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Full Length Research Paper

A quantitative assessment for quality of life: The case of metropolitan Ankara, Turkey

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Researches on evaluation of Quality of Life (QOL) gained much attention in quantitative studies and on urban areas especially since recent years. In this study two quantitative methods, namely AHP (Analytic Hierarchy Process) and ELECTRE II (Elimination Et Choix Traduisant la Realite - Elimination and Choice Translating Reality) are used to evaluate QOL. QOL was determined, compared and ranked for eight counties in metropolitan Ankara Metropolitan for the purpose of providing a database for local governments, decision makers and planners involved in policy making, as well as to construct a base for comparative analysis for different urban areas. Different weights were assigned to indicators in two experiments for the eight counties of Ankara during the QOL evaluation process. Result values showed great disparities between the counties in terms of QOL. This information is important especially in revealing problems and for the allocation of scarce resources. Determination of trends over time and awareness of changing conditions and priorities should also be considered as factors for further studies. The study also shows that both AHP and ELECTRE II method can be applied in QOL assessment and ranking.

Key words: Quality of life (QOL), AHP, ELECTRE, Ankara.

INTRODUCTION

Studies of QOL in urban areas enable us to understand the meaning of QOL in cities and the manner in which it can be measured (Marans, 2002). The overall aim of all QOL studies of urban areas is to arrive at conclusions which serve to improve the living conditions of the city residents. The combination of a healthy physical environment with social equity and a vital economy are the goals to be achieved in these studies.

The concept of Quality of Life (QOL) is complex, multi-dimensional and multi-disciplinary in nature, with the existence of a wide range of approaches and evaluation techniques. The complexity and the dynamic nature of the urban areas are challenging for QOL studies.

While some treatments of QOL found in the literatures present a conceptual review (Massam, 2002; Kamp et al., 2003) and address the major theoretical and methodological issues confronting QOL research (Pacione, 2003), other reports focuses on measuring and assessing QOL and measurement methods (Myers, 1988; Diener et al., 1997; Lo, 1997; Turksever and Atalik., 2000; Marans, 2002;). In addition, subjective assessments of QOL are based on case studies (Seik, 2000; Ulengin et al. 2001; Ibrahim and Chung 2002; Ulengin et al. 2002) and multi-criteria evaluation techniques, (Mendes, 2001; Massam and Wang, 2002; Senecal, 2003) in which QOL serves as a research interest of various disciplines.

QOL studies of urban areas concentrate on the relationship between people and their environment. In this context, the term “environment” refers to the physical, social and economic environment of the urban dwellers.

The conceptual model developed by Shafer et al. (2000) attempts to integrate the human ecosystem and sustainable communities perspective within the context of urban trail facilities. The model recognizes the basic relationships between components of a place in terms of its

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physical, social and economic realms. The model proposes that “QOL is created by an ongoing interaction between community, environment and economic quailties. The physical environment of the community should exist in such a way that it should support conviviality and provide an environment that creates a livable place.”

Not only do the physical and socio-economic conditions of the living environment determine the QOL in the urban area, but the perceived satisfaction of the individual with respect to his or her life in the urban environment is a significant factor. This can be called the “human res-ponse” to the environment.

In this context it is clear that QOL has two interconnected dimensions, namely objective and subjective dimensions. Massam (2002) called these dimensions “environmental” and “psychological.” Massam noted certain terms for the first dimension which were widely used in the literature, such as “urban QOL, community QOL, quality of place, environmental QOL”, and for the second dimension, terms such as “individual/personal QOL, subjective well being or life satisfaction.”

Massam also argues that the “perceived and/or actual QOL can be viewed on one hand as an indication or cause of attraction of a place, and on the other hand QOL can be treated as the outcome of conditions that are perceived to exist and the degree to which they meet the desires and expectations of individuals.”

Both of these two interconnected dimensions are essential quality components to complete the picture in QOL studies in urban areas. Despite all the disagreements on the definition of the urban QOL, researchers from different disciplines widely accept the importance of combining objective (actual) and subjective (perceived) quality aspects. Nevertheless many QOL studies in urban areas have focused either on objective assessment by using indicators developed from secondary data or subjective assessment via survey research.

As Pacione (2003) notes, “relatively few empirical attempts have been made to combine the two approaches in a single study despite the fact that one type of indicator can contribute to the interpretation of the other.”

It is a well-known fact that urban areas are complex and dynamic entities, and that people dominate the system. The complexity, dynamism, interactions, processes and problems of both the natural and built subsystems constitute a single urban system. When we add the multifaceted construct of QOL concept to this fact, this results in a wide range of perspectives and outputs in urban QOL research.

These outputs are formulated and documented through developing indicators and indices of QOL, and by producing maps of QOL ratings of different locations, QOL scores and outranking different locations, overall life satisfaction values/scores, etc.

In the context of comparing different locations, in some cases locations which are governed by the same local official unit in a metropolitan area could be distinct with respect to QOL. These differences could emerge from their different physical, social and economic structures. Moreover, the evaluation method used in QOL assessment, with different weights assigned to indicators, could also affect the QOL scores of the various locations.

The aims of this study are to determine the existing situation and to compare and rank the eight counties of metropolitan Ankara by applying quantative methods. In addition a base for comparative analysis of different urban areas is constructed. Two quantitative methods, namely the AHP (Analytic Hierarchy Process) and ELECTRE II (Elimination et Choix Traduisant la Realite - Elimination and Choice Translating Reality), are used to assess the applicability of these methods in QOL studies.

In this study, an assessment has been done to draw attention to the QOL differences in eight counties of metropolitan Ankara and to rank them by conducting two experiments according to the selected indicators. These indicators have been evaluated using different weights.

The results of the study should be beneficial for policy makers, physical and social planners, and for the citizens with a mission to enhance the QOL of the society. Disadvantaged groups would especially benefit as well.

THE CASE OF ANKARA

The level of urbanization is increasing in many developing countries, with Turkey probably foremost in a list of such countries. With a population estimated to be 68.2 million in 2000, and projected to reach 91.9 million by 2030, Turkey will eventually see 70.8% of its total population living in high density population centers (cities) (United Nations, 2003).

