

Classification of Urban Areas Sustainability Using AHP Model and Multi Criteria Decision Making (Case Study: The City of Rasht)

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Keywords	Abstract
Ranking Stability, Sustainable development, Analytic hierarchy process, TOPSIS.	Along with the development and increase of population in big cities, manifestation of various complex economic-social problems within cities, and the entrance of large cities of third world countries into the global economic system, city planning has come to have new dimensions. To identify development or non-development of urban regions from a stability point of view, we need to study regional inequality patterns and differences between urban areas and regions. This paper follows the aim of ranking urban areas and regions of the city of Rasht from a stability perspective. The descriptive-analytical methodology is used in this paper and a few models are applied. To rank the stability of the 3 regions and 8 areas of Rasht, from the prospect of 36 defined indicators in social, economic, ecological-physical and managerial-institutional dimensions, the status quo was analyzed using a survey, and the obtained findings were concluded with SPSS software and to weigh the indicators an AHP method was applied. Finally, the ranking of regions and areas was carried out by TOPSIS method. The final result of the studies shows that among the 8 areas of Rasht, areas in the 1st region stand on top of social class level with a priority coefficient of 0.865, and the areas in the 2nd and the 3rd regions place in next ranks with 0.316 and 0.204 priority coefficients, respectively, which demonstrate that based on social class levels, there is a significant difference between areas in the 1st, the 2nd and the 3rd regions.

1. Introduction

Human lives in a world that is not only overcome by urbanism but it is also experiencing rapid growth of poverty and unprecedented inequality. Residential areas are formed based on various natural, social, historical and economic factors, while in recent decades, the process of social, economic and cultural revolution on one hand, and the various geographical background, on the other, has caused the formation of an unbalanced spatial system at urban areas level in Iran. So, creation and reinforcement of a hierarchical order for residential areas in order to organize urban spaces is always considered in most civil enterprises of this country. So far, although there have been attempts to propose a set of indicators based on conventional views (about development), these attempts suffer structural and operational weaknesses, because there has been no attention paid to the links and interactive effects in the process of

choosing indicators and it also lacks logical and structural order in the design and measurement of the indicator system. Also, since executing these programs was merely based on the physical dimensions, and the economic and social dimensions were neglected, no significant success has been achieved. Today, developing countries, need planning and identifying their resources in order to reinforce economic and social infrastructure, get rid of dependency and remove the current unbalanced status.

Surely, in development planning for Iran, identifying the position of different regions is one of the most important factors to achieve sustainable development. Access to facilities and correct ranking of regions are matters which urban authorities should contemplate as most important in order to obtain targets such as comfort, beauty and in general, urban stability. So ranking needs careful studies and investigations. If we rank regions, spatial, social, cultural and economic differences will be revealed. Unnecessary

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concentration of urban facilities and services in some particular regions, will disturb uniformity of the city. Because affluent regions naturally have a great potential to grow, and so can gain great economic, social and service levels, whereas other regions will be dependent and so will be dominated by them. This can create a social, economic and cultural gap in urbanization systems. Differences in these aspects can not only cause a regional inequality but it also deteriorates it. Since sustainable urban development has vast, complicated aspects, dependence on one single factor seems to be unwise; So the objective of the present study is to identify the level of urban development using the sustainable development approach considering social, economic, physical-ecological and managerial-institutional indicators. therefore, every urban region is analyzed in an integrated way in the process of expanding future activities and functions based on its level. Here, ranking of the hierarchical position of urban regions and areas based on the indicators of sustainable development is a combination of social, economic, ecological-physical, managerial-institutional dimensions. But, in spite of the importance of sustainable development and the unanimity of beliefs on its basic elements, the evaluation of the sustainability status in order to rank urban regions and areas faces serious challenges. Maybe, the existence of different views and theories is one of the reasons of this situation, but it seems that lack of clear and certain parameters to define sustainability status and the necessary tools for measurements seems to be a more acceptable reason. From a sustainable development point of view and its scientific dimensions, in order to create a balance among urban regions and achieve social equality, utilizing ranking techniques can help research and its functions dramatically, in cities. This paper aims to not only analyze the status quo in the city of Rasht and the historical background of its formation but also take action based on the dimensions of sustainable urban development and using decisive standard multi-indicator techniques based on indicators and stability variables therefore. In the present study, we tried to devise a framework of sustainable development indicators using multi-indicator decisive models such as AHP and Topsis to evaluate regions and areas of the city of Rasht based on these indicators.

