Evaluation of urban sustainable development criteria by FAHP

(Case study: Vali-e-asr neighborhood, Mashhad, Iran)

Rahnama, Mohammad Rahim, Assosiate Professor of Geography and urban planning, Ferdowsi University of Mashhad

Kazemi, Khalilo Allah, *Deputy Director of Services and urban Environment of Mashhad municipality and PhD. Student of Geography and Urban planning, Ferdowsi University of Mashhad*

Shoorabi, Ramezan Ali, *Manager of Planning and supervision of the affairs of urban Services in Mashhad municipality and PhD. Student of Geography and Urban planning, Shakhes Pajouh Engineering Research institution of natural disaster*

Abstract

Social justice is one of the basic concepts of urban sustainable development. Explaining social justice concept, need to be considered primary facilities and possibilities of different city regions. Nowadays, knowing strength and weakness points of different city regions for present plans and suitable policies is necessary. Urban sustainable development is an interesting subject for regional planners and policy makers. Therefore choosing the suitable method for quantitative measurement of it is of utmost importance. So the purpose of this paper is evaluating urban sustainable development indicators and criteria. This study has been conducted based on a descriptive-analytical techniques using FAHP[1] method. The area study is vali-e-asr neighborhood, Mashhad, Iran. For evaluating of sustainability criteria in this neighborhood, 20 persons of experts and urban elites were consulted. Results showed that the main priority for the sustainable development of this neighborhoods economic indicator and socio-cultural and environmental indicators respectively, are the next priorities. Also based on the result of sub-criteria evaluation, families enjoying the urban facilities by 0.88 points, access to public services by 0.71 points, economic value of lands by 0.72 points and income households by 0.71 points are of expert's top priorities for sustainable development of vali-e-asr neighborhood of Mashhad.

Keywords: sustainable urban development, sustainability indicators, multi-criteria decision making analysis methods, vali-e-asr neighborhood of Mashhad.

---

[1] - Fuzzy- Analytical Hierarchy Process (FAHP)

Introduction

Today's man by using power of thinking during these centuries, found his way to the various fields of knowledge and tried to provide a better life by using techniques. Although the structure of life had not changed during past ages, but the problems have changed in any specific period of time that it cause human concerns. One of these problems regard to development. By entrance to 3th millennium, development still is the most important matter in front of developing countries. Entirely development by the meaning of try to improve the quality of life is the twin with human society's history, but development by the modern meaning is one of the concepts that nowadays have been discussed more than other matters in different meetings [Getis and Fellmann, 1992: 352-354].

Development and developing subject by the end of Second World War have become one of the most discussable matters within political economy field that prepare the way for numerous studies. Despite the growing opportunities that technology brings to human life, but considering the development, variation between different countries and regions are still glaring [Bakhtiari, 2003:156].

Desired aim of development is improving the life quality of all people. Therefore, efforts to achieve development should be in a way that interesting majority of people. In the case of a limited part of the society enjoying development process it cannot be called development. By developing cities the focus on principle of development will be increasing. Problems in cities indicate that sustainability criteria are not fulfilled correctly. Hence, experts are finding the way to resolve these problems. Urban sustainable development within last decades has become gradually modern paradigm in scientific literature of urban planning [Salari et al., 2014], and today sustainable development has become worldwide target [Philis and andrian, 2001]. So evaluation and awareness about each sight of sustainable development indicator could help planners to optimum allocating of funds. In this way this research intends to evaluate and analyze development indicators in vali-e-asr neighborhood of Mashhad by multi-criteria analysis method using FAHP.

