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A Framework for Quality of Life Assessment of Urban Green Areas in Europe; An application to District Park Reudnitz Leipzig

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Abstract
In the last decade, we have seen, next to the concept of sustainability, the upsurge of the concept of quality of life. Regarding quality of life the focus is in particular on cities as vehicles to improve quality of life. In this respect, the relation between quality of life and urban green is regarded as a positive one, and often described as significant. In order to improve the quality of life by means of urban green, public and private decision-makers need better information regarding the quantity and quality of urban green available in their city.
The aim of this paper is to develop an evaluation framework that can be used in the assessment of urban green spaces by means of criteria linked to the notion of quality of life. This evaluation framework is built upon the multicriteria analysis method Flag Model. This discrete multicriteria method is suitable for the assessment of projects as well as policies. The Flag Model can be used to compare various urban green spaces with each other as well as one park against *a priori* determined benchmarks. The constructed evaluation framework will be demonstrated by means of a case study. In this case study the Leipzig 'District Park Reudnitz' will be evaluated against a set of benchmark values related to policy objectives highlighting the improvement of quality of life in the city of Leipzig.

1. Introduction

The benefits of urban green spaces to residents are manifold. At the end of the 19th century, doctors and philanthropists already argued for better living conditions for an increasing working class. The remedy for resolving decline of living conditions was to divide towns into zones, to bring sunlight to unlit areas, and to establish parks and gardens in built-up areas (Thoren, 2000).

Nowadays, it is seen that the enhancement of urban green areas is a mean to mitigate the adverse effects of urbanisation, to make cities more attractive to live in, to reverse urban sprawl and to reduce transport demand. Apart from purifying air, urban green areas also serve to reduce noise pollution and to assist in the formation of microclimatic conditions suitable for citizens. As a result, there is a broad societal demand for more green in and around cities and local authorities show increasing commitment to meet this demand (BUGS, 2001). Due to their role as managers of local ecosystems, local authorities possess a key position in developing and managing urban green areas and therefore in sustainable development and the improvement of quality of life (Bergen Jensen, 2000).

This paper builds upon the results of the European Union research project "Development of Urban Green Spaces to Improve the Quality of Life in Cities and Urban Regions" (URGE[1]). An important goal of this project is to analyse to which extent urban green areas are able to contribute to urban sustainability and to an improvement of quality of life. Therefore we need to gain more insight in the various characteristics and attributes of urban green areas and the way they influence quality of life.

The present paper aims to offer a methodological framework that is useful for evaluating the effects of urban green spaces on spatial sustainability and quality of life. This evaluation framework will be demonstrated by means of the case study District Park Reudnitz in Leipzig[2].

The paper is organised as follows. In Section 2, some methodological reflections on sustainability and quality of life analysis will be offered, accompanied by a description of the multicriteria evaluation method Flag Model which forms the core of the operational evaluation framework. In section 3, a description of the European Union research project URGE is given. This research project provides us with evaluation criteria linked to quality of life and these criteria form the foundation of our presented evaluation framework and its application. The application of the Flag Model and its

empirical findings are presented in Section 4. Finally, conclusions are drawn in Section 5.

2. A decision support framework for urban green spaces and quality of life

Although sustainability and quality of life can be defined in various ways, we will in this paper adopt the simple view that the development of an economy or city has to take place within a set of pre-specified normative constraints or pathways (Van Pelt et al., 1995). Ideally, such constraints or benchmarks should be mapped out in quantitative terms, but in reality we are often confronted with qualitative, fuzzy and incomplete information. In general, there are various ways to identify and quantify such benchmarks (e.g., quality standards, carrying capacity, ecocapacity, critical loads, maximum sustainable yield or environmental utilisation space). In our approach we will put these types of benchmarks under the heading of critical threshold values (CTV) (see Nijkamp and Ouwersloot, 1998). These values constitute a crucial factor in our decision support model regarding urban green spaces. In the quality of life assessment methodology presented here we distinguish the steps shown in Figure 1.