2. Theoretical Basis

The context of sustainable development was first offered by Barbara Ward in the mid 1970 [1]. The meaning of stability in the 1970s was a logical reaction to environmental and developmental issues of the world, so that the fast development of civilization after world war II and the progress of the industries, decreased, the capacity of urban infrastructures and increased environmental wastes [2]. At the U.N. world conference on the environment and development (1987), in a report by Harlem Brundtland titled "our common future", sustainable development was defined as a process that can meet the current needs without exhausting the resources of future generations [3]. By holding "Earth" conference in Rio in 1992 in which the contribution of societies in improvement of the environment and sustainable urban development was stressed [4]. Sustainable development was seriously challenged across the world. Just like the context of sustainable development

that has been the subject of a lot of controversy, there has been no acceptable clear definition for urban stability even after "Habitat conference II" the stance of cities and neighborhoods toward sustainable development can simplify our policies and enterprises. The importance of consideration of city and neighborhood dimensions in making policies for sustainable urban development can seem even more necessary and more inevitable when we consider the different condition of different cities [5].

Sustainable urban development can be considered as the basis of renewal of economic, social, political, cultural and legal structures of which purpose is first the improvement of civilization process, urbanism, restoration of the urban environment, organizing urban economies and reinforcement of political, social and cultural dimensions of city life. Unusefulness of expansionism views which are based on the rapid increase of population and exhaustion of resources and have caused greater attention to equality between generations, levels of the consumption of the earth's resources and environmental considerations to increase [6].

Thus, analysis of the level of urban stability is necessary in order to achieving sustainable stability. In case ranking with a sustainable development stance is the final objective, there will be a need for tools and methods to evaluate the move toward stability in different dimensions (global, national and local) [7]. Stability evaluation is normally considered as a part of analysis process of the effects of different dimensions of sustainable development [8]. In other words, stability evaluation can be defined as a tool to identify and evaluate the possibility and differentiation of policies or measure economic, social and environmental effects [9]. Stability evaluation in developmental experience is used in two different fields. The first one indicates the analysis of developments in stability and the second reveals the effort to evaluate the stability of offered projects, plans, approaches or the codified laws before execution of them [10]. Stability evaluation is vastly influenced by a combination of measurement tools [11].

In the present situation, possessing an adequate collection of urban sustainable indicators to analyze this situation seems vital and strategic. Because many believe that "good stability information" is a great infrastructure to move toward urban sustainable development, in the future. Although there have been limited attempts in Iran, to propose a collection of indicators based on the common understanding (of development), these efforts seem to be structurally and operationally defective, below we introduce some of these:

First, They lack a cohesive collection of indicators in all dimensions of development; Second, They don't consider the links and interactive effects in the process of choosing an indicators; And third, They lack a logical and structural order in designing the indicator system and its measurement.

Although urban spaces have experienced many policies and attempts during the last decades, these efforts have not been effective, especially inhuman development dimensions, social security, institutional capabilities, local economic development and vital resources (water, soil, vegetation), due to the mentioned facts and issues, there is a necessity for urban spaces to be analyzed in an organized framework, with regards to the guidelines of sustainable development. Organized knowledge on one hand and permanent decision

making (wise, long-term and overall) on the other can help connect all aspects of urban life and the environment with the pleasant results of sustainable development. Therefore, in the modern conditions, the importance and necessity of sustainable development indicators is due to the fact that the most essential tool for observing the policies, plans is the effects and results of development and moving toward sustainable urban development [12]. Since choosing indicators without chose attention to the existing framework can cause irrelevant results to sustainable development, the selection of indicators in this study was based on the framework presented in sustainable development that covers its social, economic, managerial-institutional and ecological-physical dimensions.

