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RESEARCH ARTICLE

SPATIAL ASSESSMENT OF ACCESSIBILITY TO PUBLIC SERVICES IN IRAQI GOVERNORATES USING TOPSIS MODEL

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ABSTRACT

The presence of public services in adequate level is a crucial factor to achieve economic welfare and social development. Based on this view, TOPSIS model was used in this paper to rank the governorates of Iraq in terms of spatial distribution of public services and changes within 2007-2012 have been evaluated. Methodology of this research is descriptive, comparative, analytical and questionnaires method. Data used in this research are taken from statistical book published under the title of IHSES. The criteria used are the percentage of people whose housing unit is located 500 and 1000 meter distant from nearest services. These services include 1- primary school, 2- secondary school, 3- public hospital, 4- private hospital, 5- health center, 6- pharmacy, 7- police station, 8- post office, 9- place of worship, 10- youth center, 11- bank, 12- fire station, 13- municipality council, 14- bus station, and 15- market. Results showed that a significant change has occurred in the rank of governorate from 2007 to 2012. Bagdad (Ci: 0.650), Duhok (0.616), and Erbil (0.581) are in the best conditions and Babil (0.044) is in the worst conditions in terms of access to public services in 2012.

INTRODUCTION

The presence of public services in adequate level is a crucial factor to achieve economic welfare and social development and it plays an increasing role in the everyday life due to the continuity of population growth. Therefore, it is necessary to attain a balance between the availability of services and the number of population. In recent years, access to remarkable volume of services has become a key strategic consideration to achieve economic and social welfare. The population of Iraq has experienced tremendous change and an increasing growth rate during the past decade and all demographic indicators confirm this. Generally, in 2009, fertility rate in Iraq were 4.3% and the population increased from about 30 million in 2007 to 31.9 million by 2009, and according to the population projections, in this year (2016) the total population has increased to 37.8 million people (http://www.cosit.gov.iq/en/rtl-support). The above mentioned facts indicate the huge potentials of population to increase in Iraq, despite war and terrorism acts that Iraq authorities have encountered during the last period, while at the same time the public services did not witness the same level of development. The main purpose of Multiple-Criteria Decision Analysis (MCDA) or Multiple-Criteria Decision-Making (MCDM) is to determine the best candidate from a set of alternatives by evaluating several features of the alternatives (Chen and Lee, 2010).

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In spite of the fact that much scholarly papers has been written on MCDA/MCDM and its applications, according to the world literature in this regard, little attention has been paid to the role of MCDA/MCDM in the field of public services assessment, either inside cities or on the regional level. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) which is a kind of multi-criteria decision making technique was introduced to reflect the uncertainty of input data and criteria weighting values, and deemed one of the major decision-making techniques within many interdisciplinaries. There are multiple search trends in this regard. Some researchers have tried to modify the main TOPSIS model, either to enhance the statistical side of traditional model (Chen, and Lee, 2010; Jahanshahloo, 2006; Olson, 2004; Fu, 2008; Rostamzadeh and Sofian, 2011; Izadikhah, 2009; Shih, *et al*, 2007), or to achieve specific goals in some fields of study. Others tried to use TOPSIS along with other techniques like analytical hierarchy process (AHP) (Fox and Everton, 2014; Fox,W.P, 2014; Gumus, 2009; Chang, 2015), Fuzzy Analytic Hierarchy Process (FAHP) (Ertuğrul, and Karakaşoğlu, 2009; Kengpol, *et al*, 2013), total quality management (TQM) (Saremi, *et al*,2009), VIKOR method (Opricovic, and Tzeng, 2007; Opricovic, S., Tzeng. 2004) multi-choice goal programming (MCGP) (Liao, and Kao, 2011), Goal Oriented Requirements Engineering (GORE) (Mansoor, *et al*, 2015), fuzzy analytic network process (FANP) (Zhou and Lu, 2012), and AHP, Fuzzy, and Ordered Weight Analysis (OWA) (Sadidi, *et al*, 2014), to solve some practical problems in many scientific interdisciplinary to support decision-makers to enhance performance in selecting the best one among a set of alternatives, like supply management (Wang *et al* ,2009) business and economy (Yu, X, *et al*, 2011; Ye, 2010; Fan, 2011; Christian, *et al*, 2016; Dedania, *et al*. 2015; Sun and Lin, 2009; Torlak, *et al*, 2011), industry (Sun, C.C, 2010), human resource management (Mammadova and Jabrayilova , 2014; Yilmaz, and Alp, 2016; Saremi, *et al*, 2009; Wang and Chang, 2007), treated wastewater (TWW) (Jeon, *et al*, 2013; Cheng, *et al*, 2002), water management (Lai *et al*.,1994). Despite the popularity and simplicity in concept, TOPSIS is rarely applied in the field of spatial assessment of phenomenon's values. Mohammadi *et al*. (2014) introduced an article trying to assess the spatial distribution of services in urban areas using TOPSIS model to rank urban neighborhoods of Piranshahr city in Iran according to volume of services. They revealed the imbalance and inequality in spatial distribution of services between neighborhoods. In the same way and methodology, Taghvayi and Kiyoumarsi (2010) attempted to detect the level of gross inequalities in services between neighborhoods of Abade city in Iran. While in a case study on Isfahan in Iran, Nastaran *et al*. (2010) introduced a classification of urban areas to distinguish between possession and deprived areas in services.

