A Comparative Framework of Assessment Indicators for Urban Green Spaces

Research Memorandum 2002-27

Faculteit der Economische Wetenschappen en Bedrijfskunde (FEWEB)

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A Comparative Framework of Assessment Indicators for Urban Green Spaces

A case study on Dutch cities

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Abstract

The urban built enviromnent does not only comprise artefacts made up of concrete and asphalt, but also man-made green areas. Tbis paper aims to present a genera1 framework for the evaluation of urban green structures and green spaces. It is a result of the EU project 'Development of Urban Green Spaces to Improve the Quality of Life in Cities and Urban Regions' (URGE)[1]. The objective of the project is to provide a systematic and operational assessment framework, which contains methods and measures of green space development and management in cities. The main question is how urban green spaces can be developed and managed and which evaluation tools and instruments are helpful in this framework. There are four complementary perspectives in this project from which urban green spaces are analysed: ecological, economic, social and planning. The present paper offers mainly a functional typology of urban green spaces according to economic aspects as the basis for the determination of the dimensions, criteria and indicators that are relevant for the assessment of urban green spaces. The methodology is applied to cities in The Netherlands on the basis of various empirical data. The representation of contrasts and commonalities in different categories of cities is based on the so-called spider model. In this way, an economic assessment of Dutch cities will be offered from which policy conclusions are drawn.

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

1. Introduction

The modem world is in a continuous process of rapid urbanisation. This holds for all countries with industrial regions taking the lead. The United Nations forecasts that by the year 2025, more than 60% of the world's population will be living in urban areas, compared to 29% in 1950 (Sukopp, 1998). Such developments lead to a call for sustainable development. Since the World Commission on Environment and Development launched 'Our Common Future', sustainability has become an important politica1 issue (World Commission on Environment and Development, 1987). The aim of this policy document is by nature rather genera1 and global. For proper implementation of the policy recommendations, they must be translated into concrete action plans at a decentralised level, such as local communities. At the European level, the Sustainable Cities and Towns Project helped formulate a set of guidelines for sustainable local development based on comprehensive urban ecological research. A large number of cities adopted the principles when they convened in Aalborg, Denmark, in 1994 (European Commission, 1996).
The present paper is part of the URGE project which 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. The URGE project is related to the aforementioned policy issues about proper implementation of guidelines for sustainable development. Within the URGE project team, urban green spaces are considered as an important contribution to the sustainable development of cities. The research group recognises the potential of green spaces to improve the quality of urban life, but is also aware that this potential is hard to realise, as current management practices are often far from optimal. Therefore, the project includes the elaboration and testing of an interdisciplinary catalogue of methods and measures, based on experience from various European cities. This catalogue comprises criteria to evaluate ecological, economic, sociological and planning issues. The participating cities will each select two green spaces that will be used as case studies, by means of which to test the applicability of the criteria. The comparison of the results of these analyses will enable the research team to evaluate the relevant green spaces, according to their contribution to the quality of life in urban areas. This will allow conclusions to be drawn 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).
This paper addresses also the question why people are interested in urban green spaces from an economic point of view. It is therefore that economic indicators have been developed, to give US proper information tò discover the order of magnitude of demand for and supply of the multi-faceted functions of various urban green spaces, resulting in the economic value of urban green space. The economic value of nature can be defined as the total amount of welfare that nature generates for society. These are not just financial measures. One can distinguish economic values and financial values. Financial values indicate how much one must pay for a good in the market (market prices). Economic values, on the other hand, also take into account extemalities (both positive and negative) that do not involve money transfers. The economic criteria and indicators represent both economic and financial values of urban green and are represented by four distinct economic dimensions of urban green, as will be shown later in this paper.

This paper is organised as follows. The next section describes the definitions that will be used in this paper. Section 3 deals with economic dimensions, criteria and indicators. In Section 4, the spider model will be introduced as a meaningful analytical and operational tool, whereas in Section 5 this spider model will be applied on 24 Dutch cities, illustrating the presence and importance of urban green in different city types. The policy relevance and conclusions are offered in Section 6.

