Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2015/04/jls.htm
2015 Vol. 5 (S4), pp. 1266-1277/Keykha and Shahraki
Research Article

A MULTI-CRITERIA DECISION MODEL TO PRIORITIZE GAS SUPPLY TO VILLAGES WITHFUZZYAHP AND DEA APPROACH, WITH QUALITATIVE DATA (CASE STUDY: SISTAN AND BALUCHESTAN PROVINCE, IRAN)

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ABSTRACT
Currently, gas supply project to villages experience no prioritization and the National Iranian Gas Company has started to supply villages with gas by replacing fossil fuels with natural gas and increasing the share of gas in energy basket, This study aims to introduce a method for prioritizing gas supply to villages in Sistan and Baluchistan province, Iran. The extraction of gas indicators in the villages was performed through interviews with experts and gas company resources. In the first stage, gas standards were extracted based on experts` opinions and gas company resources and secondly, the criteria were weighted by fuzzy AHP model. In the third phase, selected projects in the province were selected based on criteria and prioritized by experts` comments and DEA model. The results show that, among 10 selected criteria for prioritizing the gas supply to villages, family size, and distance from the gas source, accessibility to fields, and being in the industrial vicinity of the village yield the highest weight

Keywords: *Analytical Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Ratings, Supply Gas Criteria.*

INTRODUCTION

Recent years have witnessed a rapid growth of gas consumption in various sectors due to the relatively low prices over other fuels. In addition, the gas development projects to remote villages and towns have been within prioritized programs of the government to tackle deprivation. In this regard, introducing a scientific method concerning decision making seems essential more than ever in order to extend the gas network and prioritize villages. Migration from villages to cities and depopulation of villages, seasonal life, and other gas supply-related variables have made prioritization of villages a challenge due to their large number, and their distribution. In this study, using data and effective environmental information, gas experts` opinions, and weighting of indicators, rural gas supply prioritization is performed. In this study, using an integrated approach Fuzzy AHP and DEA, a model is introduced for prioritizing gas supply to villages. The literature review is followed by methodology. Then, in the fourth section, the results are analyzed as per the case study.The last section deals with the results and recommendations.

Literature Review

Given that, today, gas supply development in remote villages and towns is a prioritized government program to tackle deprivation, rural gas supply is considered an important topic in provincial gas companies. This study identifies and selects effective factors in decision making to prioritize villages. "Bellman and Lotfi Zadeh (1970)" considered a classic decision- making model and developed its fuzzy conditions which were developed by other scientists. They considered some conditions where decision making is certain; however, objective functions and constraints are fuzzy. The second approach used later mixed decision making, objectives and constraints using the fuzzy average. Analytical Hierarchy Process (AHP) is one of the most comprehensive systems designed for decision-making with multiple criteria, because, with this technique, it provides the possibility of formulating the question in hierarchy format, as well as taking different criteria of quality and quantity into account (Ghodsi Pour, 2006). It seems that fuzzy AHP method is a systematic approach for justified selecting to this problem that uses the concepts of fuzzy set theory and the analytic hierarchy process (Ghodsi Pour, 2006). The first analytical hierarchy method was created by "Laarhoven & Pedrycz" in 1983 that was not welcomed due to the computational complexity. In 1992, another approach was introduced by a Chinese scholar called Chang. This method yields many conditions. Chang developed the analysis of fuzzy AHP. His approaches in this field is similar to Saaty AHP; however, his approach is easier than other fuzzy AHP approaches in calculating. DEA is a set of concepts and methods to evaluate the structural efficiency and inefficiency of each unit of decision -making units and provide homogeneous inputs and outputs. In addition to CCR and BCC models in the literature, other basic models such as additive models, etc. were raised (Farrell, 1957). The basic work in DEA is to compare making-decision units with each other and achieve a relative efficiency that is performed by mathematical programming.

