The perceived quality of the urban residential environment
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Chapter 1
General introduction and scope of the monograph

Adapted from a Dutch poem by M. Van Der Poppe, 1993.

Why study the quality of the urban residential environment?

With the recognition of the so-called environmental crisis in the mid 1960's, there is an increasing awareness of the environmental problems facing (the global) society. This is a result of the enhanced deterioration of the environment in the past three decades and the increasing amount of knowledge available about specific environmental problems and accidents. Depletion of the ozone layer by chloro-fluorocarbons (CFCs) and the possible enhancement of the greenhouse effect by the combustion products of fossil fuels are examples of environmental problems unfolding on a global scale. Sad examples of large-scale accidents affecting large numbers of people and vast areas are catastrophes with nuclear power plants (e.g., Chernobyl, 1986), chemical disasters (e.g., Soveso, 1976, and Bhopal, 1984), or the oil spills by oil tankers (e.g., the Exxon Valdez, 1988). On the other hand, there also is a growing awareness of the deterioration of the environment on a smaller scale: the local area. The local area comprises dwellings and neighbourhoods, which both represent people's direct habitat. The dwelling and the neighbourhood will be referred to as the residential environment.

Although the relative importance of the quality of the environment in general is still a matter of debate (see below), improving and subsequently maintaining the quality of the urban residential environment is of vital importance. This is because of the importance of the environment for other aspects of life, the specific nature of residential environments, the increasing role of urban residential environments as the main habitat of humans, and the number of people adversely affected by the prevailing condition of their urban residential environment.

At the time the environmental crisis emerged, it was also recognized that the quality of the environment is part of the overall concept of Quality of Life (QoL). This concept is supposed to reflect all aspects of a person's sense of well-being, including all factors which contribute to human satisfaction (Ott, 1978). Constituting aspects are, for instance, one's health, family life, work, social network, and, as already mentioned before, the environment (Craik and Zube, 1976). Some authors, however, argue that the importance of the quality of the human environment with respect to the quality of life must not be overstated. In relation to other aspects of QoL, the quality of the environment is considered to be of minor importance (CBS, 1987; Craik and Zube, 1976).

Likewise, the impact of environmental influences on public health is considered to be small (Kasl, 1990), especially when compared to the influence of lifestyles (e.g., eating, drinking, and smoking habits; Kroes and Kramers, 1991). Furthermore, the Dutch National Institute of Public Health and Environmental Protection (RIVM) concludes that
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environment is considered to be of minor importance (CBS, 1987; Craik and Zube, 1976). Likewise, the impact of environmental influences on public health is considered to be small (Kasl, 1990), especially when compared to the influence of lifestyles (e.g., eating, drinking, and smoking habits; Kroes and Kramers, 1991). Furthermore, the Dutch National Institute of Public Health and Environmental Protection (RIVM) concludes that although the exposure to a variety of environmental influences can threaten public health in the long term, present pollution levels are not endangering public health, at least not in The Netherlands (RIVM, 1988; RIVM, 1991).

From the above it can be concluded that the (quality of the) residential environment as an aspect of the QoL and as a public-health threat is, as yet, of minor importance, certainly when considering modern, western societies. The question thus arises: why study the quality of the urban residential environment?

First of all, a good illustration of the significance of the environment in general and the residential environment in particular is given by the 'onion soup metaphor'. What ingredients constitute a good onion soup? Besides onions, one needs salt and pepper, cream butter, garlic, herbs, cheese, and some red wine. These ingredients could be turned into a delicious onion soup. The finishing touch is a piece of French stick covered with cheese floating on the soup. But one essential ingredient not mentioned is water. Although its presence may seem so obvious, it is of vital importance. Its salience may be low relative to the other ingredients, but, as well as any other ingredient of disputable quality, bad water will lead to a bad-tasting soup. The same holds for the environment: a 'bad' environment will have a negative influence on people's general sense of QoL. Furthermore, the environment relates to the other aspects of life (i.e.: health, family, work, leisure) as water does to the other ingredients: it is the most important means for the quality and the development of the other aspects of life.

Secondly, in its system approach of the environment the Dutch National Institute of Public Health and Environmental Protection has distinguished five spatial levels (RIVM, 1988). These five levels are: the global level, the continental level, the fluvial level, the regional level, and the local level. These levels are classified on the basis of the nature of natural cycles occurring within the system. The levels are characterized by specific processes and responsible actors. For instance, typical processes at the continental level are acid deposits and deforestation. These are examples of problems that need to be dealt with at a national level (e.g., by governments) and international level (e.g., by the EU or the UNEP). At the local level construction and demolition of infrastructure are the main processes. Characteristic problems are nuisance by noise, malodour, air pollution and external safety risks. Local governments (e.g., municipalities, provinces) and individual residents are the main actors at this level. It can be concluded that because different types of environments may be identified, different types of 'environmental quality' may be defined. This monograph's focus is on the local level: on residential environments.