3. Methodology

Research approach in this research is descriptive-analytical and its type is applied research. In this study, the criteria selection are based on the framework introduced in sustainable development, and are included various aspects of social, economic, managerial, institutional, ecological and physical. The purpose of this research is ranking of areas and

regions of Rasht city in terms of stability. So, due to the factors studied, the research approach is descriptive and analytical. Also, since the results of this study can be used to implement is an applied research as well. The population of the study is three regions of Rasht city that is called region 1, 2 and 3.

Indicators of research are economic, social, ecological, physical, managerial-institutional indicators. Narrative inquiry was conducted by visiting experts of sustainable development. Variables were weighted by using the AHP model in Expert choice software. In analysis of current situation of research area, we used the SPSS software. We used LIKERT scoring and TOPSIS model for ranking the variables and sub variables and triple regions (see Figure 1 for process of study). Examples of the combination of these two methodologies applied to engineering problems can be found in [13] and [14].

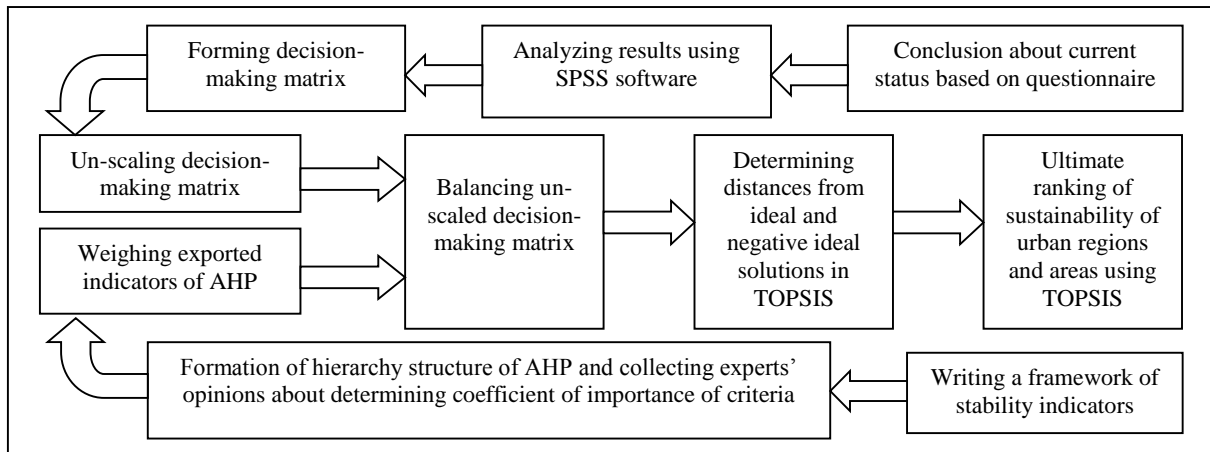


Figure 1. The process of study

4. Research Indicators

4.1. Social Dimension

From the social dimension of sustainable development, people's rights, democracy and existence is of importance which have been analyzed from social security, social solidarity, sense of belonging and social development viewpoints and attention to sense of place, identity and environmental safety can be above all other parameters.

4.2. Economic Dimension

From the economic dimension, components like equality, stability and economic prosperity have been the center of attention which evaluate the durance of urban economy and coordination between the different levels of occupations, conditions of residential areas and family finances with

parameters like the level of using government credit services, the percentage recreation and vacation expenses.

4.3. Ecological-Physical Dimension

From ecological-physical dimension, features like quality of place, access and spatial interaction and ecological quality have been analyzed with parameters like easy access to public services, urban vegetation and parks etc.

4.4. Managerial-Institutional Dimension

From managerial-institutional dimension, the role of urban institutions and urban administration is vital in passing and executing the laws, for this, dimensions and features contribution, reliability and accountability are applied (Table 1).