Ramanathan (2004) used DEA model for establishing local weight of options from paired comparisons in the analytic hierarchy process. Ming and Liu *et al.,* (2007) changed the DEA model using the AHP approach. Wang *et al.,* (2008) examined the AHP-DEA integrated approach forbridge risk assessment. Tseng (2010), in a study entitled "the performance evaluation and implementation using fuzzy network BSC", explained BSC and stated that itis a multi-criteria assessment which shows the importance of the performance criteria. Chi Sun (2010), presented a performance evaluation model through integrating thefuzzy network analysis methods and TOPSIS fuzzy.

Then Lee *et al.,* (2010), in an article entitled "Econometric analysis of R&D efficiency in the development of national hydrogen energy technology to measure the AHP/DEA relative efficiency of fuzzy integrated model", used integrated fuzzy analytic hierarchy process (fuzzy AHP) and data envelopment analysis (DEA) to measure the R&D relative efficiency in the development of national hydrogen energy technology.

Lin and Lee (2011) studied integrated DEA/AHP to evaluate the economic performance of local governments in China. Nemati (2008), in a study entitled "ranking projects baskets using Balanced Scorecard method and data envelopment analysis technique in management accounting by integrating basic DEA models and the Balanced Scorecard method"measured the efficiency and the balance of projects. Azad Nia and Ebrahimi Malek Shah (2008) studied "the selection of the appropriate method of implementing gas supply projects using AHP and fuzzy TOPSIS".

Moradi and Amid Pour (2010), presented a model to prioritize the gas supply to villages in different climates (province-based) based on economic calculations and consideration of the real opportunity situation cost. Alem Tabriz and Bagherzadeh Azar (2010), presented a model of fuzzy decision-making process for the strategic supplierselection and proposed Fuzzy network analytical model to support supplier to prioritize investments in various industries. He prioritized investment using the model and its results. Then he solved the mentioned problem using ranking units and a common set of weights. In this study, prioritizing gas supply to villagesis investigated in AHP and DEA approach.

METHODS AND MATERIALS

Research Methodology

In this study, contributing factors in prioritizing villages were first identified and then weight of each indicator was determined by fuzzy analytical hierarchy process. After that, gas supply to the villages was prioritized using DEA.

Research Steps

Figure 1 shows the general research structure. According to the figure, four villages were determined to set priorities for gas supply and then effective indices in the first phase. In the second phase, using fuzzy hierarchical analysis, the indices were weighted. The third phase was conducted using the DEA method to prioritize villages.

Phase I: Identifying Options and Indices

Research Article

In this study, the villages which are considered for gas supply were identified. Then important indicators in prioritizing gas supply are selected by using the Delphi method in various questions form for experts and, finally, more important indicators are selected using a paired comparison approach.

Phase II: Fuzzy Hierarchy Analysis

After determining the indices according to experts` opinions and paired comparison matrix and fuzzy AHP, indices weights were determined.