Eventually, Behzadian *et al*, (2012) and Abou-El-Enien *et al*. (2015) attempted to determine various application areas of TOPSIS especially within 2000-2015. It was classified into nine categories that included, (1) Supply Chain Management and Logistics, (2) Design, Engineering and Manufacturing Systems, (3) Business and Marketing Management, (4) Health, Safety and Environment Management, (5) Human Resources Management, (6) Energy Management, (7) Chemical Engineering, (8) Water Resources Management and (9) Other topics (like: Medicine, Agriculture, Education, Design, Government) through reviewing over 266 papers published in 103 scholarly journals which were disseminated in the famous library databases. The main purpose of this article is to employ traditional TOPSIS approach in the public services sector to evaluate the spatial distribution of main public services elements among Iraqi governorates. In general, the purpose of this study can be determined via three key issues: (a) ranking the Iraqi governorates according to their relative closeness coefficient on the basis of criteria that are most critical to access the prosperity in this sector; (b) providing useful information for government institutions concerned with services sector planning to evaluating their potential objectives and strategies; and (c) facilitating the mission of decision makers to separate spatial units that suffer from shortage and have high levels of efficiency in public services. The rest of the article is organized as follows. Section 2 describes data and materials employed in the article, and the methodology conducted to access the results. Section 3 provides a brief overview and the implementation steps used in TOPSIS. Results and discussions were presented in Section 4, while conclusions are proposed in Section 5.

MATERIALS AND METHODS

This study was carried out on the level of Iraqi governorates. Therefore, the statistical society is total population of Iraqi states living across 18 governorates.Key data were obtained from a field survey of public services using questionnaire method, which was conducted by the Central Organization for Statistics and Information Technology (COSIT) and the Kurdistan Region Statistics Organization (KRSO) in collaboration with the World Bank in a project called Iraq Household Socio-Economic Survey (IHSES) in 2007 and 2012. Data were collected using sample survey; IHSES-II (2012) intends to provide estimators of comparable quality for each one of Iraq's 118 gadahs (districts). This implies that the sample should be explicitly stratified by gadah, with a similar sample size allocated to each gadah, regardless of its size. A sample size of 216 households per gadah is proposed, equivalent to a total sample of 25,488 households for the country. (COSIT and KRSO and the Word Bank, Iraq Household Socio-Economic survey, second round, p. 3, 2012). The sample size of IHSES-I (2007) was 18,144 households all over Iraq. Nine hundred and seventy two households were selected in each governorate (324 households in the center of governorate and 324 households in other urban areas and 324 households in rural areas), except Baghdad, where the sample size was 1,620 households. The following formula was used to calculate the sample size in each governorate:

$$N = \frac{Z^2_{-a/2}\ .\ P(1-P).\text{deff}}{E^2}$$

Where, $Z^2_{-a/2}$ equals 1.96 (at the 95 percent confidence level). An upper bound for P (1 – P) is 0.25. The maximum acceptable error for the estimation of proportions was set to 7.7 percent, and the design effect (deff) was assumed to be 2 (COSIT and KRSO and the Word Bank, Iraq Household Socio-Economic survey, 2007, P. 15). The dataset of IHSES entails 54 criteria for each governorate and covers the years from 2007 to 2012. We capture 15 criteria that are expected to affect the assessment process of performance in public services, which evaluate the distance between households, and each sort of services. Then, answers were converted into percentage, as shown in Table 1. However, the optimum distance between each service establishment and households is different; in accordance with the theoretical criterion of spatial planning that is applied in Iraq in services sector, Table 2 shows the criteria and optimum distance used in the study.

Table 1. An illustrative model of data arrangement in IHSAS (Distance to Elementary school (m) in 2007)

Distance to Criteria	0-100	100-200	200-500	500-1000	1000-1200
Spatial unites	%	%	%	%	%
Duhok	12	4	5	1	2
Erbil	15	10	6	3	1

Multi approaches have been used in the analysis process, that combine descriptive and comparative analysis, fieldwork and questionnaires, besides the combination between Multi Criteria Decision Analysis tools (TOPSIS) and GIS capabilities.

The fundamental assumption of the research arises via asking the following question "Is it possible to apply this method to rank and assess spatial units on the basis of overall quality of public services?" We think that through utilizing TOPSIS technique, it could identify the relevance of the relative performance in public services, and indicate the degree of performance difference between spatial units, and then it could adequately evaluate and rank the relative performance of the public services at the level of governorates as spatial units. The comparison process has been conducted on a solid basis through adoption of a set of commonly accepted criteria. This technique was utilized due to many advantages stated by many researchers (Saremi, et al., 2009; Yu, X, et al., 2011; Shih, et al, 2007), the most important of which is its characteristics in appropriately dealing with linguistic variables expressed in fuzzy numbers (Chu, and Lin, 2009) in order to overcome the ambiguity, subjectivity and vagaries in parameters. Finally, the Jenk's natural breaks classification scheme in ArcGIS 10.3 environment were used to classify TOPSIS results, relating to ranking Iraqi governorates according to the level of quality public services, which is the best method of classification and designed to determine the best arrangement of values into different classes.

