Assessing and Analyzing Criteria for Housing Sustainable Development in the Metropolitan Mashhad

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ABSTRACT

The current paper is of descriptive-analytical type, aiming at assessing housing sustainable development indexes in 13 districts of Mashhad City. The present research is based on field survey where 59 sustainable development indexes regarding housing are investigated in terms of four social, economical, physical and biological criteria. To analyze data, planning quantitative models such as TOPSIS, Coefficient of Dispersion and Cluster Analysis are used. Findings reveal that in social indexes, district 9 occupies the highest rank and district 4 the lowest on; in economical indexes, district 5 is the highest and district 13 the lowest; in physical indexes, district 11 is on the top and district 7 on the bottom; in biological indexes, district 12 enjoys the highest rank and district 6 suffers the lowest rank. TOPSIS average in the composite index is 0.2526 where district 11 is in the best condition and district 9 in the worst one. Totally speaking, 15.4% of Mashhad districts are located in beyond-upper-development level, 38.4% in upper-development level, 30.8% in middle-development level and 15.4% in lower-development level in terms of housing. In sum, dispersion coefficient of 0.7455 shows so much inequality among districts.
KEYWORDS: Sustainable Development Indexes, Housing, TOPSIS Model, Urban Districts, Mashhad City.

1. INTRODUCTION

As a smallest component of settlements, housing has been developed from humans' most important needs and has created geographical phenomena in every region [17]. Today, housing and its related issues have become a global problem and different countries' planners and policy makers are struggling to solve the problems concerning the issue [3].

It may be asserted that housing problem is globally widespread. However, in developing countries, this problem has become critical because of population and urbanization rapid growth, internal immigrations, lack of sufficient financial resources, problems regarding land supply, construction materials supply and lack of specialized human forces and, most importantly, lack of proper policy and planning concerning land and housing [12]. As one of the developing countries, Iran is not an exception in this regard.

Housing is one of the problems human being has always been dealing with and trying to find appropriate and logical solution for it. The problem has troubled countries today proportionate with their condition. Whereas housing is considered next to social welfare and housing development is based on quality improvement in developed countries, it is a primary need and its supply is equivalent to food and clothes supply in Iran [13]. In other words, housing planning in Iran is mostly quantitative and planning toward sustainable development has not yet found its real position.

Most of scholars of urban studies believe that the most important factor effective on people's satisfaction with settlement in one region and their life style is housing and its ecological condition and living in unpleasant housing conditions (whether qualitatively or quantitatively) puts settlers' physical and mental health in danger [15] .

Also, housing quantity and quality is among important concerns of related planners and policy makers in such a way that in the trend of changing housing and urban planning indexes, Iranian government has considered social justice and sustainable development in housing sector as well as construction quality and settlement welfare and health assurance among qualitative goals of housing sector development [14] .

Sustainable housing is economically endurable, socially acceptable, technically feasible and environmentally compatible [4]. Also, in defining sustainable housing, Maliene emphasizes comfort and welfare, beautiful design, sustainable sewerage management, ecological construction materials as well as cooling and heating system[8].

However, investigation of important topic of sustainable development, as backbone of contemporary urban planning and among vital needs of developing countries; housing issue, among concerns of Global and Iranian metropolitans; and combination of those two topics (sustainable development and housing) with improvement of sustainability level in housing sector become important because most of the researches carried out in housing sector have been concentrated on housing quantitative and economical indexes, housing supply for citizens through developing towns and new towns, housing supply for slum dwellers and housing policy while few researches have

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performed on housing sustainable development. Therefore, paying attention to this matter is a vital necessity especially in such cities as Mashhad where large amount of population, whether settlers or pilgrims, is living.

As the second top city in Iran, Mashhad is nationally and globally recognized regarding its historical, social, cultural, economical and ecological role. However, regarding increasing growth of population in this city, the sustainability of housings and settlement areas is even more under question concerning urban sustainable development.

