Planning Metropolitan Landscapes

Concepts, Demands, Approaches

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"Can we plan metropolitan landscapes? Do metropolitan landscapes exist? What makes them different from urban landscapes? Where does a metropolitan landscape start and where does it end? Who is planning metropolitan landscapes? How are these plans made? Will the plans ever be realized?" Readers will have these and many other questions when reading the phrase "planning metropolitan landscapes". It is the aim of this book to discuss some of these questions, however, when looking for answers often new questions arise.

The book was initiated at two recently held scientific meetings. The first was the 4th workshop of the International Study Group of Multiple Land Use (ISOMUL), held at Western Washington University in Bellingham (USA) in June 2002. The meeting was entitled "Collaborative Planning for the Metropolitan Landscapes" and discussed planning and research aspects related to metropolitan landscapes, mainly in the USA and the Netherlands (Haaland & Smith, 2002). The second event was a symposium on "Landscape Dialogues in Metropolitan Delta Areas" held during the 6th World Congress of the International Association of Landscape Ecology (IALE) in Darwin (Australia) in July 2003. This meeting brought together researchers and planners to discuss specific problems of metropolitan areas located at large river deltas (Pearson & Hobbs, 2003).

A third motivation to this book came from the research interest in planning problems of metropolitan areas that are studied at three Dutch institutes: the Alterra Green World Research institute in Wageningen, the Land Use Planning Group at the Environmental Science Department of Wageningen University, and the Agricultural Economics Research Institute in The Hague. Funding for these activities came from two major research programs: the KAP program – developing planning approaches and concepts for the regional-specific implementation of multiple use of land (Tress et al., 2003a), and the DELTA program – investigating interdisciplinarity and transdisciplinarity in landscape research and planning (Tress et al., 2003b).

The contributions in this book derive from papers presented at the international meetings in Bellingham and Darwin as well as from research conducted at the abovementioned institutes. Additionally, we invited some selected experts to contribute to this book. The first part of the book presents conceptual papers on defining and understanding metropolitan landscapes. The second part deals with the demands and problems that exist in several metropolitan landscapes around the world. The third part presents a broad selection of papers that discuss approaches how to plan and manage metropolitan landscapes. Finally, the book concludes with a reflection on the concept of metropolitan landscapes as presented in this book and in current landscape research and planning.

Bärbel Tress & Gunther Tress ,
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Concepts of metropolitan landscapes

Uncertainty in planning metropolitan landscapes

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Introduction

Planning metropolitan landscapes means dealing with many sources of uncertainty simultaneously. This article discusses conceptually the nature of the uncertainty involved with metropolitan areas, landscape and planning. The key issue is that uncertainty cannot be avoided, but appropriate methods must be found to deal with it.

Defining uncertainty

Uncertainty is related to many different things such as data quality, theory and conceptualisation, model formulation, decision making and of course error and risk issues in each of these. This complexity is expressed by many terms such as uncertainty, fuzziness, vagueness, precision and accuracy. Some terms have, according to the context, a very specific definition or are used in a more general sense, sometimes even as synonyms.

Uncertainty and risk are most formally and clearly treated in statistical analysis, in particular in relation to the probability of occurrence of errors of type I or II in statistical tests and in working with fuzzy sets. These concepts become more complex when dealing with spatial data and geographical analysis. Much of the discussion of uncertainty and risk assessment is now related to the application of GIS and spatial analysis is various domains.

Longley et al. (2001) relate uncertainty to the different steps involved in the representation of geographic phenomena, in particular when using GIS and applying spatial analysis and mapping (Figure 1). The first source of uncertainty (U1) comes from the conceptualisation of the real world and the definition of geographical data. Is the reality conceived as natural objects or units, or by a more abstract representation? Much has to do with the possibility of a physical delineation or bordering of units and the classification of continuous phenomena with vague borders and complex transitions into discrete categories. In GIS this implies also the choice of the data model; representing reality by objects, vector or raster structures; reducing real things into points, lines and polygons. Conceptualising reality also depends upon culture, perception and language. The classical examples are the types of snow or seasons recognized by locals in comparison to the more general and less refined categorisation by outsiders.

The second source of uncertainty (U2) is partially the immediate consequence of the conceptualisation. It involves the choice of the level of measurement used (nominal, ordinal, interval or ratio) and of the data quality, both qualitative and quantitative. Techniques and methods of data collection and description contribute to this aspect of uncertainty. Also sampling issues are important here.

The third source of uncertainty (U3) relates to all manipulations of the data during analysis and combination of different data. The choice of (legend) categories and their operational definition is part of this and also the classification of the data. Here the specific character of geographical data is essential, in particular aspects of fuzzy borders, spatial autocorrelation, and size and scale dependency. Overlaying and combining data and modelling involve complex patterns of error propagation depending on the data quality and the nature of algorithms used. Geostatistics offer a theoretical basis for this, as well as tools for analysing spatial patterns in GIS.

The final source of uncertainty (U4) is the representation of the reality by the results of the analysed data. This is part of the reporting, the choice of indices, graphical presentation and most importantly the visualization, in particular by cartographic and computer means. Different languages of communication are involved and communication is the key issue in any kind of planning process or decision-making.

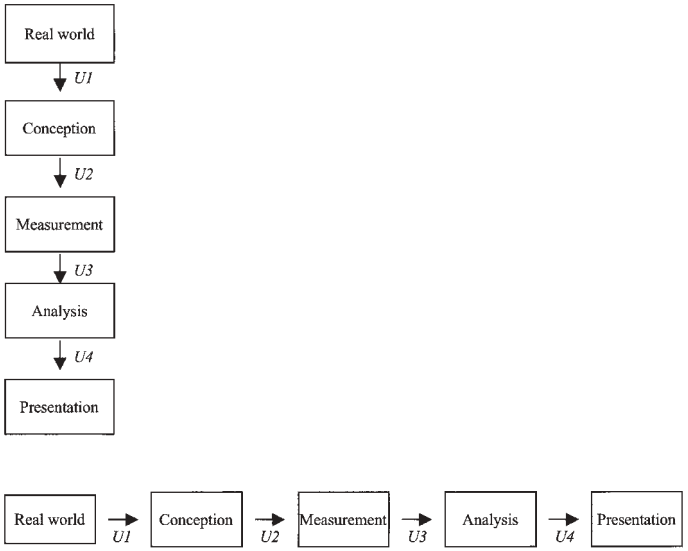


Figure 1 : A conceptual view of uncertainty (after Longley et al. 2001)

Eastman et al. (1993) discuss uncertainty and risk assessment in relation to fuzzy sets and decision making using GIS. They define risk as the likelihood of making a wrong decision and which can be assessed by the combined estimate of uncertainty caused by different sources. Two main sources are recognized: database uncertainty and decision rule uncertainty. Burrough & McDonnell (1998) list seven main factors that affect the quality of spatial data that can be sources of uncertainty:

(1) currency: are the data up-to-date?
(2) completeness of areal coverage,
(3) consistency,
(4) accessibility,
(5) accuracy and precision,
(6) error of the data (due to entry, sampling, processing),
(7) error due to analysis and modelling (error propagation).

The conclusion is that uncertainty cannot be expressed by a single attribute or variable, but a set of criteria must be used.

Defining a metropolitan area

A metropolitan area refers to the agglomeration associated with a large city. The core problem is defining the urban area as opposite to the rural or the countryside. Today for the first time in the history of humankind, more people live in urban areas than in the rural countryside (Pacione, 2003). However, 'urban areas' varies a lot in meaning (United Nations HABITAT 2001, 1996). As the degree of urbanisation approaches worldwide an apparent stabilization level between 80-90% (United Nations HABITAT, 1996; Pacione, 2001), the pattern is very specific in different world regions, resulting is very different relationship between urban areas and the countryside. In North America and Australia, urbanization can be expressed by a percentage of approximately 90% of the population spatially in rather well defined urban places with vast areas of countryside and wilderness in between. In Europe and Japan on the contrary, a similar proportion of the population is urbanized, but the urban agglomerations occupy also a much larger area of the country and the distinction between urban and rural areas becomes fuzzier, in particular in the smaller countries (Frey & Zimmer, 2001). Urbanization processes can affect rural areas in many different ways and accessibility of a

place is a key factor (Antrop, 2000b). The relation between urban and rural becomes extremely complex and receives a growing attention in spatial and environmental planning (SPESP, 2000). Cities form also networks and Functional Urban Areas are created that influence their surroundings in various ways (Antrop, 2003; Bryant et al., 2001; Cheshire, 1995). A multifunctional complex of very diverse land use types, which have a highly fragmented morphology, characterizes the urban fringe or suburban landscapes. The delimitation between urban and rural becomes a difficult task involving a lot of uncertainty and it is very unlikely that land zoning borders remain a stable delineation even for a short time.