Ankara is the second largest city in the nation, and each year since 1920, when it became the capital of the republic, the yearly increase in the urban population has been among the highest. In 2000, the average annual increase in the population of Ankara was 21.37%, which was above the average annual increase of 18.34% in the population of Turkey as a whole (Anonymous, 2003a).

Located in the centre of the country and in the center of the Anatolian plateau (Figure 1), Ankara had an estimated census of 4 million in the year 2000, with 3.5 million of the residents living in urban areas. 87% of the population living in the twenty-four counties of Ankara is urban (Anonymous, 2003).

The high population growth rate of Ankara is overwhelmingly due to a rural-to-urban migration, which started in the mid 1950s. Much of the urbanization caused by this migration is seen in shantytowns and squatter settlements, referred to disparagingly by Turks as “*gecekondu*” (Keles, 2001). These dwellings are erected on land without observance of public health and safety laws and regulations, particularly codes concerning construction and building. In particular, land use conflicts and unplanned developments with a lack of

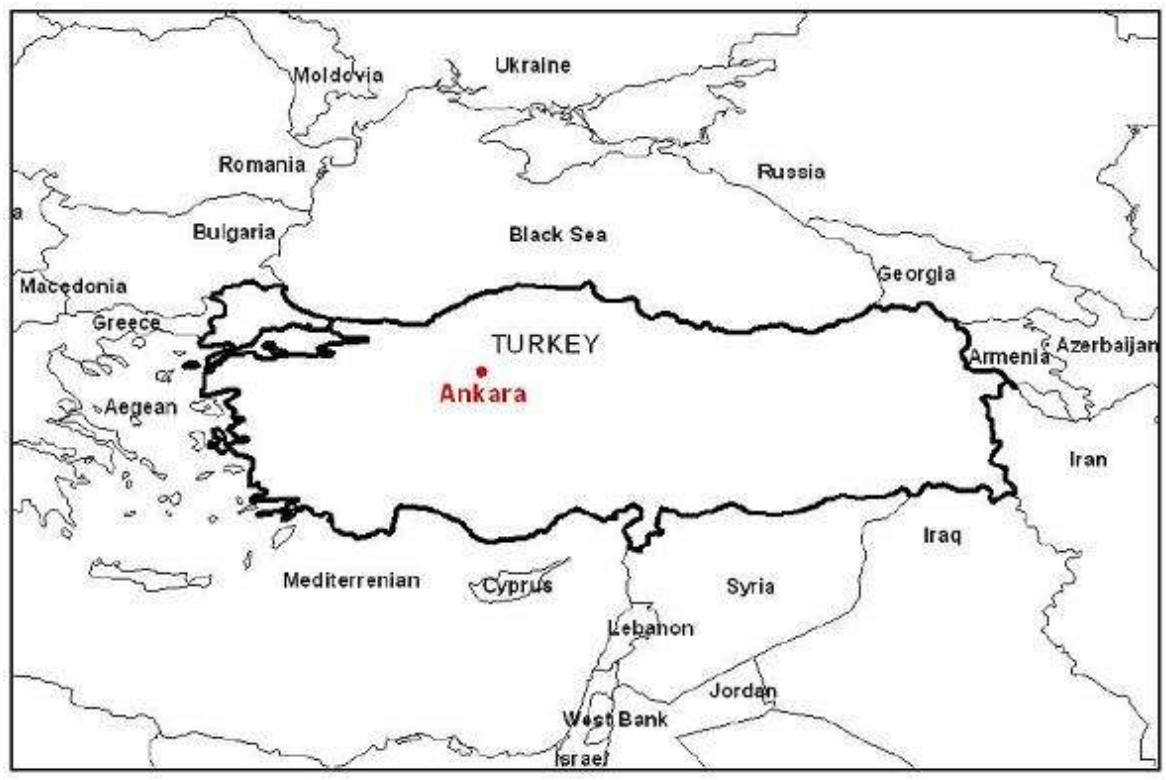

Figure 1. Location map of the study area.

infrastructure in many parts of the city are among the major problems that are facing Ankara.

An estimated 70% of the inhabitants of Ankara live in squatter settlements (Keles, 2001). In spite of this severe statistic, Ankara is essentially a city with two faces, and a city with great physical and socio-economic disparities among the different districts.

In order to cope with these metropolitan-based problems, the city center organized a municipal administration in 1984. The Ankara Metropolitan Municipality was created with the subdivision of eight smaller municipalities. These municipal subdivisions (counties) are named Altındağ, Çankaya, Etimesgut, Gölbaşı, Keçiören, Mamak, Sincan, and Yenimahalle (Anonymous, 2003). Basic information about these counties is summarized in Table 1.

These eight counties have been facing various urban problems especially during the last decades. These problems seriously affect QOL of the urban residents. On the other hand, in metropolitan Ankara as in many other cities in Turkey, there is no adequate study or research conducted by local governments and scientists concerning QOL.

MATERIALS AND METHODS

For the purpose of this study, the eight counties (having their own metropolitan administrations) have been selected as the case study area. These counties have been assigned the following designations: CN1 for Altındağ, CN2 for Çankaya, CN3 for Etimesgut, CN4 for Gölbaşı, CN5 for Keçiören, CN6 for Mamak, CN7 for Sincan and CN8 for Yenimahalle (Figure 2). Of the 4 million people who live within the Ankara Province, 3.3 million people live in these eight counties, and 90.7% of this population is urban (Anonymous, 2003).

The process followed in this study has been explained in the following sections.

Identification of domains for QOL

Mitchell et al. (2001; cited by Kamp, 2003) have noted, “In principle, all attributes of the environment and all characteristics of people are relevant domains in the person-environment relationship.” They continue by saying that, “there appears to be consensus in literature that the physical, social and economic domains form the materials of the society.”

For this study these three domains, namely “physical environment,” “social environment,” and “economic environment” have been employed to cover all the aspects of QOL.

