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Prioritizing the Sustainable Development Components to improve the level of Development with Analytical Hierarchy Process (Case Study: Sistan and Baluchestan province of Iran) Expand this title to reflect content and context

Vahid Pourshahabi[1], Masoud Pourkiani[2], Mohsen Zayandeh Roodi[3], Ayoub Sheikhi[4]

Sustainable development consists of a long-term, integrated approach to develop and achieve a healthy community by jointly addressing economic, environmental, and social issues, whilst avoiding the over consumption of key natural resources for managers and government planners in public management. Therefore, since the sustainable development refers to three major dimensions, this study aims to identify and rank the sustainable development components influencing and improving the development level of Sistan and Baluchestan province of Iran through using hierarchical analysis method (AHP) and Expert Choice software. The obtained results analyzed and ranked the factors using collected comments. Expert Choice software also indicated that the economic had the highest effect on improving the development level and the social and the environmental factors were the next priorities, respectively. Therefore, according to the results of this research, decision makers can plan to increase the development level of the study area.

Keywords: Sustainable Development; Sistan and Balushestan; Iran, Group Analytical Hierarchy Process; AHP; Expert Choice.

1. Introduction

The rapid industrial development taken place within the last century has led to many environmental and social implications around the world. The scale of these implications has gradually increased over the last couple of

[1] Student, Department of Management, Kerman Branch, Islamic Azad University, Kerman, Iran.
[2] Corresponding Author, Department of Management, Kerman Branch, Islamic Azad University, Kerman, Iran. Email: pourkiani.masoud@gmail.com,
[3] Department of Economics, Kerman Branch, Islamic Azad University, Kerman, Iran.
[4] Department of Statistics, Faculty of Mathematics and Computer, Shahid Bahonar University of Kerman, Kerman, Iran.

decades and currently, many developing and developed nations are more or less in vulnerable states (Jayawickrama, Kulatunga, and Mathavan, 2017, 571). Our built environment is responsible for some of the most serious global and local environmental changes (Alyami and Rezgui and Kwan, 2014, 167) and the future of our planet is a matter of great concern. Environmental issues and the way human communities affect ecosystem concerns have been a key part of human society from the early beginning. Since the deterioration of environmental conditions in many parts of the world, sustainable development has become a recognized goal for most human societies (Bossel, 1999). Therefore, everyman is forced to pay more attention to his environment. This is becoming more and more important since modern industrial societies are leaving even more burden on nature (Wall & Gong, 2001). It is also found that the concept of sustainable development has an important role in business and resource conservation in the 21st century (Duran et al., 2015, 807).

2. Sustainable Development

Historically, the concept of sustainable development (SD) emerged in the context of environmental concerns as witnessed by its first appearance in the World Charter for Nature. These concerns were addressed in the World Commission on Environment and Development: "Our Common Future" and were further elaborated in 40 Chapters of Agenda 21 of the Earth Summit in 1992 (Hak, Janouskova, and Moldan, 2016, 565).

The concept of sustainable development (Brundtland, 1987) came into being because of the enormous environmental, social, and economic challenges manifested in the contemporary life (Stacy and Stacy, 2012, 54). Due to the increase in environmental complexities, it is unwise to ignore the concept of sustainable development (Corina, 2013, 441). In other words, acceleration of technological development and sustainable development have become more significant in today's developed and developing countries, leading to more efficient use of natural sources so as to enable them for further use by next generations (Bircan and Gençler, 2015, 1350).

Over the years, the concept of sustainable development (SD) has led to various definitions, interpretations, and instrumentations. Basic definition of SD implies interrelation of three dimensions – Environment, Economy and Social factors- as showed in Figure 1. It means that each of these

dimensions is as important as the next one (Visvaldis, Ainhoa, and Ralfs, 2013, 23).

Figure 1: Dimensions of Sustainable Development (Keiner, 2005, 4)

Sustainable Development has definitions, principles, and dimensions which focus upon the ways the economic, social and environmental factors integrate. However, experiences of many countries showed that there are practical difficulties in integrating these dimensions and in putting the concept into operation (Darian, Salleh, and Shafiai, 2016, 160).