Table 1. Sources of indicators extraction

Dimensionsof Sustainable Development	Components	Confirming Researchers
Social	social security	Navabakhsh and Arjmand SiyahPoush [15]. Qafariand Omidi [16]. Salek [17]. Nourian [18]. Kazemian [19]. Siyamaki [20]. Urban Ecology Coalition [21]. Jozsa& Brown [22].
	social solidarity	Navabakhsh and Arjmand Siyah Poush [15]. Qafariand Omidi [16]. Rafian et al [23]. TavakoliNia and OstasiSisi [24]. BNIA [25]. Urban Ecology Coalition [21].
	sense of belonging	Qafariand Omidi [16]. Azizi [26]. Nourian [18]. Kazemian [19]. Urban Ecology Coalition [21].
	social development	Rafian et al [23]. Siyamaki [20]. Qafariand Omidi [16]. Navabakhsh and ArjmandSiyahPoush [15]. Urban Ecology Coalition [21]. Jozsa and Brown [22].
Economic	equality	Sabz Andish Payesh Consulting Engineers [12].
	stability	Sabz Andish Payesh Consulting Engineers [12].
	economic prosperity	Sabz Andish Payesh Consulting Engineers [12].
Ecological-Physical	quality of place	Sabz Andish Payesh Consulting Engineers [12].
	access and spatial interaction	Abdolahi [27]. SabzAndishPayesh Consulting Engineers [12].
	ecological quality	UN [28]. Mousakazemi [29].
Managerial-Institutional	contribution	UN [28]. SabzAndishPayesh Consulting Engineers [12].
	accountability	Abdolahi [27].
	legalism and accountability	Abdolahi [27].

5. AHP Conceptual Model for Analyzing Urban Sustainability

In analyzing any subject, there's a need for a criterion or an indicator. Choosing the right parameters, gives us the ability to make the right comparison between alternatives. But, when there are several or numerous parameters for evaluation, things get complicated, the complexity rises really high when there's a contrast between the multiple or numerous choices and they are of different types. In such situation, the evaluation and comparison processes get too complex to be analyzed by mind and there will be a need for a strong scientific tool. One of the most powerful tools for such situations is applying multi-criteria analysis methods like the analytical hierarchy process.

5.1. The Analytical Hierarchy Process Model

Applying this method requires the following 5-step process:

Step 1:

Modeling: in this stage, the problem is turned into decision making in form of a hierarchy of elements of a decision. Elements of a decision include indicators of decision making and decision alternatives. The hierarchical analytical process requires the breaking of a problem down to a hierarchy of levels. The highest level expresses the main purpose of the decision making process. The second level describes the major indexes (that can be broken down to minor and more detailed indicators in next levels). The last level represents decision alternatives [30].

In Figure 2 the conceptual urban stability analytical modal is presented based on the analytically hierarchical modal. Since in this research, the analytically hierarchical method has been applied to weigh the criteria and sub-criteria, this model has been designed in form of 3 hierarchical levels including the general objective, criteria and sub-criteria.