2. Definitions of Terminology Used

The urban environment is complexly structured and richly textured in its interweaving of a mixture of natural, built-form, economic, social and cultural dimensions (Haughton and Hunter, 1994). Therefore, the overall urban environment can be said to consist of natural, built and social components. The natural environment includes air, water, land, climate, flora and fauna, whereas the built environment contains the fabric of buildings, infrastructure and urban open spaces. The social environment embraces less tangible aspects of urban areas, such as aesthetic and amenity quality, architectural styles, heritage, and the values, behaviour, norms and culture of the resident community (OECD, 1990). This seems to be closely related to the classification used in the URGE project: ecological, economic, social and planning.
To become 'green', Haughton and Hunter (1994) argue that cities should not just clean themselves up, they need to become life enhancing and regenerative to secure reciprocity between the urban way of life and the natural web that surrounds it. Key ingredients in creating a green city are the need to look at the city in its bioregional context, and to bring about fundamental changes in the ways in which people treat nature, and treat each other.
A clear definition of urban green space is essential for the creation of relevant economic indicators. Since this paper is related to the URGE project, the definition of urban green space that is used in this paper is almost similar to the one that is used within the URGE project. The aim of the URGE project is to improve the future management of green spaces in cities and urban regions by providing methods and procedural guidelines for the inclusion of ecological, social and economic factors in the process of urban planning and maintenance. The definition used in the URGE project has been formulated by ecologists, economists, social scientists and planners, and they agreed on the following definition:

By urban green spaces we understandpublic andprivate open spaces in urban areas, primarily covered by vegetation, which are directly (e.g. active or passive recreation) or indirectly (e.g. positive influence on the urban environment) available for the users.

Green areas can be privately owned or an entrance fee can even be charged for access to them (such as is the case for botanica1 gardens etc.), as long as they are available for public use. Since the URGE project is mainly focussed on the residents of a city, tourist use is not relevant for URGE. The colour (i.e. urban blue, urban brown, etc.) is also essentially irrelevant. The importance of urban green lies in public access. Cemeteries and allotments are excluded. These could, however, be considered if they are mainly used as parks or recreation areas. Trees in streets and other small green features are generally excluded (they are not green "space"), but may be regarded on a city scale as part of the green structure (URGE, 2001).

As mentioned above, the definition of urban green space used in this paper is almost similar to the URGE definition. The most important difference is that this paper also refers to natura1 areas and forests within the boundaries of the municipality when using the term 'urban green space'. Reason for this is the availability of interesting data on this category of urban green space with which the analysis by means of economic indicators may be enriched. When we focus on the availability of urban green, we also include recreation areas, both for daily recreational activities and for extended stays. We think that these functions and activities all contribute to urban sustainability and the quality of life in the city.

3. Economic Dimensions, Criteria and Indicators

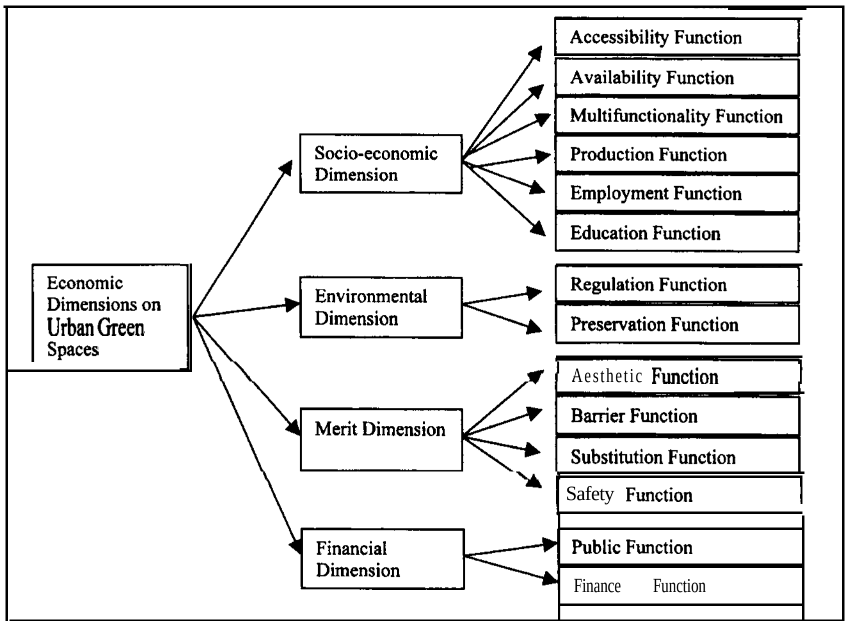
Improving the environment by means of economic instruments has been increasingly recognised in recent years. Also Agenda 21 - from the 1992 Rio Earth Summit - summarises many of the benefits of economic policy approaches. There is a particular value to looking at economic instruments in an urban context, since many of the environmental problems of cities relate to what economists would refer to as a concentration of negative extemalities, that is, non-costed environmental impacts (Haughton and Hunter, 1994). The use of economic instruments to improve the urban environment is rapidly evolving.

