



Evaluation of the Impact of Urban Development on the Climate Change in Mashhad Metropolis, Using Iranian Leopold Matrix and Pastakia Matrix

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ABSTRACT

City and climate are two human made and natural systems that influence each other. The city that influences greenhouse gas emissions leads to global warming as a result of climate change. The main purpose of this study is to evaluate the impact of urban development on the climate change (a case study of Mashhad metropolis). The research method in this study is descriptive and analytical, in which by referring to library studies and field-based studies a theoretical framework is obtained; also, by determining evaluation options according to the negative effects and consequences of urban growth and development of Mashhad metropolis in recent decades on social systems, physical, functional, transportation and access are examined. In this study, the Iranian Leopold matrix method and rapid impact assessment matrix (RIAM) as well as Microsoft Excel, Arc GIS and Google Earth software have been used. Findings in this study indicate that the functional system with the range of letters -E and number -5 has the most destructive effects on climate change in this metropolis and the physical system with letters -B and number -2 has the least effects on the process. With the increase in population in the metropolis of Mashhad, urban growth and development is extended to villages and agricultural lands, and as a result, the change of use from agriculture to urban use occurs, leading to more greenhouse gas emissions and the creation of urban heat islands. So, in order to control such things, appropriate solutions in the system should be presented.

Keywords: *Urban Development, Climate Change, Rapid Impact Assessment Matrix (RIAM), Iranian Leopold Matrix*

1. INTRODUCTION

Due to the accelerated rate of urbanization and industrialization, urban land use has expanded at an unprecedented rate [1]. Today, cities are considered the main settlements of humans; therefore, paying attention to meet all human needs to create comfort is essential, which requires accurate and comprehensive planning.

Urban planning is the basis of urban studies in the present era due to cities' rapid development. In urban planning, one cannot stay away from geographical factors and climatic elements [2], and with the continuous city sprawling, the urban conditions of eco-environment exceeded the capacity for urbanization, leading to increasingly serious conflicts between various types of land use [3].

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Because rapid urban growth has harmful effects on humans and the environment, it results in creating physical, socio-economic and environmental problems [4]. Climate change poses unprecedented challenges to urban areas [5]. Also, climate change is one of the most complex problems that human beings face now and in the future. This phenomenon is due to changes in atmospheric processes that have caused global warming and essential effects and consequences on the cycle of hydrology, especially temperature and precipitation changes, as the most critical discussion in environmental sciences [6]. Based on one of the theories, some of the reasons for climate change in statistical periods are associated with excessive human activities, particularly industrial activities and greenhouse gases. During the 20th century, amounts of greenhouse gases such as CO₂, CH₄ and NO₂, have considerably increased in the atmosphere. As much as 5 to 6.2 billion tons of dioxide enters the atmosphere annually. According to the forecasts by the Intergovernmental Panel on Climate Change (IPCC), about the population growth and the increase in the human need for energy, the amount of Carbon Dioxide will increase from 3.1 billion tons in 1985 to 4.7 billion tons in 2025 [7]. Successive droughts, severe and sudden floods, cold and hot airwaves are one of the consequences of climate change, which have caused the earth to face various crises. So, recognizing the present and future climate situation is significant for urban planners and designers [8].

1.1 Theoretical Foundations

Physical development means a reasonable process to respond to citizens' needs and demands and includes physical spaces, that for their functions and activities, it is necessary to promote social changes desirably and organically. There have always been interactions between the physical space and economic and social changes, so that any defect in one form, influences the other one [9]. As uneven urban development continues, there are increases in migration to metropolitan areas, the expansion of cities to the suburbs and the formation of informal settlements. And this kind of widespread and all-encompassing expansion in the suburbs in addition to the destruction of valuable lands, create transportation problems and increase costs, pollution and energy consumption. The suburbs face major problems such as the lack of services and infrastructure for residents [10]. Global warming has killed thousands of people around the world. One of the important reasons is

today's cities' weakness to deal with the rising temperature and the resulting phenomena. While various climate changes and global warming can affect urban areas, urban areas can also exacerbate such changes. This increase in temperature, by exceeding the temperature range of human external thermal comfort, causes many human health problems. Also, this change in climate due to the release of greenhouse gases in the atmosphere has caused vulnerabilities in the urban system and has caused sea levels to rise and create storms, droughts, floods, heat waves and cold [11]. Climate change imposes disturbances on the earth's energy balance [12]. Two important factors are human activities in the industrial areas and the development of a group of gases known as greenhouse gases increasingly being released into space, which are often the product of burning fossil fuels and changing land use, such as forests to agricultural land [8]. According to world conventions, based on sustainable development and climate change, the main goal is to reach a common destination (reducing greenhouse gases through economic, social, physical and environmental sustainability). Therefore, the indices of this study were determined based on the goals of the conventions and the studies carried out in other regions. The main purpose of this study is to evaluate the impact of urban development on climate change, with an emphasis on sustainable environmental development (e.g., the metropolis of Mashhad), and to study on the urban development elements (Table 1) and climate change (Table 2).