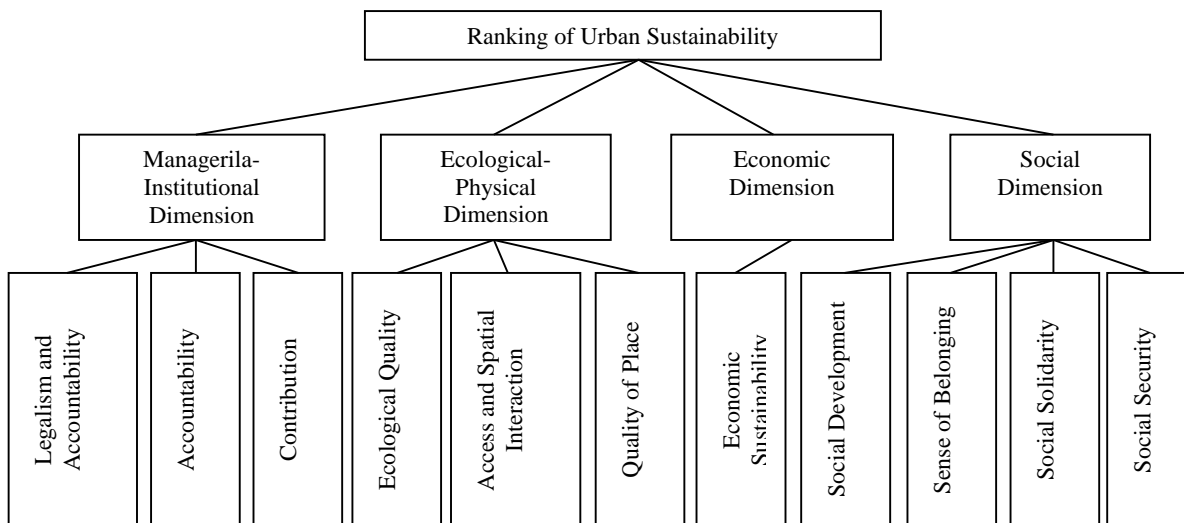


Figure 2. Modeling of hierarchy of research criteria to analyses AHP

Level 1: this level includes the general objective that the research follows. The objective of the present research is

ranking the regions and areas of the city of Rasht from a stability view.

Level 2: this level includes parameters that have been applied for stability ranking. Based on the studies on the theoretical foundations, the parameters chosen in this study include the 4 social, economic, ecological-physical and managerial-institutionaldimensions.

Level 3: this level includes sub-criteria that are divided from the criteria at level 2. The chosen sub-criteria at this level based on the 4 criteria at level 2 include:

Social dimension: including social security, social solidarity, sense of belonging and social development.

Economic dimension: including economic sustainability which is ramified from equality, and economic prosperity.

Ecological-physical dimension: including the quality of place, access, spatial interactions and ecological quality.

managerial-institutional dimension: including contribution, reliability and accountability.

Step 2:

Data are collected from experts or decision-makers corresponding to the hierarchic structure, in the pairwise comparison of alternatives on a qualitative scale as described below. Experts can rate the comparison as equal, marginally strong, strong, very strong, and extremely strong. The comparisons are made for each criterion and converted into quantitative numbers as per Table 2.

Table 2. Gradation scale for quantitative comparison of alternatives

Numerical value(s)	Option
1	Equal
3	Strong
5	Very strong
7	Extremely strong
9	Very high importance
2, 4, 6, 8	Intermediate values to reflect fuzzy inputs

Step 3:

The pairwise comparisons of various criteria generated at step 2 are organized into a square matrix. The diagonal

Table 3. The ultimate weight of criteria and sub-criteria of sustainable development

Goal	Criteria or dimensions	Weight of criteria	Sub-criteria or variables	Weight of sub-criteria
Ranking of urban areas and regions from sustainability view	Social dimension	0.385	social security	0.485
			social solidarity	0.109
			sense of belonging	0.109
			social development	0.279
	Economic dimension	0.385	economic sustainability	1
	Ecological-Physical dimension	0.087	quality of place	0.528
			access and spatial interaction	0.140
			ecological quality	0.333
	Managerial-Institutional dimension	0.143	contribution	0.481
			legalism and accountability	0.405
			accountability	0.114

6. Ranking of The Octave City Areas With TOPSIS Method

In this section, after analyzing the current situation of the research area from the viewpoint of stability indicators using

elements of the matrix are 1. The criterion in the ith row is better than criterion in the jth column if the value of element (i, j) is more than 1; otherwise the criterion in the jth column is better than that in the ith row. The (j, i) element of the matrix is the reciprocal of the (i, j) element.