Table 2. Criteria and optimum distance (m) for each criterion

Criteria years	Elementary school	Mid, basic or high school	Public hospital	Private clinic	Public medical center	Pharmacy	Police station
2007	500	1000	1000	1000	1000	1000	1000
2012	500	1000	1000	1000	1000	1000	1000

Criteria	Post office	Place of worship	Youth center	Bank	Fire station	Municipal council	Private bus/taxi	Markets
2007	1000	1000	1000	1000	500	1000	1000	500
2012	1000	1000	1000	1000	500	1000	1000	500

TOPSIS was first presented by Yoon (1980) and Hwang and Yoon (1981), to solve Multiple Criteria Decision Making (MCDM) problems based on the concept that the chosen alternative should have the shortest Euclidian distance from the Positive Ideal Solution (PIS) and the farthest distance from the Negative Ideal Solution (NIS). For instance, PIS maximizes the benefit and minimizes the cost, whereas NIS maximizes the cost and minimizes the benefit. It assumes that each criterion require to be maximized or minimized (Srikrishna S1, Sreenivasulu Reddy and A1, Vani S1, 2014). In this way, the matrix n×m with m (alternative) and n (index) is evaluated. While the examined subject is an alternative, and index is characteristics or operational parameters for selection, decision on TOPSIS is a simple and useful technique to rank a number of possible alternatives according to closeness to the ideal solution. The ideal solution should have a rank of ‗1' (one), while the worst alternative should have a rank approaching ‗0' (zero).

Advantages of this method compared to other priorities in place are:

- Both quantitative and qualitative criteria are involved in the discussion of spatial Analysis;
- Considers the conflict and similarity between indicators;
- It is a simple and fast procedure;
- Results of this model are consistent with experimental methods.

Mathematically, application of the TOPSIS method involves the following steps.

Step 1: Establishing the Decision Matrix

The first step of the TOPSIS method involves the construction of a Matrix of Data.

$$\begin{matrix} & \begin{matrix} C_1 & C_2 & \cdots & C_m \end{matrix} \\ \begin{matrix} L_1 \\ L_2 \\ \vdots \\ L_m \end{matrix} & \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1n} \\ X_{21} & X_{22} & \cdots & X_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ X_{m1} & X_{m2} & \cdots & X_{mn} \end{bmatrix} \end{matrix}$$

Where, ‗i' is the criterion index (i = 1 . . . m); m is the number of potential sites and ‗j' is the alternative index (j= 1 . . . n). The elements C1, C2…, Cn refer to the criteria (public service): while L1, L2…, Ln refer to the alternative locations (Governorate of Iraq). Elements of the matrix are related to the values of criterion i with respect to alternative j.

Step 2: Calculating a Normalized Matrix

The normalized values represent the relative performance of the generated design alternatives. At this step, we try to make the data matrix without scale, so that each data matrix is divided on the size of each index vector. Each element of the matrix *(r_{ij})* is calculated by the following formula:

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}}$$

Where, a_{ij} is each element of decision matrix, and r_{ij} is normalized value for each element of matrix.

Step 3: Determining the Weighted Matrix

The weighting decision matrix is simply constructed by multiplying each element of each column of the normalized decision matrix by the random weights. In order to calculate the weighted matrix, it is necessary to have index weights. Then, with Shannon entropy method, we calculate the index weights according to the following equations:

$$P_{ij} = \frac{aij}{\sum_{ij}^{n}=aij}$$

$$E_J = -K \sum [pij \;\; ln\, pij] \quad , \quad K = \frac{1}{ln\, n}$$

$$D_J = 1 - E_J$$

$$W_J = \frac{dj}{\sum dj}$$

Where, P_{IJ} is computed by deviation of each element of decision matrix to summation of its column, *ln* is natural logarithm and *n* is the number of alternatives (18 governorates); W_J is the weight of each criteria.

The weighting decision matrix (v) is simply constructed by multiplying each element of each column of the normalized decision matrix (n) by the Shannon entropy weights ($w_{n\times n}$).

$$V = n \times w_{n\times n}$$

$$V_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \cdots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \cdots & w_{n1} r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ w_1 r_{m1} & w_2 r_{m2} & \cdots & w_n r_{mn} \end{bmatrix}$$

The weight of each criteria is based on $\sum_{i=1}^{n} w_{i=1}$ .In this regard, the most important indicators have the higher weight. In fact, matrix (v) is computed by multiplying each element of normalized matrix ($w_{n\times n}$) by their corresponding weights of Shannon entropy (n) of each criterion.

