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Economic and Social Sustainability for Iraqi Middle Provinces

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A R T I C L E I N F O	A B S T R A C T
	This research is part of a study concerned with building an integrated framework for development of sustainable urban planning in Iraqi provinces. Seven Iraqi middle provinces are covered in this study. The aim of the study is to determine, measure and evaluate economic and social sustainability in the Iraqi middle provinces. *The stages to achieve this research were based on establishing a two levels hierarchy framework (a level for categories and a level for indicators). In this study, the Economic dimension comprised of 6 categories and 18 indicators and the Social dimension comprised of 8 categories and 41 indicators. Through using the Multi Criteria Analysis method and the Analytic Hierarchy Process, the Sustainability Index has been determined and used to measure and evaluate the economic and social sustainability in the Iraqi middle provinces*

1. Introduction

More than 50% of the worldwide population live in urban or urbanizing areas. In just five years, we will add another people, all will need jobs, food, security and opportunity. Sustainable development have become imperative to meet their own needs. [1], [2]

Generally , sustainable development concept comprises of three aspects: economic, environmental and social. There are other sources that show other aspects: sustainability, aaccording to LA21, has four dimensions, namely: economic, environmental, social and governance or institutional aspects [3], shows that the three sustainability main dimensions, all located within the governance dimension that manages and controls these dimensions.

1.1. The economic dimension

It is considered as a base for development and any disruption of it or to the draining of its resources eventually will lead to the weakening of its future development opportunities, and then a long-term economic perspective must be taken to solve the problems in order to provide effort, money and resources [4].

1.2. The social dimension:

It is the right of a normal person in a clean and sound environment in which he can practice all activities while ensuring

his right in a fair share of natural resources and environmental and social services, and investing it in order to serve his basic needs (shelter, food, clothing, air ....) as well as the complementary needs to raise his standard of living (business, entertainment, fuel ....) and without reducing the chances of future generations[4].

1.3. Indexes

An index is a synthesis of indicators or composite indicator. Formalization of an indicator that necessitates the aggregation of several data or variables results in. In the field of sustainable development, the use of indexes facilitates the interpretation and understanding of given phenomenon indicators, particularly for the public. Indexing offers an instrument for benchmarking performance and provides information to enable decision-making and directing development [5]. According to its specific goals, Indicators should tell us in what fields the city is doing better than in others, and a single sustainability index should tell us whether the city is becoming more sustainable or not. Based on an aggregation method, the index is then calculated [6].

Composite indicators development is considered to be a unique approach for sustainable development evaluation. Calculating aggregated values is one of the common methods for establishing indices. Depending on its application, composites indices can be established without or with weights [7].

2. Methods Used in the Developing Sustainability Index

For developing mathematical sustainability index, the Methods used are:

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2.1 The Analytic Hierarchy Process (AHP)

This method is most widely used Multi Criteria Decision Making method, as it presented a deriving priorities and structuring the decision problem logically and representatively. The use of pair-wise comparisons, in AHP method is, to compare the alternatives regarding to the various criteria and to assess weights of criteria" [8].

The comparisons and priority calculation of AHP pairwise are executed to get the relative weights for objectives, sub objectives, and measures on every level of criteria in the hierarchy [9]. Figure 1 describes the principal steps for achieve the AHP. Table (1) shows a preference scale using for comparison. Ref. [10] suggested using the following consistency index (CI) as in (1):

$$CI = \frac{\lambda_{max} - n}{n - 1} \qquad (1)$$

Where

CI: is the consistency index

λ_{max}: is the largest Eigen value of matrix and

n: is the number of elements within a branch being compared. This consistency index can also be expressed as a consistency ratio as in (2):

$$CR = \frac{CI}{RI} \qquad (2)$$

where:

CR: is the consistency ratio

RI: is a known random consistency index obtained from a large number of simulation runs and varies depending upon the order of matrix.