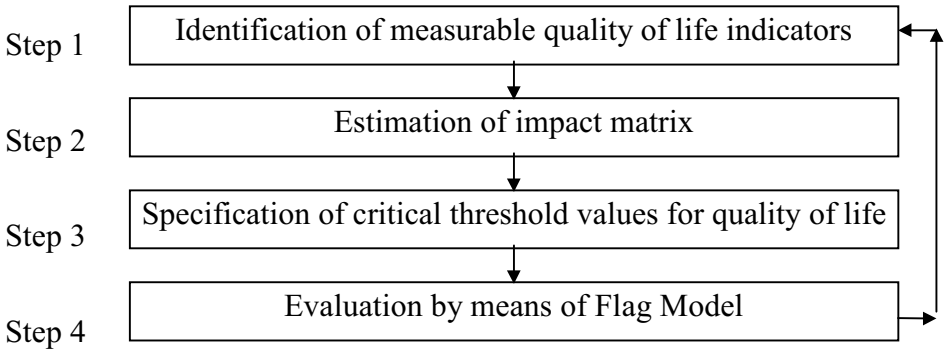

Figure 1. Steps in a quality of life assessment procedure

In this paper we will evaluate urban green spaces by using normative reference values or benchmarks in the form of critical threshold values. It is obvious that one needs to define and specify meaningful and measurable indicators in order to operationalise the notion of quality of life. However, there are no unambiguous indicators, they are always context and site-specific. Taking for granted the existence of such a set of indicators (in our case the URGE indicator set), a critical threshold value can be defined as the numerical normative value (benchmark) of a quality of life indicator. These benchmark

values ensure compliance with the (policy) objectives associated with the urban green space at hand. Exceeding such a benchmark means no-compliance and results in unacceptable high social costs.

Clearly, for each selected indicator a separate benchmark has to be determined, so that the entire set of indicators and benchmarks acts as a reference framework for judging urban green spaces on quality of life aspects. A distinction can be made between two types of indicators, namely cost and benefit indicators. If, for example, an indicator is characterised by 'a lower value is better'; a score above the benchmark signals a dangerous or threatening development with regard to quality of life. This type of indicator is labelled here as a *cost indicator*. The reverse reasoning applies to *benefit indicators*.

An important problem faced in practice is the fact that a benchmark value is not always unambiguous. In certain areas and under certain circumstances, different experts and decision-makers may have different perspectives on the precise level of a benchmark. It may even be the case that a benchmark is fuzzy in nature, and as a consequence fuzzy assessment methods need to be used (Munda, 1995). A relatively simple and manageable approach to this uncertainty problem is to introduce a bandwidth for the corresponding value of the benchmark, defined as CTV_{min} and CTV_{max}. This bandwidth mirrors the minimum and maximum range of benchmark values expressed by experts or policy-makers (Nijkamp and Vreeker, 2000). CTV_{min} indicates a conservative approach to the maximum allowable threshold for the corresponding indicator (min-max condition). CTV_{max} refers to the maximum allowable value of the indicator beyond which an alarming deterioration of quality of life will start (max-max). This process can be depicted as follows, assuming that the original CTV benchmark has an index value of 100 and the indicator concerned is a cost indicator:

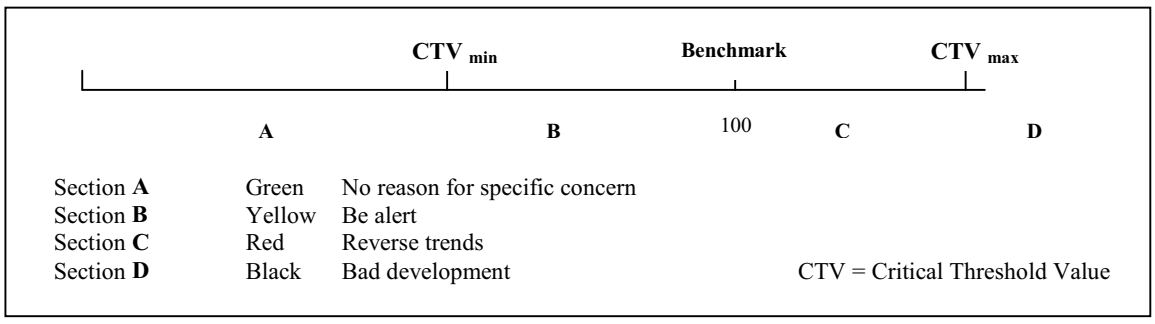

Figure 2. The relation between the colour of the flag, critical threshold values and benchmark

The Flag Model is an appealing approach to confront policy-makers with the economic, ecological and social (quality of life) consequences of urban green spaces. Furthermore,

the method also gives in a systematic way information regarding trade-offs between conflicting objectives.

