones. In other words, they believe that spending less than 32 percent of total household's income for housing including mortgage or rent, maintenance, less than 18 percent for transport (movement), and totally less than 45 percent of these 2 components can be regarded as a suitable criterion for assessing housing affordability. Real affordability of housing can be calculated based on the following equation accordingly (Isalou et al., 2014).

The index of real affordability of housing= (housing costs=movement costs)/ income*100.

Ability to walk (pedestrian-oriented): it is one of the most important and main indexes of equality-based, sustainable, and viable societies considered by many experts from the second half of the twentieth century (Hutabarat Lo, 2009). The study of conducted research in this field shows that artificial environments and facilities that they provide for their residents have a key role in creating pedestrian-oriented societies (Lesli et al., 2007). Citizen's willingness to walking should be considered and examined as well since a place cannot be considered as pedestrian-oriented in the case of all facilities, but without citizens' willingness to walk and vice versa. With this interpretation, a place can be pedestrian-oriented based on the following equation (Donovan, 2008):
Pedestrian-oriented society= willingness to walk among people + available facilities in a neighborhood

Drinking water quality index (DWQI): this index is a numeral toll for assessing water quality that is understandable easily by managers and experts (Adriano et al., 2006).

Table2- Drinking water standards according to WHO and national drinking water standard

Parameter	Current standard in Iran	WHO
NTU	5	5
PH	6.5-9	6.5-8
Total hardness (mg / l calcium carbonate)	500	600
Ammonia (mg / l)	3	1.5
Fluoride (mg / l)	0.6-1.5	1.5
Chloride (mg / l)	400	250
Iron (mg / l)	0.3	0.3
Coliform bacteria per 100 ml	0	-
Thermophile bacteria in 100 ml	0	-

Source: (Iran's 1053 standard; 2004, WHO)

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However, drinking water characteristics taken from samples by the health center or water and sewage company are determined for microbial analysis and some physical and chemical parameters (Iran 1053 standard, features of drinking water, Fourth Edition). Accordingly, some of these parameters are presented based on the guidelines of the World Health Organization and the country's current standard in Table 2.

Air quality index (AQI): is an indicator that the degree of concentration of air pollutants is classified in six categories. The six general criteria presented by the United States Environmental Protection Agency (EPA) are as follows (Benton-Short & Rennie-Short, 2008): good (0-50), average (51-100), unhealthy for sensitive groups (101-150), unhealthy (151-200), very unhealthy (201-300), dangerous (more than 300).

Noise pollution index: it refers to any unpleasant sound or combination of sounds that have harmful effects on human health (Seidman & Standring, 2010). Depending on the type of pollutants in urban areas, they can be classified in the following categories:

1- Industrial areas: it includes all factories and manufacturing centers

2- Commercial areas: noise caused by the movement of vehicles

3- Residential areas: training centers, public spaces in the neighborhood, traffic of residents' vehicles, peddlers and hawkers shout

4- Special areas: hospital, school, religious places and so on.

It should be noted that the impact of noise depends on effectiveness time, intensity, frequency, time, inconvenience, and listeners' state or activity (Gharib, 2006). Audio threshold in terms of the performance of every area are presented in table3.

Table3. Audio threshold in terms of the performance of every area

	Classification of Areas/Districts	Limits in dB(A) Leq	
		Day 6 to 22	Night 22-6
A	Industrial areas	75	70
B	Commercial areas	65	55
C	Residential areas	55	45
D	Special areas	50	40

Source: (Ehrampoush et al., 2012)

4- Research Method

The method used in this research is descriptive-analytic. Required data were collected by questionnaire, interview, presented data by relevant institutions and bodies that are described in detail below:

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Library and documentary: different references such as websites, books, and articles have been used in order to study literature review. In addition, some of required data including number of crimes, concentration of air pollutants, and so on were provided and collected via some relevant institutes such as deputy of local government planning, and General Directorate of Environmental Protection of Qom.