1.2 Research Background

Howard (1833) first studied the temperature difference between urban and rural areas. Manley (1958) then called the temperature difference between urban and rural areas, the urban heat island, after which the term entered the world of scientific literature [13]. The temperature and rainfall are also useful in determining the role and distribution of other climatic elements and are of the main and fundamental factors in climatic zoning [14]. Therefore, several studies have been conducted on the increase of global and regional average temperatures. The table below gives an overview of some studies conducted in the world and in Iran on the climate change. What has been emphasized in similar research is that changes vary in nature depending on time and place. On the other hand, the intensity and trend of changes follow different patterns (Table 3) [15].

Table 1. Table of the Theoretical Framework of Urban Development

Table of theoretical framework of urban development			
Component	Criterion	Sub-criteria	Source
Urban Development	Social	Population growth	(Abbaszadeh, Akbari Motlagh, 11, 2008)
		Population density	(Abbaszadeh, Akbari Motlagh, 11, 2008)
		Migration	(Abbaszadeh, Akbari Motlagh, 11, 2008)
	Physical	Decreased level of permeability	(Framework Convention of the United Nations on the water and air, 2007)
		Compression (grain)	(Abbaszadeh, Akbari Motlagh, 11, 2008)
		various housing	(Abbaszadeh, Akbari Motlagh, 11, 2008)
		Quality of buildings	(Abbaszadeh, Akbari Motlagh, 11, 2008)
	Operational	Changing the user	(Framework Convention of the United Nations on the water and air, 2007)
		Deforestation	(Framework Convention of the United Nations on the water and air, 2007)
		Industry	(Framework Convention of the United Nations on the water and air, 2007)
		Knowledge of the borders	(W. Neil Adger, a, d Et al.,3, 2007)
		Freight transport	(Framework Convention of the United Nations on the water and air ,2007)

Table 2. Table of the Theoretical Framework of Climate Change

Table of theoretical framework of urban development			
Component	Criterion	Sub-criteria	Source
Climate change	Atmospheric conditions	Humidity	(Alijani, believers of the oven ,Saba October, 2011, 7)
		Temperature	(Alijani, believers of the oven ,Saba October ,2011, 7)
		Rainfall	(Alijani, believers of the oven ,Saba October, 2011, 7)
		Wind	(Alijani, believers of the oven ,Saba October, 2011, 7)
	Factors of a set of products	Water temperature	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Melting ice	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Flood	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Global warming	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Heat waves	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Dry	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Rainfall changes	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Seasons changes	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Increased natural disasters	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Burning fuel and fossil	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)
		Emissions of the greenhouse gas	(Framework Convention of the United Nations about changes in water and air ,2007 ,11)

Table 3. Theoretical Background of Climate Change

Row	Review of the processor	Year	Theory	Description
1	Wang et al	2014	Temperature, relative humidity and wind in China	Significant increase in temperature, sharp decrease in relative humidity and wind speed
2	King, et al,	2013	Maximum daily rainfall in Australia	Increased daily precipitation on a global scale; the relationship is in accordance with global average temperature change near the surface and moderate critical rainfall
3	Alijani et al	2020	Minimum, maximum and average temperature, precipitation, humidity and cloud cover in Yazd	Since 1997, the situation in the region has intensified
4	Sabzi Parvar and others	2013	Temperature in arid regions of Iran	The significance of having positive annual maximum temperature for about 70 % of the seasons and the average temperature in at least about 90 % of the seasons
5	Khudaghli and others	2015	Standard rainfall in Isfahan	Intense and repeated dry years started from 2000. In 2008, the lack of precipitation.

Hassan, D., & Abbas, J., & Komia, A-F (2016). Analysis of Climate Change Trend in Qom Province and Its Consequences, Environmental Studies, Volume 1, Number 2, Fall 2016, Pages 25-40.

2. Methodology

Since urban growth and development is inevitable, in order to prevent complications, problems and irreversible changes in the structure, function and ecological process of the city bed and to harmonize the human environment with the natural environment, it is necessary to pay attention to principles, criteria and policies for ecological sustainability [16]. In this research, according to the tables of the theoretical framework, the selection of study methods has been based on environmental impact assessment, which includes several methods, such as special expert method, checklist, matrix, network and overlay maps, and among the matrix methods, we can mention the simple matrix, step-by-step matrix, Moore matrix, Leopold matrix, and fast effect evaluation matrix (Pastakia) [17]. Leopold first proposed the Leopold matrix method in 1971 to analyze the environmental impacts. It was then reconstructed and modified by Makhdoom according to Iran's native conditions and was used as an Iranian Leopold matrix by Iranian experts in the field of evaluation [18]. In this method, urban development, which is an independent variable in this study, is evaluated as the effects and climate change, which is the dependent variable is assessed as the outcome, and experts measure the impact of the effects on the outcome. Therefore, due to this method's final result, which ends in a table and has not