Table 2 shows the random consistency index values (RI) for matrices of order 1 to 10 obtained by approximating random indices using a sample size of 500[11].
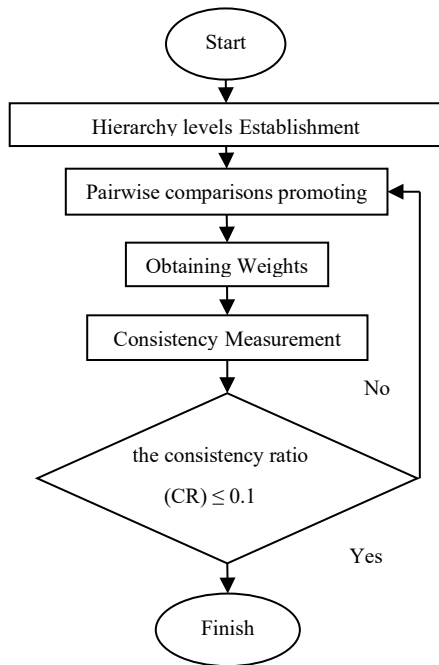

Figure 1 The principal steps for achieve the AHP [Researcher depending on [9]]

2.2 The Geometric Mean [12]

Equation (3) or (4) is used to find geometric mean:

$$G = \sum f_i \sqrt{\left(x_1^{f_1}\right)\left(x_2^{f_2}\right)\left(x_3^{f_3}\right)...\left(x_n^{f_n}\right)} \qquad (3)$$

or

$$\log(G) = \frac{\sum f_i \log(x_i)}{\sum f_i} \qquad (4)$$

Where, G: Geometric Mean

x_n: weights of each respondents' number.

f_i: respondents number for each weights.

n: $\sum f_i$: the all respondent sum.

Table 1 Saaty Rating scale

Importance	Definition	Explanation
1	Equal importance of both elements	Two elements contribute equally
3	Moderate importance of one element over another	Experience and judgment favour one element over another
5	Strong importance of one element over another	An element is strongly favoured
7	Very strong importance of one element over another	An element is very strongly dominant
9	Extreme importance of one element over another	An element is favoured by at least an order of magnitude
2,4,6,8	Intermediate values	Used to compromise between two judgments

Table 2 Average random index according to matrix size [11]

Matrix Size(n)	1	2	3	4	5	6	7	8	9	10
Random Index	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

2.3 Analysis Grey Relational (AGR) [13]

(GRA) is a measurement method for discussing the consistency of discrete uncertain sequence and its target. It initiates by the original sequence factor creation, the measurement space factor using grey-relational generation, that is classified into three types:

- Smaller-the-better grey-relational generation: the minimum of the sequence factors is the ideal factor.
- Larger-the-better grey-relational generation: the maximum of the sequence factors is the ideal factor is.
- Nominal-the-better grey-relational generation: the one with the sequence factors target value in line is The ideal factor.

In grey relational generation, (5) used for normalized data corresponding to criterion, when Lower-the-Better (LB):

$$X_{i(k)} = \frac{\max y_{i\ (k)} - y_{i(k)}}{\max y_{i(k)} - \min y_{i(k)}} \qquad (5)$$

Equation (6) used for the normalized data when Higher-the-Better (HB) criterion:

$$X_{i(k)} = \frac{y_{i(k)} - \min y_i}{\max y_{i(k)} - \min y_{i(k)}} \qquad (6)$$

Where:

$X_{i(k)}$: is the value of $y_{i(k)}$ after the grey relational generation,

min $y_{i(k)}$: is the smallest value of $y_{i(k)}$, and max $y_{i(k)}$: is the largest value of $y_{i(k)}$.

The purpose of Grey relational grade is to appear the relation degrees between the sequences say, $[X_{0(k)}$ and $X_{i(k)}$, $i = 1, 2, 3…, n]$.

The purpose of using GRA, in this research, is to normalize the values of realistic indicators by using (6) as the research intends maximum sustainability (higher is better).