Theory

Principally, development is fundamental changes in economic, social and cultural variants of a society and its implementation requires coordination between the different dimensions of it. Economic sustainable development is not possible without cultural, social and political developments and in other hand cultural, social and political developments without scientific and logical looking to economic development will not happen in long term. So for coordinating national and regional aims with regional realities, considering regional politics within the framework of macro politics of development is essential to coordinate macro politics with economic, social and cultural capabilities [Biddokht, 2007:17]. Within the process of programming to reach development and to situate on the route of it, recognition and understanding the conditions and circumstances of human societies is one of the essential actions in these lines [Rezvani, 2003:1]. Until yet a worldwide definition of development's concept has not presented and authorities express many different definition for it [Azimi, 1999:18]. Great connoisseurs such as Progfilla (1998) mean the development as a progress to aims such as decreasing poverty and unemployment and equality [Long, 1988:10]. Hoseini means development as increasing production, efficiency, improving the quantitative and qualitative level of life, improving health and therapy services and providing economic-

social needs [Hoseini, 1992:185]. Norman (1988) means development as providing fundamental needs [Shahbazi, 1991:47]. Some other connoisseurs such as Adam Smith, Bayer, Clarke, Hirschman, Myrdal and Rostov mean development as a fundamental transition from old society to modern society [Bayer, 1990:41]. Basically development means improvement conditions of life. So considering economy is knowledge about optimum using of resources to supply pecuniary and basic needs of human life, development is a steady interest for science of economy and multi-aspect processes of it [Peer, 1999:7].

In definition of development considering different statements, basic meaning of it could be show as below (figure 1).
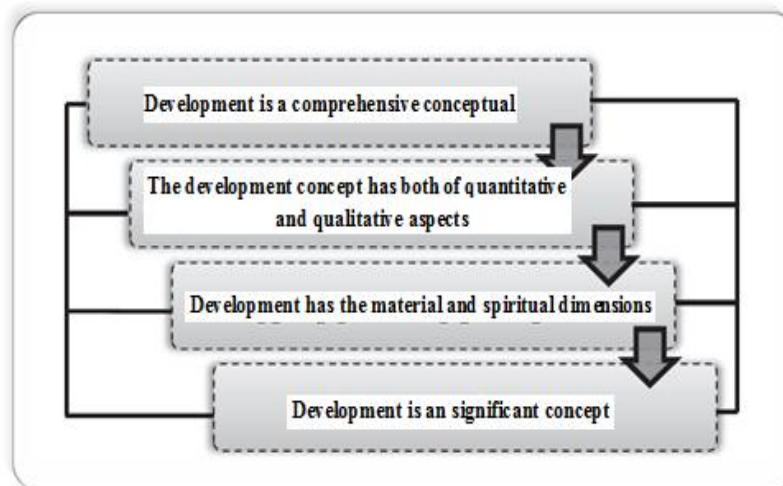

Figure 1: the main concepts of development

However, sustainability of development or sustainable development is the most important pillars of development. Sustainable development is the ideal goal for all communities including urban communities. Although the particular Widespread problems has caused the third world's attention more to achieve development not its sustainability, but it should be noted Remove the existing gap between the developed and developing world without sustainable development is not possible (**Button, 2002: 215-230**). Term development means improving the quality of life of people and promoting the welfare of the community and its sustainability is the continuation of this process during human generations. Thus, sustainable development encompasses all aspects and dimensions of human life (**Marull, 2007: 12-16**). The dominant trend of the development of form and content represents a conceptual evolution, so that has shifted from perceptions and beliefs of a single manufacturing (growing) to harvest and belief in a several structural (sustainable development)(**Choen,1991:28-34).**

Apart from the conceptual and functional differences of each these paradigms it is emphasized that indeed, are different aspects of cognitive, perceptual and objective between old and new paradigms of development. In particular, the boundary between old and new paradigms is focusing on replacing humans rather than focusing on technological development in the last decades (**Hart,1995).**

| Work force
Capital
Technology
data | **Economic dimension** |
| Social investment
Social dynamism | **Social dimension** |
| Energy resources
Natural resources
Vital resources | **Ecological dimension** |

Figure 2: Dimensions and factors of sustainable development

In addition to the components of sustainable development, it includes characteristics that can be shown in Figure (2). In this regard, the cities and urban development, particularly urban sustainable development is one of the most important basic issues of modern societies. Modern societies have made major changes in the population, such as urbanization, population and spatial inequality and…, followed by the development of towns and cities, urbanization has encountered a number of problems that are hard to live in large towns and cities. Urbanization is context of social contrasts and conflicts in every country where has become an area for accumulation and concentration of wealth and poverty (**Mourizten, 2002: 48-54**). In sustainable urban development, promote the quality of urban life including the ecological, cultural, political, facilities, social and economic sectors is applied without imposing any burden on future generations or the pressure due to loss of natural and local capital.