Economic criteria and indicators can be a very helpful tool for evaluating urban green spaces. First of all, criteria that determine functions of urban green spaces should be formulated. Secondly, indicators should be developed in order to measure and quantify the criteria. Indicators are pieces of information designed to communicate complex messages in a simplified, (quasi-) quantitative manner so that progress in the field of decision-making can be measured (Rothmans, 1997). The indicators can be measured with the help of necessary quantitative input. This necessary input consists of data that must be collected by, for example, statistical analysis, or quantitative and qualitative surveys. Indicators are bits of infonnation that highlight what is happening in the large system; they are small windows that provide a glimpse of the 'big picture' (Kuik and Gilbert, 1999).

Indicators have three functions: (1) simplification (to simplify information about complex phenomena), (2) (quasi-) quantification (to quantify information so its significance is more readily apparent) and (3) communication (to improve communication of the information to the user) (van Delft, 1997, Rothmans, 1997). The additive 'quasi' indicates that, in principle, indicators could also be qualitative. Qualitative indicators may be preferable to quantitative indicators where the underlying quantitative information is not available, or the subject of interest is not inherently quantifiable (Gallopin, 1996).

Indicators are a compromise between scientific accuracy and the demand for concise information. The basic challenge for indicator development is: 'to reduce a large quantity of data down to its simplest form, retaining essential meaning for the questions that are being asked of the data' (Kuik and Gilbert, 1999). Good indicators present information in a clear and usable form at the right time to those who need it (Boyd, 1997). Different users of environmental indicators have different needs. Thus the appropriate set of indicators depends on its particular use. Therefore it is important to determine the users of this project. The users in the short term are the project partners of URGE. In the long run, the users will be urban authorities and municipalities. To generate discussion among these people having different

backgrounds and viewpoints, and to help create a shared vision of what the community should be, indicators can be a useful tool (Sarmento et al., 2000).
A logical starting point in the development of economic indicators for urban green is the development of a functional economic taxonomy of urban green spaces. This forms the basis for determining the economic value of urban green spaces. Which functions are most relevant for a given urban green space depends on the ecological characteristics, the cultural and socio-economie setting, and the management objectives of the area in question (de Groot, 1994).
The determined functions have been classified into four economic dimensions of urban green spaces. These are successively the socio-economie dimension, the environmental dimension, the merit dimension and the financial dimension. The classified dimensions and the accompanying tünctions are shown in Figure 1.



'igure 1: Four economic dimensions on urban green spaces with their matching functions (Rodenburg et al., 2002)

The socio-economie dimension contains the functions that have an impact on welfare and quality of urban life aspects, for example, the employment function or the education function. The environmental dimension refers to scarcity elements that are linked to the physical surroundings and the environment, for example, the regulation function. The merit dimension shows the virtue of urban green to the residents. It concerns extemal effects that are useful to the visitors, for example, the barrier function when the vegetation works as a windbreak or noise barrier. The financial dimension is related to the way of financing urban green and the importance of urban greento the local authorities (Rodenburg et al., 2002).