3. Developing Economic and Social Sustainability Index

Reference [6] suggested steps for building the framework of composite indicators (index) as described in Figure 2. the steps for developing economic and social sustainability index in current study, are the following:
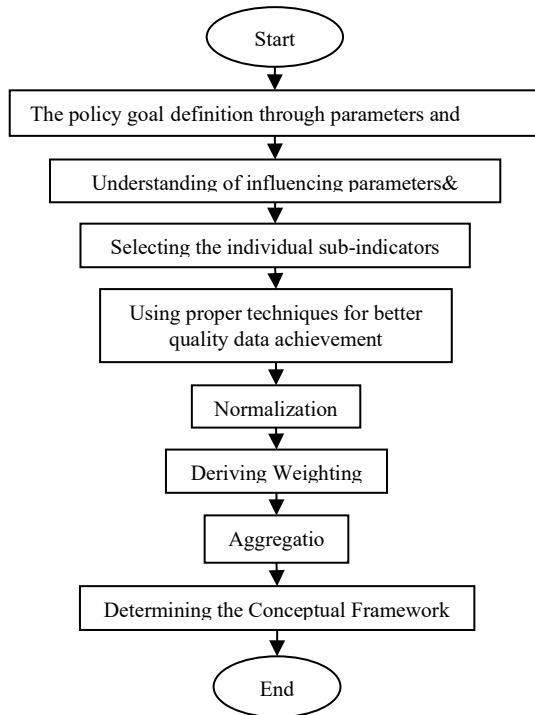

Figure 2: The Steps for establishing the framework of composite indicators [Researcher depending on [6]]

3.1. Developing Appropriate Sustainable Urban Framework

Reference [14] illustrated Developing three levels hierarchy Sustainable Urban framework for Iraqi cities (Dimensions,
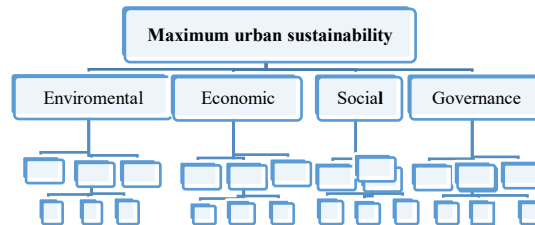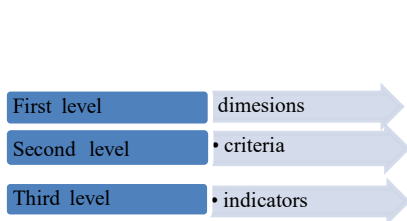
categories& indicators), as in Figure 3. This study deals with the economic and social dimension. Each dimension consists of two levels (categories level and indicators level). Six categories and eighteen indicators in The Economic dimension, and eight categories and forty-one indicators in The social dimension. the components for each dimension are shown in Table 3.

3.2. Determining Weightings Using AHP Method

Figure 4 illustrate the steps followed in the current research for determining framework components weighting by AHP method (Analysis Hierarchy Process).

The questioners used for finding the weight of categories, and indicators for economic and social dimension. The process of preparing questionnaire depends on research hierarchy framework and pair wise comparison. The questionnaire contains multiple issues and the answer accuracy needs a logical respondent with the following characteristics:

- Knowing about sustainability or urban sustainability.
- Involved in and active with projects and development of the governorate.

The researcher suggested to distribute at least (9) questionnaires for each governorate as in [15]. A list of the experts' respondents and their other information is summarized in Table 4. The number of received questionnaire respondents varies from one province to another, and the highest number of questionnaire received is (9) as in governorate of Baghdad and Salah Al-Deen and the lowest number is (4) as in the province of Wasit.

After accomplishing categories and indicators pairwise comparisons by the specialists' responses about the questionnaire, the aggregation for the individual judgments using the geometric mean as Saaty suggested in [16].

3.3. Determining Indicators Realistic Values

The researcher spent more than four months for collecting indicators realistic values for the study provinces. additional four months were needed for determining indicators values because of the difficulties to get fit value of indicator. The process of information gathering mainly depended on the Ministry of Planning / Central Statistical Organization & Information Technology (COSIT) in all its divisions, otherwise the values of indicators were obtained by other relevant ministries, authorities and departments, if information was unavailable. the process of determining values of indicators is as follows:

Figure 3: The hierarchy three levels Framework[Researcher]