Thirdly, a growing number of people already live or will live, in the near future, in urbanized environments. Approximately 50% of the world population will live in urban areas by the year 2000. At the expected size of the global population of 6,000 million people in the year 2000, some 3,000 million people will live in urbanized environments (Jager and Ferguson, 1991). Nowadays, about 40% of the Dutch population already lives in 56 so-called urbanized municipalities. These municipalities
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have a density of 1,500 addresses or more per 3.25 square kilometre. Municipalities with an address density of 1,500 or more are considered to be strongly urbanized (Den Dulk, Van der Stadt, and Vliegen, 1992). It may be concluded that urbanized residential environments are (becoming) the main habitat of people. The increasing importance of urbanized environments as dominant habitat of man has been acknowledged at the United Nation's Habitat 2 conference held in Istanbul in Summer 1996.

Finally, the influence of environmental pollution on public health as expressed in mortality figures may be considered small, certainly when compared to the influence of lifestyles. For example, cancer mortality was 235 per 100,000 people in The Netherlands in 1992. According to a study by Doll and Peto (1981) 2% (range 1%-5%) of cancer mortality is attributable to environmental pollution, mainly air pollution. For The Netherlands this would mean a cancer mortality figure of 716 (range 358-1790) due to air pollution. Although the impact at the individual level is dramatic, these figures may be considered small from a public health perspective. However, health effects due to exposure to noxious stimuli are very diverse and mortality figures are only crude indicators of public health.

As is illustrated in Figure 1.1 (American Thoracic Society, 1985) the health status of a population exposed to a noxious stimulus can be represented as a variable on a continuum. On this continuum, plotted vertically in Figure 1.1, several more or less clear demarcation points can be identified such as physiological or psychological changes, illness, or death. So, in gauging the effects of exposure to environmental pollution, less detrimental effects than mortal effects must be taken under consideration as well.

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1 Municipalities may be categorized according to their address density of the surrounding area. This is a measure of urbanization based on the concept of concentration of human activity. For more details, see Den Dulk, Van der Stadt & Vliegen (1992).

2 Agents associated with increased cancer incidence are, for instance, benzene from combustion of fossil fuels and radon, a radioactive compound, emanating from soil underneath and building materials in the dwelling.

3 The pyramid shape is the general form by which the effects of exposure to noxious stimuli may be represented. The shape of the pyramid is dependent on the number of people affected (width of the pyramid) and severity of effects (height). In turn, the number of people and severity of effects are dependent on, for instance, exposure level, duration of exposure, and susceptibility. In a worst-case scenario the shape is a squared box indicating that all people who were exposed died as a consequence. In a best-case scenario the shape is a horizontal line indicating no detectable effects in those people exposed.
Figure 1.1 Health pyramid.

Whether an effect of exposure to environmental pollution is categorized as an adverse health effect is somewhat arbitrary. For instance, the American Environmental Protection Agency (EPA) draws the line between changes of unknown significance and pathological alterations (Figure 1.1, solid arrow). On the other hand, the World Health Organization (WHO) has defined health as ‘... a complete state of physical, mental, and social well-being and not merely the absence of illness or infirmity’ (WHO, 1960). According to this definition, any deviation from this state may be considered as an unwanted health effect (open arrow). So, environmental pollution resulting in effects other than mortality or morbidity may be considered as unwanted health effects as well.

These other effects of exposure to environmental pollution, in as far as people are aware of them, are collectively called annoyance. Lindvall and Radford (1973) have defined annoyance as ‘... a feeling of displeasure associated with any agent or condition believed to affect adversely an individual or a group’. At the individual level annoyance might be considered as a minor health effect. An important aspect of annoyance due to environmental pollution, however, is the number of people affected (Winsemius, 1987). For instance, about 16 out of every 100 adult Dutch residents indicated to be annoyed by malodour due to traffic and industrial activity in 1989 (RIVM, 1991). This means that about 1,800,000 Dutch people were annoyed by malodour due to these sources in 1989. Even more people are adversely affected by noise. For instance, 60 out of 100 adult people indicated to be annoyed by noise from road traffic in 1987 (RIVM, 1991). For The Netherlands this means that about 6,600,000 adult people were annoyed by traffic noise in 1987.