Field study: it has been tried in this part to collect related data with socio-economic indexes of studied area by methods such as questionnaire and interview. However, households living in the central part of the city (12196 people) were selected as statistical society. 700 people of the society were calculated as a final sample of the volume by using Cochran formula (95% probability and error of 0.05 percent). The questions were designed according to the research entity into four forms including closed, open-ended, semi-open and five-point Likert scale.

Library: The other parts of the research were various microbial chemical and physical tests of drinking water in Qom. In fact, the researchers tried to determine the quality of drinking water in Qom i.e. piped water to homes, through library studies. It is noteworthy that all the relevant tests were done at the water temperature of 24 degrees Celsius.

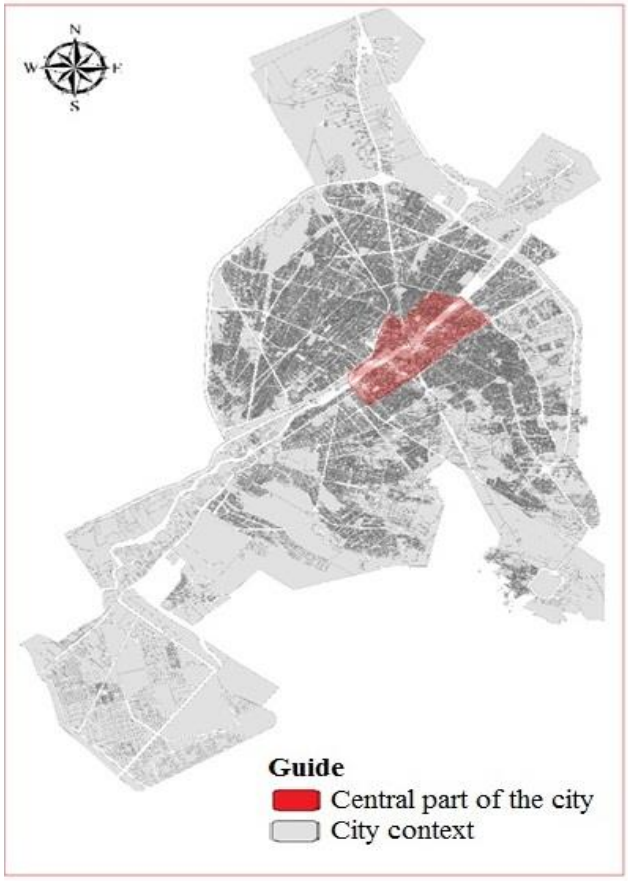
The Introduction of the Area under Study

The city of Qom, the center of the city and the province of Qom are located in the geographical position of 50 degrees and 47 minutes, 50 degrees and 56 minutes east longitude, and 34 degrees 35 minutes north latitude and 34 degrees 48 minutes respectively. The city is considered as one of the important connecting routes in the country because of north to south, South West, South east, and west roads of the country as well as North-south railway line. The city has had considerable growth during last half century due to a suitable geographical position in the country on one hand, and pilgrimage-religious sites such as the shrine of Hazrat Masumeh (A.S) and the holy mosque of Jamkaran on the other hand.

The results of presented data by Statistical Center of Iran indicate that the city's population of 959,116 people reached to 96,499 people during 1956-2006. The population of the city was increased nearly 10 times. Currently, different areas of Qom city provide different levels of quality of life for citizens due to rapid growth of urbanization. In order to present an appropriate image of their viability situation, central part of Qom city (district 7) has been selected as a studied area of this research (map1).