In order to operationalise the above mentioned multicriteria evaluation method, a software package called Flag Model has been developed[3]. This multicriteria software package evaluates the degree to which an urban green space can optimise or complies with multiple objectives, such as economic progress, safety and environmental quality.

In order to test the evaluation framework, we will apply the Flag Model to an urban green area in the city of Leipzig. The next sections will shed some light on the selection of criteria and indicators, data collection and the formulation of appropriate benchmark values for this case study, as well as the final evaluation of the park.

3. Description of the URGE project and its criteria

The URGE project, as mentioned in the introduction, considers urban green spaces as an important element in enhancing the quality of life of the urban population and contributing to the sustainable development of European cities. The aim of the project therefore is to improve the provision of green spaces in cities, both qualitatively and quantitatively. In order to achieve this goal, it is important to increase the knowledge about the complex interactions between nature, economy and social systems in urban environments, considering this as a premise to the development of modern strategies for the design and management of urban landscapes (URGE, 2001). The project includes the elaboration and testing of an interdisciplinary catalogue of criteria and indicators, based on experiences from various European cities. This catalogue comprises criteria to evaluate ecological, economic, social and planning issues regarding urban green spaces and quality of life.

From an ***ecological perspective,*** urban green spaces moderate the impact of human activities by, for example, absorbing pollutants and releasing oxygen (Hough, 1984), improve the urban climate and maintain the balance of the city's natural urban environment (Stanners and Bourdeau, 1995). From an ***economic perspective,*** green spaces might deliver products such as wood, fruits and compost as a result of urban green production. Their presence can create an increase in the economic value of an area as well as in the value of real estate, and can provide new jobs. From a ***social perspective,*** particular types of green space can embrace a wide range of activities, help to foster active lifestyles, and can be of real benefit to health. Urban green spaces

emphasise the diversity of urban areas by reflecting the different communities they serve and meeting their varying needs. They also provide safe play space for children, contribute to children's physical, mental and social development (Hart, 1997) and play an important role in the basic education of schoolchildren with regard to the environment and nature. From a ***planning perspective,*** a network of high quality green spaces linking residential areas with business, retail and leisure developments can help to improve the accessibility and attractiveness of local facilities and employment centres.

In order to evaluate the ecological, economic, social, and planning consequences one needs a set of comprehensive indicators. The URGE project provides us with such a set of criteria and indicators. The inclusion of the URGE indicator set in our evaluation framework will enable researchers and planners to evaluate the relevant green spaces on their contribution to the quality of life in urban areas. This will allow us to draw conclusions about the effectiveness of national and regional policies and their implementation. The knowledge gained will be used to improve existing green spaces and to optimise urban green policies in Europe (URGE, 2001).

In this paper, the evaluation framework presented will be applied to an urban green space in the city of Leipzig. This includes the selection of criteria and their belonging indicators from the URGE indicator set (see also Table 1). This selection of indicators consists of those indicators for which both data of the actual situation and benchmark values are available. Some examples of indicators will be given. First, the ecological indicators have been selected. Examples of ecological indicators used are: surface of urban green, measured by the number of m^2 an urban green space contains; isolatedness, measured by the distance to the next green space; and soil quality, measured by the possibility of contamination on the site. The second group of indicators consists of the economic indicators, for example: number of m^2 green space per resident living within 500m of the green space; the number of residences within 10 minutes walking distance; and whether an entrance fee has to be paid or not.

The third subset of indicators, the social and planning indicators, is represented by, among others; the presence of sports facilities; whether the urban green is used as a teaching aid or not; and safety, indicating if people feel safe during day and night while using the green space. The planning process indicators were excluded from the analysis, since there are hardly any benchmark values available for them.