However, regarding increasing growth of population in the city, the sustainability of housings in neighborhoods and districts has more and more been questioned with respect to urban sustainable development and there have been some serious problems regarding housing for current and, may be, future generations. Considering these conditions, while being aware of housing and its related infrastructures current condition, people in charge of urban affairs are obliged to determine strengths and weaknesses of each district in Mashhad and pave the way for achieving housing sustainable development indexes.

The study presented here (moving toward this hypothesis that Mashhad city's districts are not homogeneous respecting enjoyment of housing sustainable development indexes) is aimed at analyze and assess different districts of Mashhad city in terms of enjoyment of social, economical, ecological an physical indexes.

2. RESEARCH METHODS AND MATERIALS

2.1 Research Methodology

The current research is of descriptive-analytical type and it mostly consists of a survey done through field studies including observation, questionnaire and interview. Research population consists of all households residing in 13 districts of Mashhad, that is, 727963 households in accordance with 1390 (2011) Iranian Consensus. Sample size was determined by using Cochran sampling formula. Sample size was estimated as 735 households for all 13 districts.

Sampling framework was family. Sample families were chosen through multilevel clustering in such a way that firstly, 13 districts of Mashhad were considered as 13 clusters; then, some blocks were randomly selected in every cluster and some families were selected through randomly systematic method in each block and they were interviewed. In fact, sampling method in districts was carried out through quota sampling.

2.2 Introduction of Research Area

Mashhad City is located in Northwestern Iran and in Khorasan Razavi Province. Its population is 27662580 [5] . As one of the old and historical regions on the Great Khorasan Province and Old Toos, Mashhad has become the country's second metropolitan in recent decades changes. In addition to historical and religious identity, this city has many various functions in national, regional and international levels.

The metropolitan Mashhad has historical-political, economic-administrative and cultural-intellectual centrality and religious function as well as border, beyond-country situation. It accepts 10-15 millions pilgrims and tourists annually in such a way that it bears the title of the second religious city of Islam world and the second national metropolitan in terms of population [9].

The city has 13 urban districts, totally 29000 hectares. Urban population density is approximately 119.4 people per square meter [9].
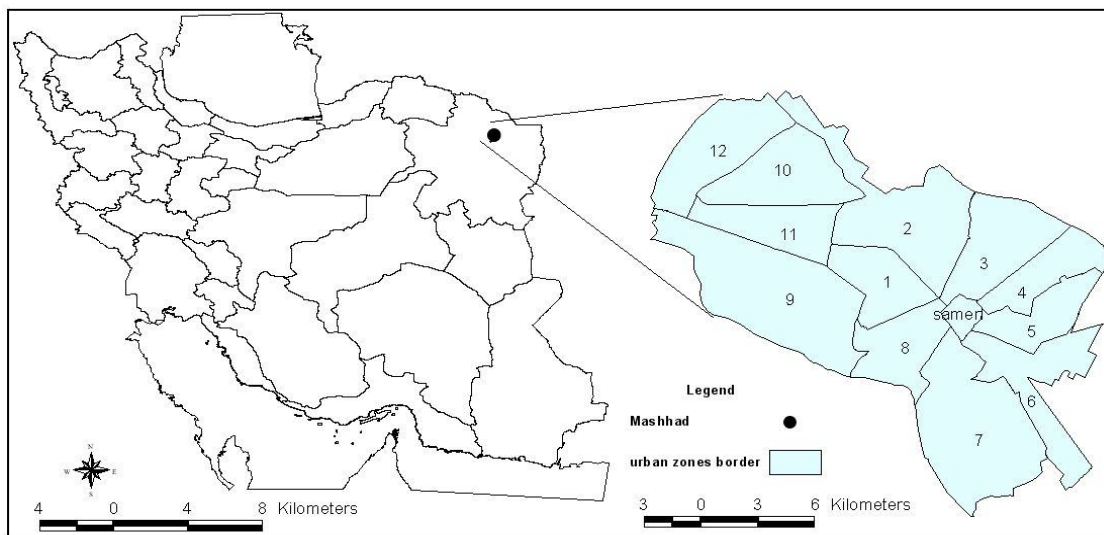

Figure 1. The location of Mashhad in Iran and Khorasan Razavi Province and the situation of each district in Mashhad.