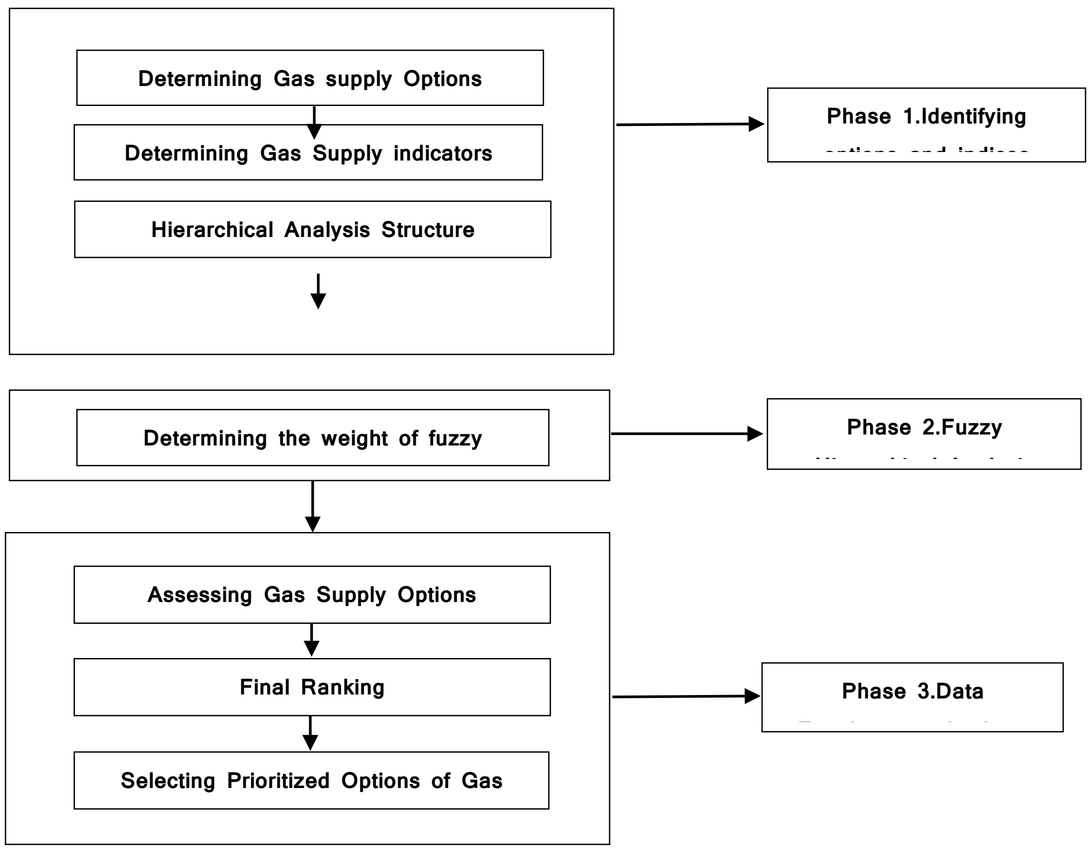

Figure 1: The Process of Research

The fuzzy theory is used to solve problems that have no clear criteria. Fuzzy numbers are classified into two triangular and trapezoidal types. The triangular fuzzy numbers are especial kinds of trapezoidal fuzzy numbers. Triangular fuzzy numbers were used in this article. Figure 2 and Table 1 show the relationship between linguistic and fuzzy numbers used in this research.

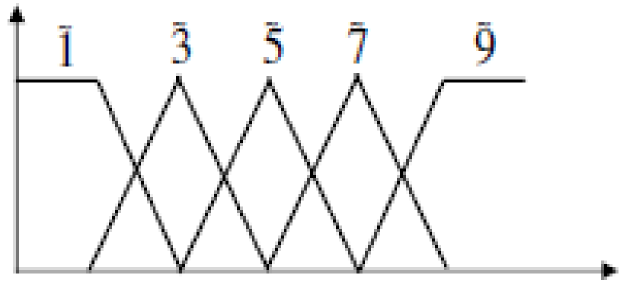

Figure 2: Expression of Fuzzy Numbers (Saati, 1990)

Table 1: Language Words and Fuzzy Scales (Chi San, 2010, page 2)

Language Values	**Fuzzy Scales of Language Values**
Very low	(1,1,3)
Low	(1,3,5)
Medium	(3,5,7)
High	(5,7,9)
Very high	(7,9,9)

Consider two triangular numbers $M_1 = (l_1, m_1, u_1)$ and $M_2 = (l_2, m_2, u_2)$ (Figure 3);