4. Use of the Spider Model

The economic dimensions on urban green space serve as either signposts for policy-making or as quantified tools for comparative analysis. As an analytical tool for our analysis, we will employ here the so-called spider mode1 (see Rienstra, 1998). Spider models can be used to visualise the relative strengths and weaknesses of the selected case studies for various chosen factors. Each factor is represented by an axis starting from the interior towards the outer boundary of the spider, in which the lowest scores are to be found in the centre of the spider. The score of each factor is based on quantitative data, standardised on a ten-point scale. It should be stressed that there is no weighing between the factors. A straightforward numerical comparison of scores related to different factors is not allowed. A score of 7 on one factor does not necessarily mean that it is a better score than a score of 6 on another factor. The envelope composed of all scores per factor forms a connecting line resulting in a surface representing the integral representation of these factors per city type. In general, one might state that the larger the surface, the better the city type in question scores. The advantage of this visualisation by means of the spider mode1 is that it is easy to show the relative score of the various city types concerning urban green.

The starting point of this analysis is that the larger the area of usable public urban green space available to the household, the better it is for health, privacy, recreation and development. In addition, the lower the density of residential use the better (OECD, 1978). For the economic assessment of the Dutch cities data from the Statistics Netherlands was used. For twenty-four different municipalities[2] several variables concerning demographics and land use were used for the analysis (see van Leeuwen et al., 2002).

Most of the cities are selected on the basis of the number of inhabitants with a minimum of 100.000 inhabitants. A few municipalities count fewer people within their borders; however, because of their importance for the province or region they are included in the analysis. Middelburg, for example, counts only 44,920 inhabitants but it is the most important city of the province of Zeeland. The twenty-four cities can be divided into four groups (see van Leeuwen et al., 2002): Big cities (4), New cities (4), Intermediate cities (8) and Peripheral cities (8) (see Table 1).

Table 1: Four groups of cities

Big Cities	*New Cities*	*Intermediate Cities*	*Peripheral Cities*
Amsterdam	Almere	Breda	Deventer
Rotterdam	Alpen aan de Rijn	Ede	Den Helder
The Hague	Zaanstad	Eindhoven	Emmen
Utrecht	Zoetermeer	s'-Hertogenbosch	Middelburg
		Leiden	Roermond
		Nijmegen	Enschede
		Tilburg	Groningen
		Zwolle	Maastricht

Source: van Leeuwen et al., 2002

The big cities are relatively old cities, which form the Randstad, the highly urbanised region in the western part of The Netherlands. They have the highest population and

[2] Statistics Netherlands provides data about municipalities. This implies that in some cases not only the cities are taken into account but also the smaller villages that are administratively related.

housing density. A high percentage of ethnic minorities live in these cities and the average discretionary income per household is relatively low. This goes often together with a high unemployment rate. The new cities are situated near the big cities and are built or expanded because of the pressure on, for example, the housing market in the big city. Also the people who do not prefer to live within a big city but who want to live nearby because of their work live in new cities. There are quite some differences between the big and the new cities. The population of the new cities is relatively young, many children under 15 and less people above 60 years old. The unemployment rate is very low in the new cities and the average discretionary income is relatively high. The housing density and the population density are much lower compared to the big cities. *The intermediate cities* show intermediate scores on the different variables, although the housing density as well as the population density are relatively high. The *peripheral cities* are often smaller cities situated in peripheral areas with an important regional function. They are the biggest city or sometimes even the only city within their region. Because of their situation in the peripheral areas the housing and population density is low. These cities often have a small percentage of ethnic minorities and a larger number of elderly.

5. Application of the Spider Model

The ahove discussed spider model will be applied to the data that are collected for the 24 Dutch cities. We have tried to get complete information on all four economic dimensions of urban green (socio-economie, environmental, merit, and financial). Unfortunately, we faced a lack of data, especially conceming the merit and the financial dimension. Therefore, the analysis so far wil1 mainly be based on data representing the socio-economie and environmental dimension.

Figure 2a presents the socio-economie data for the four city groups, weighted for the size of the population (number of inhabitants).