3.2 Research Indexes and Criteria

In this research, research indexes have been investigated under four social, economical, physical and ecological criteria, as follows:

- Social Criterion consisting of 28 indexes

Quality of access to shopping centers, bakeries, fire stations, banks, ATM kiosks, post offices, medical centers, elementary and secondary schools, nurseries and pre-school centers, public transportation, subway stations, sport facilities, internet centers and internet cafes, the condition of settles' participation in civic affairs, heating and cooling, kitchen, bathroom facilities in housings, the quality of drinking water, condition of neighborhoods regarding immoral behaviors, rubbery, density of people per room, density of people per house, quantity of households per houses, quantity of rooms per houses, quantity of households per rooms, settlement history in neighborhoods, the amount of satisfaction with neighborhoods, the condition of car crashes in neighborhoods, the condition of one housing's domination to the others.

-Physical Criterion consisting of 16 indexes:

Durability of construction materials used in housing, housing lifetime, type of construction materials used in housing, building frame structure type, building's architectural quality, building's lighting condition, humidity condition in the walls of building, building durability condition with respect to earthquake, building quality, building's front view quality, asphalt condition of neighborhood pathways, lighting condition of neighborhood passages, condition of neighborhood furniture, visual quality of buildings and landscapes in neighborhoods, flooded condition of passages while raining, condition of neighborhood passages for emergency traffic.

Economical criterion consisting of 8 indexes:

Evaluation of housing's infrastructure regarding household members (housing sufficiency), the proportion of housing costs to household income, the proportion of rent costs to household income, the proportion of maintenance costs to household income, housing ownership condition, average price of 1 square meter housing infrastructure in each district, household income amount, building infrastructure area.

Ecological Criterion consisting of 8 indexes

Waste collection condition in neighborhoods, neighborhoods condition regarding sewerage system's unpleasant smell, air pollution condition, sound pollution condition, incompatible occupations condition in neighborhoods, sewerage removal method, condition of harmful insects in neighborhoods' water canals, quality of access to green spaces and parks in neighborhoods.

4.2 Data Analysis Model

To analyze and rank data, TOPSIS model was used. The procedure is as follows:

TOPSIS model is one of the multi-criteria decision making models, which was introduced by Hwang and Yoon in 1981[11]. This model is one of the multiple attribute decision making methods, belonging to compensatory models (those models important in exchanging among indexes) of compromising-subgroup (in these subgroup models, that option is preferable which is nearest to ideal solution, that is, chosen alternative should have the shortest distance from the positive ideal solution and the longest distance from the negative ideal solution). General structure of the model is as follows [2]:

- Creating decision matrix: this matrix consists of n index and m city.
- Giving weight to indexes: This was done through Anthrop Model whose structure is as follows [1] :

$$n_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}}$$

In the next step, entropy value of every index is calculated:

$$\sum_j = -k \sum_{i=1}^{m} [n_{ij} \ln(n_{ij})] \Rightarrow k = \frac{1}{\ln(m)}$$

Entropy value of every index is between 0 and 1. After calculating values, deviance degree of every index is calculated through following formula:

$$d_j = 1 - E_j$$

Every index's relevant weight is calculated by following equation:

$$W_j = \frac{d_j}{\sum_{i=1}^{n} d_j}$$

- Creating unscaled (normalized) matrix: In this step, existent decision matrix is transformed into "unscaled" matrix by using following formula:

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=0}^{n} x_{ij}^2}}$$

- Weighted unscaled matrix: This matrix is obtained by multiplying unscaled matrix to weight matrix of every index.

- Finding positive and negative ideals: In this step: highest value of every index is determined as positive ideal (A^+) and lowest value as negative ideal (A^-).