Selecting indicators and data collection

When selecting indicators related to the three domains of QOL, there were four main concerns in this study:

- Development of a balanced set of indicators to reflect all the aspects of QOL,
- Availability and reliability of data,
- Possibility of systematically monitoring and assisting future studies

Table 1. Basic characteristics of the counties.

Designations	Counties	Area (km^2)	Population (count)	Distance to the Centrum (km)	Residential building rate (%)
CN1	Altındağ	167	422 668	1	80
CN2	Çankaya	268	714 330	9	75
CN3	Etimesgut	49	70 800	20	73
CN4	Gölbaşı	735	43 522	20	62
CN5	Keçiören	190	536 168	3	87
CN6	Mamak	471	410 359	7	93
CN7	Sincan	344	101 118	27	75
CN8	Yenimahalle	274	351 436	5	74

by use of time series,
- Possibility of making comparisons for different urban settlements by the same set of indicators.

For this selection the best and latest available, fully documented data were preferred. For this study, 14 indicators were developed under 3 domains which are; “physical environment”, “social environment” and “economic environment”.
The data for the study are gathered from:

- Satellite image data: Landsat 7 ETM + (Enhanced Thematic Mapper) acquired on July, 2000,
- Analysis of census based data of State Institute of Statistics (SIS) (for the year 2000).

Certain indicators in the data used for this study require explanation. These are related to “NDVI,” “thermal infrared emissions,” and “GDP.”
NDVI was extracted from the Landsat 7 ETM + data using the following formula to measure the degree of greenness:

NDVI = (TM4 – TM3) / (TM4 + TM3)

The ratio of the near infrared band (TM4) to the red band (TM3) is widely used as a factor in determining indices of vegetation and vegetation cover. Higher values of the NDVI (brighter tones) indicate a greater proportion of ground cover by green vegetation. The rationale for using NDVI as an indicator is given by Lo (1997), who stated that “a green environment is desirable for most urban residents [and thus] should be of importance in QOL assessment.”
The other data extracted from the satellite image are Landsat 7 ETM+ thermal infrared emissions. These data have been used as factors in indices of ineffective landscaping. A high surface temperature is not regarded as desirable with respect to the quality of the environment (Lo, 1997).

The calculations for these satellite image data are made by using GIS (Geographic Information Systems) and remote sensing software called TNT Mips. This software was used to assist both GIS and remote sensing functions simultaneously for the results of this study.

GDP was also used as a factor in making result determinations. The use of GDP is highly controversial as several authors declare that it has a weak relationship with QOL. However Button (2002) has noted that, at the urban level, measures such as GDP are often used despite their limitations. In this study, the GDP share of the 8 counties among 24 counties of Ankara, expressed as a percentage, has been used as an indicator to determine the relative economic performance of these counties.

Determination of evaluation methods

ELECTRE II Method

There are many methods that assist in the analysis of problems, support the decision-making process, and promote the development of ideas. For evaluations which contain data that are nonmeasurable, uncountable or noncomparable as this study does, the ELECTRE II (Elimination Et Choix Traduisant la Realite - Elimination and Choice Translating Reality) method was chosen for doing a multicriteria analysis of the counties in the framework of QOL.

ELECTRE II method is a well known multi-criteria decision aid (MCDA) tool. ELECTRE II outranks its results (Raju and Pillai, 1999). The concept of outranking was formulated by Roy in the development of the ELECTRE methodology. It has been widely applied to problems of environmental management (Rogers and Bruen, 1998; Akpınar, 2003). ELECTRE is a suitable technique that mixes and evaluates qualitative and quantitative data, and is a method more widely used in Europe than in the USA (Rogers and Bruen 1998). This technique is also applicable to assessment of QOL (Massam and Wang, 2002).

The outranking approach to multicriteria decision-aid builds a relation, called an “outranking relation,” which represents the decision maker’s strongly established preferences given the information available. ELECTRE starts by initializing a matrix. Each column of the matrix contains the values of every possible choice according to criteria assigned different weights. The main goal of ELECTRE is outranking by pairwise comparison between every pair of actions.

The relationship among the possible alternative pairs can be defined with concordance and discordance indices. According to “*g*” criteria, if the value of alternative A1 [g_k(A1)] is better or equal to the value of alternative A2 [g_k(A2)] **,** or [g_k(A1)] > [g_k(A2)], with the hypothesis that the A1 alternative is superior to the A2 alternative, the “*g*” criteria is said to be concordant criteria. In the opposite situation, that is [g_k(A1)] < [g_k(A2)], the “*g*” criteria is then discordant criteria (Golley and Bellot, 1999).

According to ELECTRE II, an alternative A1 strongly outranks A2 when the following three conditions are simultaneously met (McPhail and Deugo, 2002):

$$W^+ / W^- \geq 1$$
$$C_{12} = (W^+ + W^-)/W \geq c_1$$
$$D_{12} = \max [g_k(A1) - g_k(A2)] \leq d_2$$ for discordant criteria

Or, alternatively, when the following conditions are met (Golley and Bellot, 1999):