Step 4:

The principal eigenvalue and the corresponding normalized right eigenvector of the comparison matrix give the relative importance of the various criteria being compared. The elements of the normalized eigenvector are termed weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives. The mathematical form of this method is presented in Eq. (1).

$$\begin{bmatrix} a_{11} & \dots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \dots & a_{nn} \end{bmatrix} \xrightarrow{1} \begin{bmatrix} \sqrt[n]{a_{11} \dots a_{1n}} \\ \vdots \\ \sqrt[n]{a_{n1} \dots a_{nn}} \end{bmatrix} = \begin{bmatrix} \pi_1 \\ \vdots \\ \pi_n \end{bmatrix} \xrightarrow{2} \begin{bmatrix} \frac{\pi_1}{\sum_{i=1}^n \pi_i} \\ \vdots \\ \frac{\pi_n}{\sum_{i=1}^n \pi_i} \end{bmatrix} = \begin{bmatrix} W_1 \\ \vdots \\ W_n \end{bmatrix} \quad (1)$$

In this research, the combined matrix of the decision makers double comparison with 4 basic and 11 sub-factors were applied in order to prioritize city areas from a stability standpoint with the combined AHP and TOPSIS method. And their final weight that were calculated by Expert choice software are given in Table 3.

Step 5:

The consistency of the matrix of order n is evaluated. Comparisons made by this method are subjective and the AHP tolerates inconsistency through the amount of redundancy in the approach. If this consistency index fails to reach a required level then answers to comparisons may be re-examined.

In this study the level of inconsistency is controlled using Expert choice software and achieved quantities indicate acceptance of compatibility of judgments.

SPSS software, the results were defined as a dimensionless decision matrix and, in the next stage, were combined with the weight of the factors and the sub-factors (the outcome of AHP method), according to Tables 4 to 7.

Table 4. Non-scaled decision-making matrix

Option	Social dimension	Economic dimension	Ecological-physical dimension	Administrative-institutional dimension
1 st area of 1 st region	0.408	0.395	0.447	0.387
2 nd area of 1 st region	0.379	0.396	0.384	0.364
1 st area of 2 nd region	0.338	0.342	0.329	0.340
2 nd area of 2 nd region	0.337	0.342	0.339	0.350
3 rd area of 2 nd region	0.354	0.352	0.332	0.349
1 st area of 3 rd region	0.341	0.307	0.319	0.334
2 nd area of 3 rd region	0.332	0.340	0.343	0.360
3 rd area of 3 rd region	0.332	0.346	0.317	0.341

Table 5. Indicator weight- results of AHP method

Indicator weight from AHP method	0.38500	0.38500	0.08700	0.14300
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Table 6. Balanced non-scaled decision-making matrix

Option	Social dimension	Economic dimension	Ecological-physical dimension	Administrative-institutional dimension
1 st area of 1 st region	0.1572	0.1520	0.0389	0.0554
2 nd area of 1 st region	0.1457	0.1525	0.0334	0.0521
1 st area of 2 nd region	0.1303	0.1315	0.0286	0.0486
2 nd area of 2 nd region	0.1299	0.1315	0.0286	0.0500
3 rd area of 2 nd region	0.1365	0.1357	0.0289	0.0499
1 st area of 3 rd region	0.1312	0.1183	0.0278	0.0478
2 nd area of 3 rd region	0.1277	0.1310	0.0298	0.0478
3 rd area of 3 rd region	0.1277	0.1331	0.0276	0.0488

Table 7. Ideal and negative ideal solutions

Positive ideal	0.16000	0.15253	0.03969	0.05540
Negative ideal	0.11160	0.11834	0.02203	0.04778

Considering decision-making matrix professional experts, based on investigation main criteria and 8 options and results of TOPSIS method, placed 1st area of 1st region, 2nd area of 1st region and 3rd area of 2nd region with in ranks of first, second and third respectively by the importance weight of 0.988, 0.749 and 0.403. Also, obtained results show that 1st region areas located in a desired condition compared to other areas, and in addition, areas of 3rd region placed in a lower rank of stability in comparison to other areas.