Sustainable city is a town which answers basic needs of human society such as psychological and emotional needs, economic, social, cultural, and having a broad network of social communication for economic, cultural, environmental interactions or morphology and ecological characteristics of the town (**Frazier, 1997:187**). Thus sustainable development issues can be addressed in different levels of activities, including scale of international, national, regional, provincial, regional, local (municipal), locations, units, neighborhood, site and architectural scale. Compared with the definitions and concepts of sustainable development has ever offered at the international, national, regional and city levels, it can be said that the concept of sustainable development at the neighborhood scale is not yet clear certainty and its dimensions particularly in the country has not been seriously investigated and analyzed (**azizi, 2006).** The neighborhoods of the city are places and areas in which dimension of things in it are quite evident, for example, changes in household structure and changes in the generation, increase or decrease transportation and movement, the sensitivity of environmental issues such as open spaces, destruction of natural environments and increasing consumption of resources are some features that can be felt in their effect on the neighborhood scale. So it can be said that urban sustainable development is the most important strategy for improving in cities is sustainable development in urban areas but the current plan will not be possible to achieve this goal and it is necessary to review existing plans and planning. One of the major measures on these lines is to determinate and assess the sustainable development factors in urban areas. It is the aim of the present study.

Study area:

Mashhad city is the capital of Khorasan Razavi province and is the country's second largest city also is located in the northeastern province of Khorasan. This city is located at 36 degrees and 17 minutes of north latitude and 59 degrees 36 minutes of east longitude than Greenwich (**Rezvani, 2005: 27**). Mashhad city includes twelve regions. The population is approximately 2,815,541 people according to 2011 census. The population of the district is about 30,000 people. As one of the nation's metropolitan population with growing trend is rising and parallel to the increase in population, the city has had skewed distribution of urban facilities and services in various areas of the city. This shows the necessity of assessing the sustainability of the areas and smaller units such as neighborhoods. It has also been the aim of the present study.
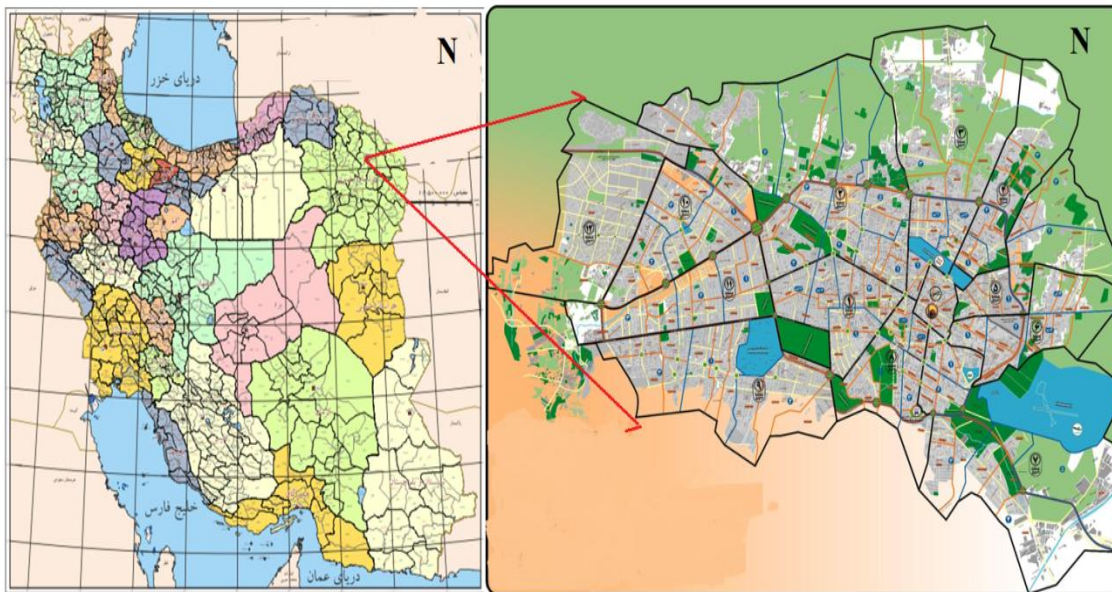
Case study: Mashhad city