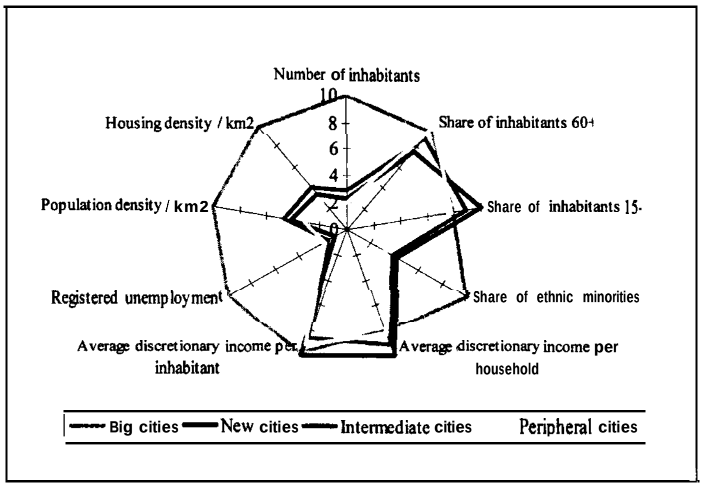


Figure 2a: General representation of the four city groups on the basis of socio-economic indicators

Not surprisingly, in this figure, the big cities have, on average, the highest scores on the socio-economie dimension, except for the share of inhabitants over 60 years old, the share of inhabitants younger that fifteen years old, and the average discretionary income per household and per inhabitant. Since the new cities count many young families, they have the highest score on the share of inhabitants younger than 15 years old. These cities also represent the highest discretionary income per household and per inhabitant, due to the fact that in many families in new cities both adults have a job. This could be the explanation for the low score on registered unemployment. The peripheral cities, on the other hand, have the highest score on the share of inhabitants over 60 years old, since they attract many retired people.

Next to the presentation of the four city groups, it is interesting to have a look at the scores of the different cities within a city group. An example is given in Figure 2b. It shows the scores of the peripheral cities on the socio-economie indicators. Except for some extreme values for Maastricht and Groningen (being the largest peripheral cities (capitals of their province), which explains the high scores on population and housing density), the average shape of the lines corresponds with the shape that represents the peripheral cities in Figure 2a.

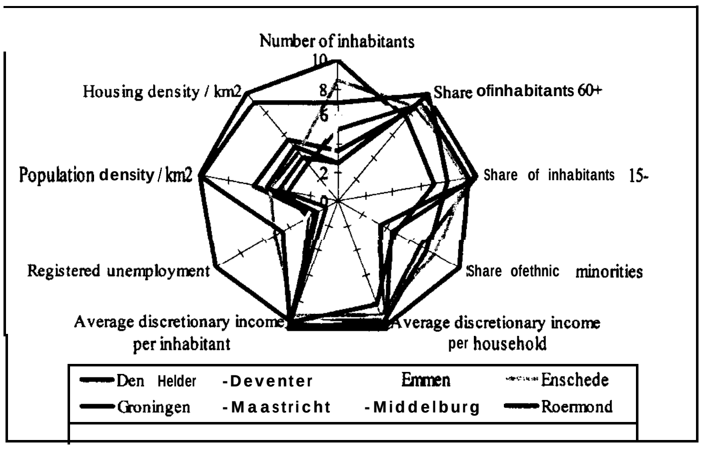


Figure 2b: General representation of tbe peripheral cities on the basis of socio-economic indicators

Apart from the genera1 socio-economie information as shown in Figure 2a and b, the spider models are an interesting tool to show other differences between the four city groups as well. The further analysis will be focussed on the availability and distribution of urban green in those city groups, representing the environmental economic dimension.

Figure 3a shows the different kinds of land use that can be found within the city groups as a percentage of the total area of the city groups. This spider model shows much more variety than the spider model in Figure 2a. Here, the big cities do not represent the highest scores on almost all factors. Factors on which they do have a high score are the total area of the city as well as the total built up area. The total area of the other three city groups is smaller, but not much different from each other. However, concerning the share of the total built up area there is much more variety. The new cities have the smallest share of built up area, but represent the highest share of housing within the built up area. This is not surprising, since these cities are mainly developed as an expansion of big cities because of the pressure on, for example, the housing market in the big city. Furthermore, it becomes clear that, also not surprisingly, the peripheral cities often have quite some agricultural activities within the municipality, whereas the intermediate cities have many nature and forest areas compared to other city groups. It is striking that the new cities have a large water surface compared to the other city groups. There seems to be a tendency that if cities have many forest and nature areas, they almost have no water and vice versa (intermediate vs. new cities). There are two possible explanations for this tendency: (1) it is easier to provide new to built cities with water than with forests (new trees take ages to develop into a real forest), and (2) the new cities are mainly to be found in the western part of the country which is the wet part. Furthermore, a combination of forests and water areas within a city does not go without saying, since forests prefer dryer areas and are therefore mainly to be found in the dry areas of The Netherlands.