- Calculating the distance between every alternative and ideals: This step is done through Euclidian distance, obtained from previous step, of every alternative from positive and negative ideals related to each index:

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^+)^2} \longrightarrow i=1, 2, \dots m$$

$$D_i^- = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^-)^2} \longrightarrow i=1,2 \dots m$$

- Calculating similarity of A_i to ideal solution: this similarity is defined as follows:

$$i=1. 2,\dots m \ , \ 0 < CL_i \le 1 \quad CL_i = \frac{D_i^-}{(D_i^- + D_i^+)} \rightarrow$$

- Ranking alternatives (cities) according to CL_i

3. Findings

To assess Mashhad districts in terms of housing sustainable development indexes, it is attempted at analyzing spatial structure of 13 districts of the metropolitan Mashhad with respect to 4 social, economical, physical and ecological criteria using TOPSIS multi-criteria decision model.

Findings indicate that in social indexes, District 8 is obtained highest rank with 0.7821 point and District 4 lowest rank with 0.0521 point. This is because residents of District 8 has access to social services such as educational, medical and cultural centers as well as shopping centers whereas District 4 enjoys less social services and facilities because of its marginal situation and presence of villages attached to the city and more distance from city center. Dispersion coefficient of 0.5385 shows relative dispersion and difference among social indexes of Mashhad districts.

In economic indexes, District 9 is obtained highest rank with 0.6890 point and District 13 lowest rank with 0.0823 point. Highness of TOPSIS point in District 9 is because of High housing ownership, housing infrastructure, low building maintenance costs because of newness of buildings and high household incomes. Also, lowness of TOPSIS point in District 13 is because of old buildings, few infrastructures, high costs of building maintenance and high rental costs in city center.

In physical indexes, District 11 is obtained highest rank with 0.8823 point and District 7 lowest rank with 0.0329 point. District 11 gets high points because of buildings' short lifetime, pleasant visual quality, buildings' architectural quality, structural durability of buildings and proper wide passages. Furthermore, District 7 obtains low point because it does not have privileges mentioned for District 11.

In ecological indexes, District 12 is obtained highest rank with 0.9021 point and District 6 lowest rank with 0.0749 point. Low point in District 6 is because of sound pollution of airport, incompatible occupations including workshops and garages, and pollution of passages and sewerage system.

Table 1. Ranking Mashhad Districts in terms of housing sustainable development indexes

Composite Indexes		Ecological Indexes		Physical Indexes		Economical Indexes		Social Indexes		Indexes
Rank	TOPSIS Value	Rank	TOPSIS Value	Rank	TOPSIS Value	Rank	TOPSIS Value	Rank	TOPSIS Value	District
4	0/2829	5	0/5983	6	0/4324	4	0/5823	2	0/7143	1
6	0/2568	6	0/4382	9	0/2030	6	0/4374	8	0/3921	2
10	0/1292	11	0/1422	7	0/2333	7	0/4128	9	0/3544	3
12	0/0872	7	0/4122	8	0/2189	13	0/0823	13	0/0521	4
13	0/0264	12	0/0921	11	0/1102	12	0/1024	12	0/1381	5
8	0/1677	13	0/0749	12	0/0988	9	0/2428	10	0/2428	6
11	0/1054	9	0/2320	13	0/0329	10	0/2329	11	0/1931	7
3	0/3182	8	0/4088	5	0/5783	8	0/4029	1	0/7821	8
2	0/5251	4	0/6928	3	0/6324	1	0/6890	5	0/4928	9
5	0/2701	3	0/7425	4	0/6093	3	0/6221	3	0/6879	10
1	0/7126	2	0/8625	1	0/8823	2	0/5987	4	0/6211	11
7	0/2528	1	0/9021	2	0/7582	5	0/1891	7	0/4278	12
9	0/1487	10	0/2224	10	0/1921	11	0/1891	6	0/4803	(samen)13
0/2525		0/4493		0/3832		0/4028		0/4267		Mean
0/1881		0/2914		0/2798		0/2145		0/2299		S.D
0/7455		0/6487		0/7305		0/5322		0/5385		C.V