Table 3: Economic and social sustainable framework component

Code	Details
2.	The economic dimension
2.1	The use of resources and energy
2.1.1	Electricity used per capita
2.1.2	Gasoline consumed per capita
2.1.3	Energy use per capita per year
2.2	Efficiency of economic development
2.2.1	Contribution of tourism to GDP
2.2.2	Investment share of GDP
2.2.3	Number of industrial projects
2.2.4	The share of government investment
2.3	Local government finance
2.3.1	Capital spending as a percent- age of total expenditures
2.3.2	Spending on research and development as a percentage of
2.3.3	Local government revenue
2.4	Services
2.4.1	Cost recovery
2.4.2	Loss in revenue as a result of power outages
2.5	Disasters
2.5.1	Percent of population living in areas at risk
2.5.2	Economic loss resulting from human and natural disasters
2.5.3	Safe design of the building of the topographic and geological
2.8	Economy population
2.8.1	Employment
2.8.2	Average family income
2.8.3	Per capita GDP
3.	The social dimension:
3.2	Health
3.2.1	The proportion of the number of hospitals and health
3.2.2	The proportion of the provision of potable water in urban areas, according to national standards
3.2.3	Hospital beds for every ten thousand people
3.2.4	rate of Mortality and birth
3.2.5	Number of doctors per capita
3.2.6	Access to sanitation facilities
3.2.7	Nutritional status of children
3.2.8	Immunization of children against disease infections
3.2.9	Prevalence of tobacco use
3.3	Education
3.3.1	The number of schools to population ratio
3.3.2	The number of researchers
3.3.3	Illiteracy rate for adults
3.3.4	Enrollment rates
3.3.5	The number of higher education graduates
3.3.6	The percentage of students who reach the fifth grade of primary education
3.3.7	The proportion of the number of students to teachers
3.3.8	The number of people who have graduated from junior
3.4	Housing
3.4.1	Housing shortage
3.4.2	The dimensions of the deficit housing and shortage ;neighborhoods, slums
3.4.3	Rent-to-income ratio
3.4.4	Optional decent housing or authorized
3.4.5	Type of tenure
3.4.6	Random housing
3.4.7	Abandoned housing
3.5	Social development and poverty eradication
3.5.1	percent of population living below the poverty line
3.5.2	The proportion of poor women , children with special needs who do not have access to community facilities and services
3.5.3	Child labor
3.5.4	Death under the age of five suffer from malnutrition
3.5.5	The proportion low-birth weight infants
3.5.6	The incidence of serious diseases
3.6	Violence and Crime
3.6.1	Violence in urban areas
3.6.2	Number of recorded crimes per 100,000 population
3.7	Urbanization and urban housing
3.7.1	The population growth rate
3.7.2	The number of families in one housing unit
3.7.3	Total net migration
3.7.4	The average household size for each family
3.7.5	The proportion of population living in urban areas
3.8	Culture of the community in sustainability
3.8.1	Public awareness of the population to hazardous
3.8.2	Percentage of the population who have gardens
3.9	Household Spending
3.9.1	Household spending
3.9.2	Average savings per household

- Some of the values were found directly.

- The researcher calculated some of these values with many equations and methods.

- Some indicators were calculated from some surveys that had a relationship to the indicators.

- Some indicators were new or that the relevant ministry responsible for providing the indicators values refused to provide the researcher with, so the researcher used an open interview questionnaire with Likert scale (i.e.,1: very low, 2: low, 3: medium ,4: high ,5: very high) to find its values.

- For the same reasons above, some of the economic indicators were found without monetary units.

- Some indicators included urban and rural regions together and some included urban only. In the first case, the indicator to be found was only for the urban through multiplication by the percentage of relevant urban in the governorate.
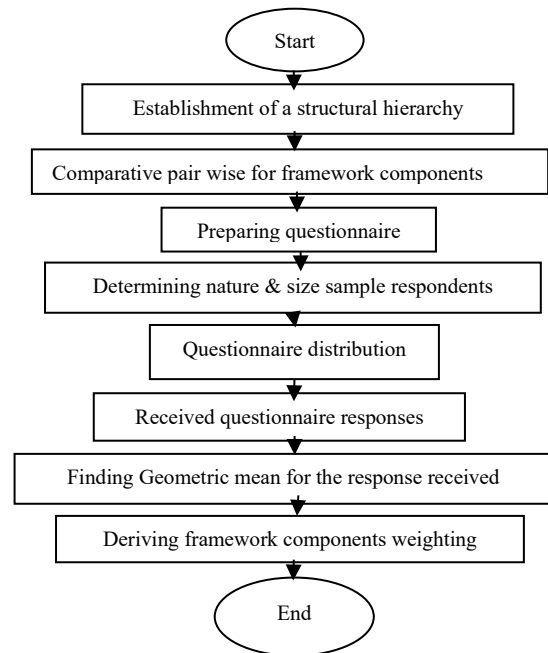