To summarize, urban residential environments are not only important means for the quality and development of other aspects of life, but are also becoming the dominant habitat of man. The adverse health effects due to environmental degradation are diverse, ranging from annoyance to mortality. Although annoyance due to environmental degradation as a health effect is much less severe than morbidity or mortality, the issue of annoyance is nevertheless a topic of concern because of the large number of people affected.

Thus, with the growing importance of the urbanized environment as the main
It should be noted that this set of environmental factors is not universal. To other institutions (e.g., governments) or situations (e.g., the global environment) different sets of factors may be more appropriate.

Land-use zoning (IMZ) is a policy instrument aimed at striking a balance between the development of activities with adverse effects on the local environment and the protection of land uses which are sensitive to these effects (VROM, 1988-1989).
environmental quality.

Most of the available EQI's are of the first type, i.e., they are based on measurements of exposure to adverse environmental conditions. The main reason for this is that these indicators can be assessed physically, that is with some kind of valid and reliable device or according to a standardized procedure. However, this does not imply that they do not depend on human judgment. Take, for instance, the measurement of malodour expressed in odour units. Instead of being physically measured, the quantification of malodour is done by means of olfactometry. Olfactometry is performed by means of a so-called 'sniffing panel'. Members of the 'sniffing panel' are presented with samples of the malodorous substance in various increasing dilutions. On the basis of their observations, i.e., whether panel members are able to distinguish diluted samples from odourless air, odour concentrations are calculated (Ham, 1985).

The main problem with respect to EQI's based on physical measurements is the weak relationship between exposure measurements and effects, such as annoyance. Several studies dealt with the dose-effect relation of environmental factors. On an aggregated level the association between exposure levels and effect were found to be strong (correlation coefficients ranging from .70 to .90). However, at the individual level these relationships were found to be much lower. Correlation coefficients between exposure levels and effect scores varied from .16 to .40 for noise (Van Kamp, 1990), malodour (Cavalini and Pulles, 1990), safety risks (Baba and Austin, 1989; Gates and Rohe, 1987), and air pollution (Hohm, 1976). Apparently other variables, next to exposure levels, affect the relationship between exposure and effect.

Effect-based EQI's pertain to exposure consequences. Consequences can be, for instance, disturbance of activities, health effects, economic effects, or changes in perceived environmental quality. EQI's based on the effects of environmental degradation circumvent the problem related to the dose-effect relationship. However, in designing effect-based EQI's the nature of the effects of environmental degradation raises problems of its own. The main problem is the quantification of effects. For instance, as was mentioned before, the Dutch National Institute of Public Health and Environmental Protection (RIVM) concluded that pollution levels, at least in The Netherlands, are not endangering public health at present (RIVM, 1988; RIVM, 1991). So, if any health effect can be found this will only result from large-scale (epidemiological) studies. At a disaggregated level (e.g., at neighbourhood level) health effects will not be very suitable as a measure for environmental quality (see also Health Council of The Netherlands, 1995). Economic effects of environmental degradation could be, for instance, decreasing property value or costs made to diminish unwanted effects (e.g., soundproofing of the dwelling) which can be expressed in monetary units. However, converting loss of environmental quality into monetary units is not without problems (see, e.g., Van der Linden and Oosterhuis, 1988; 1988a). Perceived environmental quality assessments rely on observer-based measurement. A common measure is the extent of experienced 'satisfaction', (see, for instance, Baba and Austin, 1989; Christensen and Carp, 1987; Davis and Fine-Davis, 1981; Fine-Davis and Davis, 1982; Gruber and Shelton, 1987; Ha and Weber, 1994; Jirovec and Jirovec, 1985). Data on experienced residential satisfaction can be collected by means of interviews or questionnaires. The main problem is the subjective nature of this type of indicator.

To summarize: Environmental Quality Indices provide a means to express the quality of the environment. Two types of indices can be distinguished for the
assessment of the quality of the environment: exposure-based indices and effect-based indices, each of which has its own merits and pitfalls. Exposure-based indices can provide a measure which describes the actual condition of the environment with respect to the subindices. The main problem lies in the weak relationship between actual ambient conditions and the effects of these conditions at an individual level. Indices based on the effect of environmental factors concentrate solely on the consequences. They circumvent the problem of weak dose-effect relationships. However, quantifying the effects of environmental degradation is not without difficulties.