Step 4: Identifying the Positive and Negative Ideal Solution

The positive (A^+) and negative (A^-) ideal solutions are defined according to the weighted decision matrix via the following equations:

$$A^+ = \left\{ \left(Max\ v_{ij} \middle| j \in J\right) ,\left(Min\ v_{ij} \middle| j \in J'\right) \right\}$$
$$A^+ = \{V_1^+ ,V_2^+ ,V_3^+ , \dots , V_n^+ \}$$

$$A^- = \left\{ \left(Min\ v_{ij} \middle| j \in J\right) ,\left(Max\ v_{ij} \middle| j \in J'\right) \right\}$$
$$A^- = \{V_1^- ,V_2^- ,V_3^{-+} , \dots , V_n^- \}$$

Where, J is associated with the beneficial attributes and J' is associated with the non-beneficial attributes. A^+ is the positive ideal (the best governorate according to special criteria,); A^- is the negative ideal (the worst governorate according to special criteria).

Step 5: Calculating the Euclidean distance from the ideal and non- ideal solution for each alternative

Distance from positive (s_i^+) and from negative ideal (s_i^-):

$$s_i^+ = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^+\right)^2}$$

$$s_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^-\right)^2}$$

Where, i=criterion index, j=alternative index and v_{ij}=each component of weighted matrix; v_j^+ is the maximum value of each criteria; v_j^- is the minimum value of each criteria.

Step 6: Measuring the relative closeness of each governorate to the ideal solution

For each competitive alternative, the relative closeness of the potential location with respect to the ideal solution is computed as:

$$C_i^+ = \frac{s_i^-}{s_i^- + s_i^+}$$

Where, C_i^+ is the closeness of each alternative to the ideal alternative.

Step 7: Ranking the Preference Order

According to the value of *Ci,* the higher the value of the relative closeness, the higher the ranking order and hence the better the performance of the alternative.

Table 3. Decision Matrix: The proportion of households that have access to public services to all households in the province in 2007

Governorate	primary School	Secondary School	Public Hospital	Private Hospital	Health Center	Pharmacy	Police Station	post office	worship	youth center	bank	Fire Station	muncipility	bus and car station	market
Duhok	66.99	65.65	15.13	42.28	49.63	49.26	38.87	23.44	87.54	34.42	24.85	16.10	29.45	68.32	83.90
Ninevah	58.36	49.97	7.75	32.25	36.13	33.42	24.67	12.10	76.18	15.38	9.87	5.31	18.04	53.21	44.08
Sulaimaniya	54.43	49.70	14.98	18.65	50.43	52.67	24.76	15.86	92.31	21.23	12.21	4.80	22.84	73.06	23.06
Kirkuk	78.60	55.14	9.55	14.87	40.51	41.72	23.70	12.09	92.14	10.16	13.18	2.30	10.64	59.49	58.89
Erbil	53.39	72.63	35.23	42.68	61.36	62.60	45.11	25.45	89.91	35.90	30.42	9.98	39.63	58.61	26.44
Diala	63.84	67.30	27.36	36.48	48.27	44.10	41.98	26.97	87.50	23.27	13.99	5.03	28.85	65.33	57.55
AL-Anbar	48.02	66.36	17.58	26.72	35.16	45.69	35.51	20.55	86.38	20.49	16.65	7.28	20.55	47.79	44.53
Baghdad	62.74	75.63	34.65	66.23	60.93	78.09	47.49	31.67	90.37	46.14	40.28	5.53	37.53	85.91	78.98
Babil	38.35	47.62	8.46	25.26	36.15	37.31	21.55	10.89	63.38	10.66	11.70	3.01	14.14	59.56	27.35
Kerbela	48.20	50.65	19.28	32.03	38.07	42.16	29.74	19.77	77.94	23.37	14.87	5.88	25.82	75.16	40.03
Wasit	52.83	51.82	28.04	24.71	36.95	31.76	26.80	20.45	64.29	24.01	15.10	6.82	21.38	51.43	25.95
Salahadin	43.80	59.46	17.18	34.65	41.29	51.14	36.34	19.34	77.29	22.71	15.20	4.37	17.30	48.17	45.08
AL-Najaf	45.05	62.07	16.87	48.76	61.30	59.44	39.01	23.68	80.65	25.39	20.59	5.26	15.33	74.46	41.95
AL-Qadisiya	50.93	57.34	16.55	31.82	42.31	43.24	36.95	34.73	68.18	29.60	17.72	10.49	43.12	64.10	38.34
AL-Muthanna	49.19	47.91	9.40	12.76	42.81	25.17	31.55	18.56	71.69	21.58	12.06	6.50	23.09	69.84	37.94
Thi Qar	60.02	65.58	23.84	32.47	51.76	41.65	38.59	28.66	80.33	29.78	22.82	8.35	31.82	67.53	47.22
Missan	68.01	53.65	28.57	31.91	48.99	41.93	44.88	33.00	79.58	33.07	24.15	10.40	47.90	55.12	30.59
Basrah	46.55	61.09	16.60	36.72	44.42	48.67	28.88	21.12	87.45	23.71	17.00	5.25	35.66	71.98	25.83

Reference: The Iraq Household Socio _ Economic Survey (IHSES 2), 2012

RESULTS AND DISCUSSION

Nowadays Iraq experiences an unbalanced growth like other under developing countries; this country has much political and economic challenge due to tribal wars, political and economic instability and terrorism. The sum of these factors greatly reduced the quality of life and livability in this country. On the other side, distribution of services between governorates is not based on spatial and social justice. Results of this research confirm above subjects. Therefore, a comparative matrix of positive and negative ideals (Table 6) indicates that there are severe imbalances between the provinces of Iraq in terms of access to public services. Therefore, Baghdad as a largest city and the capital of Iraq has maintained its first rank during 2007-2012.