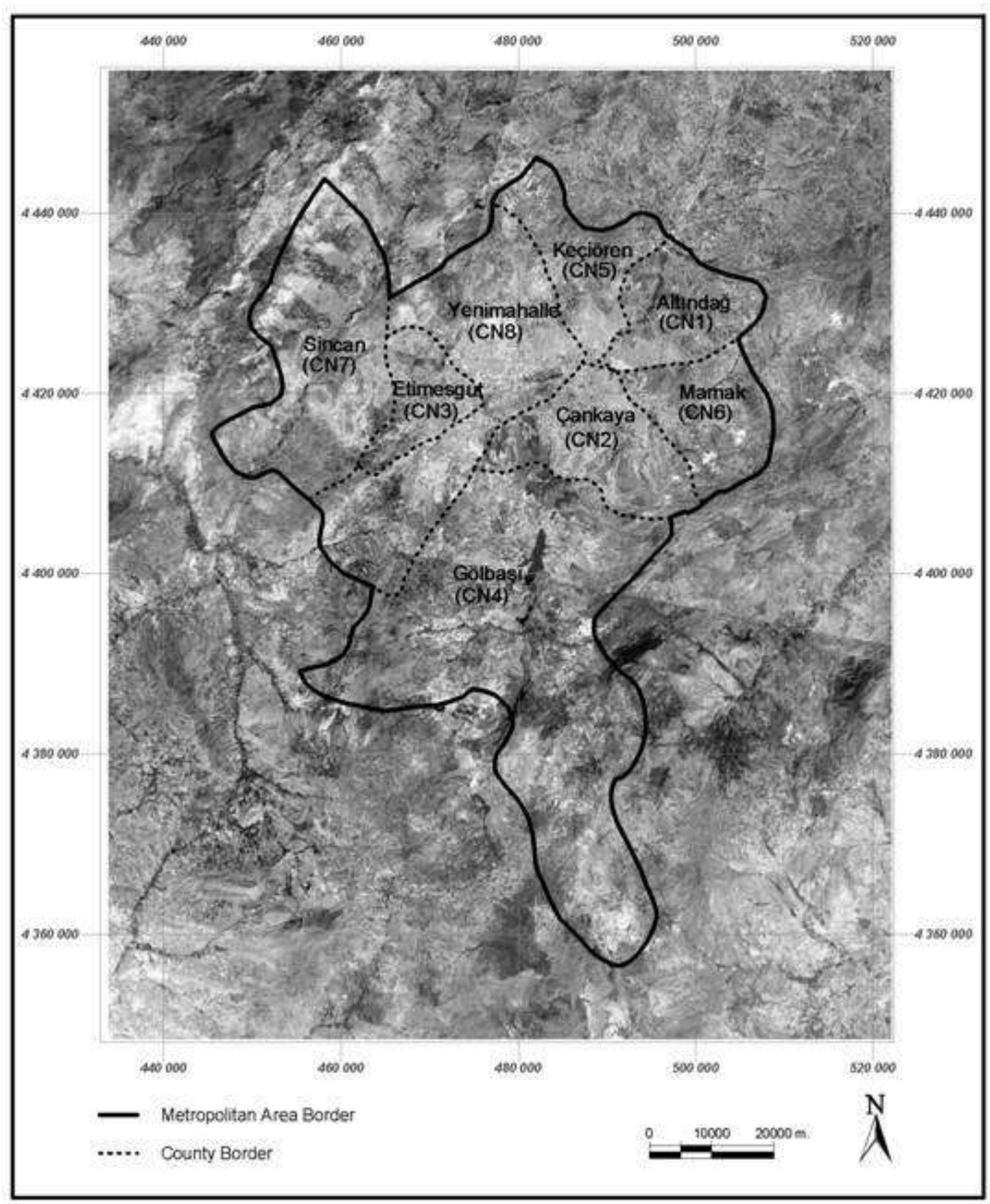

Figure 2. Ankara metropolitan area.

$W^+ / W^- \geq 1$
$C_{12} \geq c_2$
$D_{12} \leq d_1$

There is a weak outranking relationship when the following three conditions are simultaneously fulfilled (Golley and Bellot 1999):

$W^+ / W^- \geq 1$
$C_{12} \geq c_3$
$D_{12} \leq d_2$

The definitions and abbreviations in these formulas are as follows (Golley and Bellot, 1999):

C_{12}: the concordance index among alternatives A1 and A2
W^+: the sum of criteria weights in the cases where $[g_k(A1)] > [g_k(A2)]$
$W^=$: the sum of criteria weights in the cases where $[g_k(A1) = g_k(A2)]$
W^-: the sum of criteria weights in cases where $[g_k(A1)] < [g_k(A2)]$
W: the sum of the sum of criteria weights, or $W^+ + W^= + W^-$
D_{12}: the discordance index, in cases where $[g_k(A1)] < [g_k(A2)]$

In these formulas the *c* values are concordance thresholds and verify that $1 > c_1 \geq c_2 \geq c_3 > 0$, and *d* values are discordance thresholds and verify that $d_2 > d_1 > 0$.

Table 2. AHP pair wise comparison scale.

Intensity of relative importance	Definition	Explanation
1	Equal importance	Elements are equally important
3	Moderate importance of one over another	Experience and judgment slightly favor
5	Essential or strong importance	Experience and judgment strongly favor one over another
7	Very strong importance	One is very strongly favored over another
9	Absolute importance	The evidence favoring one over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between two adjacent judgment	

Source: Saaty (1983); Ramanathan (2001); Duke and Hyde (2002).

AHP (Analytical Hierarchy Process)

To assign weights to indicators, the Analytic Hierarchy Process (AHP) method was chosen so as to evaluate all indicators affecting the assessment in an analytical set (Duke and Hyde, 2002). AHP is a MCDM method and a problem-solving framework. It is a systematic procedure for representing the elements of any problem. It organizes the basic rationality by breaking down a problem into its smaller constituent parts, and then calls for only simple pairwise comparison judgment to develop priorities (assign weights to indicators) in each hierarchy (Saaty, 1983).

As Lotfi and Solaimanithere (2009) state, there are numbers of MCDM methods available for selection e.g. Multi-Attribute Utility Theory (MAUT), Multiobjective Programming (MOP),Novel approach to imprecise assessment and decision environments (NAIADE). The AHP approach, developed by Satty is one of the more extensively used MCDM methods. This technique is one of the MCDA methods with many capabilities which is used in different scientific disciplines. It is widely applied to humanfields such as resources allocation, project design, planning for urban development, maintenance management, policy evaluation. Obtaining solutions in the AHP is not a statistical procedure, because it can help either a single decision maker or a decision group to solve a MCDM problem. One of the most important advantages of AHP relates to its ability to measure quantitative and qualitative characteristics of a decision. In addition AHP is flexible to allow revision. The decision makers can expand the elements of the hierarchy and change the expert judgments from time to time. The use of the AHP has been accepted as a leading multi-criteria decision model to assign priorities to the criteria or indicators involved.