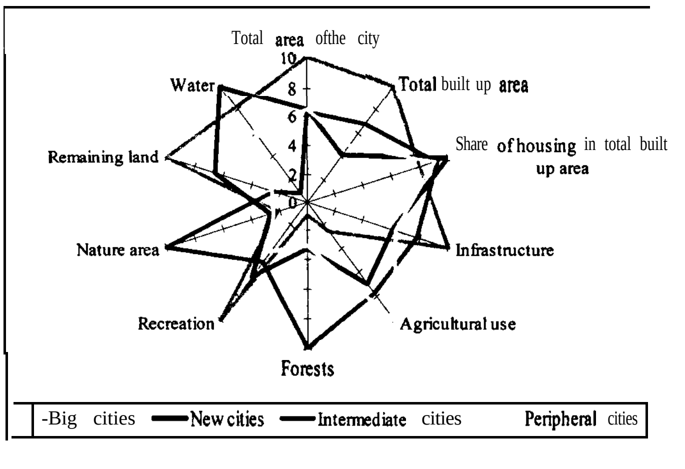


Figure 3a: General land use within the four city groups

Figure 3b shows the scores of the big cities on genera1 land use within the cities. Especially Amsterdam and Rotterdam seem to be responsible for the scores on the left side of the spider, whereas Den Haag and Utrecht seem to be responsible for the scores on the right side of the spider. All four cities have a high score on recreation, which is directly reflected in the integrated spider in Figure 3a.

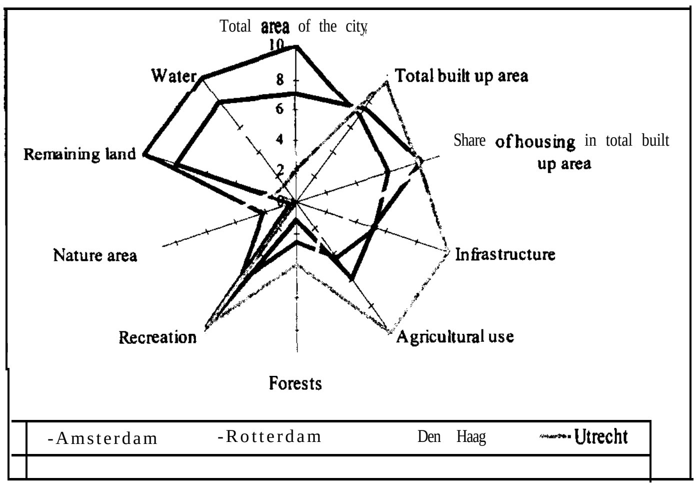


Figure 3h: General land use within the big cities

The genera1 land use can even be split up further into specific types of green land use within the four city groups. Figure 4a shows the different types of urban green areas within the four city groups in hectares per inhabitant. The total area for recreation purposes as well as the total nature area has been split up into sub-groups. This figure is very illustrative, since it immediateiy shows that the big cities have a very low share of different types of urban green per inhabitant. The new cities have much park area per inhabitant as well as the best opportunities for day recreation, whereas the intermediate cities have the best opportunities for longer stay recreation. It is striking that the peripheral cities, with their relative high share of inhabitants over 60 years old, have a relatively higher share of sporting fields per inhabitant than the new cities, witb their relatively high share of inhabitants younger than 15 years old.