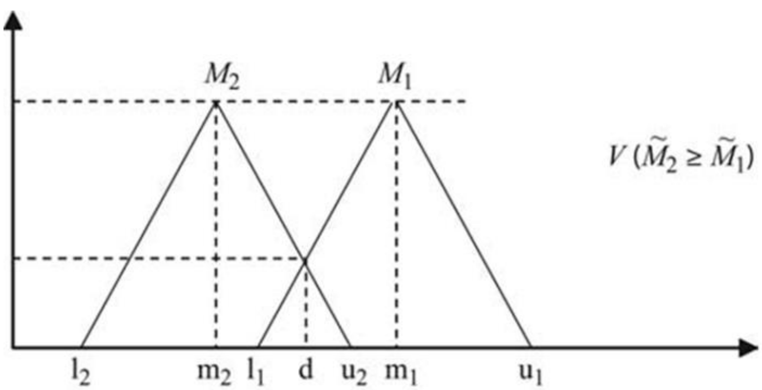

Figure 3: M1 and M2 Triangular Numbers (Saati, 1990)

Mathematical operators are defined as equations (1), (2), and (3):

$$M_1 + M_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2) \tag{1}$$

$$M_1 * M_2 = (l_1 * l_2, m_1 * m_2, u_1 * u_2) \tag{2}$$

$$M_1^{-1} = \left(\frac{1}{U_1}, \frac{1}{M_1}, \frac{1}{L_1}\right), M_2^{-1} = \left(\frac{1}{U_1}, \frac{1}{M_2}, \frac{1}{L_2}\right) \tag{3}$$

AHP was first introduced by Saaty in 1970s to allocate the scarce resources and planning needs. This approach can be useful when making decision is faced with several options and decision criteria. Indicators can be quantitative or qualitative. The basis of AHP lies in paired comparisons (Adel Azar). One of the most important benefits of AHP is its simple structure. Forming a hierarchical structure, AHP can compare options based on relevant indicators and eventually prioritize options. The biggest problem of AHP is the certainty of paired comparisons. For flexibility in judgment and making decision, the AHP could be combined with fuzzy theory of Lotfi Zadeh (1970). McLaren and Pdrykz (1983) first introduced it. Decision-makers have come to the conclusion that it is better, for better comparison, to define the value of the indices and options within a range, not as a fixed value, because in some cases, decision-maker is not able to express his idea clearly and strictly (Kahraman *et al.*, 2003). Therefore, fuzzy relationships are used in fuzzy AHP to express the importance of indices weight. As mentioned, in this study,fuzzy AHP method was utilized to calculate the weights using extended analysis.In extended analysis, the amount of S_k which is a triangular number, is calculated from equation (4) for each line of paired comparison matrix;

$$S_K = \sum_{j-1}^{n} M_{kj} * \left[\sum_{i-1}^{m}\sum_{j-1}^{n} M_{ij}\right]^{-1} \quad (4)$$

Where *k* represents the number of rows and *i* and *j*, showing options and indicators, respectively. In the extended analysis approach, after calculation of S_k, we must obtain the proportion of largeness. Generally, if M_1 and M_2 are two fuzzy triangular numbers, the largeness proportion of M_1 on M_2, shown with $V(M_1 \geq M_2)$, as equation (5):

$$\begin{cases} V(M_1 \geq M_2) = 1 & if\ m_1 \geq m_2 \\ V(M_1 \geq M_2) = hgt(M_1 \cap M_2) & otherwise \end{cases} \quad (5)$$

Where:

$$hgt(M_1 \cap M_2) = \frac{u_1 - l_2}{(U_1 - L_2) + (m_2 - m_1)}$$

The larger amount of a triangular fuzzy number than *k* other triangular fuzzy numbersis given as equation (6);

$$V(M_1 \geq M_2, \dots, M_K) = V(M_1 \geq M_2), \dots, V(M_1 \geq M_K) \quad (6)$$

Equation (7) is used to calculate the indices weight in paired comparison matrix:

$$w'(x_i) = Min\{V(S_i \geq S_k)\}, \quad ,k = 1,2,\dots,n. \quad k \neq i \quad (7)$$

Therefore, the weight indices vector will be as follows:

$$W'(x_i) = [w'(c_1), w'(c_2), \dots, w'(c_n)]^T \quad (8)$$

This is the abnormal coefficients vector of fuzzy analytic hierarchy process.