Source: Authors' calculations

Totally speaking, Table 1 shows that dispersion coefficient of each index and composite index is so high. Furthermore, in composite index, 0.7455 is obtained, showing heterogeneity and divergence among urban districts in terms of studied indexes. Therefore, regarding TOPSIS point and inequality coefficient, there is inequality among Mashhad Districts with respect to those indexes. According to these, research hypothesis is confirmed.
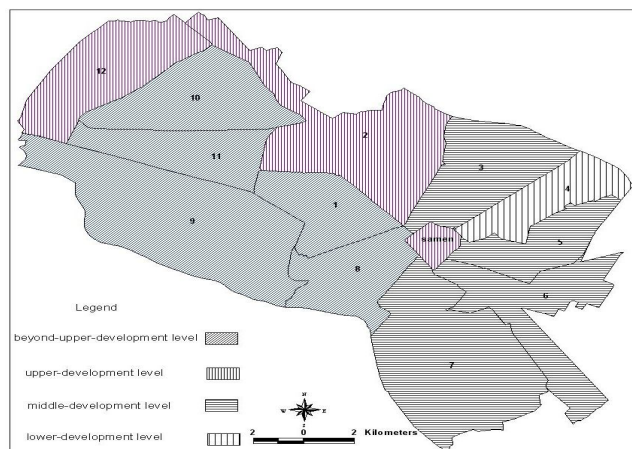 Therefore, grouping Mashhad Districts are recommended in terms of enjoyment of Social, Economical, Physical and Ecological indexes of housing sustainable development (Table 2 & Figure 2-5).

To analyze studied indexes more effectively, considering TOPSIS point of composite indexes as benchmark, 13 districts are categorized to 3 heterogeneous groups (Table 2 & Figure 2). Also, according to Table 2, districts' categorization is drawn. Furthermore, using cluster analysis, 13 districts are clustered in 3 heterogeneous groups.

Table 2. Grouping Mashhad Districts in terms of enjoyment of Social, Economical, Physical and Ecological indexes of housing sustainable development.

Development Degree	Homogeneous District			
	Social Indexes	Economical Indexes	Physical Indexes	Ecological Indexes
Beyond upper	1-8-9-10-11	1-9-10-11-12	8-9-10-11-12	1-9-10-11-12
Upper	2-12-13	2-3-8	1	2-8
Middle	3-5-6-7	4-6-7-13	2-3-4-5-13	3-7-13
Lower	4	5	6-7	4-5-6

Source: Authors' calculations

Figure 2. Ranking Mashhad Districts in terms of enjoyment of Social Indexes of housing sustainable development.
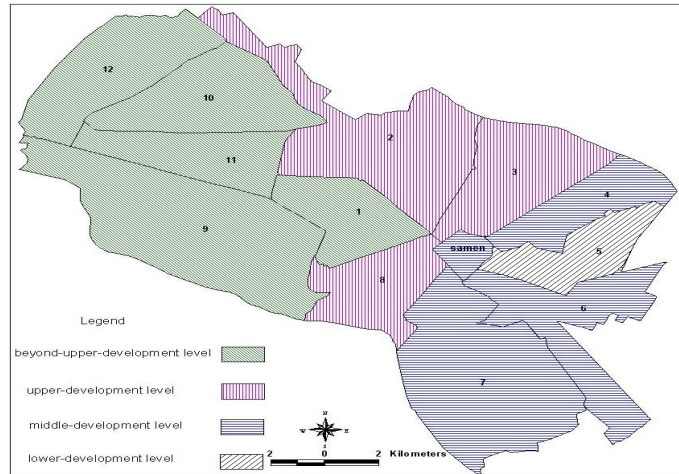
Figure 3. Ranking Mashhad Districts in terms of enjoyment of Economical Indexes of housing sustainable development.
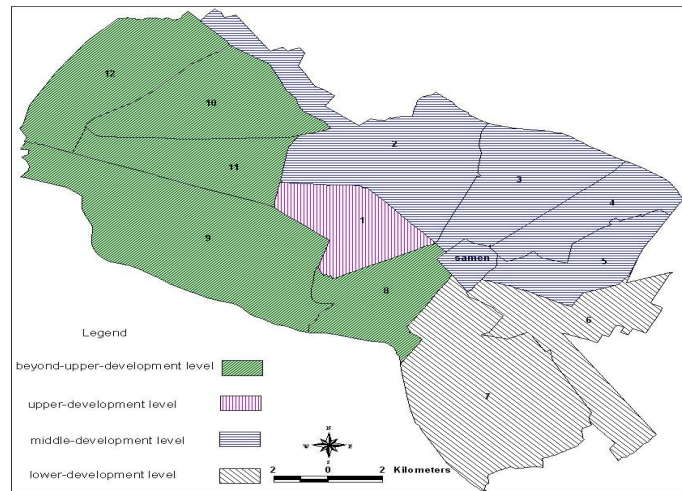