Several approaches to define an urban place are possible. It can be based upon (1) the size or spatial extent of the built-up agglomeration, (2) the population size, (3) morphology and (4) various functional characteristics. All definitions demand specific data and use different sources, depending also upon data availability. The most basic distinction is between data based upon physical phenomena and their morphology and data based upon artificial constructed spatial units. An example of the first group is the use of land cover; an example of the second group is the use of statistical census units. The delineation of the urban area often results in a very different outcome using the one or the other approach. Frey & Zimmer (2001) refer in this context to over- and under-bounded boundaries of an urban area. Over-bounded urban areas are the ones where the urban agglomeration extends morphologically beyond the administrative, political or census borders that are used to define the urban place. Under-bounded urban areas still contain a lot of open (rural) space within their administrative boundary. Thus, also the uncertainty involved with land cover classification is a source of uncertainty in defining urban areas. The best example is the definition of built-up land: it can be defined as a pixel in a digital imagery classified as such, it can be the footprint of a building, it can also be the complete cadastral lot on which buildings are situated. Each definition results in a very different result of the estimation of 'built-up', which makes indicators describing an urban area, based upon land cover highly uncertain (Antrop & Van Eetvelde, 2000).

A second source of uncertainty results from the highly dynamic nature of urbanisation and urban areas. The lack of reliable and up-to-date information about the urban environment and landscapes is demonstrated several times in the first Assessment of Europe's Environment (Stanners & Bourdeau, 1995). Land cover and land use change rapidly in urbanized areas. Satellite remote sensing and image interpretation are very often the only means to keep inventories up-to-date. Urban land cover categories are increasingly defined by the technical possibilities of satellite image classification and the accuracy that can be obtained (Sugumaran et al., 2002; Herold & Menz, 2002; Hung, 2002). Nevertheless, consecutive assessments of land cover are not always comparable because also definitions of categories shift as well as data quality, due to new technology in data capture and analysis that is used.

Landscape diversity and heterogeneity, as well as fragmentation are related to uncertainty as well. Larger diversity, heterogeneity and fragmentation result in more complex forms of multifunctional land use. Larger the complexity implies more uncertainty about the real situation and processes at a precise moment. There is a basic logic in defining landscape heterogeneity or complexity by the Shannon-Weaver diversity, which is based upon the information entropy (Antrop & Van Eetvelde, 2000).

Clearly, urban areas are difficult to comprehend and to be defined in a practical operational way.

Landscape and uncertainty

The European Landscape Convention defines landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Council of Europe, 2000). The definition is a mix of two very different views, which Cosgrove (2003) describes as two different landscape discourses. The ecological approach focuses upon

the interactive processes between nature and human activities, where the latter is increasingly considered as disturbance to the ecological balance. The second discourse is called semiotic and focuses on the cultural meanings, context and processes in the shaping of the landscape, intimately related to the landscape perception. Consequently, landscape research and applications in planning use and combine very different methods from natural and social sciences. Objectivity and subjectivity are both involved and the approach towards uncertainty may be very different.

Landscapes are also dynamic and evolve almost continuously (Antrop in press). Urban landscapes are highly dynamical and rapid changes introduce a growing uncertainty related to the processes involved, data gathering and monitoring. Today, the speed and frequency of changes pose problems to people to adapt to their ever-changing new environment, hence a crisis of the landscape is created (Lemaire, 2002). Changes are seen and evaluated as improvements or deterioration of the previous or existing state. However, this judgement is mainly based upon a particular view of utility or in referring to the realization of a particular goal or condition. Consequently, not everyone does perceive changes in the same way always and one type of change can result in conflicting positive and negative evaluations.

Highly dynamical landscapes, such as metropolitan ones, can be seen as complex systems in a state far from equilibrium as defined by Prigogine (Prigogine & Stengers, 1987). Trends for future development become then hardly predictable and processes of chaotic development and self-reorganization are likely to occur (Portugali, 1999). Prigogine & Stengers (1987) applied their theory even on processes of urban sprawl.

The holistic nature of landscape, which integrates the complex reality of the physical environment with perception and psychological meaning, which combines different hierarchical scales of complexity of highly dynamical systems, is basically uncertain.

Uncertainty in planning and decision-making

Essentially, spatial planning is a complex of activities that aim to steer ongoing processes that structure our environment, and so our landscapes. Basically, the actual situation or trends are considered as unsatisfactory and should be improved. Scenarios of the future development can be defined and visions for the future are formulated. Decision-making implies making choices between the possible outcomes that are proposed or expected. As a complex process dealing with a hardly predictable future, a lot of variables and stakeholders, planning implies a lot of uncertainty. At least following factors related to planning uncertainty should be considered.

Spatial planning aims to steer or (re)direct the 'natural', *autonomous development* in a predefined and selected area to achieve a preconceived goal. The autonomous development is the overall result of all actions taken by numerous and very different actors with little concertation. The impact of individual stakeholders (in particular landowners) depends upon their status, reflected by the size of their property and the means to maintain or transform it. The impact of small landholders will be restricted to small areas, such as their garden or the places they use for recreation. Although the effect upon the change of the global landscape might seem minimal, the large number of individual landowners multiplies these small impacts. Inevitably, a large number of forces act mostly independently and increase entropy and chaos, the opposite of a well-organized and planned situation (Antrop, 1998). Thus, planning basically implies restoring order and reducing entropy. The scale of the autonomous development always transcends the individual actions that often refer to the individual property and aims specific goals. The future of an autonomous development is described as a trend with a rather vague and uncertain outcome. In most cases, these trends are often extrapolation of case studies or samples using available information, which is often incomplete, imprecise and often outdated. Decision-making is based upon this kind of imperfect knowledge and has to deal with uncertainty and risk.

A first factor on uncertainty resides in planning itself. In the attempt to steer the autonomous development, the planner becomes part of the process itself and thus planning is changed as well. During the 1960s-1990s, physical planning was based upon the realization of master plans, which fixed the possible land uses in the future for each tract of land (Albrechts, 2001). Their realization was mainly based upon sector logics and a lot of lobbying. Many different forms of planning exist and referred to in various ways such as land use planning, town and countryside planning, regional planning physical planning and urban planning. Differences in meaning do exist between countries. The term *spatial planning* was introduced in the early-mid 1990s (Tewdwr-Jones, 2001). It was adopted at the European level as an encompassing neutral term to avoid confusion with more specific national terminology. Spatial planning is seen as a reference to a range of public organizations, policy mechanisms and institutional processes all involved in the future use of space at various scales (Tewdwr-Jones, 2001). Since the 1990s, *strategic spatial planning* was generally introduced as a new approach to the more static planning of the master plans. It proceeds in a different, participatory and consensus model and acts at several levels of policy making simultaneously, but not always in a concerted manner (Albrechts, 2001). When in the past, master plans gave some certainty of the future land use, at least for a predefined period, the new mode of strategic spatial planning involves more uncertainty in many aspects as its participatory method involves many stakeholders.

A second group of factors is related to the characteristics of the ongoing changes. Their speed, frequency and magnitude increased unprecedented in the second half of the 20th century (Antrop, 2000a). Many new elements and structures are superimposed upon the previous, traditional ones, which become highly fragmented and loose their identity. Certainly in densely habituated regions, many complex, new landscapes are created, which are highly dynamic and little is known about the ongoing processes (Brandt et al., 2001). A basic principle in landscape ecology states that landscapes change 'naturally' because new needs or functions demand adapted spatial structures and initiate a continuous iteration (Forman & Godron, 1986). The driving forces are generally well recognized: urbanization, changing accessibility and mobility patterns, and globalisation. However, detailed information of the mechanisms involved, the interactions and the impact at a detailed local level is often lacking. Planners and policy makers are in growing need of up-to-date and significant data and scientific knowledge.

A third source of uncertainty in planning comes from the delay between non-concerted decisions or actions and the physical emergence of the results, i.e. becomes expressed in the landscape. The overall change of a landscape, of its character, is the result of numerous small, consecutive changes in land use on small tracts of land, which each of them, separately, hardly influence the character. Typical examples can be seen in the new landscapes of suburbs and holiday resorts. Many examples illustrate this concept. How many trees must be felled before a characteristic tree row or alley loses its character and only clumps of solitary trees are seen. One building will not transform a rural landscape in and urban one, but what if the rule is applied that new buildings are acceptable when they are located at a close distance of already existing ones? Landscape ecology provides in the percolation theory a theoretical background to understand and analysis problems as these (Klopatek & Gardner, 1999; Turner & Gardner, 1990), but are hard to apply in planning.

A fourth source of uncertainty in planning resides in the methods and techniques used. Technically; planning is making choices between alternative options or scenarios. The decision-making process involves very different methods and techniques, which each have proper characteristics regarding uncertainty. A typical example is the frequently used method of multi-criteria evaluation. Each step in the process has distinct contribution to the final uncertainty of the decision.

Step 1: choice of the criteria: mainly related to data uncertainty involving data quality and definition of categories and classification rules

Figure 2: Autonomous and planned development.