Thus, the purpose of a sustainable development assessment is to provide decision-makers with an evaluation of 'from global to local' integrated society–economy–environment systems in short-term and long-term perspectives to assist them determine whether actions should be taken in the process of sustainable development or not (Tan and Lu, 2016, 71). Accordingly, the formulation of policy and strategy to develop the country, it must concern real benefits and environmental costs in the three above mentioned areas (Sutthichaimethee et al., 2015, 325). However, the difficulty of taking a three-dimensional (environmental, economic, and social) sustainability approach is being experienced in many places, so local communities are adapting sustainable development to their individual contexts (Kusakabe, 2013, 1).

2.1. Indicators of Sustainable Development

Indicators play a key role in making sustainable development implementable by defining it in directly or indirectly measurable terms. They can also reflect and guide human values. They can reflect existing human values since "we measure what we care about", but they also amplify the importance of what ends up being measured, since "we care about what we measure" (Meadows, 1998, 8). For years, indicators have been used as a tool used to obtain more information about issues such as health, weather, and economic welfare. Compared to the indicators of economic and social aspects, environmental and sustainable development indicators are just relatively new phenomena to concern (Segnestam, 2002, 1).

The United Nations Conference on Environment and Development in 1992 recognized the important role of indicators in aiding countries make informed decisions about sustainable development. At the international level, the Commission on Sustainable Development (CSD) approved its Work Program on Indicators of Sustainable Development in 1995. The first two sets of Sustainable Development Indicators (henceforth CSD indicators) were developed between 1994 and 2001. They have been extensively tested, applied and used in many countries as the basis for the development of national indicators of sustainable development (United Nations, 2007, 3).

Rio+20 Summit was named after June 2012, for it took place 20 years after the 1992 Rio de Janeiro Earth Summit that allowed, as already mentioned, the adoption of the first international documents, mandatory or voluntarily, on sustainable development: two international Conventions (one regarding the fight against climate change and the other concerning the safeguarding of biodiversity) and also an Action Program that brought together many of the Recommendations for the states in economic, social, and environmental areas (Dogaru, 2013, 1346).

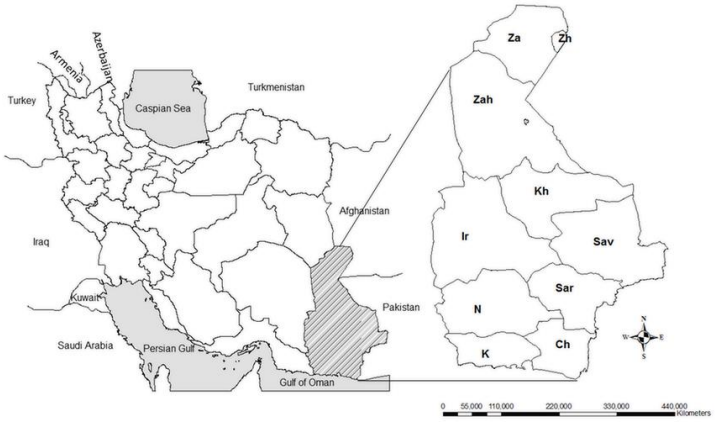
Sustainable development indicators (SDIs), which reflect key trends in the environment, social systems, economy, human well-being, and quality of life, have been seen as major and effective tools in measuring progress toward SD goals (Tran, 2016, 418). So, a better equilibrium between social, economic, and environmental goals is strongly needed to build a true index of sustainable development (Bravo, 2014, 148). Interest and

various activities related to sustainable development indicators among many international organizations have increased in the past years. The Organization for Economic Cooperation and Development has developed and published indicators for both particular areas (resource use and environmental outlook), sectors (households or transport) and developed a standardized indicator-based framework for countries' environmental performance review (OECD, 2005). The United Nations Environment Program has regularly published the Global Environmental Outlook, which has used a set of indicators to underline the choices available to policymakers across a range of environmental, social, and economic challenges (UNEP, 2007). At the regional level, the European Environmental Agency (EEA) has intensively developed and used indicators for assessment of the European environment (Hak, Kovanda, and Weinzettel, 2012, 46).