Using equation (9), abnormal results obtained from the equation (8) get normal. Normalized results from equation (9), *W* is called.

$$W_i = \frac{w'_1}{\sum w'_i} \quad (9)$$

Third Phase: Data Envelopment Analysis

Finally, according to the final weight calculated in the second phase, the villages are prioritized and the best option is selected intervalbased on DEA method. In this research, expert opinion (gas supply experts) is used to prioritize villages in the form of statements including excellent, good, average, bad, and very bad. In this scale, the former and latter level of better statement is not clear. In many articles, qualitative data have been discussed. Cooper introduced a solution to deal with sequential and interval data and called inaccurate DEA. Despotis introduced a method to deal with imprecise data. Zhou determines the unit's efficiency in optimistic condition by converting sequential data into precise data. However, the method considers a large number of zero inputs and outputs for calculating the performance. Wang introduced a solution for DEA models with sequential data. Due to the fact that this study has a qualitative output (the expert idea), it needs to use imprecise models. In this paper, we used Wang model with fixed boundary for gas company data and the results were obtained for comparison units. At this stage, the quantitative data by interval DEA technique were examined and assessed and then gas supply to villages was prioritized based on efficiency interval. The basis of DEA is to compare decision making units and obtain the relative efficiency performed by mathematical programming. In this study, we used Wang model with fixed boundary for gas company data (Jahanshahloo *et al.*, 2007).

Suppose L=N without losing the generality, assume that the first output is sequential and sequential relationship is considered as follows for simplification (Hosein Zadeh Saljughi and Eslami Giski, 2012):

$$y_{11} \geq y_{12} \geq \cdots y_{1n}, \tag{10}$$

Due to the fact that DEA models are sustainable over the changing in unit, the sequential relationship can be rewritten as follows:

$$1 \geq \tilde{y}_{11} \geq \tilde{y}_{12} \geq \cdots \geq \tilde{y}_{1n} \geq \delta, \tag{11}$$

Where δ is a small positive amount, reflecting the ratio of the minimum possible amount of $\{y_{1j} | j = 1, \dots, n\}$ to its maximum possible value and is estimated by the decision maker. Considering $\tilde{y}_{1j} \in [\delta, 1], j = 1, \dots,$ npoor sequential data can be convertedinto interval data.

If the sequential relationship (11) be strictly true,

$$1 \geq \tilde{y}_{11} > \tilde{y}_{12} > \cdots > \tilde{y}_{1n} \geq \delta, \tag{12}$$

Strict sequential relationship$\tilde{y}_{1j} + \tilde{y}_{1j+1}, j = 1, \dots, n,$, can be converted to weak sequential relationship $\tilde{y}_{1j} + \tilde{y}_{1j+1}, j = 1, \dots, n,$ by considering given priority parameter $\chi > 1$ that is determined by the decision maker and with respect to the$\tilde{y}_{1j} \in [\delta\chi^{n-j}, \chi^{1-j}],\ \ j = 1, \dots, n,$ strict sequence data into the interval data.

With converting weak sequential and strict data to interval data, it can be used for obtaining upper and lower efficiency range DMU_k by two following models with assumptions $x_{ij} \in [x_{ij}^L, x_{ij}^U]$and $y_{rj} \in [y_{rj}^L, y_{rj}^U]$,

$$\max E_k^U = \sum_{r=1}^{s} u_r y_{rk}^U$$

$$\text{s.t} \qquad \sum_{r=1}^{m} v_i x_{ik}^L = 1$$

$$\textstyle\sum_{r=1}^{s} u_r y_{rj}^U - \sum_{r=1}^{m} v_i x_{ij}^L \leq 0, \text{all } j, \tag{13}$$

$$u_r, v_i \geq \epsilon \ \text{ all } r, i.$$

$$\max E_k^L = \sum_{r=1}^{s} u_r y_{rk}^L$$

$$\text{s.t} \qquad \sum_{r=1}^{m} v_i x_{ik}^{U} = 1$$

$\sum_{r=1}^{s} u_r y_{rj}^{U} - \sum_{r=1}^{m} v_i x_{ij}^{L} \leq 0, \text{all } j,$ (14)