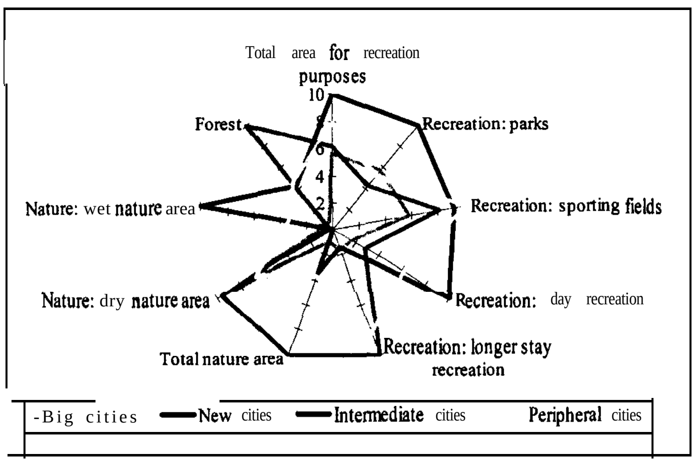


Figure 4a: Green land use within the four city groups

A comparison between Figure 4a and Figure 4b shows that the high scores of Almere on total nature area, forest, and longer stay recreation are not represented in Figure 4a. This individual share does not seem to be enough to outweigh other city groups on these factors. The emphasis is in this spider model (Figure 4b) on the right hand side: parks, sporting fields and day recreation. These are also the factors on which the new cities have a high score in the spider model representing the four city groups (Figure 4a).

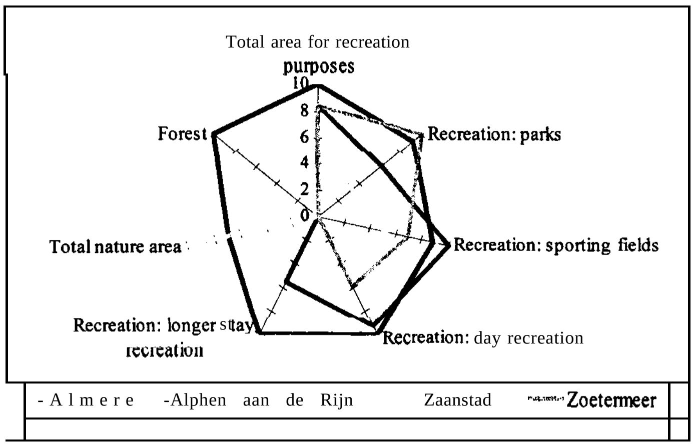


Figure 4h: Green land use within the new cities

The available data on the environmental dimension of urban green (Figure 3a and 4a) could be divided into two categories: human-made areas and natura1 areas. Analysing the data from this point of view results in the conclusion that especially the big cities have a high score on the human-made factor as a percentage of the total area of a city (Figure 3a). The natural areas (nature, forest, and agriculture) are mainly represented by the other city groups. However, if we have a look at the area of human-made urban green per inhabitant (Figure 4a), the big cities have a very low score. The explaining variable for these two different scores could be the very high population density in big cities.

After having analysed the socio-economie and the environmental economic dimension separately, it is interesting to see what the spider models will show when we combine those two economic dimensions of urban green.

First of all, we had a look at the combination of socio-economie indicators and the general land use indicators of the environmental dimension. Figure 5 shows that a high population density and a high housing density often go together with a very low share of agricultural land use and nature and forests, but also with an abundance of recreation areas. On the other hand, there seems to be a clear relation between a lower population and housing density and the presence of agricuhural land.