3. Study area

The target area (the Sistan and Baluchestan region, 25°3′–31°28′N, 58°47′–63°19′E) in this study (Figure 2) comprises two sections: Sistan in the north and Baluchestan in the south. Among 31 provinces of Iran, Sistan and Baluchestan, as the second largest province (after Kerman province), is located in the southeast of the country, bordering Pakistan and Afghanistan and its capital is Zahedan. Its area is 181,785 km² with a population of 2.5 million people. The province consists of 36 cities, which are almost identical in terms of climatic and cultural conditions.

Figure 2: Location of the Sistan and Baluchestan province, Iran



4. Method of Study

The method of this research is developmental and descriptive. The statistical population of this study consists of two groups. The first group is made up of knowledgeable experts. The number of people in this statistical society is not clear and the sample size is 70 people. The second group includes all high education graduates in Sistan and Baluchestan province with 65012 people, and according to the Cochran formula, the sample size is 382. The data used in this study was collected through 10 questionnaires whose validity and reliability were confirmed. The data has been analyzed using Excel, SPSS, AMOS, and EXPERT CHOICE Software, and has resulted in a model that has three social, economic, and environmental dimensions with 23 indicators. Finally, the indicators presented in the model are prioritized and the policy makers can plan on the basis of these priorities in order to promote the development level of the province with a sustainable development approach.

4.1. Identification of indicators

In the first stage, given that many researchers have introduced various indicators in their studies, the basic indexes in each dimension of the model have been identified by analyzing the articles and the existing books using content analysis method. Content analysis is indigenous to communication research and is potentially one of the most important research techniques in social sciences (Krippendorf, 1989, 403). The content analysis method is based on the hypothesis that by analyzing linguistic messages, one can discover the meanings, priorities, attitudes, perceptions as well as the organization of the world. At the end of this phase, 93 indexes of books and articles which were related to the research topic were extracted.

4.2. Delphi Process

The Delphi technique is well suited as a means and a method for consensus-building by using a series of questionnaires to collect data from a panel of selected subjects (Hsu & Sandford, 2007, 1). Delphi usually undergoes four distinct phases. The first phase is characterized by exploration of the subject under discussion, wherein each individual contributes additional information apparently pertinent to the issue. The second phase involves the process of inferring how the group views the

issue. If there is significant disagreement, that disagreement is explored in the third phase to bring out the underlying reasons for the differences and possibilities to evaluate them. The last phase, a final evaluation, occurs when all previously gathered information has been initially analyzed and the evaluations have been fed back for consideration (Linstone & Turoff, 2002, 6).

4.2.1. Selecting experts

In the second stage, the indices obtained in the previous step became the Delphi's five-point Likert questionnaire. Then the Delphi questionnaire was sent to the experts. The questionnaire involved both closed and open questions. Selection of individuals for the Delphi process depended on the experience and expertise required in the subject under study. Doblecq et al. (1975) considered three groups of people eligible to Delphi study:

1) The top management decision makers who will utilize the outcomes of the Delphi study;

2) The professional staff members along with their support team; and

3) The respondents to the Delphi questionnaire whose judgments are being sought" (Delbecq, 1975, 85).

Generally, panel members are selected through targeted (judgmental) inaccuracies. The judgment method is based on the assumption that the researcher's knowledge of the community can be used to make panel members (Keeney et al., 2005, 208). One of the methods of judging sampling is the snowball method. The Snowball or Referral sampling yields a study sample through referrals made among people who share or know of others and those who possess some interesting characteristics for the researchers (Biernacki, 1981, 141). So, using snowball sampling method, four panels of experts were selected regarding the following topics:

- Panel 1- Experts on educational, cultural and social issues;
- Panel 2 - Experts on therapeutic issues;

- Panel 3 - Experts on economic, agricultural and livestock, and infrastructure issues;
- Panel 4 - Experts on environmental issues.

4.2.2. Number of Participating experts in the Delphi process

Different researchers have never reached consensus on the optimal number of collaborators in the Delphi process. But it is noted that 10 to 15 people can be enough. Witkin and Altshuld (1995) argued that the approximate size of a Delphi panel is generally less than 50 people (Witkin and Altshuld, 1995). According to Ludwig (1997), in most Delphi studies, between 15 and 20 respondents are used (Ludwig, 1997: 2). So, in this research, 20 experts have been used for each panel (In some panels, the same people have been involved).