$u_r, v_i \geq \epsilon \text{ all } r, i.$

This approach convert weak sequential data $\tilde{y}_{11}, \tilde{y}_{12}, \ldots, \tilde{y}_{1n}$, to the same period and do not consider any differentiation for them, and since $\tilde{y}_{1k} = \delta$ is considered to get the low efficiency rangeand $\tilde{y}_{1j} = 1,\ \ j = k+1, \ldots, n$, is determined, the equation (11) is not applied.Without losing information and for simplicity, we assume that only the first output is sequential data and sequential relations (11) is correct. By assigning the greatest possible value to the first output DMU_k and the lowest possible value to the first output DMU, upper efficiency range bound of DMU k can be used. So with substituting $y_{1j} = 1,\ \ j = 1, \ldots, k$, and $\tilde{y}_{1j} = \delta,\ \ j = k+1, \ldots, n$, this upper bound can be obtained by the following model (Saljughi and Giski, 2011):

$$E_k^U = \max u_1 + \sum_{r=2}^{s} u_r y_{rk}$$

$$\text{s.t} \quad \sum_{r=1}^{m} v_i y_{ik} = 1,$$

$$u_1 + \sum_{r=2}^{s} u_r y_{rj} - \sum_{r=1}^{m} v_i y_{ik} \leq 0, \qquad j = 1, \ldots, k,$$

$u_1 \delta + \sum_{r=2}^{s} u_r y_{rj} - \sum_{r=1}^{m} v_i y_{ik} \leq 0,\ \ j = k+1, \ldots, n,$ (15)

$$u_r, v_i \geq \epsilon \text{ all } r, i.$$

$y_{1j} = 1,\ \ j = 1, \ldots, k$, and $\tilde{y}_{1j} = \delta,\ \ j = k+1, \ldots, n$,are an optimal answer the following question:

$$E_k = \max u_1 y_{1k} + \sum_{r=2}^{s} u_r y_{rk}$$

$$\text{s.t} \quad \sum_{r=1}^{m} v_i y_{ik} = 1,$$

$u_1 y_{1j} + \sum_{r=2}^{s} u_r y_{rj} - \sum_{r=1}^{m} v_i x_{ij} \leq 0,\ \ j = 1, \ldots, n,$ (16)

$$1 \geq y_{11} \geq y_{12} \geq \cdots \geq y_{1n} \geq \delta,$$

$$u_r, v_i \geq \varepsilon \text{ all } r, i.$$

Proof: consider (y_{1j}^*, v_i^*, u_r^*) is optimal solution of model (16). u_1^* is reduced to $\tilde{u}_1$ so that the relationship $u_1^* y_{1j}^* \geq u_1^* y_{1k}^* = \tilde{u}_1$ is established.

$u_1^* y_{1j}^* \geq u_1^* y_{1k}^* = \tilde{u}_1 \ \ j = 1, \ldots, k$ (17)

According to equation (17) the following equation is true:

$$\tilde{u}_1 + \sum_{r=2}^{s} u_r^* y_{rj} - \sum_{r=1}^{m} v_i^* x_{ik} \leq$$

$u_1^* y_{1j} + \sum_{r=2}^{s} u_r^* y_{rj} - \sum_{r=1}^{m} v_i^* x_{ij} \leq 0, \quad j = 1, \dots, k,$ (18)