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5- Research findings

The Introduction of Statistical Population

The study of age status of sample respondents indicate that 24.4 percent of them is less than 25 years old, 53.7 percent of them are between 26 to 50 years old, and 21.9 percent are more than 50 years. Therefore, most respondents (more than 53 percent) are in middle age category (26 to 50). Gender situation of respondents also indicates that 62.4 percent are men and 37.6 percent are women. Therefore, men constitute the majority among sample society of the research. Educational status of respondents was also examined. It was determined that 14.6 of respondents were at elementary level, 19.1 percent at junior school, 30.4 percent were at high school and pre-university, and 17.3 percent were highly educated. Importantly, illiteracy rate accounted for the lowest percentage; only 8.7 percent illiterate and 9.9 percent with informal education. Employment status among the statistical population indicated that 55.3 percent of respondents were employed and 44.7 were unemployed. 71.3 percent of them were self-employed, 20.7 percent were occupied in administrative jobs (public private and institutions), and 8 percent of them had informal jobs (hawkers, itinerant, and dealer). 82.9 percent of them worked outside their neighborhood and 17.1 employed inside the neighborhood.

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Equality

The study of residents' access to services and facilities within the neighborhood and their judgment about fair sharing of resources and municipal services (quantity and quality) than other urban areas in Qom were basis of evaluation of equality index in this study. Accordingly, more than 42 percent of respondents stated that the quality and quantity of existing facilities in their dwelling place were equal to other places in the city. On the other hand, 30 percent of respondents believed that this number was low or very low, and 28 percent of them said the amount was high or with better quality than other areas (diagram1).

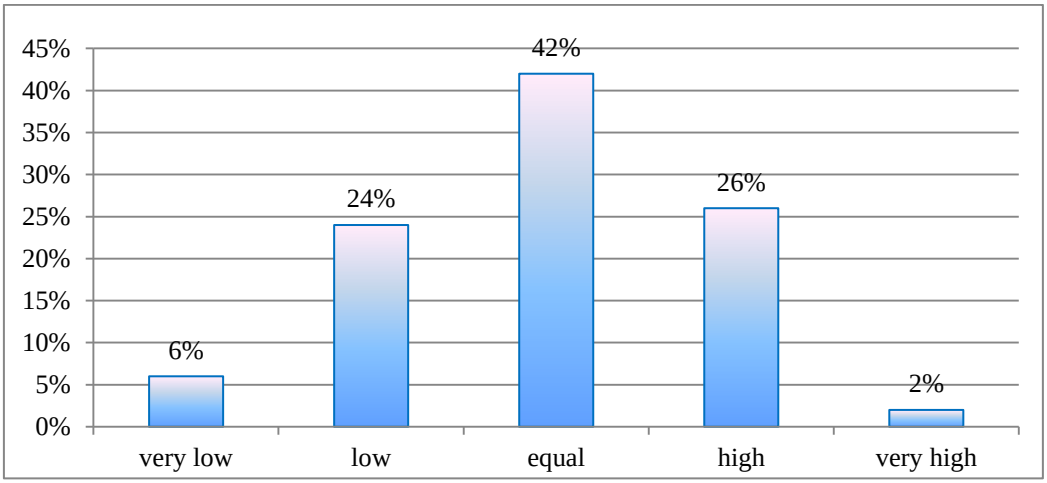


Diagram1. Qualitative and quantitative status of services in comparison with other areas in the city
Source: (Researchers' calculations, 2012)

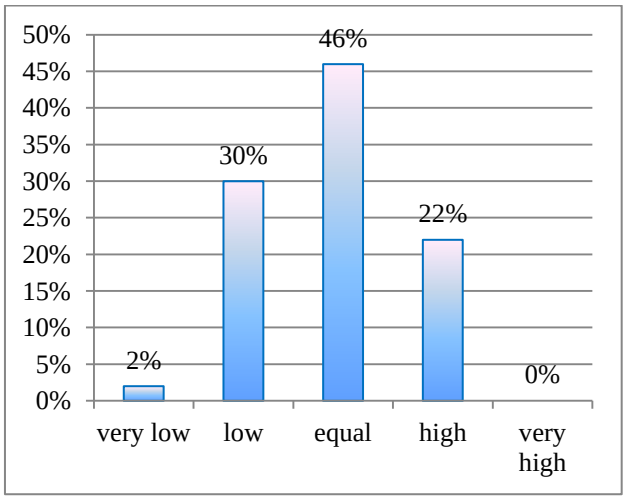


Diagram2. The amount of residents' access to neighborhood services
Source: (researchers' findings, 2012)