Figure 4: Flowchart for weighting framework components by AHP method [Researcher]

Table 4: Summary the respondents' information

provinces		Diala	Al-Anbar	Baghdad	Babylon	Kerbela	Wasit	Salah ALDeen
No. of respondents		8	5	9	7	5	4	9
Certificate	B.A.	2	0	0	0	2	2	3
	M.A.	2	0	4	3	2	0	1
	Ph.D.	4	5	5	4	1	2	5
profession	Planner	1	1	1	0	1	1	3
	Engineer	4	1	1	1	2	2	1
	Lecturer	4	3	3	6	2	1	5
Years of practice	10 to20	3	2	2	4	3	3	1
	more than 20	5	3	3	3	2	1	8

3.4. Indicators Influence identifying on Sustainability

Table 5 illustrated the direction of indicators against sustainability.

Table 5: Signs of indicators against sustainability [Researcher]

Signs of indicators	Means of the signs
-	If the indictor value increased sustainability decreased.
+	If the indictor value increased sustainability increased .

3.5. Using Analysis Grey Relational for Normalization indicators values

Because of the indicators values were not the same each other units, the normalization was performed to obtain one unit for all values of indicators, additionally to obtain sequential in the indicators values.

Equation (6) was used for normalization indicators values, the limits of indicators values normalization are between (0-1).

3.6. Determining Dimension Sustainability Index (DSI)by Aggregation

The base for determining the economic and social sustainability Indices is the aggregation as in (7).

$$DSI=\Sigma[W_c (\Sigma W_i X_i A_i)] \qquad (7)$$

Where:
DSI: Dimension Sustainable Index
W_c: Weight of Category c; W_i: Weight of Indicator i;
X_i: Normalized obtained of indicator value i in the study area;
A_i: 1 or -1, that depends on indicator i influence on sustainable; i: indicator Number for the category c;
c: categories Number.

4. Results

4.1. Categories and Indicators weight for Economic and Social Dimensions

Tables 6 and 7 show the weights and ranks of economic dimension categories.

It is clear from the table that the category(C2.1) ranking in two provinces is the second and fourth ranking and the highest weight in the Babylon province. the category(C2.2) ranking in two provinces is the first ranking and the highest weight in the Wasit province. The category(C2.3) ranking in three provinces is the first ranking and the highest weight in the Salah ALDeen province and sixth rank in two other provinces. The category(C2.4) ranking in three provinces is the first ranking and the highest weight in the Diala province .and second rank in two other provinces. The category(C2.5) ranking in three provinces is the sixth ranking and the highest weight in the Salah ALDeen province .and second rank in two other provinces. The category(C2.8) ranking in three provinces is the fifth ranking and the highest weight in the Diala province, third and fourth rank in

two other provinces. Tables 8,9 and10 show the weights and ranks of social dimension categories.

It is clear from the table that the category(C3.2) ranking in three provinces is the first and the highest weight in the Kerbela province. the category(C3.3) ranking in two provinces is the first ranking and the highest weight in the Wasit province and second rank in four other provinces. the category(C3.4) ranking in two provinces is the fourth ranking and the highest weight in the Al-Anbar province and fifth rank in two other provinces.

the category(C3.5) ranking in two provinces is the third ranking and the highest weight in the Diala province and fifth rank in three other provinces. the category(C3.6) ranking in two provinces is the sixth ranking and the highest weight in the Salah ALDeen province and seventh rank in three other provinces. the category(C3.7) ranking in three provinces is the eighth ranking and the highest weight in the Al-Anbar province. the category(C3.8) ranking in two provinces is the third ranking and the highest weight in the Diala province and fifth rank in two other provinces. the category(C3.9) ranking in two provinces is the seventh ranking and the highest weight in the Baghdad province and eighth rank in two other provinces. Table 11shows the priority summary for economic and social dimension categories.