Methodology:

The research method is descriptive – analytical and is based on the process of Combining Methods. In order to evaluate urban sustainable development indicators in the study area, at first the necessary criteria were extracted from various sources. Based on this study, for implementing the methodology using identified criteria a questionnaire designed and were distributed among 20 experts, scholars and civic leaders who knew the study area by a stratified random sampling method. The proposed criteria weight is calculated based on the AHP method. Functional structure model used is as follows:

Functional structure of the model used in this study

In order to assess the weight of indicators in the present study (From the perspective of experts) has been used of the fuzzy AHP model. The first step in this model is transformed weights obtained into fuzzy numbers that in the present study Fuzzy numbers used in this model is the triangular fuzzy numbers will

be as M = (m, α, β). Such a set of geometric space in a fuzzy environment is shown in Figure 3 (**Ataie, 2011:110-120).**
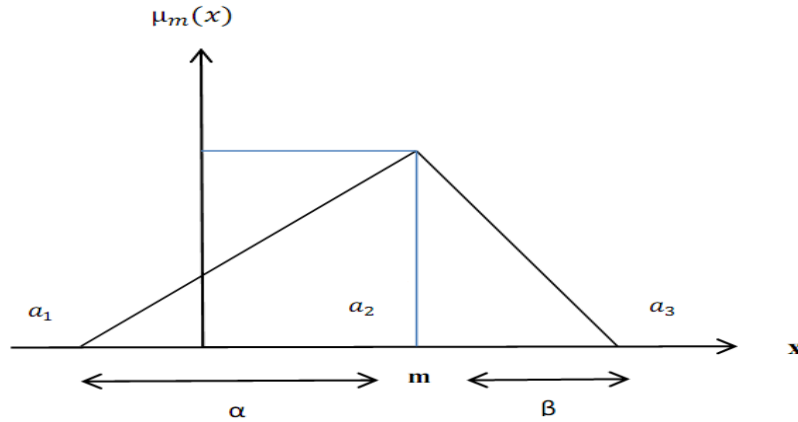

Figure 3: Membership function of the triangular fuzzy numbers.

Mathematically, the membership function of the triangular fuzzy numbers will be as follows:

$$\begin{cases} 1 - \dfrac{m - x}{\alpha}, & m - \alpha \leq x \leq m \\ 1 - \dfrac{x - m}{\beta}, & m \leq x \leq m + \beta \\ 0 \quad \text{در غير اينصورت} \end{cases}$$

The third phase will consist of paired comparison matrix using triangular fuzzy numbers in the present study are accomplished.

$$\tilde{A} = \begin{bmatrix} \tilde{x}_{11} \tilde{x}_{12} & ... & \tilde{x}_{1n} \\ \tilde{x}_{21} \tilde{x}_{22} & ... & \tilde{x}_{2n} \\ ... & ... & ... & ... \\ \tilde{x}_{m1} \tilde{x}_{m2} & ... & \tilde{x}_{mn} \end{bmatrix}$$

Fourth Stage is Si calculated by the following equations:

$$S_i = \sum_{i=1}^{m} M_{gi}^i \otimes \left[\sum_{i=1}^{n} \sum_{i=1}^{m} M_{gi}^i \right]^{-1}$$

$$\sum_{i=1}^{n} \sum_{i=1}^{m} M_{gi}^i = \left(\sum_{i=1}^{n} l_i , \sum_{i=1}^{n} m_i , \sum_{i=1}^{n} u_i \right)$$

$$\left[\sum_{i=1}^{n}\sum_{i=1}^{m} M_{gi}^{i}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} l_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} u_i}\right)$$

In these relations "i" is row number and the "C" is column number.