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On one hand, the amount of residents' access to neighborhood services was proposed that 46 percent of them said that their accessibility was average; on the other hand, 32 percent of them considered it in a low level, and 22 percent stated that it was high (diagram2).

Social Cohesion

Social cohesion is one of the other social indexes investigated in this study. In the framework of this issue, the respondents of the survey were asked about their familiarity with their neighbors, at first. According to figures set forth in Table 4, nearly 43.9 percent of resident in the central part did not know any of their neighbors whereas 34.2 percent of them know their neighbors well and very well. Meanwhile, 21.9 percent of respondents relatively know their neighbors. On the other hand, the amount of residents' interaction was examined in their daily contacts that more than 53 percent of residents stated that they had no relationship or dialogue in their daily contacts while 22.6 percent of them evaluated their interaction with their neighbors high or very high. Finally, in an assessment about residents' communication in the central part of Qom, it was determined that 46.4 percent of them did not have any communication with each other and 31.7 percent of them had high communication. It would definitely be said that various Iranian ethnic groups and foreign citizens from different countries such as Iraq, Afghanistan and Pakistan can be considered as the most important factors in reducing social cohesion among residents in the area.

Table4. The amount of residents' cognition, interaction, and communication with each other in the central part of the city

Amount / Index	Very low	Low	Average	High	Very high	Total
Cognition	10.3	33.6	21.9	30.1	4.1	100
Interaction	18.4	25.1	33.9	16.7	5.9	100
Communication	11.3	35.1	21.9	29	2.7	100

Source: (Researchers' findings)

Real affordability of housing

Households' income status is of great importance in the real affordability of housing analysis. Therefore, available data in this field shows that 14.9 percent of households earn less than 300 thousand Tomans[1], 29.8 percent earn between 301 and 600 thousand Tomans, 23.4 percent earn between 601 and 900 thousand Tomans, 19.1 percent earn between 901thousand Tomans and 1,200,000 Tomans, and 12.8 percent earn more than 1,200,000 Tomans. According to calculations in the state of households' income, it was specified that their monthly average income is nearly 685 thousand Tomans.

Housing costs and households' movement are two other influential factors on housing affordability. The

1- Each Toman is equal to 10 Rials

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findings indicated that 8.9 percent of households' income is spent on movement, and 39.4 percent is spent on housing on average. Therefore, more than 48.3 percent of households' cost is spent on housing and movement totally (diagram3).

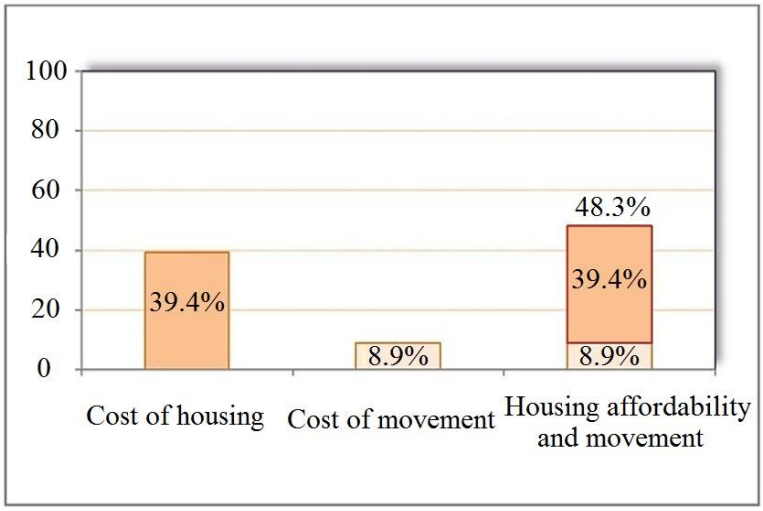


Diagram3. The average costs of residents' housing and movement in the central part of Qom city
Source: (Researchers' findings)