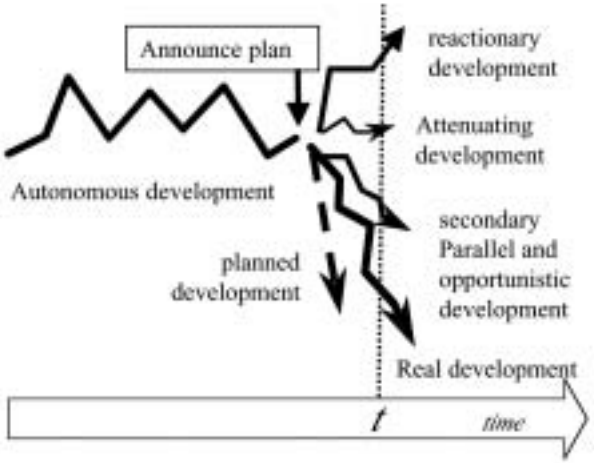
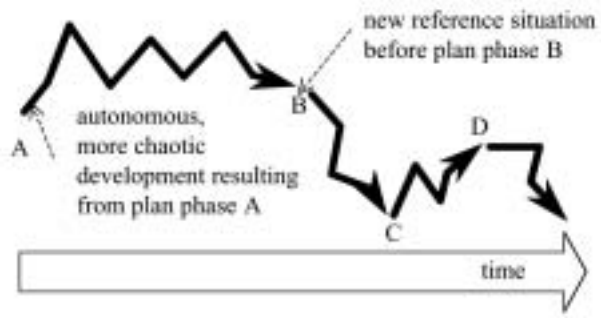


Figure 3: the 'step-by-step' rule of planned development.



Step 2: defining the decision rule: mainly related to model uncertainty and error propagation in the selected method
Step 3: defining the weights: related to the definition and selection of the criteria, but also to the participatory method and rules used
Step 4: defining the risk and trade-offs: what is acceptable? This involves stakeholders, politicians, experts and the population in general.

Finally, the autonomous evolution and the planned development interfere and make that the initially intended planning is seldom achieved and many parallel but not planned developments are possible (Antrop, 2000a) (Figure 2). Consequently, the new state of the landscape is the result of planned actions mixed with processes of autonomous development. This new state then forms the reference base for future changes, which behave more or less chaotic in some general planned direction. This process can be referred to as the 'step by step' rule (Figure 3).

Conclusions

Uncertainty is an essential part of life and is an essential characteristic in landscape change and planning. Adequately dealing with uncertainty is applying the precautionary principle (Mitchell, 2002). Numerical methods to assess uncertainty are available, but do not reflect the overall uncertainty. A model of assessing uncertainty in planning metropolitan landscapes could be based upon consecutive steps of evaluation. First, the uncertainty related to concepts and definitions involved in metropolitan (urban) areas, landscape and planning should be analysed. Clear concepts and definitions will reduce already a lot of uncertainty and will give a more precise reference for the information needed and the quality of the data to be used. Critical analysis of data quality and error propagations in the analysis can be achieved with more technical and tools resulting in a more numerical expression of uncertainty. The assessment of uncertainty induced by processes of change in land-

scapes, in particular in metropolitan areas, is largely based upon data availability and quality and change. The highly dynamical character of these landscapes demand trend analysis, extrapolation of results and scenario building. Participatory spatial planning will have to work with these basically uncertain and incomplete data and will induced even more uncertainty when many stakeholders are involved. At this stage it becomes difficult to apply hard rules assessing uncertainty and the focus shifts towards the discussion of risks and trade-offs. Uncertainty is then partially absorbed by clear decisions and responsibilities. Clearly, dealing with uncertainty is a transdisciplinary matter.

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Metropolitan matterscape, powerscape and mindscape

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Introduction

The north-west European delta metropolitan area includes the Ruhr area in Germany, the biggest part of the Netherlands, and the north-western part of Belgium (I will refer to this area as the Deltametropole). In this region, approximately twenty million people live in a relatively small area. Landscapes in the Deltametropole have changed dramatically over recent decades. Generally, social processes develop more rapidly, mainly influenced by the momentum of economic growth, technological achievements and the ever-increasing flood of information (Harvey 1989; Castells 2000). The result is that much has changed spatially.

The world of research and policy making focuses a great deal of attention on the quality of Deltametropolitan landscapes (e.g. Zoest, 1994; Mansvelt & Lubbe, 1999), although the term evokes much ambiguity. It is a collective term that recurs in studies that embrace a large variation of aspects of interest, like ecological quality, economic quality or aesthetic quality. Moreover, the way in which quality is expressed also differs: scientists try to come up with measurable quantities (e.g. the magazine 'environmental quality'), policy makers and planners with norms (e.g. Giorgis, 1995; Ministerie van Volkshuisvesting en Ruimtelijke Ordening, 2001; Nohl, 2001), and among citizens, quality is a matter of worthwhile experience.

In the Deltametropolitan area, spatial planning is confronted with some peculiar problems, like (a) density of people and activities, (b) landscape beauty, and (c) intensive agricultural use. In the perceptions of these problems as brought up by scientists, debaters and policy makers, different phenomena of landscape are often intertwined, making the concept of landscape obscure. This leads to conceptual problems with problematic practical consequences, like coming up with expensive solutions that may never work, as will be shown in this paper.

The aims of this paper are (1) to explain a threefold landscape ontology (ontology is about the nature of being) used to deconstruct the obscurity of the concept of landscape, (2) to discuss its epistemological (epistemology is about gaining valid knowledge) consequences, and (3) to use this theory as a tool to point out fallacious claims and sharpen problem perceptions in discourses about the Deltametropole.

For the sake of clarity, the theory will be posed first, and defended later. In section two, I will explain a threefold ontology of landscape. The next section is about the accompanying epistemology. In section four, the philosophical background will be briefly described. The landscape theory will be applied to disentangle complicated discourses about Deltametropolitan landscapes in section five.

A threefold ontology of landscape

We can divide reality into three modes of reality: physical reality, social reality and inner reality (e.g. Habermas, 1984; Störig, 1990a). Phenomena in these modes of reality are different with regard to their existence.

Phenomena in physical reality are made of matter. The existence of phenomena in physical reality is objective, in the sense indicated by Searle (Searle, 2000): the existence of objective phenomena does not depend on an individual subject's desires, moods, intentions of awareness. Therefore, only one physical reality exists. For example, trees or rocks exist, whether I am aware of them or not, whether I like them or not.

Social reality consists of implicit or explicit rules, regulating the behaviour of people belonging to the group to which these rules apply. For example, in many societies it is forbidden to cut a tree growing at a public place, without official permission. These rules are constituted by, and expressions of, power. Without power, rules don't make any sense; one can just cut the tree without any consequences. Social reality is intersubjective, that is, it is created between subjects forming social groups. Because many different groups exist, many different social realities exist. An individual can be a member of many groups on different scales, involuntary or voluntary. For example, a person be a state citizen of the Netherlands, by birth, and be forced to respect the official laws. The same person can be a member of the local skateboarders-culture, and take over the habits that organise the kinds of clothes to wear.

Inner reality is constituted by consciousness or states of mind. For example, the experience or imagination of a tree and the associations it involves. Inner reality is subjective, it exists in the minds of subjects only. The number of inner realities is exactly the same as the number of conscious subjects in the world, since inner reality is the product of consciousness.

Landscape appears in these realities as three different phenomena, which I will call matterscape, powerscape and mindscape.

Mattercape is the landscape in physical reality. We perceive this landscape as a material reality, described as a system of facts and laws of nature. It is the landscape in which one can walk about in, for instance, get wet in and fall down on the ground.

Powerscape is the landscape in which we act according to specific norms. Powerscape is produced in society as a system of norms and objectives. These norms and objectives are sometimes clearly formulated in the form of laws, rules and regulations, and (government) plans, and are sometimes embodied in customs and traditions. Powerscape is a system of norms that regulates how members of a particular society are required to behave with respect to the landscape.

Mindscape is the landscape as people experience it and one that is very personal in meaning. It is the landscape produced by imagination and meaning-giving processes. Mindscape is a system of essentially individual values, judgements, feelings and meanings that are related to the landscape. It exists in the minds of individuals.

Epistemology: truth, justness and truthfulness

How can we gather knowledge and when is this knowledge valid? This is the domain of epistemology. Habermas makes a distinction between three fundamentally different validity claims (Habermas, 1984). Statements are true if they correspond with an objective state of affairs (e.g. it is true that water runs from up to down). Statements are just if they correspond with or fit in with norms that groups of people follow (e.g. it is just not to pollute water in our community). Statements are truthful if they correspond with the contents of consciousness of the subject: all that occurs in the conscious mind, the domain of the thoughts, wishes, intentions, desires and feelings (e.g. it is truthful that I find water fascinating).

These validity claims correspond with the three modes of reality. Knowledge about the landscape as it appears in physical reality is valid if true, knowledge about the landscape as it appears in social reality is valid if just, and knowledge about the landscape is valid if truthful. Hence, the epistemological correlates of matterscape, powerscape and mindscape can be called the true landscape, the just landscape and the truthful landscape, respectively.