Table 4. Decision Matrix: The proportion of households that have access to public services to all households in the province in 2012

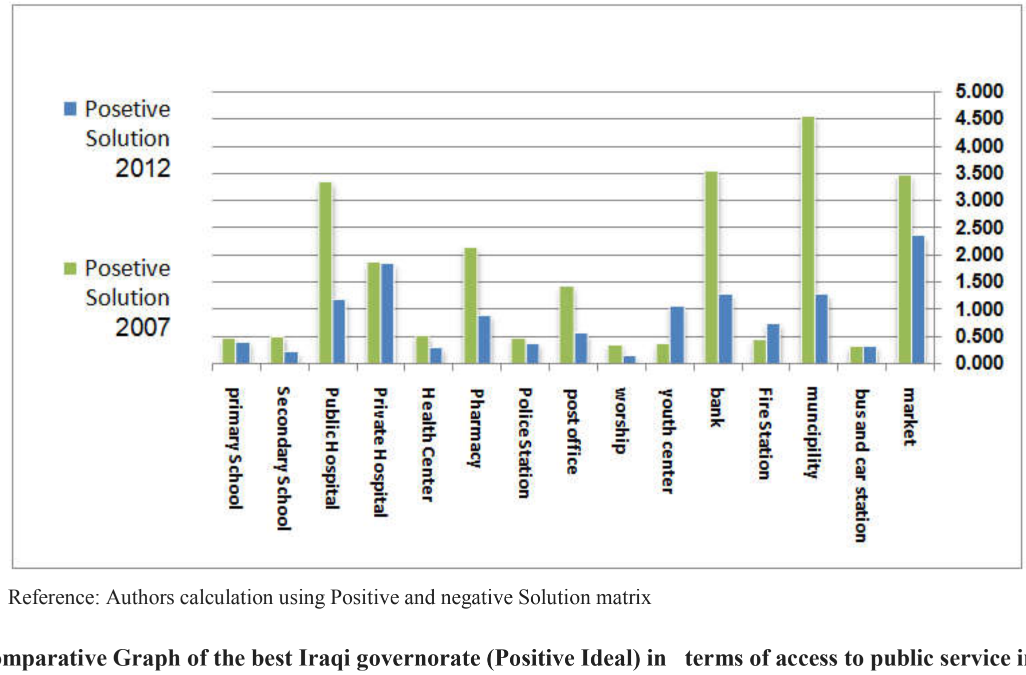
Governorate	primary School	Secondary School	Public Hospital	Private Hospital	Health Center	Pharmacy	Police Station	post office	worship	youth center	bank	Fire Station	municipality	bus and car station	market
Duhok	68.4	63.3	36.2	21.5	46.5	30.9	37.2	22.4	63.2	65.2	20.8	5.8	21	66.5	32.6
Ninevah	82.3	61.6	11.9	6	59.9	65.6	52.7	19.3	91.7	37.9	10.2	1.7	13	72.4	70.4
Sulaimaniya	71.9	70	16.8	19.8	53.7	22.4	39.7	17.8	90.4	62.1	18.9	8.8	32.9	56	29.1
Kirkuk	87.1	74.9	9.2	6.9	54.7	60.6	34.2	12.2	91.8	66.2	11.4	5.2	13	89.3	88.9
Erbil	62.7	58.3	13.8	12.4	36.4	36.8	37.8	13.6	85.3	70.3	19.9	1.8	26.3	79.9	41.8
Diala	76.1	72	25.9	21.6	57.7	65.3	40.8	27.8	82.5	52.6	23.7	9.1	28.8	83.1	34.1
AL-Anbar	51	72.9	11.9	4.4	49.3	57.4	29.1	13.8	88.8	46.9	7.3	1.7	10.3	88.2	43.5
Baghdad	82	90.7	50.8	22	72.6	90.5	55.3	46.5	96.7	75.4	50.1	9.3	64.9	96.4	88.4
Babil	43.2	46.7	10.6	3.1	31.7	39.6	24.9	13.4	60.8	49	13.2	2.8	12.4	68.9	27.7
Kerbela	46.1	49.5	11.1	5.4	38	42.7	34.8	13	82.6	53.7	10.7	4.1	17.7	87.1	34
Wasit	69.6	63.6	24.3	9.6	42.6	40.9	33.5	22.9	75.1	61.6	14.9	4.5	22.6	75.6	33.1
Salahadin	56.9	60.7	16.7	6.2	37.1	45	29.4	13.6	85	54.6	12.3	2.3	19.3	52.4	45.6
AL-Najaf	59.7	70.5	16.2	9.7	47	61.2	48.7	24.2	74.5	71.7	17.5	3.4	15.2	89	41.8
AL-Qadisiya	53.6	56.9	16.9	8.9	43.6	34	37.5	21.6	60	62.4	11.7	6.3	40.9	77.1	34.1
AL-Muthanna	54.5	44.7	12.5	8	42.1	27.9	29.2	18	67.7	49.6	13.3	3.2	12	82.6	26
Thi Qar	64	63.3	20	4.3	47.6	36.4	28.3	20.1	68.8	64.6	13.2	6.4	19.1	72.7	26.8
Missan	56.6	45.5	9.1	0.7	36.9	35.3	29.9	17.5	57.3	49.2	9.6	5	44.1	66.1	25.1
Basrah	69.6	78	18.7	8.4	42.1	53.2	29.5	20.2	96	40.9	13.5	5.2	49.3	77.5	27.8