However, it should be said that households' appropriate accessibility affect extremely their movement affordability. Relatively high price of housing in the neighborhood has caused the average ratio of housing costs to household income be somewhat more than the usual standard (32 percent of monthly income only for housing). The detailed results suggest that nearly 53.3 percent of households in the neighborhood spend more than 30 percent of their income on housing cost while 46.7 percent of households spend less than 30 percent on housing cost.

It is necessary to mention that approach of rental housing was used to determine housing costs and price of rental housing was calculated by identifying the type of housing and its ownership. Accordingly, minimum rental housing is equal to 100 thousand Tomans and at most 400 thousand Tomans. It was estimated to 280 thousand Tomans in a month. In the following, the average cost of households' movement was questioned. In addition, the statistics indicate that 68.9 percent of households spend less than 18 percent of their monthly income for movement and 31.1 percent of them spend more than 18 percent.

Walking

Different factors play role in the formation and emergence of pedestrian-based environments. Facilities of neighborhood services from one hand, and citizens' willingness to walk during the day from other hand, were the most important variables studied in this research. Accordingly, the number of existing activities and performances in the central part of the city was identified first. According to table5, there is a relatively

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favorable mix and diversity of land uses in the studied area.

The results in this field indicate that 68.6 percent of residents evaluated access to services and facilities through sidewalks as high and very high and only 9.9 percent of them stated that situation is inappropriate.

Table5. The situation of land uses in the central part of Qom City

Land use	Number	Area	Ratio
Residential	11124	1769393	38
Commercial	2156	367332	8
Municipal services	401	294446	6.4
workshops	50	7425	0.2
Green space	13	156039	3.4
Administrative	121	102543	2.2
Religious	285	224596	4.9
Passages	-	1360147	29.7
Facilities	118	85642	1.9
Isolated and dilapidated	815	210789	4.6
Total	15083	4578378	100

Source: (researchers' findings)

22.5 of people stated that these facilities are relatively moderate. On the other hand, 71.8 percent of them had high and very high desire to walk while only 3.2 percent of them had no desire to walk. Meanwhile, 25 percent of respondents stated a moderate willingness. In this regard, central part of Qom city can be considered as a pedestrian-oriented environment.

Water quality

According to the figures in table 6, city water of Qom has no microbial contamination. Chemically, it is classified in saline water due to the high hardness and chloride; because of geochemical sources of drinking water in Qom. In addition, low amount of water fluoridation is a problem that exists in most parts of the country. The situation is slightly more sensitive than mountainous areas because of hot weather conditions.

Table6. Results of water tests in the city of Qom

Parameter	Measured values
NTU	1.18
PH	7.13
Total hardness (mg / l calcium carbonate)	576
Ammonia (mg / l)	0
Fluoride (mg / l) 19	0.32
Chloride (mg / l)	431
Iron (mg / l)	0
Coliform bacteria in 100 ml	0
Thermophile bacteria in 100 ml	0

Source: (Researchers' findings)

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Air quality

Air pollution is one of the environmental problems that is caused by increase in amount of ancillary compounds (gas and non-gas) atmosphere. This phenomenon can cause unpleasant consequences such as cardiovascular diseases, eye inflammation, and respiratory tract in humans in the long term (Rao and Rao, 2011). Data provided by the Department of Environment studies in Qom have indicated that the average amount of air pollutants in the central part of Qom city was 4.102 ppb during 2010 that is known as unhealthy conditions for sensitive groups.