A more detailed description of AHP and its applications can be found elsewhere (Saaty, 1974; Saaty, 1983; Ramanathan, 2001). The application of AHP to a decision making problem involvesfour steps (Ramanathan, 2001).

Step 1: The decomposition step. This step calls for structuring the hierarchy to capture the basic elements of the problem. An effective way to do this is first to work from the focus at the top level downward to criteria bearing on the focus in the second level, followed by subcriteria (or sub-indicators) in the third level, and so on, from the more general to the more particular and definite (Saaty, 1983).

Step 2: The pairwise comparison step. The step of comparative judgments calls for setting up a matrix to carry out pair wise comparisons of the relative importance of the elements in the second level with respect to the overall objective of the first step (Saaty, 1983). A judgmental matrix is formed and used for computing the priorities of the corresponding elements (Ramanathan, 2001). First, criteria (or indicators) are compared in a pairwise fashion with respect to the goal. A judgmental matrix, denoted as A, will be formed using the comparisons. Each entry a_{ij} of the judgmental matrix is formed comparing the row element A_i with the column element A_j:

$A = (a_{ij})$ (i, j = 1, 2 .... the number of criteria)

For example, the comparison of any criteria or indicators, C_i and C_j (say GDP and unemployment) with respect to the goal is made using question of the type: of the two criteria or indicators C_i and C_j, which is more important with respect to a economic environment. Table 2 details the pairwise comparison scale universally used in the AHP (Duke and Hyde, 2002). The entries a_{ij} are governed by the following rules.

$a_{ij} > 0$; $a_{ij} = 1 / a_{ji}$; $a_{ii} = 1$ for all i

Because of the above rules, the judgmental matrix A is a positive reciprocal pairwise comparison matrix (Ramanathan, 2001).

Step 3: The step of local priorities and consistency of comparisons. The local priorities of criteria (or weighting of components) are obtained and a consistency of the judgment is determined. In an ideal case, perfect consistency of individual or aggregate preferences would exist when $a_{ik}\, a_{kj} = a_{ij}$ for all i,j,k, and meaning that weights w_i and numerical ratings a_{ij} satisfy $w_i / w_j = a_{ij}$ for all i,j.
The priorities of criteria (or weights of indicators) can be estimated by finding the principal eigenvector w of the matrix A. That is,

$Aw = \lambda_{max} w$

When the vector w is normalized, it becomes the vector of priorities of the criteria (or indicators) with respect to the goal. λ_{max} is the largest eigenvalue of the matrix A and the corresponding eigenvector w contains only positive entries. At this point the consistency index (CI) and consistency ratio (CR) are calculated. The consistency index then using the departure of λ_{max} from n is compared with corresponding average values for random entries yielding the CR.

Table 3. The RI (Randon index) values.

Size	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Source: Saaty (1983).

In the AHP method for an $n \times n$ matrix, in calculating CI (Consistency Index) and CR (Consistency Ratio) the following formulas have been employed (Saaty, 1983; Akpınar 1995):

$$CI = (\lambda_{max} - n) / (n - 1)$$
$$CR = CI / RI$$

The consistency index for a randomly generated $n \times n$ matrix is denoted as RI. RI values are random consistency values, and every RI value which corresponds to an "n" value as recommended by Saaty (1983) is used to make the calculations. The RI values for matrices of different sizes are shown in Table 3. In the calculations of these values, results in which CR < 0.1 are desirable (Duke and Hyde, 2002). A consistency ratio above 0.1 requires revisions of the judgments in the matrix (Saaty, 1983; Dai et al., 2001).

Step 4: The aggregation of local priorities. Once the local priority of the elements of different levels is available as outlined in the previous step, they undergo aggregation. For aggregation, the following principle of hierarchy composition (Ramanathan, 2001) is used: The weight of indicator is the product of the local priority or weight of the indicator within subset1 and the local priority or weight of indicator within subset 2.

$$W = W1 \times W2$$

APPLICATION OF THE METHOD TO CASE AREA

Assignment of weights to indicators using AHP

There are a series of indicators to assess QOL. Usually selection of the appropriate indicators is not an easy task. For this reason, the research team has discussed the subject and concluded there are fourteen indicators, which are significant to the goal and the concept of research and available data.

These fourteen indicators fall under three domains of QOL (physical environment, social environment and economic environment) and are described as follows (with the expression of their values described in brackets):

Physical environment: (a) Normalized difference vegetation index (NDVI) [count]; (b) Thermal infrared emissions [count]; (c) The area covered by buildings [percentage of total area]; (d) Environmentally friendly fuel consuming houses [percentage of total houses], (e) Piped water installed buildings [percentage of total buildings].

Social environment: (f) Population density [count of persons per square kilometer], (g) Ratio of students to teachers in primary school system [number], (h) University graduates within the total population of literate persons [percentage]; (i) Buildings constructed for educational and cultural activities (number/ 100 person) , (j) Buildings constructed for education, social activities and health services (number/ 100 person).

Economic environment: (k) Gross Domestic Product (GDP) (share of percentage in the Ankara Province), (l) Unemployment (percentage of total population), (m) Commercial buildings (number/ 100 person), (n) Industrial buildings (number/ 100 person).

The first step in AHP method is to establish a hierarchy of indicators (Figure 3). To do this, a set was established to compare every main and sub-indicator group with each other. After establishing the set illustrated below, reciprocal matrices were formed to evaluate indicators in the context of the AHP method.

A group meeting was held for the purpose of establishing the hierarchy and assigning weights. This meeting was organized by the research team, and the Delphi method was applied to the set judgment matrices with pairwise comparisons in the AHP. This meeting was held with a wide range of participants in order to involve all the stakeholders of the counties. The representatives from each municipality of the eight counties and a group of citizens were present in this meeting. The outputs of this meeting guided the research team in reaching consensus values.