In this monograph the development of an effect-based EQI for urban residential environments is presented. The effects that are considered are the level of residential satisfaction in general and the amount of annoyance experienced by residents. The resulting effect-index is a so-called Perceived Environmental Quality Index (PEQI). The main reasons for developing a PEQI are the fact that most available EQI's are exposure-based and the problematic relationship between exposure and effect. PEQI's are not the only adequate environmental quality indices. Both types of indices are valuable tools to assess the quality of the urban residential environment. Or, to quote Craik:

'A truly comprehensive assessment of environmental quality would include an appraisal of the quality of the experienced environment.' (Craik and Zube, 1976) (p. 5).

1.3 General aim of this monograph

This monograph focuses on the perceived quality of the urban residential environment. It originated from earlier research on noise annoyance (see, e.g., Van Dormolen, Van Kamp, De Vries-Griever and Altena, 1988; Van Kamp, 1990), annoyance due to malodour (see, e.g., Cavalini, 1992; Pulles and Cavalini, 1989), and neighbourhood satisfaction (see, e.g., Koeter-Kemmerling and Pulles, 1990) conducted at the Center for Energy and Environmental Studies, University of Groningen, The Netherlands (IVEM/RuG) during the past decade. The main objective of this monograph is to define, analyze and model the concept of environmental quality with special emphasis on urban residential environments. The outcomes may be used for the development of an instrument that is capable of measuring the quality of the urban residential environment as perceived by residents.

The remainder of this monograph is organized as follows: In Chapter 2 the perceived quality of the urban residential environment is discussed at greater length. The concept of residential quality is elaborated from three different perspectives. First the policy maker's view on the quality of the urban residential environment is presented. Next, theoretical aspects concerning perceived environmental quality are discussed. This is followed by an overview of the relevant empirical research on environmental quality. From the conclusions drawn from these three viewpoints several research hypothesis are postulated and research questions are formulated.

In Chapter 3 a general outline of the empirical research methods used in 4 empirical studies presented in this monograph is discussed. In the first study a so-called Hierarchical Multiple Regression (HMR) approach is used. Typically, in a hierarchical multiple regression analysis the observed variance in a higher-level variable is predicted from the observed variance in relevant lower-level variables. In the second and third
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study a Multi-Attribute Utility (MAU) approach is used. Multi-Attribute Utility Theory (MAUT; see, e.g., Keeney and Raiffa, 1976; Von Winterfeldt and Edwards, 1986) represents a group of models and procedures that can be used to facilitate value measurement in complex tasks or problems (Westenberg, 1993). In the fourth and final study a Conjoint Analysis (CA) approach is used (Green and Srinivasan, 1978; Green and Srinivasan, 1990; Louviere, 1988; Vriens and Wittink, 1990). Conjoint analysis is a multi-variate technique to study the structure of respondents' preferences for a set of products or objects. Hypothetical products or objects are constructed by combining the relevant characteristics at various levels. On the basis of overall evaluations the relative importance of each characteristic can be reconstructed (Hair Jr, Anderson, Tatham, and Black; 1992). The merits and shortcomings of the relevant methods and procedures are discussed.

Chapters 4 to 7 deal with the four empirical studies that were undertaken. In each chapter the general outline of the presentation of the studies follows the successive steps of the empirical cycle, namely: introduction, method, results, and discussion/conclusions. In Chapter 4 the first study is presented. This study focuses on inventorying, evaluating, and assessing the relative importance of relevant neighbourhood features. A questionnaire was used in which residents are asked to evaluate their present residential situation in terms of satisfaction. Subsequently, the Hierarchical Multiple Regression approach was used to identify relevant neighbourhood features and to estimate their relative importance. In Chapter 5 the second study is described. This study focuses on inventorying and estimating the relative weight of important neighbourhood features. In face-to-face interviews respondents were asked to 'build up' the concept of environmental quality from its basic aspects in a traditional 'MAU' approach. In Chapter 6 a study is described which is a replication of the previous study in as far as it concerns the research methodology. In this study, however, all respondents were workers at various municipal services and therefore considered to be experts as in contrast to residents. In Chapter 7 a Conjoint Analysis experiment is described that was conducted to elicit relative weights for the relevant residential characteristics. Residents evaluated various quality profiles. The holistic evaluations were used to estimate attribute weights.

Finally, in Chapter 8 the general conclusions of the results of the four studies described in the previous chapters are presented. The conclusions are discussed in light of the research hypotheses and methods. The implications of the results and conclusions for policy making, theory and future research are discussed.