However, the amount had different states in different seasons. Diagram4 shows that air pollutants even approaches to adverse conditions late fall and throughout the winter. In addition, Nitrogen dioxide (7.29 ppb) and Ozone (3.13 ppb) had the highest shares among pollutant.

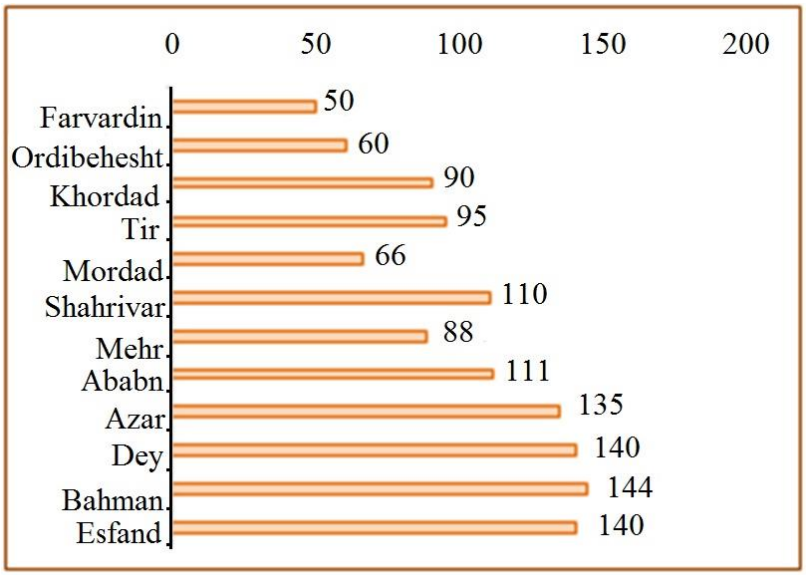


Diagram4. Concentration of air pollutants during 2010
Source: (Researchers' findings)

Noise status

Rapid growth of urbanization, number of activities and vehicles in the central part of most cities in Iran, particularly in Qom city, have caused that audio threshold of these areas show high figure in all day or night. The figures in table 7 prove the claim that noise level of all the stations in the central city of Qom known, as commercial sector is 67dbA in average that is higher than defined standards. Presumably, vehicles are one of the most important sources of noise pollution in this part of the city.

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Table7. Noise level in the stations located in Masouniyeh area

Station	Noise level dbA
Astaneh Square	66
Saeidi Square	68
Azar Street	64
Shohada Square	70
The average of the area	67

Source: (Researchers' findings)

In addition to data from these stations, conducted survey about tranquility situation in the neighborhoods of the area suggests that vehicle traffic (56.1 percent), noise of peddlers (36.9 percent), children's noise (1.9 percent), noise of some land uses such as hotels (5.1 percent) are the most important factors disturbing the tranquility of neighborhoods in the central part of the city.

6- Conclusion and suggestion

The idea of viability has been considered and hailed by many experts, researchers, and relevant institutions as an appropriate framework for assessing the quality of living conditions in cities during the recent years. It has been tried in this research to study and analyze the viability situation of central part of Qom city by using mentioned approach including eight main criteria.

Generally, the findings have indicated that the equality and social justice are in appropriate situation regarding social index. Economically, it should be said that even though desirability of the location (proper accessibility) of housing in the central part of the city has caused reduce in transportation costs, high housing costs affect the actual situation of housing affordability in this part of the city. Finally, three factors of environmental quality of air, water and noise are away from specified standards. Undoubtedly, this goes back to focused traffic conditions in the place that had adverse effect on these indexes. Fortunately, proper distribution and allocation of facilities in the neighborhood has resulted in economic affect in reducing transport costs as well as pedestrian-oriented causes. Therefore, it is suggested that particular policies such as decentralization of activities, change in development policies based on vehicles, attempt to stabilize old residents (renovation, increase in the quality of neighborhood services) to be adopted in order to improve quality of life in the city.

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