Scientific knowledge creating the matterscape image is gathered by disciplines investigating the external nature, like ecology, geology, hydrology, soil science and environmental science. The facts and laws that describe the true landscape apply to everyone. Naturally, there can be disagreement as to whether a certain assumption is true or not. Many modern epistemologists arrive at convincing conclusions that the truth is essentially unknown, following

the ground-breaking epistemological theories of Kuhn (1970) and Feyerabend (1975). Moreover, a basic perspective underlying postmodern thought is the assumption that all true claims are human constructions, and therefore include historically developed conditions and contingent propositions. In philosophical terms, epistemological objectivity does not follow from ontological objectivity (Searle, 2000). This however does not mean that the truth, constructed or not, applies to everyone. If it is true that water flows downwards, then it is true for everyone regardless of what an individual thinks.

Scientific knowledge creating the powerscape image comes from disciplines involved in research into social reality, such as sociology, social geography, ethics and economics. These disciplines gather knowledge about the norms and interests that connect different groups of people to the landscape, and the accompanying social processes that often have to do with spatial intervention. The norms that shape the just landscape are not universal: what one group of people thinks is just can differ from the opinion of another group. Different systems of norms exist alongside one another, like rough camping is allowed in the one country and not in the other.

Scientific knowledge creating the mindscape image is found in disciplines involved with the inner world, such as environmental psychology and human geography, which I would like to call 'experience sciences'. These disciplines investigate how people experience landscapes and what these landscapes mean to people. Values that people attach to the landscape are only applicable to the individuals themselves, though different individuals can have similar preferences, or they can be influenced by images that are socially acquired. It can be that almost all people have a strong appreciation of landscapes with water, but that does not stop an individual from perceiving them as not beautiful: the criterion for judgement of this kind is whether it corresponds with the inner convictions of the individual that expresses an opinion, and not whether it is in agreement with the majority. Table 1 is a summary of the basic properties of the three phenomena of landscape.

Table 1: A threefold theory of landscape

landscape phenomenon	matterscape	powerscape	mindscape
mode of reality	physical reality	social reality	inner reality
validity claim	true	just	truthful
science	natural sciences	social sciences	'experience sciences'

Table 1 may create the misconception that social scientists and 'experience scientists' are not involved with the truth but with the just and the truthful, respectively. This is not the case: they, like all scientists, also seek the truth, but not the truth about landscape.

When sociologists investigate the way in which a group of people deals with the landscape, they focus on the group of people and not on measurements of the landscape. A sociologist attempts to get to the bottom of the truth about the group of people. Within this group powerscape appears as a system of norms. The scientist who registers the norms of an organisation with respect to the landscape, expounds about powerscape as constructed by this particular group of people.

Like a sociologist, an 'experience scientist' (e.g. an environmental psychologist) would not assess the landscape, but the experiences of people. The environmental psychologist investigates the truth of the inner-self, the content of the person's consciousness. Mindscape is manifested through the experiences of the person. The environmental psychologist investigating a person's experiences of the landscape, therefore, mindscape as that person constructs it. So, social scientists and 'experience scientists' derive their answers from groups of people or individuals and not from landscapes, and are thus not primarily concerned with matterscape, though they are still concerned with the truth.

We can use the three phenomena to describe every landscape or element of landscape, the descriptions being non-transferable from one to the other in any logical way. For instance, in matterscape, a road can be described

as a strip of concrete or asphalt of a certain thickness; in powerscape as a place where rules apply; and in mindscape as a phenomenon that one can either consider as unsightly or beautiful. A garden in matterscape has a certain size, while in powerscape it is a piece of private terrain where access is denied to just any and everybody, and in mindscape it is a place that people have feelings about and where they can let their imagination run free to their heart's content.

More suitable everyday terms are those of the landscape as object, the landscape as organisation and the landscape as story. Although these terms are less precise philosophically than matterscape, powerscape and mindscape, or the true, just and truthful landscape, they satisfactorily overlie the essence. The presented landscape theory builds on a long tradition of thought in western philosophy, which will be summarised in the next section.

Philosophical background

From time immemorial, man had been able to discern and differentiate three capacities: (1) to think and to learn, (2) to want and to act, and (3) to feel and to imagine (Störig, 1990b). These capacities can be seen as three basic attitudes of our human psyche when confronted with phenomena (Störig, 1990b).

The first philosopher to elucidate these three capacities was Plato, from whose ideas three main themes can be derived: the logos (reason), the concept of the true reality (Bierens de Haan, 1954), the ethos (morality), actions based on ideals of the good, and the pathos (love), perception of beauty by means of love. For instance, in his principal work 'the state' and in 'Phaedrus', thought, will and desire are distinguished in man's soul (Störig, 1990a; Vries, 1957). Although ethics and morals form the framework of his thoughts, Plato says that every theme demands an independent understanding of it (Bierens de Haan, 1954).

Locke is much more explicit about the independence of the capacities. He calls his differentiable provinces the first, most universal and natural subdivision of the objects of human understanding, entirely different and separable from each other (Locke, 1959). In other words: knowledge about the one domain says nothing about the other domains, for instance, no norms can be derived from facts. People can let their thoughts shed light on the things themselves (physica), on their own actions (practica) and on the signs by which thoughts and emotions are made inherent (semioitike).

In his book 'a treatise of human nature' Hume adopts this tripartite approach: the titles of the three parts of the book being 'of the understanding', 'of morals' and 'of the passions' (Hume, 1968). This tripartite approach is also the basis of Kant's ambitious and influential life work, the three 'critiques'. The question Kant asks himself is how do we build an image of the world (Störig, 1990b). He looks for the answers in the 'critique of pure reason', about knowing, the 'critique of practical reason', about acting, and the 'critique of judgement', (it is about aesthetic judgements), about feelings and imagination.

In Western culture this tripartition has also got empirical backing. Dumézil studied many myths in several Indo-European cultures and discovered they were remarkably and unequivocally similar in structure (Dumézil, 1958). We could call these structures fundamental principles in a culture: it is after all reasonable to assume that myths reflect the fundamental structures of a culture (Tiryakan, 1980). The first principle is the production of goods, at the core of which is well-being in relation to the physical surroundings: the farmer being the archetype. The second principle is maintaining order of the mutual relationships between people, steered by management and legal systems: the soldier being the archetype. The third principal is giving meaning to the world around us, the archetype of which is the shaman or priest (Dumézil, 1958). It is plausible that these principles prevailing in all Indo-European cultures have been in existence for ages. After all thousands of years ago the original culture split up and became diversified.

Table 2: Three human capacities

Habermas	Plato	Locke	Hume	Kant	Dumézil
truth	logos	physica	under-	pure reason	farmer
	true		standing		
justness	ethos	practica	morals	practical	soldier
	good			reason	
truthfulness	pathos	semeiotike	passions	judgement	priest
	beautiful				

Table 2 presents a comparison of the terms of the different authors. Although there could be a shift of emphasis here and there, a common line is not difficult to see. The thread is that man has disposal over three capacities or attitudes, in which the world appears as three different phenomena. In the next section the theory will be applied to discourses concerning the landscape of the Deltametropole.

Landscape discourses

The density discourse

The Deltametropole is intensively occupied with people and their activities. A few years ago, the Dutch minister responsible for spatial planning put all future claims for housing, water-management, nature development, industrial sites, office buildings, etc. together, and concluded that the Netherlands has a lack of space to respond to these claims. Multiple land use was introduced as a strategy to tackle the related problems. The central idea is to use the same place for a multitude of purposes: multifunctional. The multiple land use research program and debates concentrate mainly on technical solutions, like using the third dimension (e.g., building offices crossing highways), and under ground building (e.g., industries, shopping centres). Thus, the density discourse focuses on matterscape.

Is Deltametropolitan matterscape too dense? Absolutely not: if Dutch people would live in New York density, only a very small part of the Netherlands would have been occupied. All land use claims could be easily met. The density problem is primarily a mindscape problem: people experience the landscape as too dense.

The problem with the multiple land use strategy exclusively focussing on matterscape is that, without research, nobody can know if these expensive so-called solutions will ever work. Of course, technical solutions can offer a more efficiently organised use of space. But maybe, people will experience the landscape even as more dense.

The landscape beauty discourse

As stated in the introduction, landscapes in the Deltametropole are changing fast and in some cases dramatically. More and more space outside the cities is being used for buildings and much space is being taken up for all sorts of infrastructural facilities. Improvements in agricultural efficiency have changed the face of the countryside, especially since the Second World War. Large areas are being claimed by nature development. Plans for changing water management are made, in anticipation of the affects of global climate change predictions. Much of these spatial transformations – some drastic, some less drastic in nature – are taking place in the most Western countries of the world. These processes are becoming more and more unpredictable. Global irrational powers can radically change entire regions in a short space of time (Castells, 2000). For instance, a major international company can decide to erect an enormous office building in a certain region.

Generally, many of these changes are largely rated as negative: people find that they detract from the beauty of the landscape (Nohl, 2001). 'At the turn of the millennium it is probably safe to say that the masses of the West-

ern world are emerging from concerns with standards of living to confront both global and private issues of environmental quality, says Porteous' (Porteous, 1996). This is especially the case in the Deltametropole: many people feel a lack of landscape beauty, and a loss of landscape identity.