Figure 4. Ranking Mashhad Districts in terms of enjoyment of Physical Indexes of housing sustainable development.
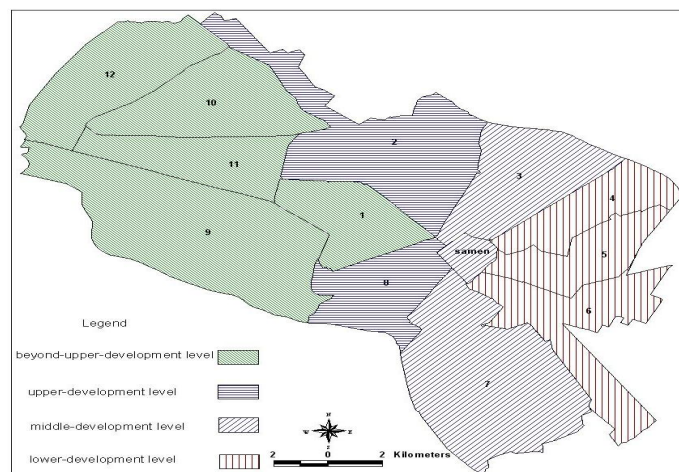

Figure 5. Ranking Mashhad Districts in terms of enjoyment of Ecological Indexes of housing sustainable development.

Table 3. Grouping Mashhad Districts in terms of enjoyment of composite indexes of housing sustainable development.

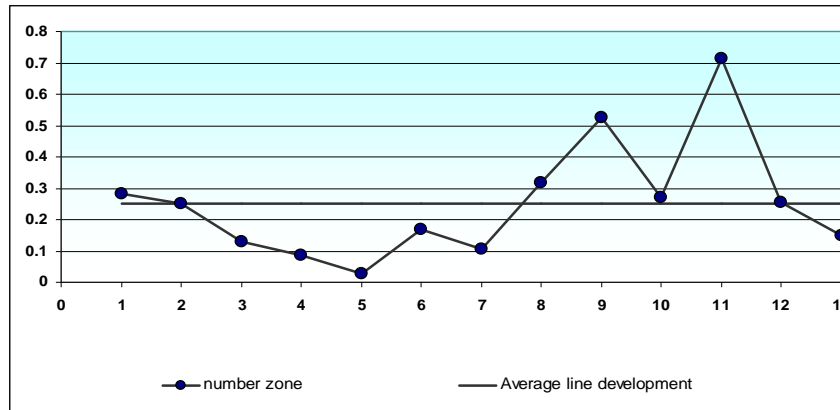| Group	Categories Distance	Development Degree	Homogeneous District	Quantity	Percentag
1	+0.45	Beyond upper	9-11	2	15.4
2	0.26-0.44	Upper	12-2-10-1-8	5	38.4
3	0.25-0.64	Middle	7-3-13-6	4	30.8
4	-0.063	Lower	5-4	2	15.4