Step Five: it would be calculated large degree of S_is for all parameters in which the large degree of two fuzzy number of $S_1 = (l_1, m_1, u_1)$ and $S_1 = (l_2, m_2, u_2)$ can be defined as:

$$\begin{cases} 1 & \text{اگر} m_1 \geq m_2 \\ 0 \text{اگر} u_2 \geq l_1 \\ \dfrac{l_2 - u_1}{(m_1 - u_1) - (m_2 - l_2)} \text{در غیر اینصورت} \end{cases}$$

Step six. Calculate the indicators weight in the paired comparison matrix. Therefore, the following equation is used:

$$d'(A_i) = Min\, V(S_i \leq S_k) \quad k = 1,2,\ldots,n$$

Thus, not normalized weight vector for the indicators under study will be as follows:

$$W'(d'(A_1), d(A_2), \ldots, d(A_n))^T$$

Calculating the final weight vector is the final stage in this model.

$$W = (d(A_1), d(A_2), \ldots, d(A_n))$$

Findings

For the analysis of indicators and variables related to neighborhood sustainability, initially, Paired comparisons questionnaires were given to experts and were asked them to determine Weight and importance of overall and subsidiary goals in form of paired comparison for the studied neighborhood based on Satty range from 1 to 9. The result of this step is the initial matrix of paired comparisons.

It should be noted that the matrix about the sub-criteria for each criterion, was made for the entire the decision making team. In continuance, fuzzy paired comparison matrix was organized. To do this and to determine triangular fuzzy numbers, minimum polls were considered as first component (l_i), mean polls as second component (m_i) and maximum polls as third component.

After calculating the overall opinions of experts as the main criteria for the threefold factors, calculation S_i is done in several steps... at first the value of $\sum_{i=1}^{m} M_{gi}^{i}$ is computed for each row of the matrix.

At the end of this step the value of S_i is calculated for each row of paired comparison matrix as follows:

About sub-criteria or tributary indicators of the three main criteria of researches, the results of calculations are as follows: (Table: 1).

Table 1: calculate the value of S_i for sub-criteria of research

Cooperation of dwellers and urban management in making security	Syptom	S_i	Deal of Fuzzy		
Rate of social contribution in developed neighborhood	C1	S_1	(0.209,	0.297,	0.328)
Membership in clubs and social associations	C2	S_2	(0.245,	0.250,	0.258)
Contribution with neighbors for developing neighborhood	C3	S_3	(0.108,	0.118,	0.138)
Contribution with management organizations for developing neighborhood	C4	S_4	(0.120,	0.136,	0.165)
The role of social cohesion and awareness in developing neighborhood	C5	S_5	(0.073,	0.110,	0.144)
Role of acceptance of the culture and social flexibility	C6	S_6	(0.225,	0.247,	0.310)
Rate of population with high education	C7	S_7	(0.020,	0.051,	0.098)
Families enjoying the urban facilities	C8	S_8	(0.132,	0.224,	0.172)
the resident's interest to the neighborhood	C9	S_9	(0.107,	0.368,	0.640)
Public spaces for social Interaction	C10	S_{10}	(0.021,	0.256,	0.019)
Access to public services	C11	S_{11}	(0.018,	0.125,	0.963)
Access to public transformation	C12	S_{12}	(0.123,	0.416,	0.759)
Economic beneficiary of commercial activities	C13	S_{13}	(0.022,	0.272,	0.539)
Land cost	C14	S_{14}	(0.109,	0.117,	0.224)
Amount of households income	C15	S_{15}	(0.205,	0.215,	0.228)
The population employed in the manufacturing sector	C16	S_{16}	(0.108,	0.468,	0.298)
The population employed in the agricultural sector	C17	S_{17}	(0.120,	0.236,	0.685)
The population employed in the scientific - technical sector	C18	S_{18}	(0.073,	0.190,	0.584)
Quality of compatible land use locating in the neighborhood	C19	S_{19}	(0.025,	0.107,	0.510)
Environmental aesthetics role on sustainability neighborhood	C20	S_{20}	(0.020,	0.151,	0.638)
Accesses and green field site quality of the neighborhood	C21	S_{21}	(0.232,	0.244,	0.172)
Waterfront Design Quality and Environmental Design on Sustainability Neighborhood	C22	S_{22}	(0.107,	0.368,	0.640)
Cleanliness and neatness conditions of spaces on sustainability neighborhood	C23	S_{23}	(0.021,	0.256,	0.019)
Quality of organizing local sewerage and waste	C24	S_{24}	(0.018,	0.125,	0.163)
Quality of residential land uses in terms of construction standards.	C25	S_{25}	(0.123,	0.126,	0.159)