The main policy strategy is to develop norms for protecting landscapes that are thought to be beautiful, like natural and historical places. In this case, a mindscape problem is ought to be solved with a powerscape solution. One of the problems is that many opportunities to enhance landscape beauty, e.g. by making new businessparks beautiful, don't get much attention.

The intensive agriculture discourse

Generally, the agricultural use in the Rhine metropolitan area is highly intensified, creating problems like pollution and bad smells. A strategy to solve these problems, is to develop industrial agroproduction parks, concentrating all kinds of agriculture in one spot, making use of ultramodern technologies (Alterra, 2000). A proposal to do so met furious opposition. The idea behind the opposition is that it is disgusting to treat animals as industrial input. The strange thing is that contemporary agriculture in this area is already high-technology industrialised business, so the proposal for agroproduction parks is just makes this character explicit. This is a mindscape problem. Many people have a romantic image of agriculture, an image that doesn't represent modern agriculture anymore.

Conclusion

In the perceptions of the three mentioned problems, a general misconception is to assign a solution to a certain landscape phenomenon, while the problem exists in another landscape phenomenon, as is the case in the density and the landscape beauty discourse. Another problem is that each phenomenon has its own dynamics. The agriculture case showed that agriculture in mindscape is relatively independent of agriculture in matterscape: the images of people don't necessarily represent the properties of modern agriculture, they are produced in romantic discourses. Many problems in deltametropolitan areas are mindscape problems: therefore, the only way to solve these problems properly is by using knowledge about mindscape. If solutions for mindscape problems are assigned to matterscape or powerscape without any reflection, it is unknown if they will work. Policy-makers building on these fallacious perceptions are just gambling.

At many occasions when I presented this landscape theory I was asked whether we can know if this theory is true or not. The answer is simple and may be disappointing for some: we will never know. As argued in section three, I don't believe it is possible at all to prove a theory is true or not, regardless which theory. Every theory is a product of human imagination, a way of looking at things. For example, the ecosystem-theory (or maybe better, the various versions of it) is a way of looking at nature, relations between dead and living nature, and relations between species. As long as it helps organising empirical knowledge, and predicting future events, the theory makes sense. But we never will be able to prove the ecosystem-theory itself, since it is an abstract model. I cannot defend the presented landscape theory as being true. Instead, I can defend it as making sense and being useful, as it helps to sharpen problem perception in complicated situations.

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Leadership literacy: Public interest in land-use governance

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Introduction

When we step outside it is what we see, smell, hear, feel, and engage everyday: the metropolitan landscape. It is rough and refined. As members of the wise species, we occasionally turn to reflect on our environment, both built and natural, and the theatre of daily journeys. We increasingly speak of governance systems at work behind the scenes. Perhaps we need to step backstage on occasion. Do those who make decisions understand basic terms of reference about good governance? Are these decisions reflected in our landscapes?

Words. Bits of data. Social constructs. Yet in governance, a process which has profound effects on many lives and systems, some words are commonly used but not so commonly understood. An important element of any contract or legislation is the interpretation section, yet there has been little provided for decision-makers in interpreting the very approach to governance itself. Consider this paper as a few thoughts on how to help people get along. Examples of words which are much used, sometimes criticized and abused, which will be addressed in this paper, include leadership, governance, public

interest, deliberative, triangulation, fairness, reasonableness, and consensus.

Leadership illiteracy is a problem in our larger global village, but we are sometimes blind to the problems in our council chambers and boardrooms. This paper was inspired through a pattern of recent decisions in British Columbia which raise the question of leadership literacy at several levels. There was no shortage of scientific and contextual information; there was no shortage of due process and public relations, and even good intentions. In each case there seemed to be judgment skills applied. Yet such skills had been developed largely in the hurdy-gurdy of individual stress-filled lives, specialized experience and eagerness to get to a solution.

In the province of British Columbia alone, the authority for the exercise of discretion in the public interest related to metropolitan landscapes lies with a variety of ordinary people. From elected members of the legislative assembly, to deputy ministers employed in civil service, to appointed regulatory officers, to local government councilors elected from the private sector, to commissions and boards appointed from community leaders of diverse backgrounds, and many more strata-council directors, how many have studied, or even thought about, leadership literacy?

The decision pattern is woven of many jurisdictions. The only common element is that people are expected to make policy and decisions based on science, and economics, and personal experience, but too rarely from an understanding of the public interest. There is no legacy of good precedent, because senior players cannot leave a legacy of matters of which they know not. The lack of leadership literacy of principles leads to deficient strategic processes, naïve organizational structures, and wasteful regulations. Recent examples in our little corner of the world include a federal regulation for an arbitrary, and zero-tolerance, no-build zone around creeks and streams; the decentralization of the provincial Agricultural Land Commission, after celebrating twenty-five years in stewardship of an Agricultural Land Reserve representing less than 3% of the province; a shotgun referendum on matters of aboriginal right, not preference; CityPlan, a local community planning exercise which was an innovative staff initiative which was lost in mistrust, confrontation and frustration when filtered up through Council, and; even at the smallest level of community, strata-property councils are reduced to arguing over access to information and personal interests, not community principles. On the other hand, hallmarks of leadership literacy are principled processes, balanced regulations and organizational structures, and increased standards of strategic understanding through education.

Leadership literacy is the front end of the larger decision-making process. If decisions are "in the public interest" and the decision-maker does not understand this concept, it is unlikely that the decisions will stand up to scrutiny. Leaders of communities, on the other hand, ought to be able to separate language of worth and principles, from that of mere baffle-gab, to avoid living in their own little wonderlands (Locke, 1690; Carroll, 1872). More significantly, when the values behind the words become lost or indistinct, the results can be tragic to the metropolitan landscape. We need to choose our words carefully, and help each other understand.

A call for leadership literacy in governance is not to say that there is a prevailing illiteracy in all matters of governance. Many people have varying degrees of expertise and understanding about some or many aspects. Yet most are deficient in some areas – of particular concern is the lack of understanding basic values of the public interest, and of frameworks which promote trust and predictability, not merely efficient decisions. Collectively these appear to point to a lack of understanding about the concept of public interest.

Conversations: no common sense

What is the language of common understanding here? Eastern or Western? Religious or agnostic? Scientific or literary? Of wealth or poverty? With apologies to those of other cultures and languages, this is a start to appreciate a few words in English.

There is no common sense. It takes work. Local authorities will not intuitively possess a common sense of their constituents and public obligations, without focused and continuing education. For that matter, there is no common sense in matters of public policy, apart from concepts of change, complexity and diversity. We come from different genes, different cultures, different value systems, different experiences, different education. All we can try to do is operate from a level of learned understanding, beginning with basic terms of reference and frameworks.

Good advice is to assume nothing. In building the planned community of Reston, Va. in the 1970s New Town era, one of the most important decisions Mr. Simon made was to retain, even before planners, a series of different people each of whom could talk the language of one group of constituents – farmers, public service personnel, investment bankers, and planning and design consultants – to communicate a clear statement of an integrated vision (Simon, 2002). And that was with constituents who were all from the same area, speaking the same language.

What thoughts are behind those preoccupied faces in your board rooms or council-chambers? Background circumstances cloud listening: the effect of breakfast, the boss and Baghdad. Yet studies indicate that often a more basic resistance to objective governance exists due to frustration from lack of good information, lack of understanding of the importance of values or principles (including long-term benefits to time and risk management), and, perhaps in some cases, a resistance from just feeling being left out of the loop, or even from a fear of making binding decisions at all.

Yet apart from circumstances and governance objectivity, what about background values? What if you had an international business person, a humanist, a new Canadian or American, and an artist on a council and assumed a common sense? Such a group was each asked for the five words considered to have the greatest impact on others' lives. The corporate strategist spoke of "profitability", "competitive advantage", "intellectual capital", "alignment", and "mobility". The humanist raised "fanaticism", "indifference", "memory", "peace" and "children". An executive from a developing nation thought of "techno-ubiquity", "info-glut", "digital divide", "cyber-war" and "non-linear". The recording artist spoke of "the commons", "justice", "honour", "shame", and constant negotiation or "unfinishedness" (WEF, 2001).

The challenge of leadership literacy is to build at least some common context for understanding among diverse dialects, even within the English language, and to help lift barriers to conversation, and communication.

Why?

We tend not to stand by when urban centres decay or engineering wrecks natural environments, but respond with an intellectual force to do things better. This energy, twinned with the happy convergence of information technology over the past two decades, addressed tensions among diverse human and natural conditions. The potential for the rising tide of knowledge to help us all gets better every day, with exciting concepts of distributed intelligence and modeling (Lane, 1997; National Science Foundation, 1998; Hammond, 2000) and just the incredible access to the quantity and quality of material on the world-wide web (Google, 2002). Now even lawyers are painfully familiar with concepts of land-use management and engineers are advocates of sustainability. Most politicians have felt relief through better information in the heat of turf wars over natural or urban landscapes, and industry fosters new realms of information and change managers.

For the first time ever, perhaps we can shift from a quest for knowledge, to a quest for judgment. A shift from the gathering of information, to the ability to use that information. A shift in focus from "what" and "how", to "why".