Reference: The Iraq Household Socio _ Economic Survey (IHSES 2) , 2012

Table 5. Weight of each criteria (Using Shannon entropy method)

weight of each criteria	primary School	Secondary School	Public Hospital	Private Hospital	Health Center	Pharmacy	Police Station	post office	worship	youth center	bank	Fire Station	municipality	bus and car station	market
W_j (2007)	0.017	0.017	0.116	0.195	0.02	0.055	0.024	0.059	0.013	0.016	0.112	0.115	0.136	0.011	0.086
W_j (2012)	0.015	0.01	0.085	0.062	0.016	0.03	0.025	0.046	0.006	0.056	0.067	0.092	0.068	0.012	0.066

Reference : Authors calculation using Shannon entropy method



Reference: Authors calculation using Positive and negative Solution matrix

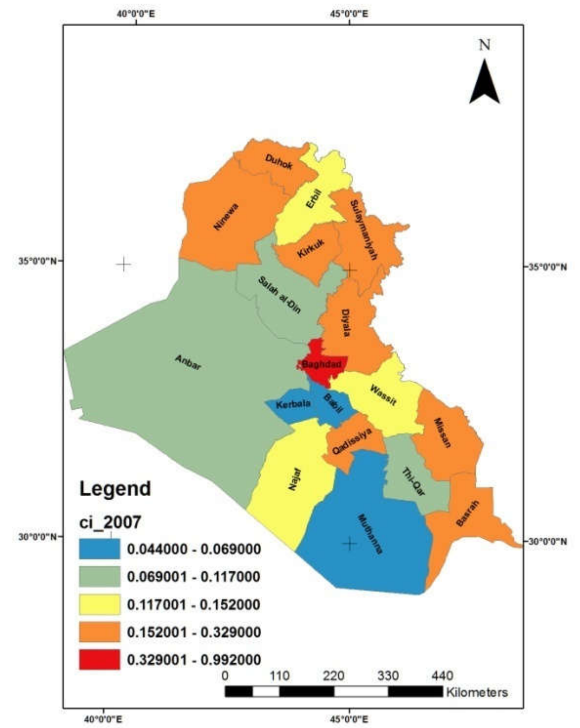
Graph 1. Comparative Graph of the best Iraqi governorate (Positive Ideal) in terms of access to public service in 2012 . 2007

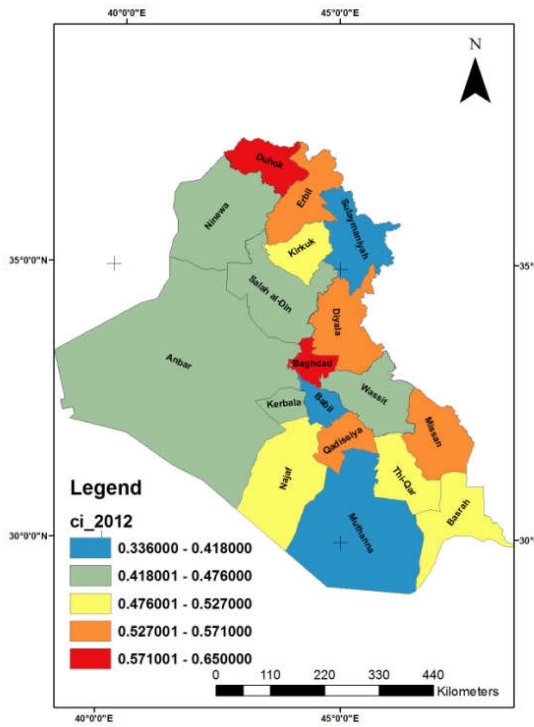
Table 6. Comparative matrix of the best and worst Iraqi governorate in terms of access to public service in 2012 . 2007

Index	Year	Governorate Name / Value	primary School	Secondary School	Public Hospital	Private Hospital	Health Center	Pharmacy	Police Station
Positive Ideal	2007	Governorate	Kirkuk	Baghdad	Baghdad	Baghdad	Baghdad	Baghdad	Baghdad
		Value	0.476	0.503	3.349	1.866	0.526	2.134	0.461
	2012	Governorate	Kirkuk	Baghdad	Erbil	Baghdad	Erbil	Baghdad	Baghdad
		Value	0.349	0.222	1.186	1.84	0.303	0.896	0.377
Negative Ideal		Governorate	Babil	Al- Muthanna	Missan	Missan	Babil	Suliemaniya	Babil
	2007	Value	0.117	0.122	0.107	0.002	0.100	0.131	0.093
	2012	Governorate	Babil	Babil	Ninevah	Al- Muthanna	AL -Anbar	AL_ Muthanna	Babil
		Value	0.094	0.088	0.057	0.068	0.099	0.093	0.078