And the following:

$$\tilde{u}_1 \delta + \sum_{r=2}^{s} u_r^* y_{rj} - \sum_{r=1}^{m} v_i^* x_{ik} \leq$$

$u_1^* y_{1j}^* + \sum_{r=2}^{s} u_r^* y_{rj} - \sum_{r=1}^{m} v_i^* x_{ij} \leq 0, \quad j = k+1, \dots, n,$ (19)

$u_1^* y_{1k}^* + \sum_{r=2}^{s} u_r^* y_{rk} = \tilde{u}_1 + \sum_{r=2}^{s} u_r^* y_{rk}$ (20)

According to relations (18) and (19), the sentence is proven. According to the statement, we can simply showthat the optimal model (15) and (16) are equal.

$$E_k^U = \max u_1 + \sum_{r=2}^{s} u_r y_{rk}$$

$$\text{s.t} \quad \sum_{r=1}^{m} v_i y_{ik} = 1,$$

$$u_1 + \sum_{r=2}^{s} u_r y_{rj} - \sum_{r=1}^{m} v_i y_{ik} \leq 0, \qquad j = 1, \dots, k,$$

$u_1 \delta + \sum_{r=2}^{s} u_r y_{rj} - \sum_{r=1}^{m} v_i y_{ik} \leq 0, \ j = k+1, \dots, n,$ (21)

$$u_r, v_i \geq \epsilon \ \text{ all } r, i.$$

Proposition: $y_{1j} = 1, \ j = 1, \dots, k,$ and $\tilde{y}_{1j} = \delta, \ j = k+1, \dots, n,$ are optimal answers to the following question:

$$E_k = \max u_1 y_{1k} + \sum_{r=2}^{s} u_r y_{rk}$$

$$\text{s.t} \quad \sum_{r=1}^{m} v_i y_{ik} = 1,$$

$u_1 y_{1j} + \sum_{r=2}^{s} u_r y_{rj} - \sum_{r=1}^{m} v_i x_{ij} \leq 0, \ j = 1, \dots, n,$ (22)

$$1 \geq y_{11} \geq y_{12} \geq \cdots \geq y_{1n} \geq \delta,$$
$$u_r, v_i \geq \varepsilon \ \text{ all } r, i.$$

Analysis of the Results

Initially, four villagers were determined to prioritize gas supply. Important indicators of gas supply were sent to experts in the form of 15 questions and finally 10 more important indicators were selected. In this study, to determine the validity of the questionnaire using Cronbach's Alpha was used. As Cronbach's Alphais closer to 1 number, it yields better content validity. Sekaran, 2001, using SPSS, reported that reliability of questionnaire is 0.826. After obtaining unit paired comparison matrix, using geometric mean $\acute{a}_{ij}$, we act according to AHP algorithm so that the mean of each row is obtained among (l, m, u) scales and using the formula (l+2m+u)/4, defuzzification and normalization are fulfilled. As a result, we reach the weight of each criterion. Table 5 shows the results.

Table 2: Weight and Ranking of Rural Gas Supply Criteria

Gas Distribution Criteria	Number of Families	Distance from Gas Source	Acquiribility of Route's Lands	Village being in the Vicinity of an Industrial Unit	Cost per Branch	Climate Conditions	Village being in the Vicinity of Jungle	Existence of Job Making Projects in the Village	Path Texture and Abstacles	Aggregation of a Few Villages
Standard Weight	0.167	0.155	0.126	0.110	0.092	0.082	0.076	0.067	0.063	0.057
Standard Rating	1	2	3	4	5	6	7	8	9	10