An example of a pairwise comparison matrix to assign the weights to the indicators is presented in Table 4. All matrices can not be presented here because of limitations of space. After considering the hierarchy of indicators within the AHP method, all indicators were compared with each other (an example of this comparison is given in Table 4). For every pairwise comparison matrix, a maximum eigenvalue, (a number is an eigenvalue of the square matrix A if there exists a nonzero vector x such that, Eigenvalues are used to determine the stability of critical points of systems of first-order, autonomous differential equations) consistency index, and consistency ratio were calculated. (Again all resulting tables cannot be presented because of limitations of space).

For these calculations, simple software developed in DOS by Karakaya 1995 was used. In these calculations the percentage of inconsistency was initially assumed to be < 0.15, which was found to increase the validity and lead to satisfactory judgments. Weights for every indicator were obtained through the calculations of all the matrixes and effects of indicators on each other according to hierarchy.

All eigenvalues in the matrices resulting from every indicator group were correspondingly evaluated with their own subgroups. These are gathered in Table 5. As a necessity of hierarchy set, every element is affected by the evaluations of its previous set. In this study all three components are equally valued (0.3333 for each).

An example of the overall $W = (W1 \times W2)$: here $W1$ is for physical environment and $W2$ is the NDVI:

$$W = 0.3333 \times 0.1339 = 0.0446 \ (\times 100 \approx 4)$$

Note that all values are multiplied by 100 and rounded to an integer to simplify the calculations.

Assessment process using ELECTRE II method

In the assessment process, the real values (census-based and satellite image data) have been placed into the initial matrix (Table 6). However, all values in the initial matrix have been normalized to be evaluated within the ELECTRE II Method. During the

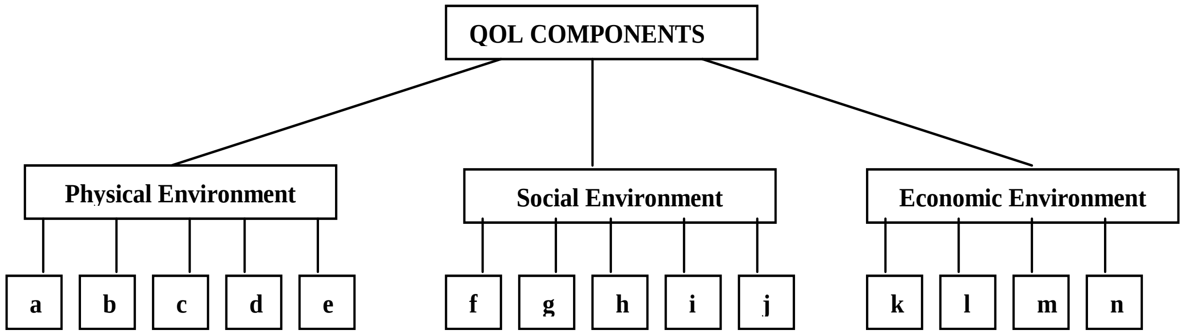

Figure 3. Hierarchy of indicators.

Table 4. Pairwise comparison matrix for "economic environment" indicators.

	GDP	Unemployment	Commercial building	Industrial buildings	Weight
GDP	1	1/2	2	3	0.2739
Unemployment	2	1	3	4	0.4620
Commercial buildings	1/2	1/3	1	3	0.1780
Industrial buildings	1/3	1/4	1/3	1	0.0862

Largest eigenvalue: 4.8845.
Consistency Index (CI): 0.0292.
Consistency Ratio (CR): 0.0324.
Random Consistency: 0.9000.
Percent of Inconsistency: 10.0000.

Table 5. Eigenvalues and weights of the indicators.

QOL components	Subset1 indicators	Subset1 weight (W1)	Within subset2 weight (W2)	Overall weight (W)	Weight (rounded to integer) W
Physical environment		0.3333			
	(a)		0.1339	0.0446	4
	(b)		0.1272	0.0423	4
	(c)		0,0779	0.0259	3
	(d)		0,2395	0.0798	8
	(e)		0.4215	0.1404	14
Social environment		0.3333			
	(f)		0.0874	0.0291	3
	(g)		0.2612	0.0870	9
	(h)		0.1563	0.0520	5
	(i)		0.2355	0.0784	8
	(j)		0.2596	0.0865	9
Economic environment		0.3333			
	(k)		0.2739	0.0912	9
	(l)		0.4620	0.1539	15
	(m)		0.1780	0.0593	6
	(n)		0,0862	0.0287	3

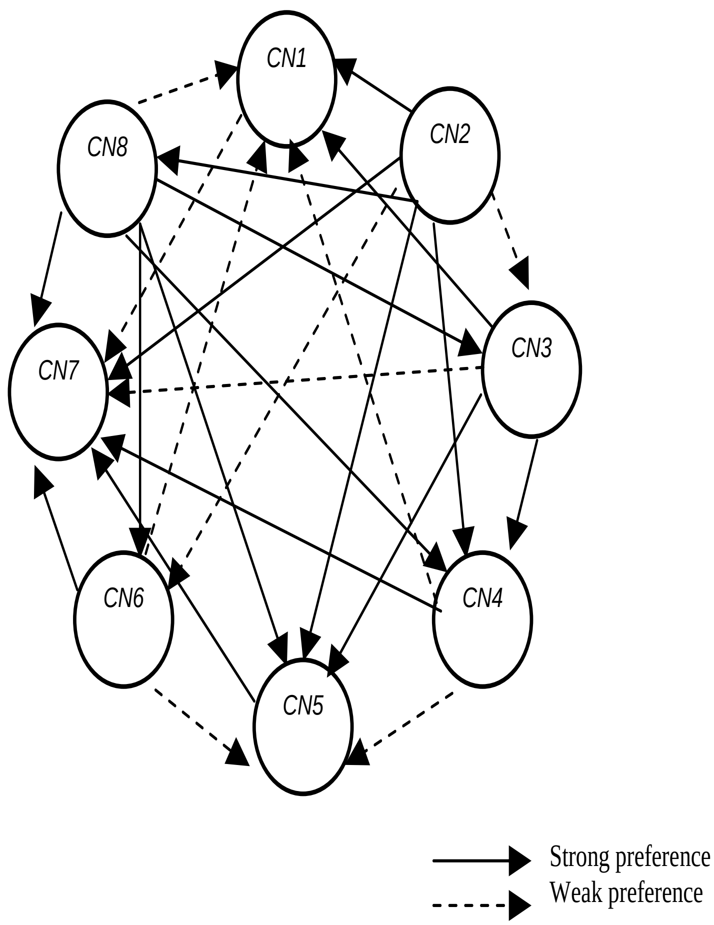

Figure 4. Preference graph using ELECTRE II method (by assigned weights using AHP).