Have our decision-making frameworks and judgment skills kept pace with the what and how of information? Effective decisions avoid the tremendous waste of time and effort in challenging, recriminations, and correcting mistakes. There are courses and programs which deal with the tools of leader-

ship, and many which address the substantive decisions of leadership, but rare are the programs which try to mitigate the disconnect behind understanding the basic terms of reference and values in leadership, and the acts of governance.

Think about a few trends which reflect our global future:

(1) nations will increasingly have a more diversified cultural mix due to immigration patterns and needs (Trinity Western, 2001; Baxter, 2001);

(2) possibly as a result, a shift away from national, and toward civic or local patriotism (WEF, 2002; Orr, 1992);

(3) a continuation, if not escalation, of land-use conflicts whether in increasingly urban areas, or with respect to resource, recreational, historical, environmental or aboriginal title; and

(4) an increasing need for more people to make more decisions which respond to an increasingly complex set of cultural and conflicts-of interests.

These trends may vary depending upon national and regional perspectives. The concern is that more and more people are called upon to make more profound decisions without a principled foundation. We can see the convergence of the need for more people to make decisions, and a trend to download costs of government, and therefore decision-making responsibility, to the local level, Add an amazing dose of complexity as technology increases access to good information. The result is that risk/success models tend to blur. No longer do we consider just ecosystem risk-management, or economic risk-management, but all of the above. With the theatre of operations for land-use decisions being downloaded to the local level, and with the increasing demands and expectations of a diverse community and decision-makers relying on limited resources, there is even more at stake and more need to make principled decisions, the first time.

Leadership literacy in governance: Vocabulary

Leadership

Leadership is under scrutiny. Business meltdowns and global governance issues only underscore the need to remember first principles and clarify our ever more demanding expectations of how we can get along. The challenge used to be to help knowledge-workers think of themselves as business executives: those who strategically plan and use information to make decisions which affect the work or products of others. Yet do all those who counsel others, and those who sit on boards and commissions as appointees, and those who sit in judgment of regulations as employees, and those who sit on councils and legislatures as elected representatives, see themselves as "executives", let alone leaders? The word "executive" imparts a predisposition for efficiency and short-term economic return, yet even corporate governance discussions turn to leadership to express essential qualities of building trust and integrity, process values of being candid, open, consistent and inspiring, and personal characteristics of passion, courage, patience, and reliability. If executives strategically manage, leaders dream with a deadline (O'Toole, 2002; Bennis ,2001).

Leadership does not necessarily equate with "good leadership". Leadership does not imply a positive outcome but the ability to influence others positively or negatively. "Positive" is also relative to your terms of reference – there will be those who hold that leadership requires focus on special interests, whether in business or politics, or for social or environmental concerns. Leadership in governance of a public interest, on the other hand, or rather good leadership, should focus on the big picture of what is best in the larger community interest. This involves a more complicated appreciation of balance.

One priority of leaders is learning, with a view to what should be, not what is. Leaders take responsibility for continually expanding their capabili-

ties and that of others in their organizations to understand complexity, clarify vision and improve shared mental models (Senge, 1990). Leadership is rarely intuitive, but rather is developed through effort as a learned set of skills and understanding (Goleman et.al., 2002).

Leadership requires learning about others' learning. Leaders must understand the different styles and processes for learning among different individuals. A single memo or a one-time barrage of new and conceptual information will be of little lasting educational effect for most people. There are those with photographic memory, and those with inspired attention, but the rest of us tend to more timeless limitations of, we hear and we forget, we see and we believe, we do and we understand, and then we forget and start over (K'ung fu Tze, 500 BC; Gardner, 1983).

Governance

Governance is the exercise of authority within an organization. Governance in the context of metropolitan landscapes is how people get along in a public sense of community.

Governance work tends to be compartmentalized as private sector, or corporate governance; public sector governance, and; everything else, as the third sector. Many principles and best practices cut across sectors, for example time and cost effectiveness. A major distinction, however, is the concept of the public interest in decision-making in public governance.

Governance analysis generally includes concepts of distributed power or authority, born of knowledge and values, and living through decision-making frameworks. Unfortunately there are no standardized terms of reference (although the International Standards Organization is thinking about it), and this is not the place for a more detailed review other than to note the following as generally accepted components:

(1) power, either from might or collective will;

(2) authority, the right to exercise power as granted or delegated, generally through public or private constitutions;

(3) intelligence, or applied values, principles and knowledge expressed through decisions; and,

(4) frameworks, as the organizing systems for exercising authority (and fighting about it afterwards), including information, communication, compliance, evaluation and accountability loops.

If you are sitting down, that patch of land under your chair is subject to international conventions; national laws; regional (state or provincial) laws; local or community laws and bylaws; and may attract the attention of business associations, special-interest associations or neighbourhood association bylaws; corporate or strata property bylaws, in addition to leasehold or other contractual conditions. This invisible and often tangled web of abstract concepts is intended to help people get along, living together in communities (Lai, 1988).

One term of reference worth understanding is "constating documents". Constating documents are those which crystallize elements of governance related to power. These documents include constitutions, legislation, and bylaws. The best of such documents have been appreciated as "magnificent inventions which seek to balance diverse opinions with organized effectiveness" (FEIMDC, 2001).

Public Interest

Metropolitan landscapes are in our public realm. It's a group thing. Yet those who make decisions about our public realm are politicians, business people, and advocates. They have political interests, personal interests, business interests and special interests. How many of them have sat down and studied the public interest? How it differs? What it means? Apart from this general perspective, a more specific trigger for the need to define public interest is the use of the phrase, or derivative expressions, in legislation. In British Columbia, a "public-interest" test is in statutes from agricultural lands,

to environmental assessment, land-title, local government legislation, traded securities and even motor-vehicle regulation. Yet its scope and even parameters are rarely defined or even outlined, and the web of authority to exercise legislated discretion in the public interest further falls to a variety of ordinary people, from appointed regulatory officers, to a deputy ministers employed in the civil service, to local government councils elected from the private sector, to commissions and boards appointed from community leaders of diverse backgrounds.

First, what it is not. The public interest in governance is not merely,

(a) the public interest in what Shania Twain wore to the Super Bowl;

(b) the business interest in the public benefits of economic growth;

(c) the special interests of industry, environmental or social justice groups, nor

(d) the public service, particularly when public service operates according to the business rules of their employer, which may or may not have anything to do with the public interest.

The public interest is, foremost, a balance of all of the above. The big problem is when people equate "public interest" with "common sense". Simple, obvious and wrong. They confuse a self-evident "public interest" with "my public interest", and "common sense" is assumed to be "common to those who agree with my sense".

We do seem to be hammering out a better definition of public interest in response to the challenges and opportunities presented by technology and the information age.

Can we define something as complex as the public interest? With directed study we can place research instruments on Mars, and better educate business professionals to succeed in global markets. We have tackled and defined "sustainability". If we can do all that, we also can begin to understand better what the public interest means. It is important for those who are charged with the responsibility of decision-making in the public interest. It is important for the rest of us. Although "public interest" is used in university programs, legal rights, institutes and debates, there is a distressing lack of attempts to define the term itself.

A seedling definition of the public interest for leadership decisions in land-use governance was proposed in an earlier paper (Fushtey, 2002). Gleaned from literature and case-law, and floor burns on boards and councils and commissions, that work proposed that any use of "public interest" in public policy should proceed only on an informed understanding of certain attributes. These are that the interest is alive and evolving; balanced; fair; informed; inter-jurisdictional; long-term; pluralistic; positive; reasonable; respectful; and accountable.

Many of these attributes may seem to be self-evident. However each year important decisions are made in ignorance of, or flaunting, such principles. A checklist can both expedite future decisions by avoiding uncertainty over basic concepts, and avoiding revisiting less-informed decisions.

Leadership literacy in governance: Grammar

If part of literacy is understanding the terms of reference, another part is understanding how they are used together. This section provides examples of techniques which promote informed and fair decision-making, and then provides examples of governance models, three public and one hybrid, at different scales of land-use.

The pursuit of informed decisions received a giant boost with information technology. A few concepts, nothing really new, are flagged here for us to remember, and to track developments, for benefits to informed decision-making:

Deliberative Polls

Deliberative polling is a consultation process with an information -leveling component: a representative group of people are presented with all sides

of an issue, allowed to put questions to experts and debate amongst themselves, before being asked to cast considered votes on the matter (Economist 1998). In a public utility commission's consultations, in a nice hotel for a weekend, the invitees worked in small groups with trained chairmen. Skepticism gave way to admiration. The results have been described as "extraordinary", with participants "genuinely enthralled" with the opportunity, and responded with "prodigious" attention spans. (Economist, 1998, p. 31).

Deliberative participation

Two generations of work in public participation processes have seen the refinement of both the processes and the need for information leveling, and expectation management. The City of Vancouver mounted an impressive City Plan process in the mid-1990s which left as a legacy, due to workshops and integrated lectures and information sessions, a constituency which was much more informed about the causes, effects and options of urban decision-making. This legacy persists today in the sophisticated decisions endorsed by the Vancouver public in matters of transportation and social compassion. Yet in budget cuts eliminating the "continuing" education of citizens involved in public participation, will we see a return to expressions of parochial, narrow special interests from citizens in lip-service consultative processes?