Table 1. Three dimensions and the criteria used in the evaluation of District Park Reudnitz

Dimensions	Criteria	Indicators	Data	Value
Ecological	- Fragmentedness	- *Isolatedness of the area*	Quantitative	120 m
		- *Surface of the area*	Quantitative	50.000 m^2
		- *Connectivity to next green area*	Qualitative	1
	- Soil quality	- *Quality of the soil*	Qualitative	1
		- *Soil sealing*	Quantitative	24%
	- Biodiversity	- *Number of exotic species*	Quantitative	12.8%
	- Barrier	- *Noise reduction from surroundings*	Quantitative	55dB
	- Naturalness	- *Proportion of the surface which is heavily worn*	Quantitative	0.5%
Economic	- Availability	- *Number of m^2 green space per resident*	Quantitative	4.4 m^2
		- *Percentage of residents within 10 min. walking distance*	Quantitative	12%
	- Accessibility	- *Average distance between entrances*	Quantitative	85 m
	- Production	- *Exploitation of natural resources*	Qualitative	1
	- Finance	- *Do visitors have to pay an entrance fee?*	Qualitative	No
Social And Planning	- Educational resource	- *Is the area used as a teaching aid?*	Qualitative	No
	- Recreational facilities	- *Presence of sports facilities*	Qualitative	4
		- *Presence of additional recreational facilities*	Qualitative	3
		- *Presence of facilities for children*	Qualitative	3
	- Safety	- *Do people feel safe in the area?*	Quantitative	51%
	- Management regimes	- *Proper management*	Qualitative	2
		- *Co-operation within the administration*	Qualitative	2
		- *Creation of income*	Qualitative	0
	- Citizens involvement	- *Information available*	Qualitative	2
		- *Instruments to involve citizens*	Qualitative	3
		- *Co-operation between authorities and education and recreation providers*	Qualitative	No
		- *Thematic trails*	Qualitative	No

4. The application of the Flag model on the District Park Reudnitz

In this section we apply the Flag Model on District Park Reudnitz in Leipzig and evaluate the park according to its related quality of life objectives. The main purpose of the Flag Model is to analyse whether an urban green area can be classified as acceptable or not in the light of a set of benchmark values reflecting quality of life issues. The most important input for the Flag Model is the so-called impact matrix, a table that contains the values of the respective indicators for the urban green area(s) considered as well as the *a priori* specified benchmark values (Vreeker et al., 2002).

For the analysis of the Reudnitz Park in Leipzig we selected 25 indicators from the URGE indicator set for which both data of the park and associated benchmark values are available. During the development of the District Park the municipality of Leipzig formulated these planning benchmarks but they also include objectives that apply for the city of Leipzig as a whole.

The Flag Model uses three classes of indicators, which correspond to three dimensions of quality of life; Environmental, Economic, and Social and Planning dimensions. In our case study, eight indicators are related to the ecological class, five indicators to the economic class, and twelve to the social and planning dimension. In our evaluation of the park we defined the lower critical threshold value, the benchmark (derived from planning objectives), the upper critical threshold value and the 'score' of the concerning green area on the particular indicator (see also Figure 1). The lower and upper critical threshold values are derived from, respectively, the minimum and maximum possible score of the indicator as decided on in the URGE project.

In order to obtain robust results, we evaluated the urban green area in two different ways. In our first analysis (S.1) we used the planning targets provided by the city of Leipzig as benchmark values (CTV). The second analysis (S.2) can be seen as a sensitivity analysis or a robustness test, for which we used the various planning targets as CTV_{min} or CTV_{max} and imposed therefore more strict benchmark values on the indicators. The results of both analyses are provided in Table 2 and Figures 3 and 4.