achieved the desired result in this study, the second method called Rapid Impact Assessment Matrix (RIAM) has been used. First introduced by Christopher Pastakia in 1998, this matrix can objectively and conceptually evaluate and compare options in plans and projects and display the results clearly and concisely in the form of tables and graphs. Reproducibility, high accuracy, flexibility, and conversion of outcome assessment from subjective to the objective are other benefits of RIAM analysis. For this reason, this method is used as a powerful tool for implementation and calculation of environmental consequences of projects [19]. The research method in this study is descriptive-analytical, which is used in the metropolis of Mashhad as a study area. The present study has been conducted using two library and field-based methods, so that by determining the factors of urban development and environment in Mashhad, using library studies and current maps (the third comprehensive plan of Mashhad metropolis) and conducting a research on the background of the subject under study, a list of indicators of two independent and dependent variables has been compiled, and an online questionnaire, shown in Table 4, has been provided to specialists and experts in this field in order to score. The output information of the questionnaire, using the Pastakia formula

method, calculated the effect of each variable of urban development as the effects on the variable of climate change as the consequence, and the scoring result is given in Table 5, which have been analyzed using SPSS, Excel, GIS and Google Earth software. In this study, the statistical population is 130 people, and using Cochran's formula, the sample size in the study area was determined to be 97 people. Also, in this study, for the reliability of the questionnaire, Cronbach's alpha calculation method has been used, which is equal to 0.791 and shows the correlation between the

questions. And in order to evaluate the validity of the questionnaire, with the advice and approval of specialists and experts in the field of urban planning and geography, the content validity of the questionnaire has also been approved.

- (A1) (A2) =AT Relationship 1
- (B1) +(B2) +(B3)=BT Relationship 2
- (AT)(BT)=ES Relationship 3

Table 4. RIAM Evaluation Criteria

Criterion	Score	Description
A1= The importance of the situation	4	National and international importance
	3	Regional and national importance
	2	Importance for peripheral areas
	1	Only relevant for local conditions
	0	No matter
A1= The magnitude of the effects	+3	Very positive effect
	+2	The effect means a significant positive
	+1	Positive effect
	0	Ineffective
	-1	Negative effect
	-2	The effect means a significant negative
B1= Durability of effects	-3	Very negative effect
	1	Unchanged
	2	Temporary
B2= Reversibility	3	Permanent
	1	Unchanged
	2	Reversible
B2= Cumulative effect	3	Irreversible
	1	No effect
	2	Non-cumulative effect
	3	Cumulative effect

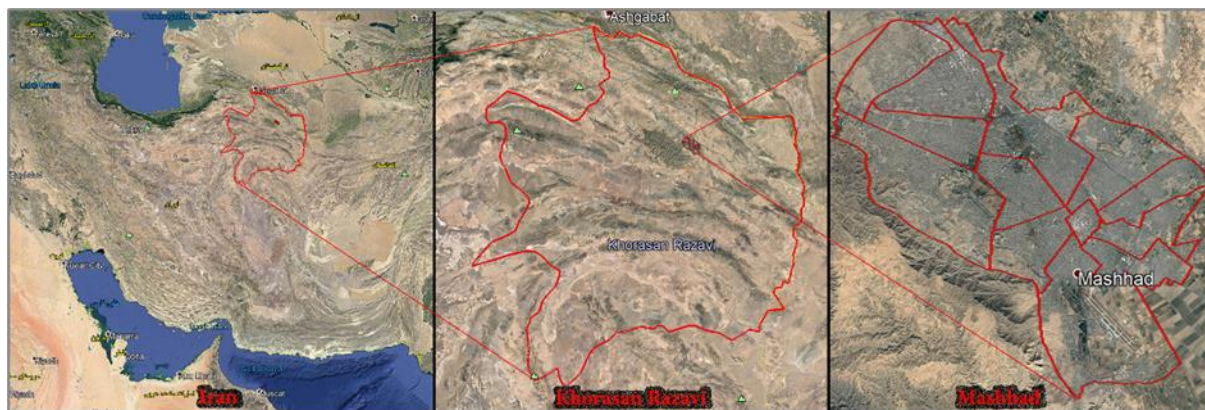
Table 5. Scoring Results

Describe each score	The range of characters (RV)	Numerical range (RV)	Rating of the set limits the length of the RIAM (ES)
Very positive effects	+ E	5	To 108 72
Significant positive effects	+ D	4	To 71 36
Medium positive effects	+ C	3	To 35 19
Positive Effects	+ B	2	To 18 10
Few positive effects	+ A	1	To 9 1
Unchanged	N	0	0
Minor negative effects	-A	-1	To -9 -1
Negative effects	-B	-2	To -18 -10
Moderate negative effects	-C	-3	To -35 -19
Negative effects mean significant	-D	-4	To -71 -36
Very negative effects	-E	-5	To -108 -72

2.1 The Geographical Territory of Research
 Khorasan province with an area of about 15% of Iran is one of the largest provinces in the country. This area is located in a place with the geographical features of mountains, plains, plateaus and deserts in two main northern parts. It is formed in the northwest and south. This province, which is located in the northeast of

the country, has the most border lines with neighboring countries (Turkmenistan and Afghanistan). In the latest political divisions of the country, Khorasan province has 25 cities, 81 towns, 82 districts and 227 rural district and 7750 villages [20] (Figure 1).