Finally, based on the final formula normalized and not normalized weight of the main criteria sustainability of neighborhood is calculated. According to the final weights obtained from the viewpoint of the experts economic factors are more important in the sustainability of the neighborhood and social factors - cultural and ecological are next priorities. Similarly, the operation of the final weight calculation for sub criteria of each factor is also discussed.

Table 2: final weight of the sub- criteria on neighborhood sustainability

Cooperation of dwellers and urban management in making security	not normalized weight	normalized weight
Rate of social contribution in developed neighborhood	0.76	0.0366
Membership in clubs and social associations	0.79	0.037
Contribution with neighbors for developing neighborhood	0.64	0.0372
Contribution with management organizations for developing neighborhood	0.61	0.0377
The role of social cohesion and awareness in developing neighborhood	0.67	0.0374
Role of acceptance of the culture and social flexibility	0.71	0.0371
Rate of population with high education	0.45	0.0379
Families enjoying the urban facilities	0.63	0.0376
the resident's interest to the neighborhood	0.88	0.0419
Public spaces for social Interaction	0.69	0.038
Access to public services	0.7	0.0381
Access to public transformation	0.71	0.0413
Economic beneficiary of commercial activities	0.66	0.0412
Land cost	0.68	0.0416
Amount of households income	0.72	0.042
The population employed in the manufacturing sector	0.77	0.0422
The population employed in the agricultural sector	0.67	0.0405
The population employed in the scientific - technical sector	0.46	0.0367
Quality of compatible land use locating in the neighborhood	0.66	0.0362
Environmental aesthetics role on sustainability neighborhood	0.7	0.036
Accesses and green field site quality of the neighborhood	0.62	0.036
Waterfront Design Quality and Environmental Design on Sustainability Neighborhood	0.69	0.0361
Cleanliness and neatness conditions of spaces on sustainability neighborhood	0.55	0.0363
Quality of organizing local sewerage and waste	0.59	0.0364
Quality of residential land uses in terms of construction standards.	0.64	0.0359

Compute the final weights for sub-criteria research shows that the sub-criteria of economic factors has more weight than the other criteria and represents the views of experts in which these criteria are prioritized on sustainability neighborhood.

Results

Urban neighborhoods as the smallest unit of spatial organization play an important role in urban sustainability, so that the formation of identity, community, local economy, safety, environment and physical development and social relations are associated with the sustainability of urban neighborhoods. In recent decades by dramatic changes in the spatial structure of urban areas has reduced the role of political, social, economic and environmental pollution and has had shortcomings such as environmental pollution, unemployment, poverty, marginalization, poor housing, social - psychological and cultural problems especially wasting material and spiritual capitals. Today, in order to solve the problems of urbanization, local community development approach with an emphasis on urban sustainability has found a special place in urban management. Today, attention to urban sustainability indices in spatial - Physical development plans of cities is much important. In recent decades, Mashhad city as one of the metropolitan has been increasing growth. This type of development is not commensurate with the urban sustainability factors and currently, in most tissues especially in new fabrics is facing to a major failure of equal access to urban facilities. Therefore, the study of access to urban facilities and services is one of the important indicators of cities sustainable development. Fundamental studies to identify constraints, deficiencies also proper planning in this regard can make a better future for equitable access to opportunities in the urban areas of the city. In this regard, the results based on multiple criteria decision making analysis techniques in evaluating and measuring sustainability indicators for development of vali-asr neighborhood suggests: the main priority for sustainable development neighborhood is emphasis on economic indicators. Also sub-criteria evaluation of research has shown that the following parameters are the main priorities of the experts for sustainable development of vali- asr neighborhood in Mashhad city: Families enjoying the urban facilities with a score of 0.88 and 0.71 points of access to public services, as well as the economic value of land and household income with a score of 0.72 and 0.71.