Source: research findings

Table 3: Table Ranking Indices by AHP

	Number of Families	Climate Conditions	Village Being in the Vicinity of Jungle	Distance from Gas Source	Village being in the Vicinity of an Industrial Unit	Cost per Branch	Acquiribility of Route's Lands	Path Texture and Abstacles (Mountain, river, Valley,…)	Existence of job Making Projects in the Village	Aggregation of a few Villages
Village 1	0.325596	0.165976	0.182494	0.211947	0.247737	0.167711	0.362112	0.414358	0.607439	0.4619
Village 2	0.430401	0.350163	0.327591	0.206953	0.126078	0.010309	0.081296	0	0.220206	0.300478
Village 3	0.050417	0.31561	0.255926	0.315903	0.363311	0.41099	0.224785	0.36432	0.154637	0.087794
Village 4	0.193586	0.168251	0.233988	0.265198	0.262874	0.41099	0.331807	0.221322	0.017718	0.149828

source: research findings

The weight of AHPis considered asDEA input and the output is expert opinion given in Table 4.

Table 4: Input and output data of gas supply projects in villages

	input										output
	Number of Families	**Climate Conditions**	**Village being in the Vicinity of Jungle**	**Distance from Gas Source**	**Village being in the Vicinity of an Industrial Unit**	**Cost per Branch**	**Acquiribility of Route's Lands**	**Path Texture and Abstacles (Mountain, River, Valley,…)**	**Existence of Job Making Projects in the Village**	**Aggregation of a Few Villages**	**Expert's View**
village 1	0/325596	0/165976	0/182494	0/211947	0/247737	0/167711	0/362112	0/414358	0/607439	0/4619	0.7
village 2	0/430401	0/350163	0/327591	0/206953	0/126078	0/010309	0/081296	0	0/220206	0/300478	0.4
village 3	0/050417	0/31561	0/255926	0/315903	0/363311	0/41099	0/224785	0/36432	0/154637	0/087794	0.6
village 4	0/193586	0/168251	0/233988	0/265198	0/262874	0/41099	0/331807	0/221322	0/017718	0/149828	0.5

source: research findings

Table 11: Prioritization Results

		Efficiency Range
First Priority	Abtar	[0/71218,0/71223]
Forth Priority	Daman	[0/140,0/145]
Second Priority	Kolahdooz	[0/390527,0/390533]
Third Priority	Shams Abad	[0/226800.0/226804]

After selecting the desired villages to prioritize and evaluate the impact of 10 criteria on them, results were sent to experts. After collecting the opinions of experts and based on verbal language, these terms were converted in to quantitative data based on fuzzy scale. The numbers obtained in the preceding stage are based on the geometric mean elite scores and fuzzy AHP considered as input and Table 3 shows the results of the project show the weight of each criterion.

With substitution of the data in Table 4 in the DEA range model and without loss of generality and for simplicity, we assumed that only the first output is sequential data and sequential relations (11) is true. By assigning the maximum possible value to the first output of $DMU_k$and the minimum possible value to the first others output DMU, wecan calculate the upper bound efficiency range of DMU. So by putting $y_{1j} = 1,\ \ j = 1, \dots, k,$ and $\tilde{y}_{1j} = \delta,\ \ j = k+1, \dots, n,$ the upper bound of cab be obtained from the results of equations (21) and (22) (Saljughi and Giski, 2011).

Conclusion

Currently, gas supply project to villages experience no prioritization and the National Iranian Gas Company has started to supply villages with gas by replacing fossil fuels with natural gas and increasing the share of gas in energy basket. This study aims to introduce a method for prioritizing gas supply to villages in Sistan and Baluchistan province, Iran. In this study, we identified the effective factors in village prioritization. Then the weight of each indicator was determined by fuzzy AHP. After that DEA method was utilized to prioritize the villages. We concluded that, after studying fuzzy AHP and DEA to determine the weight, Abtar scored the first ranking. Then are Shahid Kolahdouz, Shams Abad, and Daman, respectively. Finally, future researchers are proposed to evaluate and asses the feasibility of project concerning village gas supply. They can also work on economic feasibility of such projects.

ACKNOWLEDGEMENT

Here we want to acknowledge the Sistan and Baluchestan Gas Company because of supporting the current project.

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