Figure 1. Introduction of the Study Area



3. Discussion and Conclusion

3.1 Analysis of the Physical System Data in the Metropolis of Mashhad

Increasing population and urbanization, as the most critical aspects of global change, have provided the prelude to widespread urban growth and development. Therefore, the increase in population and size of cities and towns in the world, as a result of increasing urbanization, has had a great impact on humans and the environment [21]. Factors that were examined at the physical level in this study include reducing the level of permeability or tissue compaction, tissue finesse, materials and quality of buildings, different types of housing, and marginal areas.

All these factors are commonly found in any city or in the old contexts and suburban areas, and the city of Mashhad is no exception to this rule, particularly the area around the shrine and suburban areas in the north and northeast. Also, different types of housing were studied in this research as one of the physical factors. Different types of housing include high towers that effectively discuss weather conditions (wind) and biological factors (soil). In general, as can be seen in the output of this study’s questionnaire, the physical discussion in terms of the impact on climate change is seen as the least effective factor with a rate of 2- and the letters –B (Table 6).

Table 6. Range of RV and ES of the physical system in the Metropolis of Mashhad

Review system	The range of characters (RV)	Numerical range (RV)	Environmental ranking in RIAM (ES)
Negative effects	-B	-2	To -18 -10
Physical			To -18 -12

(Source: Authors)

According to Figure 2 and Figure 3, it can be seen that physical factors have the most significant impact on natural disasters with the

number -18 and the least impact on seasonal changes with the number -10.

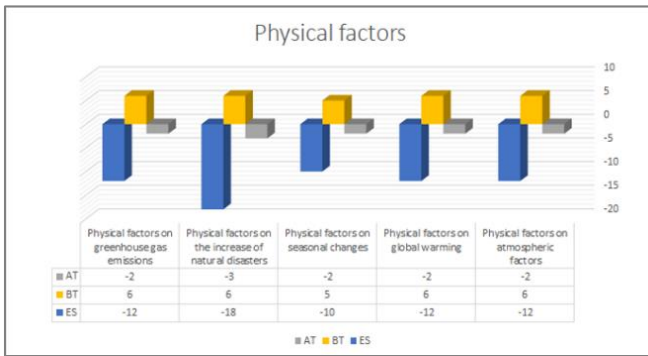


Figure 2. Measuring the Impact of Physical Factors on Atmospheric and Environmental Factors

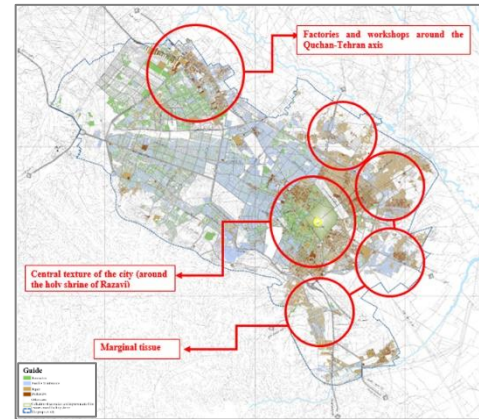


Figure 3. Determining the Social Factors Affecting the Climate Change in the Metropolitan Area of Mashhad

3.2 Analysis of Social System Data in the Metropolis of Mashhad

In the city of Mashhad, as a mother city and the center of influence for the surrounding cities, internal migration is relatively high, and the presence of immigrants in this city can be considered in the form of city to city or village to city. The increase in immigrants is directly related to population growth. Also, in the city of Mashhad, population growth, apart from the issue of immigrants alone, has an upward trend, while it also increases with the increase of immigrants. The increase in population and also the increase in immigrants have caused urban development in the

city of Mashhad so that with the development of Mashhad, the surrounding villages are connected to the city and in some places, cheap lands and proximity with convenient access to areas with industrial workshops and people have led to population density. Also, in the city's central part (around the Razavi holy shrine) due to pilgrims' presence and extra-urban uses, there is population density and high energy consumption. After studying these factors in this research, the highest score belonged to the factors affecting global warming and greenhouse gas emissions, and in general, social factors were in the second category with a numerical score of -3 and the letters -C (Table7).

Table 7. Range of RV and ES of social system in the Metropolis of Mashhad

Review system	The range of characters (RV)	Numerical range (RV)	Environmental ranking in RIAM (ES)
Moderate negative effects	-C	-3	To -35 -19
Social level			To -35 -21

(Source: Authors)

According to the Figure 4 and Figure 5, social factors have the greatest effect on greenhouse gas emissions with the number -35 and the least effect on seasonal changes with the number -21.