4.2.3. Agreement in the Delphi process

The major statistics in Delphi studies are measures of central tendency (means, median, and mode) and level of dispersion (standard deviation and inter-quartile range) used to present information concerning the collective judgments of the respondents (Hasson, Keeney, & McKenna, 2000).

According to Chia-chien (2007), the Delphi process can be repeated continuously until a consensus is reached (Chia-Chien, 2007, 2). However, Cyphert and Gant (1971), Brooks (1979), Ludwig (1994, 1997), and Custer, Scarcella, and Stewart (1999) point out that in most cases, three iterations are often sufficient to collect the needed information and to reach a consensus.

To reach consensus among experts, some criteria recommend that a consensus of 80% is acceptable (Chia-Chien, 2007, 4). Green (1982) argues that at least 70% of the collaborators involved in the Delphi process need to be unanimous, but Scheibe et al., (1975) showed that using percentages is inadequate, and a more reliable and measurable alternative to the stability of respondents has to be repeated in iteration.

In this study, Kendall’s Coefficient of Concordance was used to determine the degree of experts' perceptions using the Delphi method. The Kendall’s Coefficient of Concordance is a measure to determine the

degree of coordination and agreement among several rank categories per N person. Such a scale is particularly useful in studies assessing "the existing validity among judges" (Legendre, 2010, 164). To decide whether to stop or to continue the Delphi round, a strong consensus among members of the panel is required which is based on the amount of Kendall's Coefficient of Concordance. Table 1 shows how to interpret the various values of this coefficient.

Table 1: Correlation coefficient interpretation (Agunbiade & Ogunyinka, 2013, 314)

Kendall's Coefficient of Concordance	Interpretation
0.90 to 1.0	Very high positive correlation
0.70 to 0.90	High positive correlation
0.50 to 0.70	Moderate positive correlation
0.30 to 0.50	Low positive correlation
0.00 to 0.30	Negligible correlation

The quantities of Kendall's Coefficient of Concordance for various stages of the Delphi process are shown in Table 2. It should be noted that the Kendall's Coefficient of Concordance Test was performed in SPSS 19 software.

Table 2: Test Results for Kendall's Coefficient of Concordance

Panel number	First round		second round		Third round		Fourth round	
	Kendall's Coefficient	Consensus	Kendall's Coefficient	Consensus	Kendall's Coefficient	Consensus	Kendall's Coefficient	Consensus
1	0.055	Negligible	0.213	Negligible	0.492	Low	0.704	High
2	0.143	Negligible	0.180	Negligible	0.786	High	Consensus in third round	
3	0.217	Negligible	0.573	Moderate	0.774	High	Consensus in third round	
4	0.247	Negligible	0.368	Low	0.738	High	Consensus in third round	

Considering that in the questionnaires sent to experts, they were asked to remove unnecessary indicators and suggest useful indicators for adding

to future periodic questionnaires, the number of the final indicators proposed by the experts decreased to 81 indicators.

4.3. Determining the present situation of the indicators

After identifying the research indicators in the previous stages, the status quo of the indicators has been extracted from the latest statistical journal of Sistan and Baluchestan province.

4.4. Determining the desirable situation for indicators

At this stage, Delphi method was re-used to get the desired status of the indexes. At the end of this stage, the present situation and the most desirable status of sustainable development indicators for the cities of the province have been identified. In the next step, the present and the most desired situations of the indicators will be compared to identify the chronic gaps for development.

4.5. Comparing the existing status and desired status of indicators

The gap analysis was used to compare the existing situation and the desired situation of the indices. Because the indicators are in different scales and there is no possibility of performing arithmetic operations on them, eliminating the effect of different scales and converting all of them into a standard scale require a scaling-based method. In this method, equations (1) and (2) were used according to the purpose (Boulanger, 2008, 49).

$$\text{Equation 1:}\quad x'_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}}$$

$$\text{Equation 2:}\quad x'_{ij} = \frac{x_j^{max} - x_{ij}}{x_j^{max} - x_j^{min}}$$

Equation (1) is used when the maximization of criterion or index is considered, and equation (2) is used to minimize the desired criterion. At this stage of the research, all present and desirable values of the indicators are standardized using these two equations.