7. Results and Conclusion

Today, obtaining sustainable development is one of the most essential issues for countries, especially for developing countries. Developing countries need a correct understanding of the environment and adequate planning in national and regional scales in order to staying away from underdevelopment, political, economic and cultural poverty, etc. and to achieve an appropriate development. The increase of the gaps between the rich and the poor in local, national and regional scale and environmental crises in the last 5 decades are solid proofs of mishandling the strategies and objectives of development. Mostly, enterprises in developing countries are made by the government in a concentrated way. And normally, the applied resources are not much connected with the potentials and needs, therefore, the gap and duality between

the regions increase regularly space guidelines for cities, sustainable development are determined based on the weaknesses and strengths of their areas and regions, development therefore, by comprehending the position of urban residential areas, with regards to the framework of sustainable development indicators, it's possible to make plans with an open mind and perspective.

In this research, in order to rank the regions and areas of the city of Rasht from a stability standpoint, after analyzing the theoretical fundamentals, a framework was devised for the indicators of urban sustainable development in 5 basis dimensions which are social, economic, ecological-physical and managerial-institutional, and through each, dimension, the current situation was analyzed. Since each dimension and each indicator has a different effect on achieving urban sustainable development from a weight viewpoint, the decision making analytic hierarchy process (AHP) was used in order to analyzing each dimension and indicator correctly, based on its importance and role in urban sustainable development. And finally, the areas and regions of the city of Rasht were ranked from a stability standpoint with TOPSIS method. overall, the findings in this research indicate that the most effective parameter in the different stability ranks between the regions and areas of the city of Rasht, is the indicators of the economic dimension of sustainable development. The indicators of the social dimension of sustainable development are the second most effective parameter, and the ecological-physical and

managerial-institutional dimensions are the next factors, respectively besides, the findings of the study reveal that the areas in region one of the city of Rasht, from the standpoint of the indicators of sustainable development, seem to be in better condition rather than other regions, also areas in region 3 have the lowest stability compared to the areas in the 2 other regions.

8. Suggestions and Guidelines

8.1. Social Guidelines

According to the conducted analysis, the indicators connected with this dimension, have a great role in the creation of the stability difference between the areas and regions of the city of Rasht of which the most effective are the indicators of the social security components, sense of belonging to a place and social development, below, there are some suggestions for improving their situation:

- Improvement of the city lightening especially at night and the active role of police force in poor neighborhoods.
- Activating the role of mosques and social institutions, which are located in areas and inside neighborhoods, in order to increasing social security.
- Improving the quality of places where there are public gatherings and the atmosphere of residential areas by improving and restoring these places, also by regularly controlling these areas by locals that volunteer to increase local security.

8.2. Economic Guidelines

The present research results express that the indicators of the economic dimension are the most effective indicators in creating the stability difference between the regions and areas of the city of Rasht among which the components of economic equality and economic stability have the greatest role in creating this difference.

Anyway, in order to improve the condition of economic indicators, there have been some suggestions as listed below:

- creating places for people to make investments and can help the economic prosperity of the city;
- offering adequate credits to private sector investors and encouraging them in order to creating jobs in the city.
- Expansion of facilities and equipment shortage of which can lead to migration of the population from less affluent areas of the city and increase of the costs.

8.3. Ecological-Physical Guidelines

The condition of regions and areas of the city of Rasht from an ecological-physical dimension of sustainable development show that the most effective indicators in this dimension belong to the components of access, spatial interactions and environmental quality for th improvement of which, the followings can be advised.

- Decentralization of business centers in downtown areas.
- Conversion of some old and abandoned buildings located in neighborhood.
- Pricing the parking garages to reduce the use of automobiles.

- Attention to and improvement of urban furniture esp. in public places and streets.

8.4. Managerial-Institutional Guidelines

Considering the completed analysis, the most effective indicators in this dimension belong to the components of accountability and legalism for which the followings can be advised.

- Improving the authority of the city council of Rasht as an institution that can unite the activities and plans in urban management.
- Applying of sustainable urban development based on information technology in the city of Rasht is really vital information technology can play an important role in optimization of sustainable development process because of its multiple applications in economic and social fields.

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