Referenda

Think of a referendum as a super poll, which is unfortunately, in North America, often the antithesis of deliberative. Principles for the use of referenda also seem to be imperfectly understood.

For example, how can the public interest be served by a referenda on matters of principle, if the principle involves a minority? This was a hot issue in British Columbia recently, regarding the nature of First Nations' peoples rights to local governance. Millions of dollars and hundreds of thousands of hours were spent because apparently no-one remembered that our nations are great because,

(a) there is an need to respect and protect minority rights
(b) the fulfillment of public functions ought to be undertaken in a manner which does not undermine public trust and confidence, and
(c) we try to establish safeguards in law against the "tyranny of the majority."

Referenda may work for questions of preference or taste. Common examples are, "should this budget be allocated here or there". A more recent situation in California allowed voters to decide whether to stay the course for two years looking at a bankrupt state, or change horses in mid-stream. This has also been criticized as undermining the representational system of governance, as time and money spent on campaigning and government transition could arguably be better spent on public policy questions – and the timing of such a referendum could also directly or indirectly affect rights due to the deferral of public policy questions under consideration.

The policies and protocols of using referenda should provide for informed decision-making in a cost-effective and responsible way. Unless referenda questions are clear and unambiguous, and the process is coupled with an educational function and a deliberative framework for a serious examination of the pros and cons of a question, the results are not informed responses.

Triangulation

Triangulate information. We can never have perfect information, but at least by increasing the sources there is a greater likelihood that the real answer lies somewhere between the points. Triangulation is the evolution from one, to two, to three (or more) perspectives for decision-making. Decision-makers often rely on information from a single source. Two perspectives are used in an adversarial or adjudicated process, perhaps due to the courthouse homily that everyone is lying, the questions are how much and why. With the recent benefits of information technology and distributed intelligence, a

fundamental requirement of every decision in the public interest should be the need to hear at least three perspectives on a problem

Collaboration: Building Consensus

An intriguing trend of the past twenty years has been to more consensus-based decision-making. One reason has been cost and complexity of dispute and risk management processes which are more effective through the co-operative efforts of parties to agree upon process and facts as well as outcomes.

Consensus ad idem. A meeting of the minds. Consensus is a willingness to allow for less than full agreement on all details by all parties, but to proceed or be bound by the consent conditions. Frequently, the way to achieve consensus of outcome is to work up to it, through agreement on information, process and principles. For those involved, a significant value of a contract is often the process itself.

In the context of governance, consensus can required at each stage in a process, for information, principles, rules of procedure, or outcome. The need for an organized approach to consensus-building becomes even more important to balance increasingly diverse conditions among people from diverse backgrounds. Good examples abound, including the Toowoomba City Council mandate: "Being 'fair dinkum' and doing the right thing by everyone – the council, your boss, your fellow workers, the public, the ratepayers, yourself and your family." (Queensland, 2001).

Peer Review

Even the application of peer reviews is being reconsidered if in the absence of effective (long-term) information and deliberation processes. Increasingly the process and results of peer reviews lead to questioning whether it is realistic to pull people from separate lives and expect them to sift through a barrage of new experiences, new processes, new concepts (often of law), and conflicting (adversarial) presentations of facts? Perhaps the concept of peer review was intended to refer those with learning in the skills and judicial values required, not merely arbitrary citizenship.

Examples include:

(a) trial by one's peers in a jury at law is being questioned by the time and cost, and records of decisions overruled on appeal;

(b) professional hearings in which, although the courts have been resistant to interfere with a professional board's findings of competence or negligence, the courts are also increasingly aware that understanding principles of fundamental justice and fairness are not the expertise even of many professionals (Trinity Western 2001);

(c) public-sector peer reviews in British Columbia are another example which can undermine credibility in matters of land-use management, when decisions of an administrative manager are reviewed by (i) the manager's "peers" within the same municipality or collegial group who are likely already in conflicts of interest due to their work with the municipality, or (ii) by a council briefed by such peers.

In every case, perhaps better decisions would result not from peers, but from knowledgeable neutrals.

Fairness: Reasonable Apprehension of Bias

There are experts who deal with procedural fairness, and this is not the place for a more detailed review of processes and systems. However one aspect of fairness may get lost in governance frameworks, and that is whether individuals are in a conflict of interest, or bias, in the exercise of their discretion.

A concern is the reliance on individuals to play multiple roles in decision-making. Multiple roles work fine with intelligent, principled individuals with a lot of time. By the same token, both elections and jails are unnecessary, if everyone is intelligent and principled. The problem is that pragmatic reali-

ties of life and work in an increasingly competitive environment require an element of skepticism in establishing frameworks for effective decisions. The checks and balances of having different minds involved are required to balance circumstances of individuals who are new to the job, have inadequate learning, no time to reflect on the principles, or for any reason are not impartial due to a vested background or interest in certain outcomes. Similarly, the taint of conflict of interest imparts bias when the decision-maker is paid or supported by one of the parties, or when then decision-maker both controls the information management and decision-making process.

Problem examples include decision-makers within a municipal employment stream, deciding on matters in the public interest when the municipality is a party to the matter, or others who are asked to wear the hats of both information managers and decision-makers. A little rethinking of organizational structures, and leadership literacy education could go a long way to restoring public trust and cost-effectiveness in decision-making.

Going Forward: Guidelines and Watchlists

Looking at a metropolitan landscape on the ground, we see the results of demand and compression. Yet increased demand for limited metropolitan resources only decreases the margin for error in decision-making. Lands resources are both scarce and complex. Edge interfaces of systems or communities increase the richness of diversity and aggressive competition. A dynamic of perceived time constraints increasing pressure and escalating frustration, results in compressed response time, poor processes or decisions requiring review, and escalating frustration for those involved.

Looking ahead, two tools could help: (1) statements of values and principles, and (2) watch lists to manage issues and concerns.

On the former, the human condition seems to need help in remembering what ought to be, and thoughtful guidelines are recommended. Religions, the law and professionals have codes as touchstones for conduct. We place our communities, lives and landscapes in the hands of those who govern us – could we not also expect similar accountability? The words "code" and "ethics" may be seen as influenced by western values or unduly constraining. "Principles of conduct" may better respect diversified cultural backgrounds and focus on a collaborative, objective leveling of understanding in governance. On the spectrum of governance documentation, "values" could be used to describe fundamental desired qualities, "principles" could be used to describe the application of values in a general way, and "standards" could be the application of principles to more specific contexts or circumstances. A periodic process of review is important both to refine the statements and to build consensus with new players or members, and re-engage more senior members.

A watch-list is a punch-list of hot topics deserving special monitoring. What works or doesn't – how is it doing? What might be changing –what is the status? What needs to be refined? turfed? A watch-list of and for the public interest which is periodically reviewed will also help community leaders better align expectations and understanding over the long term.

In an age of increasing need for balanced and effective decisions, public governance must be treated as a serious responsibility and learned expertise. Consistent and supportive documentation will include constating documents which imbed the need for leadership literacy education. Problem-based learning models can be structured as programs for periodic, short sessions to build understanding through exposure to new information, application, and reminders. The cycles of succession in boards and councils must also be acknowledged through introductory and more advanced streams of governance education.

Leadership literacy in land-use management is one aspect of building a common understanding through the principled use of terms of reference. It lays some ground-work for better communication and collaboration, and hence better risk and success management.

Challenges to leadership literacy include the diversity of our backgrounds,

other demands on decision-makers' time, and even basic resistance to the concept that leadership is learned, not intuitive. Yet when words are all we have to understand each other, these challenges are merely opportunities for success.

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Demands and problems of metropolitan landscapes












Between two cities: The ecological footprint of Vancouver and Seattle in Northwest Washington

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Introduction

Over a quarter century ago, geographer Edward Gibson warned rural area residents on Vancouver Island of significant regional impacts of a proposed airport across Georgia Strait on reclaimed land southwest of Vancouver (Gibson, 1976). The idea that this land reclamation and development project could affect the extent of urbanization and the fate of fishing and forestry industries on Vancouver Island was controversial, and many Canadians ignored the warning. Since 1976, Vancouver has turned into a dynamic growth engine for British Columbia and all of Canada. Driven by immigration from Hong Kong and elsewhere in Canada, and aided by a technology boom in the late 1990s, Vancouver seemed well on its way to becoming a significant, cosmopolitan metropolitan center by the end of the 20th century. A report from BC Stats, the province's statistical agency, notes that advanced technology manufacturing and service industries are still a small part of total GDP in British Columbia, only about 4 percent in the year 2000. However, these sectors are growing much more rapidly than the rest of the BC economy, and are providing a very dynamic new economic base (Schrier et al., 2001). The population increases that have occurred as a result of these trends have been substantial, and as Gibson suggested years ago, there has been an accompanying spillover of urbanization from Vancouver into the Lower Fraser Valley and across Georgia Strait to Vancouver Island and the adjacent Gulf Islands.