After standardizing the values of the indices, to obtain the gap between the existing status and the desired condition, the differences between the

desired and the existing values were calculated. According to Chui et al (2016) and Abdelhamid et al. (2015), the quartiles were used to identify the chronic gaps in the province's development path. Accordingly, 24 out of the 81 indicators studied in this study had more gaps than the third quartile of the data and were identified as indices with chronic gaps. Therefore, according to the findings of this study, in order to promote the level of development of Sistan and Baluchestan province, it is necessary to plan to improve the level of indicators specified in Table 3.

Table 3: Indicators that have chronic gaps in the development path of Sistan and Baluchestan province

Dimensions	Components	Indicators
Social	Educational	Population literacy
		Number of Volume 2 Secondary Schools
		Number of Teachers for Volume 1 Secondary Schools
		Number of vocational training centers
		The ratio of the number of professors to the students
	Cultural and Social	The number of cinema halls
	Therapeutic	Number of beds in the hospital
		Number of health centers
		Number of Sub-specialist doctors
		Number of pre-hospital emergency rooms
Economic	Economy	Percentage of service sector employees
		Number of active cooperative companies
	Infrastructure	The length of the railways
		Length of highways
		Mobile penetration rate
		Percentage of Internet Access
		Number of fire stations
Environmental	Environmental Protection	Capacity of wind power projects
		Capacity of solar power projects
		Gas-to-household split ratio
	Environmental Pollution	Per capita gasoline
		Per capita consumption of kerosene
		Per capita gas oil consumption
		Per capita consumption of mazut (Fuel Oil)

4.6. Method of Prioritizing Sustainable Development Indexes

4.6.1. Analytical Hierarchical Processes (AHP)

The Analytic Hierarchy Process (AHP) is a logical Multi-Criteria Decision-Making technique that allows decision makers to model complex problem-based on mathematics and human psychology (Gupta et al., 2015, 212). The multiple criteria decision making (MCDM) methods are frequently used to solve real world problems with multiple, conflicting, and incommensurate criteria. MCDM problems are generally categorized as continuous or discrete, depending on the domain of alternatives (Pirdashti et al., 2011, 8). In this study, multiple criteria decision modeling (MCDM) was used, which considers more than one criterion in decision-making environments.

The theory and practice of the evolution of Analytical Hierarchical Processes (AHP) have created an excitement of many researchers in various fields including oil and gas, arts, humanities, health, education, business, military, politics, and construction industry. AHP helps people with the intuitive, the rational and irrational, and with risk and uncertainty towards complex situation. The idea of AHP was designed by Dr Thomas Saaty in the 1970s while he was a professor at the Wharton School of Business. In 1983, he joined Dr. Earnest Forman (a professor of management science at George Washington University) to co-found the Expert Choice (Yunus et al., 2013, 467).

4.6.2. Expert Choice (EC) Software

Expert Choice software is a quick-to-learn and easy-to-use product for Collaborative Decision Making to help research intuition. It is a graphical based structure which is able to apply judgment to objectives and finally achieve the ultimate goal. The advantage of using this software is that it helps decision makers arrive at the best decision, but it also gives a crystal clear picture for that decision. This is true since the given results provide extra internal validity through visual integration in testing sensitivity analysis (Yunus et al., 2013, 467). The AHP and Expert Choice software engage the decision makers in structuring a decision-making process into smaller parts. Beginning from setting a goal to achieve it, objectives and sub-objectives and alternatives are determined. Decision-makers then make a simple pair-wise comparison judgment throughout the hierarchy

priority to arrive at the overall priorities for the alternatives (Yunus et al., 2013, 467). This paper presents the application of Analytical Hierarchical Process (AHP) using Expert Choice.

4.6.3. Designing Questionnaires for Expert Choice

Designing the questionnaires for the experts requires designers to spend enough time and attention for the answers of the questionnaires prepared by the expert. The original design includes all pair-wise to all criteria, objectives, and alternatives (Yunus et al., 2013, 468). Table 4 shows the Preference Level and the Numeric Values ranging from 1 to 9 and used in selecting the significance of the criteria.