Source: Authors' calculations

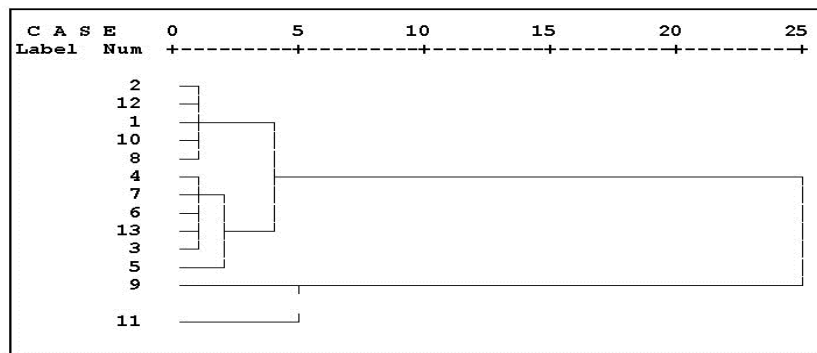Figure 6. Condition of every district in terms of mean TOPSIS point

Figure 7. Clustering Mashhad Districts in terms of enjoyment of composite indexes of housing sustainable development.
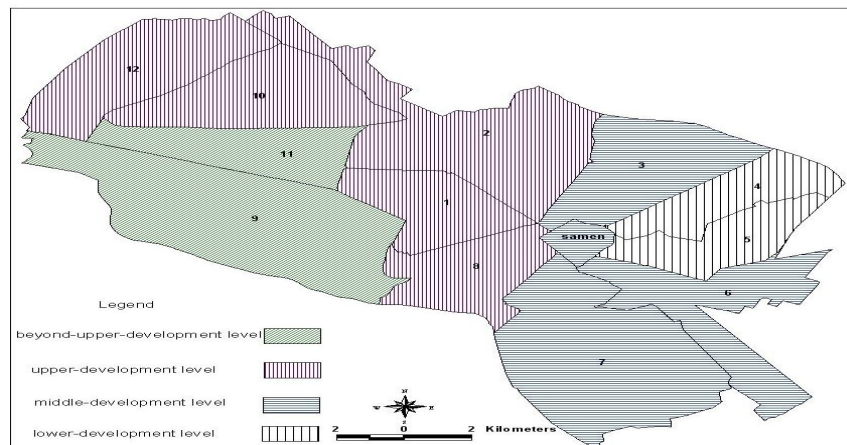

Figure 8. Ranking Mashhad Districts in terms of enjoyment of composite indexes of housing sustainable development.

4. Concluding Remarks

Following points are concluded according to research findings:

- Findings indicate that there is inequality among 13 districts of Mashhad in terms of enjoyment of housing sustainable development indexes.

- According to Table 1, highest amount of inequality is among physical indexes and lowest amount of inequality is among economical indexes. In sum, composite index shows so high inequality among districts with dispersion coefficient of 0.7455, revealing improper distribution of services among districts.

- Noting that highest amount of TOPSIS point is 1, according to findings of studied composite indexes, mean TOPSIS point, i.e., 0.2525 is low and shows so high distance of every district from ideal highest level. District 5 with 0.0264 is on the bottom with so much distance from ideal and even mean level whereas District 11 with 0.7126 is on the top with little distance from ideal level.

- 15.4% of Mashhad districts are located in beyond-upper-development level, 38.4% in upper-development level, 30.8% in middle-development level and 15.4% in lower-development level in terms of housing.

- Concerning heterogeneous clusters of districts in terms of studied indexes, to achieve to housing sustainable development indexes, Districts 3, 4, 5, 6, 7, 13, covering 46.1% of urban area and standing in the level lower than composite index's mean TOPSIS point, should be a priority to planning and social justice.

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