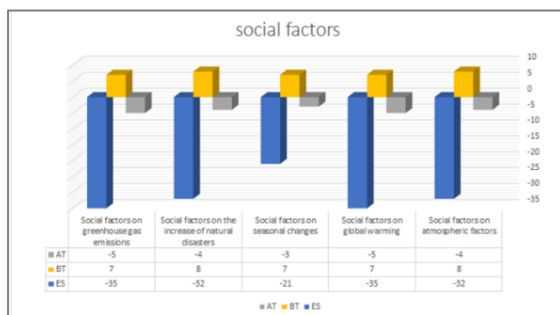


Figure 4. Measuring the Impact of Social Factors on Climatic and Environmental Factors

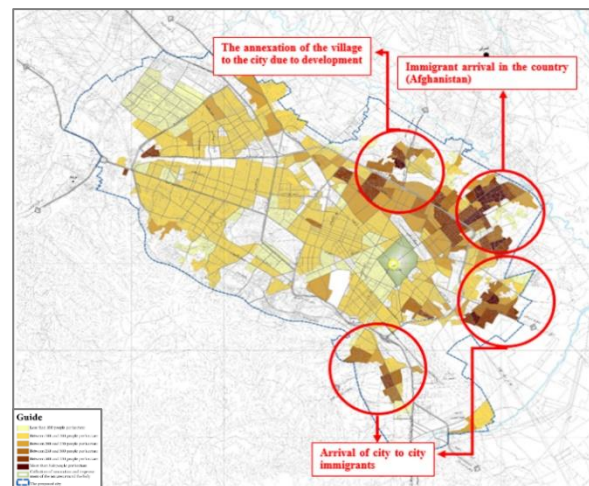


Figure 5. Determining the Social Factors Affecting the Climate Change in the Metropolitan Area of Mashhad

3.3 Analysis of Transportation System and Access System Data in Mashhad Metropolis

The different pollutants that different transportation systems leave in the city are also very effective in climate change, as can be seen in the answers to questions by experts. Also, transportation facilities affect air pollution about their location.

Table 8. . Range of RV and ES of transportation and access system in the Metropolis of Mashhad

Review system	The range of characters (RV)	Numerical range (RV)	Environmental ranking in RIAM (ES)
Negative effects mean significant	-D	-4	To -71 -36
Transportation and access agents			To -53 -45

(Source: Authors)

According to Figure 6 and Figure 7, transportation and access factors have the most significant impact on global warming with -45 and the least impact on atmospheric factors with -35

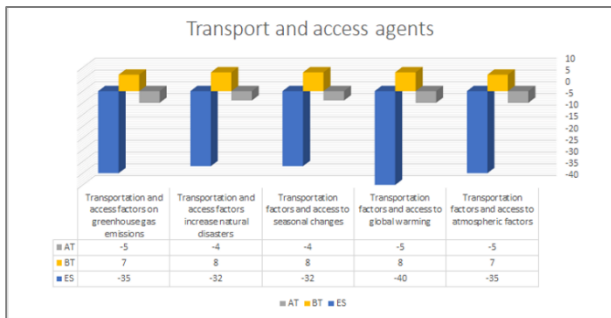


Figure 6. Measuring the Impact of Transportation and Access Factors on Atmospheric and Environmental Factors

3.4 Analysis of Data on the Functional System of City Lands in the Metropolis of Mashhad

The expansion of cities horizontally, which leads to the destruction of agricultural land, is also a severe threat to natural resources. In the city of Mashhad also the gardens and agricultural lands are destroyed with the expansion of the city, and also the heights of the south of Mashhad, which are an important part of the natural resources of this city, are in the hands of the builders. Every day we see the destruction of this city's southern heights and the emergence of several towers. According to the estimated GIS maps of Mashhad city for two periods of 2007 and 2013, in 2007 agricultural lands covered 47.87% of the city's total lands. After they were occupied, the number reached 40.80% in 1392, turning into other land uses, including urban use (Yazdankhah, Karbasi, Abkar, & Paluj, 2017).

If the intercity terminal is in the wind direction, or the inner-city terminal or city bus stop is located in a depression, the city will undoubtedly be directed towards air pollution. According to the transportation system calculations, the access factor is in the range of letters -D and ES numbers (-45 to -35) are located in the average negative effects (Table8).