normalization process, all values are normalized using formulas derived by Beccal et al. (1998).
In these algorithms, S_{ij} are real values.

$$\left|\frac{S_{ij} - \min S_{ij}}{\max S_{ij} - \min S_{ij}}\right|$$

Is used when increasing the value is desirable, e.g., when an increased value of NDVI is desirable.

$$\left|\frac{S_{ij} - \max S_{ij}}{\max S_{ij} - \min S_{ij}}\right|$$

Is used when decreasing value is desirable, e.g., when a decreased unemployment rate is desirable. The results of this transformation are given in the evaluation matrix (Table 7). Using this evaluation matrix, the concordance and discordance indices were calculated, and the concordance and discordance matrices were computed. These matrices are presented in Tables 8 and 9. To carry out the last evaluation, the thresholds $c1$, $c2$, $c3$, $d1$, and $d2$ were determined. In this study, the often-used concordance thresholds have been determined. In this process, comparisons and calculations were carried out by using Microsoft EXCEL software.

RESULTS

Considering these thresholds, all counties were outranked. In this study, as a precondition of $1 > c1 > c2 > c3 > 0$; $c1 = 0.8 > c2 = 0.7 > c3 = 0.6$ and as a precondition of $d2 > d1$; $d2 = 1$, $d1 = 0.5$ were accepted.

The relationship among counties was determined considering concordance and discordance thresholds. After considering these relationships the preference graph was drawn (Figure 4).

For example:

In the Concordance matrix, CN2 - CN7 = 0.9 > $c1$. In the Discordance matrix, CN2 - CN7 = 0.6 < $d2$. Accordingly,

Table 6. Initial matrix.

Units	(a) Count	(b) Count	(c) (%)	(d) (%)	(e) (%)	(f) Person/km^2	(g) Number	(h) (%)	(ı) Number/100 person	(j) Number/100 person	(k) Share%	(l) (%)	(m) Number/100 person	(n) Number/100 person
CN1	-0.038	124.265	17.500	9.100	94.000	2438.000	27.000	5.000	0.036	0.038	20.400	16.000	1.117	0.584
CN2	-0.052	116.529	9.000	45.200	98.000	2871.000	24.000	24.000	0.066	0.040	21.300	10.100	0.227	0.011
CN3	-0.045	138.164	4.000	11.800	96.000	3496.000	27.000	15.000	0.036	0.049	3.200	10.200	1.035	0.123
CN4	0.046	127.073	6.000	1.900	96.000	85.000	31.000	9.000	0.038	0.017	2.000	11.400	0.349	0.158
CN5	-0.025	122.779	18.000	18.200	98.000	3541.000	31.000	8.000	0.029	0.013	11.200	13.200	0.091	0.005
CN6	-0.020	117.374	10.000	4.300	99.000	914.000	26.000	5.000	0.033	0.015	6.000	15.600	0.241	0.045
CN7	-0.008	145.305	12.500	3.400	98.000	842.000	38.000	5.000	0.021	0.010	4.000	14.800	0.154	0.326
CN8	-0.024	128.409	3.000	49.200	99.000	2020.000	26.000	16.000	0.043	0.035	14.100	12.800	0.080	1.077

Table7. Evaluation matrix

W	4 (a)	4 (b)	3 (c)	8 (d)	14 (e)	3 (f)	9 (g)	5 (h)	8 (ı)	9 (j)	9 (k)	15 (l)	6 (m)	3 (n)
CN1	0.142	0.730	0.033	0.152	0.000	0.319	0.785	0.000	0.333	0.717	0.953	0.000	0.000	0.459
CN2	0.000	1.000	0.600	0.915	0.800	0.193	1.000	1.000	1.000	0.769	0.000	1.000	0.141	0.994
CN3	0.071	0.248	0.933	0.209	0.400	0.013	0.785	0.526	0.333	1.000	0.062	0.983	0.920	0.889
CN4	1.000	0.633	0.800	0.000	0.400	1.000	0.500	0.210	0.377	0.179	0.000	0.779	0.259	0.857
CN5	0.275	0.782	0.000	0.344	0.800	0.000	0.500	0.157	0.177	0.076	0.476	0.475	0.010	1.000
CN6	0.326	0.970	0.533	0.050	1.000	0.760	0.857	0.000	0.266	0.128	0.207	0.067	0.155	0.962
CN7	0.448	0.000	0.366	0.031	0.800	0.780	0.000	0.000	0.000	0.000	0.104	0.203	0.071	0.700
CN8	0.285	0.587	1.000	0.039	0.970	0.440	0.857	0.578	0.488	0.641	0.630	0.542	0.000	0.000

between CN2 and CN1, from CN2 to CN7 there is a strong preference.

From the analysis of the preference graph, tables of direct (Table 10) and inverse (Table 11) arrangement were prepared.

Additionally, all processes mentioned above were repeated in a second experiment by assessing equal weights to the indicators (100/14 = 7.142). In this experiment, the same concordance and discordance thresholds ($c1 = 0.8 > c2 = 0.7 > c3 = 0.6$ and $d2 = 1$, $d1=0.5$) of the previous process were used. The results obtained by considering the direct and inverse arrangement tables (Table 10 and Table 11).

When the calculation is done considering both the strong and weak preferences together, the results of outranking are as follows:

CN2 > CN8 > CN3 > CN6 > CN4 > CN5 > CN1 > CN7

When the weights were assigned by using AHP.

On the other hand, the outranking of second experiment is given below:

CN2 > CN8 > CN3 > CN4 > CN6 > CN5 > CN1 > CN7

Table 8. Concordance matrix.