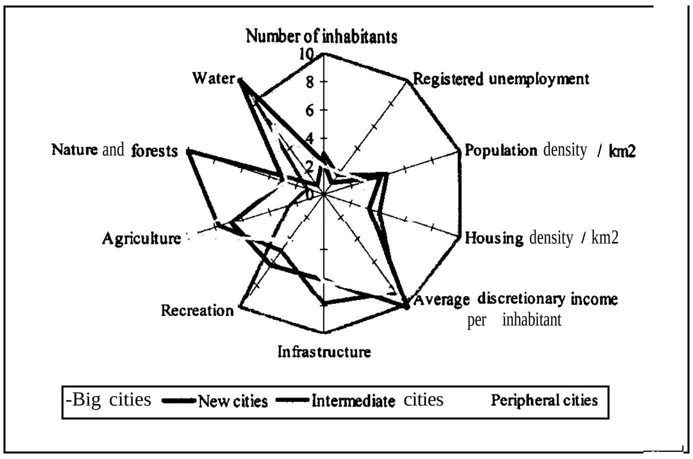
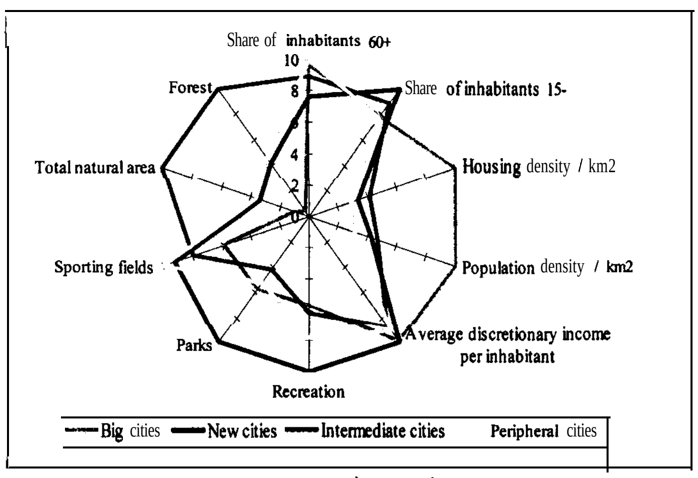


Figure 5: **Socio-economic** dimension versus **environmental** dimension **(general** land **use)**

If we make another **combined** analysis of socio-economie **and** environmental **economic** indicators on a lower, more detailed level, showing the kind of urban green land use per inhabitant within the different city groups (Figure **6),** we see that there is **quite** some similarity in pattems. **Many** cities have common visualisations, **except** for one or hvo indicators, which, **however,** are no **real** explanatory **factors.** This spider model nicely illustrates that a **very** high housing and population density **goes** together with a **very** low availability of natura1 **areas** and forests per inhabitant.



Figtue 6: Socio-economie dimension versus **environmental** dimension **(green land use)**

In the next **section,** the policy **relevance** and the genera1 conclusions that **can** be drawn **from** these spider models **will** be described.

6. Policy relevance/conclusions

Cities can be recognised as the centre of economic growth, human civilisation and places were cultural and commercial ideas are bom. But cities are also places which put a heavy burden on the environment and which can have an unhealthy climate for the population. Therefore a concern has emerged for the concept of sustainable cities: cities which aim to meet the needs of the current population in an efftcient and responsible manner without reducing the opporhmities for the next generations. The use of urban green is a new, but important topic of social science research work. With help of economic dimensions we tried to evaluate cities and their urban green spaces. In this paper we focussed especially on the socio-economie and the environmental dimension of urban green areas.

The analysis by means of the spider models showed interesting results. A final conclusion of the economic assessment on the twenty-four Dutch cities is that, when focussing on the availability of green areas in and directly around the cities, the big cities show the lowest scores on the availability of urban green within the municipality. They accommodate less green spaces, especially less natura1 green spaces, not only as a percentage of the total land use, but also conceming the availability per inhabitant. However, since big cities have a high population and housing density the availability of urban green spaces might even be more important than in other city types. Therefore, more attention should be paid to the analysis of urban green spaces in (big) cities with high population and housing densities. Such an analysis should not only focus on the availability of urban green spaces, but also on the importance of urban green spaces for the inhabitants of cities.

Regarding the research limitations of an application of the economic dimensions on planning processes, the first problem that we have faced in applying this framework to Dutch cities is to collect relevant data. The difficulties in collecting data stem from both a lack of data, and the classification categories or different measures that the cities used, creating difficulties in comparison. Another problem related to data collection is the administrative structure of the cities. The existence of several urban administrations within the city requires collecting data from different sources, which is a very difficult task. These difftculties decrease with the willingness of the urban administrations to participate in these kinds of projects.

The next steps of the URGE project will include the combination and integration of the various criteria and indicators belonging to the various dimensions of the different perspectives used in the project (ecological, economic, social and planning). Some of them will overlap, others won't, but it will be necessary to deploy them unambiguously. These integrated criteria will be used in a case-study approach to European cities to create the necessary information. In this experimental stage they may face various difftculties, even contradictions, which may then lead to the necessity to improve the criteria and indicators used so far. However, this experience will provide an opportunity to develop a common language among the different disciplines in green planning and management.

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