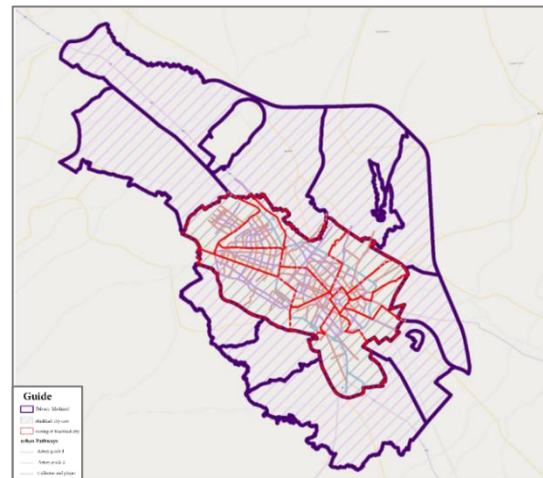


Figure 7. Determining the Factors of Transportation and Access Affecting the Climate Change in the Metropolitan Area of Mashhad

Also, in the central part of Mashhad, the existence of extra-urban uses such as Razavi Holy Shrine, high-rise hotels and offices in the city is a factor affecting the temperature in these areas. With an average per capita of 2.3 percent, the industrial sector in Mashhad is important in this part of study. Many factories and industrial workshops in the Quchan-Tehran axis cause wind and pollutants to flow into the city in different seasons. As shown in the map, even the future development of Mashhad area, completely covers the agricultural lands and the green belt of Mashhad and parts of the heights. This, in itself, will lead to many environmental hazards. According to experts, land-use change, deforestation, industry and marginalization have a high impact on this area, so it has the highest score in the questionnaire, and according to the calculations at the functional level, with the range of letters -E and ES

numbers (-90 to -72), it is in the state of very negative effects (Table 9).

Table 9. Range of RV and ES of functional system in the Metropolis of Mashhad

Review system	The range of characters (RV)	Numerical range (RV)	Environmental ranking in RIAM (ES)
Very negative effects	-E	-5	To -108 -72
functional			To -90 -72

(Source: Authors)

According to Figure 8 and Figure 9, functional factors have the greatest impact on increasing natural disasters by -90.

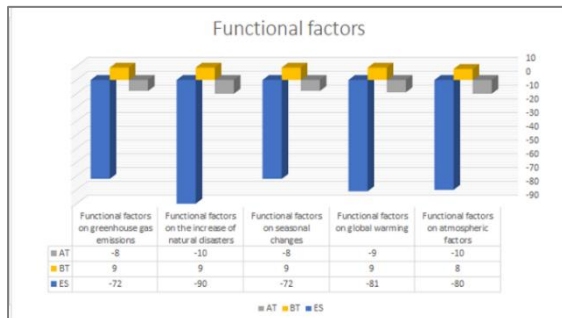


Figure 8. Measuring the Effect of Functional Factors on Climatic and Environmental Factors

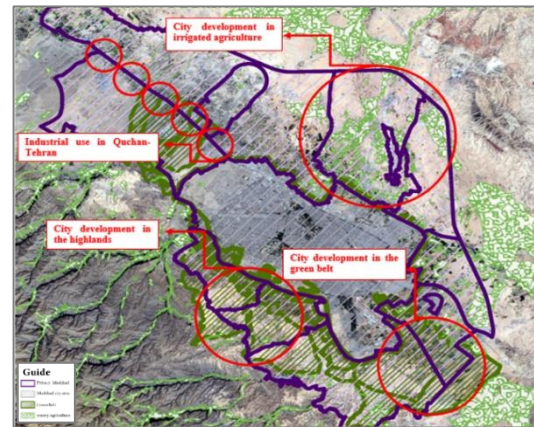


Figure 9. Determining the Functional Factors Affecting the Climate Change in the Metropolitan Area of Mashhad

In general, in this study, the impact of social, transportation, physical and functional factors on climate change has been identified, and these factors are analyzed in the metropolitan area of Mashhad from the least effective to the most effective ones. Of course, the trends of all these factors affect each other because, with population growth, the city moves towards development and causes changes in functional, physical and transportation levels. Knowing the city and managing this trend in cities is a necessity of urban planning.

Table 10 shows the average numbers of the calculations of the answers to the questions of the Pastakia method, in which each effect in the

Table 10. Determining the Effectiveness of the Studied Systems

System and description of each score	The range of characters (RV)	Numerical range (RV)	Environmental ranking in RIAM (ES)	
			Bottom line ES	Upper bound ES
Minor negative effects	-A	-1	To -9 -1	
0			0	
Negative effects	-B	-2	To -18 -10	
Physical			-18 To -12	
Moderate negative effects	-C	-3	To -35 -19	
Social level			-35 To -21	
Negative effects mean significant	-D	-4	To -71 -36	
Transportation and access agents			-53 To -45	
Very negative effects	-E	-5	To -108 -72	
functional			To -90 -72	

(Source: Authors)

bottom row shows the effective system, so that the negative effects with the letters -B and ES numbers (-18 to -10) is related to the physical system with numbers (-18 to -12), the moderate negative effects with letters -C and ES numbers (-35 to -19) is related to the social system with numbers (-35 to -21), the significant negative effects with letters -D and ES numbers (-71 to -36) is related to the system of transportation with numbers (-45 to -35), and finally the very negative effects with the letters -E and ES numbers (-108 to -72) is related to the functional system with numbers (-90 to -72) (Figure 10) .