	CN1	CN2	CN3	CN4	CN5	CN6	CN7	CN8
CN1		-	-	-	-	-	0.6	-
CN2	0.9		0.7	0.8	0.9	0.7	0.9	0.7
CN3	0.7	-		0.8	0.7	0.5	0.7	-
CN4	0.6	-	-		0.6	0.5	0.7	-
CN5	0.5	-	-	-		-	0.8	-
CN6	0.6	-	-	-	0.6		0.8	-
CN7	-	-	-	-	-	-		-
CN8	0.7	-	0.6	0.7	0.9	0.8	0.8	

Table 9. Discordance matrix.

	CN1	CN2	CN3	CN4	CN5	CN6	CN7	CN8
CN1		-	-	-	-	-	0.8	-
CN2	0.9		0.8	1.0	0.3	0.6	0.6	0.4
CN3	0.5	-		1.0	0.5	0.7	0.8	-
CN4	0.7	-	-		0.4	0.6	0.4	-
CN5	1.0	-	-	-		-	0.8	-
CN6	0.8	-	-	-	0.4		0.1	-
CN7	-	-	-	-	-	-		-
CN8	1.0	-	0.9	0.9	1.0	1.0	0.7	

Table 10. Direct arrangement of the counties.

	Length of out-paths (strong preferences)	Length of out-paths (weak preferences)
1st county CN2	-	-
2nd county CN8	-	1
3rd county CN3	-	2
4th county CN6	1	1
5th county CN4	-	3
6th county CN1	2	3
7th county CN5	3	2
8th county CN7	5	2

When weights are equally assigned as *W*=7.142 for each indicator.

In both experiments that were done to assess QOL in the eight counties of Ankara Province, Cankaya County (CN2) outranked the other seven counties. In contrast, Sincan (CN7) was outranked by all others. According to these results, Cankaya (CN2) is the best and Sincan is the worst county in terms of QOL. One striking result was, although subjective weights have been assigned to the indicators to assess the QOL in the first experiment, there was only a slight difference in the outranking of the second experiment, which is done by equally assigned weights. The outranking of first three and last three counties remained the same in both experiments. Distinct real values of the counties under three domains were factors in this result. In addition, subjectively assigned weights did not have a strong impact on the outranking. Although the eight counties that are taken into evaluation altogether describe the same metropolitan area and administered by the same head office, their economic, social and physical conditions are quite different than each other. Çankaya (CN2) which has ranked as the first

Table 11. Inverse arrangement of the counties.

	Length of out-paths (strong preferences)	Length of out-paths (weak preferences)
1st county CN2	5	2
2nd county CN8	4	2
3rd county CN3	3	1
4th county CN6 and CN4	1	2
5th county CN5	1	-
6th county CN1	-	1
7th county CN7	-	-

in classification has a strong structure in economic and social aspects, meanwhile, Sincan (CN7) which has ranked the last is a problematic county especially in physical, environmental and educational and educational matters.

CONCLUSION AND DISCUSSION

It should be noted that in QOL assessments, different methods, different indicators can lead to different results. In this context, it is not true to say that ELECTRE II is not the best method to assess the QOL. Massam and Wang (2002) have compared various methods to assess the QOL. Though ELECTRE II was chosen for the assessment, it is very difficult:

- To say that ELECTRE is a suitable method for this problem,
- To list all the advantages and disadvantages of this method in regard to the other methods.

Moreover, the result could change or remain the same when using different methods, and it is also difficult to predict the reason and extent of this change (Zanakis et al., 1998).

Therefore, the same area could be re-evaluated with the same indicators with a different method and the results could be discussed. Even for the evaluations obtained by using ELECTRE II, different thresholds can be used.

On the other hand, with respect to the case area, a specific problem occurred during the study, emerging from geographic units in Turkey. The metropolitan boundaries do not fit the county boundaries in Turkey, and with respect to the data from the State Institute of Statistics, these data could be obtained only on a county scale. In other words, it is not possible to obtain any data appropriate to a metropolitan area (Turksever and Atalik, 2001).

It follows that what occurs on a county scale may not indicate what occurs in metropolitan areas, possibly pointing out a weakness of this study. However, although the county scale data has been used for this study, it could be said that the results reflected the status of the metropolitan region concerning QOL.

A final note should also be made with respect to data collection. Difficulty was encountered with data collection limiting the study in terms of indicator selection. For many years, material wealth and economic development have been associated with QOL by a majority of people and of politicians in Turkey, as in many other developing countries. Only recently, a growing awareness of QOL in the sense of covering all of its aspects has come to be realized. As a consequence of this awareness, it is especially the case that the metropolitan administrations of the big cities of Turkey have become interested in QOL studies. Nevertheless there is lack of adequate studies about Turkey in this field. At this time, such as study as this study would be but a sample for the administrative units and policy makers in terms of making determinations about existing conditions and about the status of other living environments in the periphery, and in making comparisons among the different locations.

The aim of this study is to outrank eight counties of Ankara Province by conducting two experiments regarding different weights assigned to the indicators. The study was evaluated using the ELECTRE II and AHP methods, and the results supported the validity of these methods in the QOL assessment and outranking.

The results of the study show that both experiments resulted in similar outrankings despite the different weightings. The possible reason for this outcome could be the great physical and socio-economic disparities among the counties. There is a serious problem of inequity in resource allocation.

To conclude, despite some limitations in assessing QOL in urban areas of a developing country such as Turkey, it is worthwhile to make these assessments to form a point of departure. The study can also be supported with subjective assessments in the next step. The integration of the perceptions of citizens in QOL assessments will provide additional information and enhance the validity of objective assessment.

Determining the trends over time and being aware of changing conditions and priorities should also be considered for further studies. Monitoring progress in moving towards an enhanced QOL is useful in setting goals, developing policies and planning. However, this will also help as an early warning and in determining trends prior to the occurrence of serious problems, making it possible to avoid “end of pipe” solutions that are usually the case in Turkey.

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