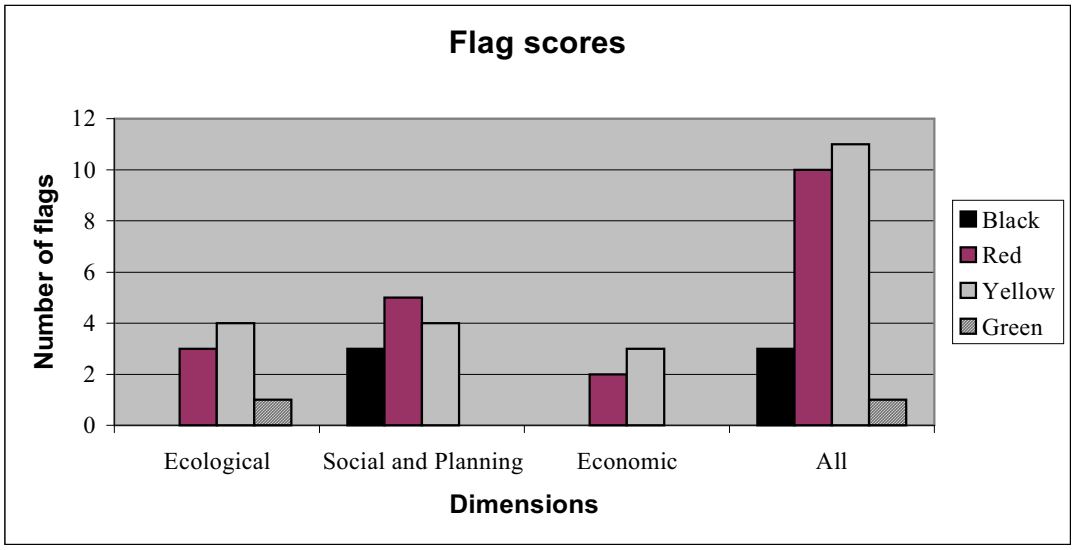

Figure 3. Number of flags per quality of life dimension for the first flag analysis (S.1)

Figure 3 shows the results of the first analysis (S.1). From this figure we can see that in total three black flags, ten red flags, eleven yellow flags, and one green flag are assigned

to the various indicators. Most of the black flags concern the social and planning dimension.

Table 2 shows the various indicator outcomes together with the different flags assigned to them in the first analysis (column S1). From this table we can see that the social indicators that received a black flag are green as teaching aid, co-operation, and safety both day and night. The safety indicator can be seen as a physical problem within the area. The other two indicators have only qualitative scores ('yes or no'), which partly explains the bad score, since there is no graduation possible except for 'good' or 'bad'. 'Naturalness' receives the only green flag in the ecological group. The social group scores the most red flags, meaning that certain trends should be reversed. The economic dimension of indicators scores two red flags; 'green space per resident within 500m distance', and 'average distance between entrances'.

Table 2: Indicators, benchmarks and flag outcomes (B= black, G= green, R= red, Y= yellow)

	Indicator	CTV-min	Benchmark	CTV -max	S.1	S.2	Difference
Ecological	Surface of urban green	40000	45000	50000	Y	G	+
	Isolatedness	50	100	250	R	R	0
	Connectivity	0	1	4	Y	Y	0
	Soil sealing	5	25	30	Y	G	+
	Naturalness	2	5	10	G	G	0
	Number of exotic species	15	25	50	Y	G	+
	Noise from surroundings	40	50	55	R	R	0
	Soil quality	0	3	4	R	R	0
Social	Sports facilities	1	4	5	Y	Y	0
	Additional recreation facilities	1	3	3	R	R	0
	Facilities for children	1	3	4	Y	Y	0
	Instruments to involve citizens	1	4	5	R	R	0
	Green as a teaching aid	1	1	2	B	B	0
	Information available	1	3	4	R	R	0
	Co-operation	1	1	2	B	B	0
	Thematic trails	1	1	2	Y	Y	0
	Co-operation within administration	1	3	4	R	R	0
	Creation of income	0	1	3	R	R	0
	Proper management	1	3	3	Y	Y	0
	Safety both day and night	60	75	95	B	B	0
Economic	Green space per resident within 500m	2.5	6.0	10.0	R	R	0
	Number of residences within 10min distance	0	10	30	Y	G	+
	Average distance between entrances	30	57	90	R	R	0
	Entrance fee	1	1	2	Y	Y	0
	Exploitation of natural resources	1	1	4	Y	Y	0

The yellow flags are quite equally distributed over the dimensions, since both the social and the ecological dimension score four yellow flags and the economic dimension three. Summarising, based on flag colours, we can say that the ecological dimension has the best score, whereas the social dimension has the worst score, although one has to keep in mind that the number of indicators and therefore the numbers of flags differ between the dimensions.