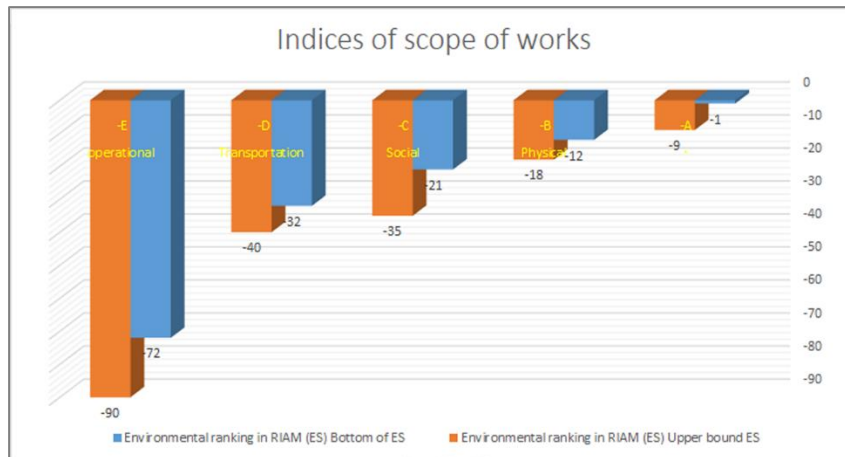


Figure 10. Determining the Effectiveness of the Studied Systems

4. Conclusion

The city of Mashhad has enjoyed high population growth in the last century. According to the statistics of the city of Mashhad in the first official census of Iran, which was conducted in 1957 and the census of 2017, which was the last official population census of Iran, the population of Mashhad had an upward trend. Immigration from Mashhad to its suburbs has also created the issue of population density in these areas. Therefore, the increase in population of Mashhad has led to housing problems. As a result, by the overflow of the population (mainly immigrants), the city is forced to develop horizontally in the surrounding areas and vertically within the city, which has been a factor in initiating other factors to reach the urban heat island. With the growth and expansion of the city and the disappearance of agricultural lands and gardens and their conversion into urban uses, including residential, industrial and workshop areas, the issue of land-use change and the creation of a marginal texture begin.

Moreover, this beginning is accompanied by a low-quality material in terms of materials, finesse and compactness of the fabric and an unplanned construction, so the existence of this type of housing contributes to energy loss and it influences over time on creating urban heat islands. From a functional point of view, basic attention can be paid to the type of user. The industry is a polluting function that should be placed according to the approved design and privacy and the desired performance type. Also, the existence of old factories on the Quchan-Tehran axis, which are weak both physically and functionally, leads the city to heat.

On the other hand, the city of Mashhad is a pilgrimage and touristic city, which leads to the transfer of pilgrims. The central part of Mashhad

(Samen region) due to the Razavi holy shrine, which plays a global role, increases population density and consequently the demand for travel to other parts of the city, which increases the need for transportation in different parts. Existence of public or even worn-out public transportation, lack of transportation and directing people to use private transportation are factors that help increase greenhouse gas emissions, which will eventually affect global warming and climate change.

by providing a suitable solution, cooperation between the responsible bodies, realistic foresight, shortening the hands of profiteers, etc., the excessive environmental degradation and its consequences can be prevented. As an example, several cases in different systems can be mentioned:

In the social field

- Preventing the vulnerable systems to destroy due to illegal immigration and nomad processes
- Preventing the sale of agricultural land to immigrants for housing
- Applying population control policies in unstable areas
- Raising residents' awareness in applying population control policies
- Establishing rules and regulations for the entry of immigrants into metropolitan areas
- Raising public awareness to reduce greenhouse gas emissions

In the field of transportation and access

- An acceleration in the collection of used cars
- Paying attention to standards in fuel production
- Expanding the urban green belt space
- Reducing traffic in crowded places (Shohada Square, streets leading to Imam Reza shrine, etc.)

- Immediate and serious reinforcement of the public transportation system with emphasis on bus, metro and bicycle network
- Establishment of multistorey car parks at the entrances and exits of urban areas, in order not to use private vehicles and provide public transportation in areas, especially in high-traffic areas such as Samen area and the middle west and east, having the highest incoming and outgoing trips.

In the physical-functional field

- Preventing urban land use changes
- Increasing the amount of open and green spaces, especially in the entrance axis of the city (Quchan-Tehran)
- Preservation and expansion of gardens and agricultural lands
- Promoting urban agriculture for urban areas around Mashhad (Nodeh neighborhood)
- Improving the quality level of the attached texture from the village to the city
- Solving the problems related to the body in the mentioned areas