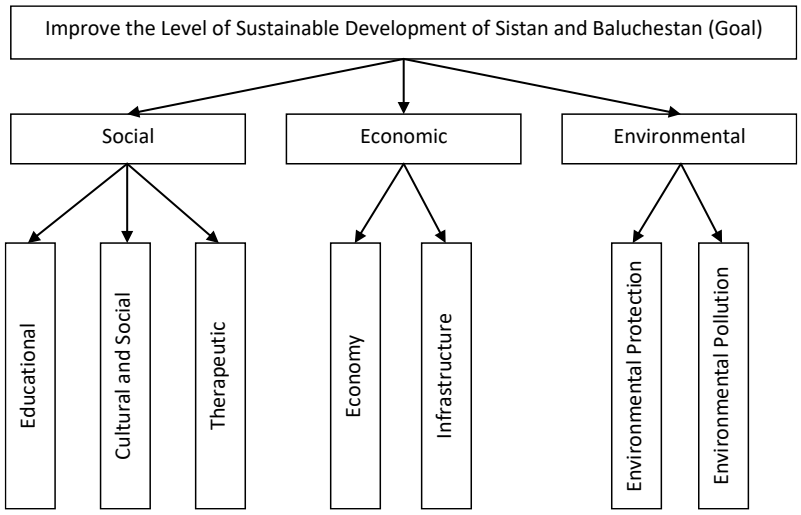
Table 4: AHP Preference scale (Yunus et al., 2013, 468)

Preference level.	Numeric Value.
Equally preferred.	1
Moderately preferred.	3
Strongly preferred.	5
Very strongly preferred.	7
Extremely preferred	9
Intermediate values between the two adjacent judgments.	2, 4, 6, 8

5. Results

Dimensions and components of sustainable development used to improve the development level of Sistan and Baluchestan Province are presented in the hierarchical tree of Figure 3. The first level is dedicated to research objective (Improve the level of Sustainable Development of Sistan and Baluchestan province). In the second level, Dimensions of sustainable development and in the third level, the components of sustainable development are shown, respectively.

Figure 3: Hierarchical tree of AHP



The weights achieved for each main dimension are shown in Figure 4. According to the information obtained, economic factors with the weight of 0.520, social factors with the weight of 0.340, environmental factors with the weight of 0.140 were determined by the experts. Also, the inconsistency rate of data, 0.04, is less than 0.10 and indicates the consistency between the paired comparisons.

Figure 4: Weights of Main Criteria

The weights achieved for each component related to the social dimension of sustainable development are shown in Figure 5. According to the obtained information, the hierarchal array of the components includes:

Therapeutic with the weight of 0.558, Cultural and Social with the weight of 0.320, and Educational with the weight of 0.122, respectively. In addition, the inconsistency rate is 0.02, which is less than 0.10 and indicates the consistency between the paired comparisons.

Figure 5: Weights of Components related to the social dimension

The weights achieved for each component related to the social dimension of sustainable development are shown in Figure 6. According to the obtained information, the hierarchal array of the components includes: Infrastructure with the weight of 0.800, and Economy with the weight of 0.200, respectively. In addition, inconsistency rate is 0.00, which is less than 0.10 and indicates the consistency between the paired comparisons.

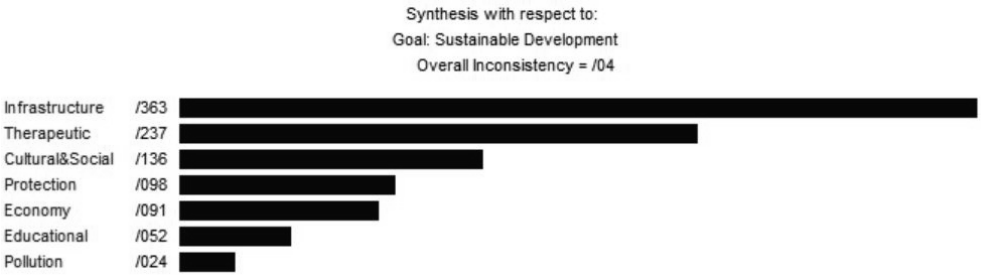
Figure 6: Weights of Components related to the Economic dimension

The weights achieved for each component related to the environmental dimension of sustainable development are shown in Figure 7. According to the obtained information, the hierarchal array of the components includes: Environmental Protection with 0.800 weights, and Environment Pollution with 0.200 weights, respectively. In addition, inconsistency rate is 0.00, which is less than 0.10 and indicates the consistency between the paired comparisons.