In the sensitivity analysis (S.2) we assumed that depending on the type of indicator, either cost or benefit, the upper or lower CTV of the indicator concerned is represented by the value of the benchmark. The result will be a narrowing of the range between the benchmark values and CTV_{min} or CTV_{max}. This means that, for example, for soil quality (which should be as high as possible), the CTV_{max} corresponds with the benchmark value, i.e., the planning objective, resulting in a higher benchmark to overcome for the indicator concerned. For isolatedness (which is a cost indicator) the CTV_{min} corresponds with the value of the benchmark, i.e., the planning objective. When the score on the indicator 'isolatedness' is below the lower CTV, it will receive a green flag.

When we take a look at Figure 4, we see that the most important difference with Figure 3 is that more green flags appear. This time we have five green flags instead of one. Four of them are assigned to the ecological dimension of indicators (number of exotic species, soil sealing, naturalness, and surface of urban green). The economic class gained one green flag for the indicator 'number of residences within 10 minutes distance'.

Summarising, the robustness analysis (S.2) shows even clearer that the ecological class has the best scores, whereas the social class has the lowest score, since it depicts three black flags and no green flags.

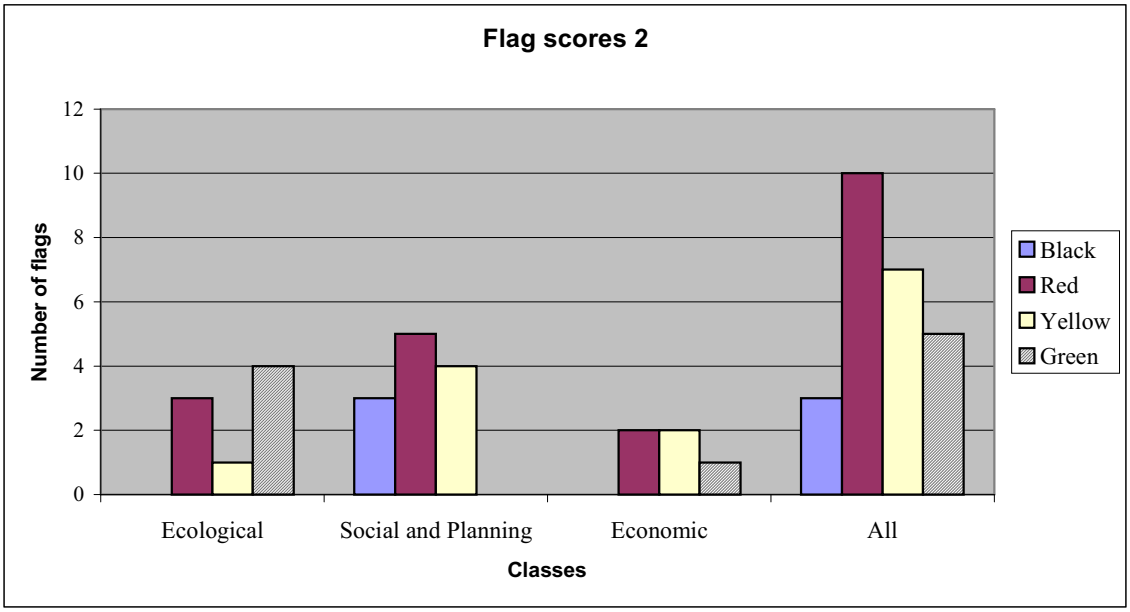

Figure 4. Number of flags per quality of life dimension for the second flag analysis (S.2)

5. Conclusions

The aim of this paper was the development of an evaluation framework for urban green spaces. This evaluation framework should be able to capture the influence urban green spaces have on quality of life aspects. It appears that the Flag Model by using CTVs or benchmarks in combination with policy objectives offers a useful operational framework for quality of life assessment at the urban level.

Endnotes

[1] This project is funded under Key-Action 4 "The City of Tomorrow and Cultural Heritage" of the Programme "Energy, Environment and Sustainable Development" of the 5th Framework Programme of the European Union.

[2] The results of the case-study District Park Reudnitz are draft results of the URGE project. They are used to illustrate the Flag model.

[3] The Flag Model software has been developed as a deliverable of European Union research project SAMI.
SAMI, *Strategic Assessment Methodology for the Interaction of CTP-Instruments*, Deliverable 5: SAMISoft, DG7 Transport Research (Strategic), European Union, Fourth Framework Programme, 2000.

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