Table 6: Weights and ranks of economic dimension categories

Category	C2.1		C2.2		C2.3	
Provinces	Rank	Value	Rank	Value	Rank	Value
Diala	2	0.157	5	0.115	4	0.117
Al-Anbar	1	0.072	2	0.078	1	0.283
Baghdad	4	0.109	6	0.055	1	0.179
Babylon	2	0.177	1	0.199	6	0.030
Kerbela	4	0.148	3	0.159	6	0.074
Wasit	3	0.153	1	0.241	2	0.213
Salah ALDeen	6	0.072	5	0.075	1	0.238

Table 7: Weights and ranks of economic dimension categories

Category	C2.4		C2.5		C2.8	
Provinces	Rank	Value	Rank	Value	Rank	Value
Diala	1	0.181	6	0.080	3	0.132
Al-Anbar	2	0.273	6	0.065	3	0.086
Baghdad	2	0.178	3	0.122	5	0.093
Babylon	5	0.075	3	0.144	4	0.142
Kerbela	1	0.163	2	0.160	5	0.111
Wasit	1	0.163	6	0.037	5	0.053
Salah Aldeen	3	0.174	2	0.200	4	0.098

Table 8: Weights and ranks of social dimension categories

Category	3.2		3.3		C3.4	
Provinces	Rank	Value	Rank	Value	Rank	Value
Diala	4	0.115	2	0.148	6	0.107
Al-Anbar	8	0.068	4	0.111	2	0.169
Baghdad	1	0.160	2	0.149	5	0.135
Babylon	1	0.261	2	0.176	5	0.089
Kerbela	1	0.206	2	0.133	3	0.121
Wasit	3	0.132	1	0.220	4	0.128
Salah Aldeen	7	0.093	1	0.163	4	0.121

4.2. Economic and Social Sustainability Index

In the current research, many mathematical equations, Microsoft Excel program was used. Table 12 shows a sample of sustainability index calculations for the economic dimension of Diyala province in excel sheet: After making calculations, Table13 illustrate the values of each sustainability dimension index in the current research. Figures 5and6 illustrate economic and social index for each province in study area. In the economic dimension, Baghdad got the first ranking followed by Wasit, and Salah ALDeen got the last ranking followed by Babylon. As for the social dimension, Baghdad got the first rank followed by Babylon and Wasit got the final ranking followed by Diyala.

Table 9: Weights and ranks of social dimension categories

Category	C3.5		C3.6		C3.7	
Provinces	Rank	Value	Rank	Value	Rank	Value
Diala	1	0.153	5	0.109	8	0.077
Al-Anbar	5	0.094	6	0.083	1	0.200
Baghdad	3	0.143	7	0.066	8	0.037
Babylon	5	0.089	7	0.068	3	0.167
Kerbela	5	0.109	6	0.102	4	0.111
Wasit	2	0.139	7	0.060	6	0.074
Salah Aldeen	3	0.128	2	0.151	8	0.062

Table 10: Weights and ranks of social dimension categories

Category	C3.8		C3.9	
Provinces	Rank	Value	Rank	Value
Diala	3.000	0.131	7	0.092
Al-Anbar	3.000	0.118	7	0.075
Baghdad	6.000	0.081	4	0.137
Babylon	4.000	0.105	8	0.036
Kerbela	7.000	0.097	8	0.076
Wasit	5.000	0.095	8	0.051
Salah ALDeen	5.000	0.113	6	0.113

Table 11: The priority summary for economic and social dimension categories.

Economic Category priority		Social Category priority	
Category	Rank	Category	Rank
C2.4	1	C3.2	1
C2.3	2	C3.3	2
C2.2	3	C3.5	3
C2.1	4	C3.8	4
C2.8	5	C3.4	5
C2.5	6	C3.6	6
		C3.7	7
		C3.9	8

2. Conclusions

In general, Degree of sustainability dimensions of Iraqi provinces, was very low: and Baghdad province got first in the economic and social index maybe it's because it is the capital. Salah ALDeen province got the last position in the economic index. Wasit province got the last position in the social index. The negative sign of the dimension index value means the sustainability was declined in that dimension. The economic index consisted of only one province with negative signal (Kerbela).