References:

1. Amin biddokht. A, measurement of the cities developed in Semnan province, journal of Training and development Geography, education ministry press, (2006)

2. Rezvani. M, Measurement and analysis of rural development in Sanandaj city using GIS, journal of geography and development, Num 3, (2004)

3. Ataie. M, Fuzzy multi-criteria decision –making, Shahrood University of technology Press,(2011)

4. Hosseini. M, Comparison of the degree of rural areas development using Taxonomy methods, Jahad journal, Agricultural ministry, Num 184-185, (1989)

5. Baier. G, Pioneers of development, translate by Hedayati and Yaseri, Samt press, Tehran, 1989

6. Shahbazi. A, The meaning of dissemination of appropriate technology in the development flow, Scientific journal, (1990)

7. Azimi. H, Underdevelopment circuits in economy of Iran, Ney press, Tehran, (2003)

8. Beyranvandzade. M, Alizade. S, SorkhKamal. K, Assessment development in northern Khorasan province, Journal of geographical space, Azad islamic university of Ahar, (2011)

9. Salari. F, Alizadeh. S. Beyranvandzadeh. M, Study on sustainable urban development in the city of Zabol with emphasis on the approach of (CDS), National conference of sustainable architecture and urban development, Bookan, (2013)

10. Rahnamaie. M, pour Mousavi. S, the examination of instability of security in metropolitan Tehran based on sustainable development factors, Journal of geographical researches, Num 57, (2006)

11. Bakhtiari. S, A comparative analysis of the industrial development of different provinces in the country, Commercial Bulletin, (2002)

12. Ahmadi Atefe, et al, (2013), Optimal Localization of Green Spaces by Using Fuzzy Logic(Case Study: Region 2 of Dezful Municipality), International Journal of Emerging in Engineering and Development, Issuse 3, Vo.1.

13. Alizadeh kamran, . Kh., Shahabi, H.(2009), Necessities of GIS Usage in urban water   management At The Time of Natural Accidents (Case Study: Saghez City), International Conference on Geographic, Paris, France.

14. Richard, peiser(2002), Decomposing urban Sprawl. Town planning Review, Liverpool. VOL, 172.No3.

15. Shade,N(2004). The evolution of the Sprawl Debate in the United state. Hastings Journal of Environmental Law and Policy,5,137.

16. Listokin ,D(2002). A National Perspective on land Use policy alternatives and Consequences, Prepared for the farm foundation.

17. J.A.G. jaeger et al. Suitability criteria for measures of urban sprawl Ecological indicators 10 (2010).

18. Bullard, R.D.(2003) Atlanta Megasprawd. Forum for Applied Research and Public policy 14.

19. Dawkins, C.J. and A.C. Nelson(2002). Urban containment policies and housing prices: an international comparison with implications for future research, land use policy, VOL.9.

20. Srivastava, S.K., and Gupta, R.D., (2003), monitoring of changes in landuse/landcover using multi-sensor satellite date, map india conference 2003.

21. Malczewski , J.,2004, GIS –based land-use suitability analysis: a critical overview, progress in planning 62.

22. Malczewski, J.(1999), GIS AND multi criteria Decision Analysis, John Wiley and so

23. Ghodsipoor, S. H.(2003), Analytical hierarchy process(AHP). Tehran: Amir Kabir university