Index	Year	Governorate Name / Value	worship	youth center	bank	Fire Station	municipality	bus and car station	market
Positive Ideal	2007	Governorate	Baghdad	Baghdad	Baghdad	Baghdad	Baghdad	Baghdad	Baghdad
		Value	0.354	0.365	3.541	0.437	4.549	0.312	3.476
	2012	Governorate	Kirkuk	Baghdad	Baghdad	Duhok	Missan	Baghdad	Baghdad
		Value	0.158	0.053	1.282	0.746	1.285	0.328	2.351
Negative Ideal	2007	Governorate	Missan	AL-Anbar	AL-Anbar	AL-Anbar	AL-Anbar	Salahadin	Missan
		Value	0.124	0.092	0.075	0.015	0.115	0.092	0.277
	2012	Governorate	Babil	Ninevah	Ninevah	AL-Anbar	kirkuk	AL- Anbar	Sulaimanya
		Value	0.075	0.051	0.077	0.015	0.063	0.101	0.178

Reference: Authors calculation using TOPSIS Model





Reference: Authors calculation using TOPSIS Model and Arc GIS

Map 1. Ranking of Iraq governorate according (ci) in 2007

Map 2. Ranking of Iraq governorate according (ci) in 2012

In addition, there are significant gaps in terms of access to public services between this city and other provinces of Iraq. This means that there is extreme centralization of facilities and services in Bagdad. However, the important issue is that distribution of public services and access to facilities moves towards spatial balance, such that in 2012, the distance of positive ideal (the best governorate) and negative ideal (the worst governorate) declined according to each criterion compared to 2007. In addition, standard deviation of positive and negative ideal decreased from 1.430, 0.038 in 2007 to 0.639, and 0.035 in 2012, respectively. Assessment and review of distance from positive (Si^+) and negative solution (Si^-) show a significant result, such that in 2007 the average of Si^- is 1.954 and the average of Si^+ is 6.596; while this value in 2012 is equal to 1.217 and 1.054 respectively. Standard deviation of Si^- decreased from 1.731 in 2007 to 0.775 in 2012 and standard

Table 7. Comparative matrix of the best and worst Iraqi governorate in terms of distance form Ideal Alternatives, Final rank of each governorate in 2007, 2012

Governorate	2007				20012			
	Si-	Si+	Ci	Rank	Si-	Si+	C_I	Rank
Duhok	2.522	6.489	0.280	5	2.567	1.602	0.616	2
Ninevah	2.232	6.932	0.244	6	0.635	0.797	0.444	15
Sulaimaniya	1.998	6.709	0.229	7	0.515	0.718	0.418	16
Kirkuk	3.363	6.860	0.329	2	1.047	1.023	0.506	9
Erbil	1.193	6.880	0.148	11	1.925	1.387	0.581	3
Diala	2.550	6.156	0.293	4	1.404	1.185	0.542	5
AL-Anbar	0.988	7.467	0.117	13	0.732	0.855	0.461	14
Baghdad	7.894	0.067	0.992	1	3.462	1.861	0.650	1
Babil	0.354	7.684	0.044	18	0.253	0.503	0.335	18
Kerbela	0.560	7.503	0.069	16	0.765	0.874	0.466	13
Wasit	1.055	6.987	0.131	12	0.817	0.904	0.475	12
Salahadin	0.897	7.186	0.111	14	0.826	0.909	0.476	11
AL-Najaf	1.262	7.041	0.152	10	1.244	1.116	0.527	7
AL-Qadisiya	1.808	6.626	0.214	9	1.347	1.161	0.537	6
AL-Muthanna	0.398	7.658	0.049	17	0.481	0.693	0.409	17
Thi Qar	0.697	7.369	0.086	15	1.208	1.099	0.524	8
Missan	2.006	6.878	0.226	8	1.728	1.314	0.568	4
Basrah	2.667	6.242	0.299	3	0.955	0.977	0.494	10

Reference: Authors calculation using TOPSIS Model

deviation of Si^+ is 1.689 in 2007. However, this value declined to 0.324 in 2012 too. Reviewing closeness to ideal solution (*Ci*) as a final index shows that Baghdad (0.992) and Babil (0.044) are in the first and last rank in 2007 and this rank has not changed in 2012 (Table 7). The rank of Kirkuk and Basra governorates have dropped from second and third in 2007 to ninth and tenth in 2012. In addition, Nineveh and Sulaymaniyah have dropped from sixth and seventh to fifteenth and sixteenth; while the provinces of Duhok and Erbil have taken above ranks due to the security and economic development of the regional governorate of Kurdistan (Table 7). Generally, provinces that are faced with the phenomena of insecurity, war and violence, political and social instability, their rank of benefiting public services at national level has dropped. However, safe and lawful provinces have improved in this situation.