Table 12: A sample of economic sustainability index calculations of Diala

Code	Wc	Ci	Wi	Xi	Ai	WiXiAi	CI
2.1	0.157						
		2.1.1	0.416	0.026	-1	-0.011	
		2.1.2	0.200	0.001	-1	0.000	
		2.1.3	0.384	0.016	-1	-0.006	
					∑	-0.017	-0.003
2.2	0.115						
		2.2.1	0.228	0.000	1	0.000	
		2.2.2	0.211	0.049	1	0.010	
		2.2.3	0.377	0.028	1	0.011	
2.3	0.117					0.021	0.002
		2.2.4	0.185	0.023	1	0.004	
		2.3.1	0.295	0.051	1	0.015	
		2.3.2	0.431	0.013	1	0.006	
		2.3.3	0.274	0.037	1	0.010	
2.4	0.181					0.035	0.004
		2.4.1	0.439	0.016	1	0.007	
		2.4.2	0.561	0.006	-1	-0.003	
2.5	0.080					0.003	0.001
		2.5.1	0.209	1.000	-1	-0.209	
		2.5.2	0.284	0.600	-1	-0.171	
		2.5.3	0.506	0.506	1	0.256	
2.8	0.132					-0.124	-0.010
		2.8.1	0.184	0.084	1	0.015	
		2.8.2	0.494	0.282	1	0.139	
		2.8.3	0.323	0.065	1	0.021	
						0.176	0.023
						DI	**0.018**

Table 13: The values of economic and social index

Provinces	EconomicIndexDI2	Social IndexDI3
Diala	0.018	-0.116
Al-Anbar	0.02	-0.062
Baghdad	0.202	0.092
Babylon	0.003	0.084
Kerbela	-0.008	0.005
Wasit	0.046	-0.128
Salah ALDeen	-0.014	-0.044

The social index consisted of four provinces with negative values (Wasit, Diyala. Al-Anbar and Salah ALDeen). The dimension sustainability indexes (DSI) were varied from one province to another because of the index value depends on the categories and indicators weights and the indicators realistic value where the weights are based on the nature of region and the opinions of experts while the indicators realistic value depend on several things, as the following:

- The difference in topography and geography of the region, which contributes to different capacities.

- The difference in population density in each province, which affects the distribution of economic projects and development plans.

- The direction of the longitudinal transport is determined along the Tigris and Euphrates rivers, neglecting the horizontal transport, which affects the distribution of economic projects and development plans in the study provinces in addition to the other aspects (environmental and social).

- The priorities of the governorate determined by the central and local governments in the province.
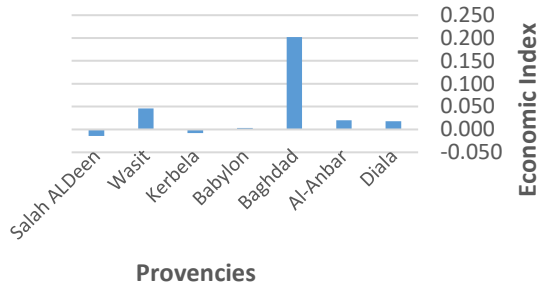
Figure 5: Economic indexes for each province in study area
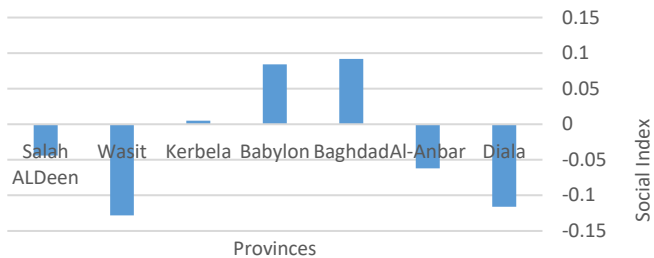
Figure 6: Social indexes for each province in study area

Conflict of Interest

There is many conflict such as respondents sample characteristics as mentioned in Section (3.2) are rare and if we find them, they will be very busy, so the researcher did the following steps for questionnaire distribution:

- Traveling for each governorate,
- Selecting most of the respondents,
- Distributing at least (9) questionnaires for each governorate, and
- Attending an open interview with respondents to ensure the understanding of questionnaire and to insuring the consistency of answers

Acknowledgment

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