References

1. Alijani, B., & Qavidel Rahimi, Y. (2005). *Comparison and prediction of annual temperature changes in Tabriz with global temperature anomalies using linear regression and artificial neural network methods*. Journal of Geography and Development , 6, 21-38.
2. Alijani, B., Moayed Fard, S., & Sabaei Mehr, M. (2010). *Study of climate change in Yazd in relation to urban and regional development*. Journal of Urban Research and Planning , 3, 41-58.
3. Asadi Shirin, G., & Gholam Ali Fard, M. (2015). *Adaptation of criteria and assessment of environmental consequences of Ghaemshahr landfill using Leopold and RIAM matrices*. Journal of Research in Environmental Health , 3.
4. Ataei, H., & Fanaei, R. (2013). *Examination of the trend of changing the temperature series of Shiraz City in relation to urban development planning*. Journal of Urban Research and Planning ,(15), 57-76.
5. Azadkhani, P., Soleimani, S., & Omidi, M. (2017). *Investigation of physical-spatial development model of Ilam city with Shannon and Holdern entropy model*. Journal of Urban Development Studies ,4, 4-25.
6. Bulkeley, H., & M.Betsill, M. (2003). *Cities and Climate Change*. In H. Bulkeley, & M. M.Betsill, Urban sustainability and global environmental governance (p. 14). London and New York: Taylor & Francis Group.
7. Buzasi, A., Palvolgyi, T., & Szalmane Csete, M. (2021). *Assessment of climate change performance of urban development projects – Case of Budapest, Hungary* . Cities.
8. Darabi, H., Jafari, A., & Akhavan Farshchi , K. (2016). *Analysis of climate change trends in Qom province and its consequences*. Journal of Environmental Science Studies , 2, 25-40.
9. Farnhad Consulting Engineers. (2016). *The third comprehensive plan of Mashhad*. Mashhad.
10. Hatami Nejad, H., Mehdian Bahnemiri, M., & Mehdi , A. (2013). *Study and analysis of urban management performance in the physical development of the city Case study: Babolsar city*. Fifth Conference on Urban Planning and Management. Mashhad: <https://civilica.com/doc/207977/>.
11. Hosseini , S., Ali Mohammadi , M., Nabizadeh , R., & Deghani , M. (2016). *Investigation of environmental effects of fuel transmission line project to Chabahar combined cycle power plant*

- Preventing the establishment of contaminating workshops and industries in urban areas
- Improving and upgrading existing infrastructure
- Construction and relocation of air pollution industries outside the city limits
- Establishing regulatory bodies to prevent illegal constructions
- Assigning various activities to barren lands inside the city to prevent the spread of horizontal irregularities in the city
- Preventing the process of land exchange, especially in areas located in the suburbs
- Improvement and renovation of the old neighborhoods of the city, especially the texture around the Razavi holy shrine.

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- using Iranian matrix. Journal of Environmental Health Engineering , 1, 20-29.
12. KHordadi, M. J., Islamian, S. S., & Abedi Kopaei, J. (2007). *Investigation of meteorological parameters in several regions of Iran*. Technical workshop on the effects of climate change on water resources management. Tehran: <https://civilica.com/doc/115811/>.
13. Luan, C., Liu, R., & Peng, S. (2021). *Land-use suitability assessment for urban development using a GIS-based soft computing approach: A case study of Ili Valley, China*. Ecological Indicators .
14. Mazidi, A., & Narangi Fard, M. (2016). *The effect of urban development and land use changes on the climatic elements of Shiraz and Fasa*. Journal of Applied Research in Geographical Sciences (Geographical Sciences) , 40, 131-154.
15. Mir Moghtdai, M., Rafieiyan, M., & Sangi, E. (2010). *reflection on the concept of interdependent development and its necessity in urban areas*. Municipalities Monthly , 98, 44-51.
16. PoorMosavi, S., Farhoodi, R., Hosiyani, S., & Hosiyani, S. (2013). *An analysis of the horizontal expansion of the city of Mashhad in recent decades (1335-1335) and its impact on soil resources*. Journal of Geography and Planning , 50, 259-280.
17. Sanagar Darbani, E., Rafieian, M., Hanaei, T., & Monsefi Proper, D. (2018). *Evaluation of the effects of climate change on changes in outdoor thermal comfort using physiological equivalent temperature index (PET) in Mashhad*. Journal of Geographical Research , 3, 38-57.
18. Sayah Nia, R., Makhdoom, M., & Faryadi, S. (2017). *Ecological indices in assessing the potential of urban growth and development (Case study: Tehran metropolis)*. Journal of Environmental Sciences , 1, 77-88.
19. Soltanieh, M., & Ahadi, M. (2004). *Global Warming Convention on Climate Change and International Obligations*. The fifth biennial national conference of the Iranian Association of Environmental Specialists <https://civilica.com/doc/13975/>. Tehran: <https://civilica.com/doc/13975/>.
20. Walizadeh, S., & Shokri, Z. (2015). *evaluation of the application of leopold matrix in assessment of environmental impacts (eia) of solid waste management alternatives in birjand city*. Journal of Health and Environment , 2, 249-262.
21. Wang, H., Qin, F., Xu, C., Li, B., Guo, L., & Wang, Z. (2021). *Evaluating the suitability of urban development land with a Geodetector . Ecological Indicators .*