Figure 7: Weights of Components related to the Environmental dimension

The weights of components related to the main criteria (social, economic, and environmental dimensions) are presented according to improvements in the development level of Sistan and Baluchestan Province which is based on the obtained results, infrastructures, and the therapeutic factors have the highest weights among other components. Also, the rate of overall inconsistency is 0.04 which indicates the consistency between paired comparisons (Figure 8).

Figure 8: Weights of Components related to the main criteria



6. Conclusion

Sustainable development encourages researchers to conserve and enhance the resource base, by gradually changing the ways in which technologies are developed and used. Countries are supposed to meet their basic needs of employment, food, energy, water and sanitation. Most official plans encourage the countries to commit certain things and work towards given goals, which is the only way all of these things will work. It is a never-ending, continuous process that cannot be finished overnight, but organizations like the UN believe that if all work together to move towards their goals, their efforts can eventually be accomplished at sustainable development. The authors of this article believe that in order

to achieve sustainable development, each region of the country must have its own program. To this end, sustainable development components have been ranked to promote the development level of Sistan and Baluchestan province in Iran, in order to provide the possibility of planning for its future sustainable development.

The data of this research was obtained using experts' opinions and was analyzed in Expert Choice software. The results of this analysis indicate that the economic dimension with a weight of 0.520 is the most important factor for promoting the development level of Sistan and Baluchestan province. Among the components considered to enhance the development level of the province, the "Infrastructure" component with a weight of 0.363 and "therapeutic" component with a weight of 0.237 were known as the most important items. The results of the sensitivity analysis for this study show that if the weight of the "environmental" dimension increases, the "environmental protection" component will be the most important factor used for promoting the provincial development. Similarly, if the weight of the "social" dimension increases, the "Therapeutic" component will be the most important factor in promoting the development of the province. Therefore, in order to promote the development of Sistan and Baluchestan province, the local decision makers must consider the dimensions and components of sustainable development that are mostly prioritized to base their future planning and policy- making on these priorities.

Regarding the results of prioritizing the indices of the native model derived from this study, it is suggested to increase the length of the railway lines to improve the infrastructure situation in the study area. To this end, it is suggested that the government provide the conditions for private sector investment. As there is a common land border between Sistan and Baluchestan Province and Pakistan and Afghanistan, investment can also be made by these countries. The length of highways will also increase through state-sponsored highway construction projects, and will lead to infrastructure development for sustainable development in the region under study. To finance these projects, the government can proceed by selling tickets and taking tolls. The third most important indicator in the infrastructure component is the number of fire stations. In order to upgrade this index, existing vehicles and equipment should be restored, private facilities used and new machines purchased. Increasing the percentage of Internet access can also help to improve the level of

development of the area under study. To this end, it is suggested that the use of satellite internet for villagers be provided. It is also necessary to reduce the cost of using the Internet and provide the necessary training to users.

To improve the therapeutic component, it is suggested that the number of emergency bases in the examined area be increased. For this purpose, it is suggested that continuing training courses are provided for staff of emergency departments. Also, the use of air and motorized emergency stations is recommended. Increasing the number of health care centers is possible through funding from international organizations. Also, the government can take advantage of private sector capabilities by providing incentives (such as tax breaks). Another important indicator is the number of hospital beds. In this regard, it is suggested that the government take action to attract foreign investors, especially from neighboring countries. Paying low interest loans and lowering tax rates can also pave the way for private sector entry into the issue. The number of sub-specialist doctors can also be increased by attracting students from various medical courses among native people. Meanwhile, the government should provide facilities and incentives for physicians to stay in the area.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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