REFERENCE

Central organization for statistic and information technology of Iraq & Kurdistan region statistics organization& the word bank 2007. Iraq household socio – economic survey.(www.cosit.gov.iq and www.wordbank.org/iq).

Central organization for statistic and information technology of Iraq & Kurdistan region statistics organization& the word bank 2012. Iraq household socio – economic survey.(www.cosit.gov.iq).

Chang, Yu-Wei, 2015. Employee Performance Appraisal in a Logistics Company. Open Journal of Social Sciences,3, 47-50.(http://dx.doi.org/10.4236/jss.2015.37008)

Christian, A.V., Zhang, Y. and Salifou, C.K. 2016. Country Selection for International Expansion: TOPSIS Method Analysis. Modern Economy, 7, 470-476. (http://dx.doi.org/10.4236/me.2016.74052)

CHU,TA-CHUNG. 2002. Facility Location Selection Using Fuzzy Topsis Under Group Decisions. International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems. 10, (06), 687-701 http://www.worldscientific.com/doi/abs/10.1142/S0218488502001739).

Dedania, H.V., Shah, V.R., Sanghvi, R.C. 2015. Portfolio Management: Stock Ranking by Multiple Attribute Decision Making Methods. Technology and Investment, 6, 141-150.(http://dx.doi.org/10.4236/ti.2015.64016)

Ertuğrul, İrfan. & Karakaşoğlu, Nilsen. 2009. Performance evaluation of Turkish cement firms with fuzzy analytic hierarchy process and TOPSIS methods. Expert Systems with Applications, Volume 36, Issue 1, Pages 702–715.(doi:10.1016/j.eswa.2007.10.014)

Fan, C.K., Lee, Y.H., Lee, L.T., & Lu, W.Q. 2011. Using TOPSIS & CA Evaluating Intentions of Consumers' Cross-Buying Bancassurance. *Journal of Service Science and Management,* 4, 469-475. (doi:10.1016/j.eswa.2008.01.034)

Kengpol, A., Rontlaong, P., & Tuominen, 2013. A Decision Support System for Selection of Solar Power Plant Locations by Applying Fuzzy AHP and TOPSIS: An Empirical Study. Journal *of Software Engineering and Applications*, 6, 470-481. (http://dx.doi.org/10.4236/jsea.2013.69057)

Liao, C.N. & Kao, H.P. 2011. An integrated fuzzy TOPSIS and MCGP approach to supplier selectionin supply chain management. Expert Systems with Applications, Volume 38, Issue 9, 10803–10811. (doi:10.1016/j.eswa.2011.02.031)

Mansoor, A., Streitferdt, D., & Füßl F.F. 2015. Alternatives Selection Using GORE Based on Fuzzy Numbers and TOPSIS. Journal of Software Engineering and Applications,8, 346-359. (http://dx.doi.org/10.4236/jsea.2015.87035)

Mohamadi, J & Rasoli, M & Dastineh, H & Parhiz, F 2014. Analysis of services spatial distribution in the urban areas (Piranshahr city as a case study) journal of sociological research , vol 5 , nomber1, Iran.

Nastaran. et al paper, 2010. TOPSIS techniques used in the analysis and rating of the sustainable development of urban areas (Case Study of Isfahan, Iran).

Opricovic, S., Tzeng,G.H. 2004. Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. *European Journal of Operational Research,* Volume 156, Issue 2, 445–455.

Rad, A.R.J., & Busch, W. 2011. Porphyry Copper Mineral Prospectivity Mapping Using Interval Valued Fuzzy Sets Topsis Method in Central Iran. Journal of Geographic

Information System, 3, 312-317.(http://dx.doi:10.4236/ jgis.2011.34028)

Sadidi, J., Saeedi, R., Torahi, A., & Firuzabadi, P.Z. 2014. Determining the Optimal Algorithm to Locate the Best Place for Earthquake Refugee Camps: A Case Study for Tehran, Iran. Positioning, 5, 97-106. (http://dx.doi.org/ 10.4236/pos.2014.54012)

Saremi, M., Mousavi, S. F., & Sanayei, A. 2009. TQM consultant selection in SMEs with TOPSIS under fuzzy environment. Expert Systems with Applications, 36, 2742–2749.(doi:10.1016/j.eswa.2008.01.034)

Sun, C.C., Lin, G.T.R. 2009. Using fuzzy TOPSIS method for evaluating the competitive advantages of shopping websites. Expert Systems with Applications, 36, 11764–11771 (http://dx.doi:10.1016/j.eswa.2009.04.017)

Taghvaei & Kiyoumarsi 2010. The benefit of municipal services for urban neighborhoods by using TOPSIS, Case study: Abade city , Iran).

Yilmaz, F., Alp, S. 2016.Underlying Factors of Occupational Accidents: The Case of Turkey. Open Journal of Safety Science and Technology, 6, 1-10. (http://dx.doi.org/ 10.4236/ojsst.2016.61001)

Zhou, X., Lu, Mi, 2012. Risk Evaluation of Dynamic Alliance Based on Fuzzy Analytic Network Process and Fuzzy TOPSIS. Journal of Service Science and Management, 5, 230-240.(doi.org/10.4236/jssm.2012.53028)

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