To the south, Seattle has experienced an analogous transformation. Local economic history in this metropolitan area has been marked by employment cycles at The Boeing Company for the last 50 years. A significant downsizing from 1969-71 plunged the area into a recession. Local leaders banded together and launched efforts to diversify the economy, building up the container-based port industry, and related international trade. From the 1980s forward, several significant high tech sectors also began to grow. Microsoft's founders decided to return to their hometown to build a new software company. Microsoft became a giant in the industry and stimulated formation of over 3000 other software enterprises in the area. The Fred Hutchinson Cancer Research Center was established, and launched a research program in partnership with the University of Washington Medical School that gave birth to over a hundred biotechnology and biomedical device companies. Like Vancouver, the Seattle area has grown in population and it has impacted the surrounding region in a variety of ways.

The purpose of this paper is to review the growth trends in these two metro areas, and to examine the impacts and potential impacts of the metro areas on the region in between – Skagit and Whatcom Counties, a region often designated as Northwest Washington. These counties are predominantly rural in character. Each has one or more substantial small cities along the Interstate 5, the major north/south highway that links Seattle to the Canadian border and the city of Vancouver. However, the rest of these two counties is rural, much of it forested and some of it used for agriculture. Population

and employment growth trends and forecasts are reviewed, and these trends are examined within the construct of an "ecological footprint."

Growth trends in three areas: Vancouver, Seattle and Northwest Washington

Vancouver

From 1992 to 2001, the Vancouver metropolitan area grew from 1.7 million to 2.0 million residents, an expansion of 19 percent. This expansion was driven by both natural increase and net in-migration of 20,000 to upwards of 45,000 persons per year. Newspaper accounts and conversations over the years with Vancouver residents suggest two significant factors that drove this expansion:

- The flight of affluent Hong Kong residents to Canada in anticipation of the end of British sovereignty; and
- Immigrants from other Canadian provinces who wanted to take advantage of the mild climate and expanding economy in the Vancouver area in the mid-1990s.

A weaker economy in the late 1990s slowed the flow of immigrants from other provinces, as did a smooth governmental transition in Hong Kong that re-assured many long term residents that they had a future in that region.

What makes the Vancouver region growth trends interesting for this paper is that the expansion tends to sprawl into adjoining jurisdictions over time, rather than being contained in the City of Vancouver itself. As Figures 1 and 2 show, the Vancouver area is expected to continue its growth (Figure 1), but Vancouver proper is expected to have a declining share of the total population of the urban area (Figure 2), according to projections from BC Stats. The projections suggest that the City of Vancouver proper will grow from 578 thousand in 2000 to over 700 thousand by the year 2026 (21 percent expansion),

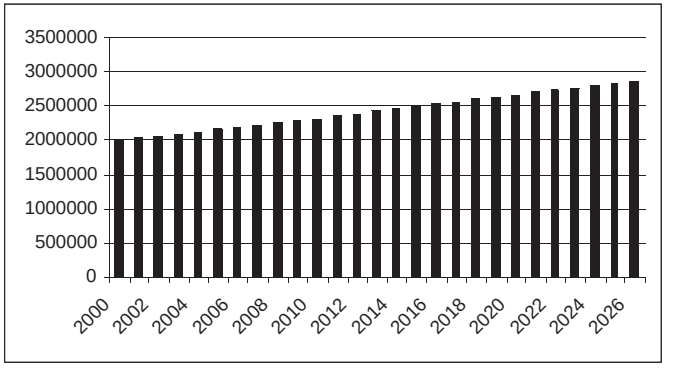

Figure 1: Vancouver Region Population Projections

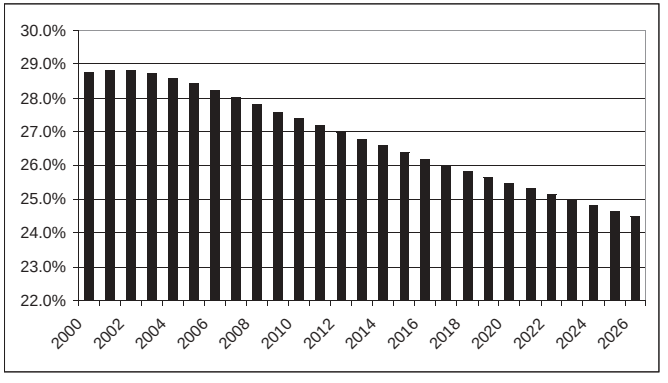

Figure 2: Vancouver's Projected Share of Greater Vancouver Regional District Population

but the surrounding suburban jurisdictions will grow more rapidly, resulting in an increase from 1.43 million to 2.16 million (51 percent expansion).

Seattle

South of the border in the Seattle region, similar trends are taking place. Several counties need to be aggregated to capture the urbanized area known as the Puget Sound region. On the eastern shore of Puget Sound, King and Snohomish Counties are aggregated together with Island County to constitute the Seattle-Bellevue-Everett PMSA in US statistical series, and Pierce County, home of Tacoma, the second largest city in the state of Washington, lies on King County's southern border. Visitors to the area perceive a more or less seamless urbanized area as they drive north to south through Snohomish, King, and Pierce Counties along Interstate 5. In addition, Kitsap County, located on the western shore of Puget Sound is linked to Seattle by ferries. Many Kitsap residents commute to work in the Seattle area. For transportation planning purposes, Snohomish, King, Pierce, and Kitsap are aggregated into a federal planning unit called the Central Puget Sound. This 4-county region is used in the analysis below, excluding but Island County is not included in the statistics because it is small in population and more rural in character. Using data from state agencies for this 4-county aggregated Puget Sound region, trends in population can be discovered to compare to trends in the Vancouver region.

Population in the Puget Sound was 1.934 million in 1970, but had reached 3.148 by 1998, an expansion of 63 percent over a 28 year period. Projections from the Puget Sound Regional Council suggest that the urban area could reach a population of 4.688 million by 2030, a projected expansion of 49 percent over the 32 year forecast horizon. Like Vancouver, the Seattle area attracts net migration from other parts of the United States, as well as other countries. Throughout the 1970s and 1980s, much of the net in-migration was associated with upswings of employment at Boeing, whose workforce vacillated between 39,000 at its low point in 1971 and over 100,000 at two points in the last two decades. During the inevitable downturns in airline orders, substantial layoffs released a workforce that often tended to stay in the area rather than moving on to opportunities elsewhere. From the mid-1980s onward, the rapid growth of the biotechnology/biomedical equipment and software industries provided an alternative source of employment for Boeing workers during the downturns. These new industries became in themselves a net draw for in-migration as new and rapidly expanding companies recruited talented workers out of other regions. These industrial developments led to the forecast of further growth in the Puget Sound despite a slowing rate of growth of the US population overall.

Detailed population projections for the central city and its suburbs comparable to the Vancouver Regional District are not available for the Puget Sound region. However, U.S. Census data readily show that the Seattle area is also spreading out, with higher growth rates in the suburban and/or unincorporated portions of the Puget Sound Region (Table1). Outside Seattle city limits, population growth has proceeded at twice the pace inside the city.

The pace of growth in this region as a whole is roughly of the same order of magnitude as that of the Vancouver metropolitan area. These two metro areas are in different countries, but are subject to many of the same regional and international dynamics, producing comparable growth trajectories.

Table 1: Population Growth: Seattle vs. Rest of Central Puget Sound (CPS)

	1990	2000	Percent Change, 1990-2000
Seattle	516,259	563,374	9.1%
Rest of CPS	2,232,636	2,712,473	21.5%

Source: U.S. Department of Commerce, Census 2000

The situation in between

In the two U.S. counties lying between the international border and the Puget Sound urban area, the population and employment base has also been growing. In fact population grew more rapidly in these two counties during

1970s and the 1990s, and a bit more slowly during the 1980s, than in the Puget Sound (Table 2). The two Northwest region counties combined reached a total population level of 266 thousand in 1999. Likewise, employment grew substantially in the Northwest region, exceeding the pace of employment expansion in the Puget Sound in each decade (Table 3).

Table 2. Population Growth

	Northwest	Puget Sound
1970-1980	30.2%	15.6%
1980-1990	19.8%	22.7%
1990-2000	32.8%	21.3%

Source: U.S. Department of Commerce, Census 2000

Table 3 Employment Growth

	Northwest	Puget Sound
1970-1980	49.9%	49.5%
1980-1990	49.3%	41.2%
1990-2000	33.1%	28.6%

Source: U.S. Department of Commerce, Census 2000

Personal income per capita trends tell a very different story, however. Figure 3 demonstrates a widening gap between the level of personal income per capita in the Northwest region and in the Puget Sound. Starting from a position of near equality in 1970, the gap has steadily increased during the 1980s and 1990s. King County is home to a number of high tech industries that generated substantial wealth, including Microsoft, McCaw Cellular (now AT&T Cellular), Aldus (now Adobe), Amazon, and Real Networks. Each of these companies made their founders and a number of early employees wealthy as their stock in these companies reached high values in the late

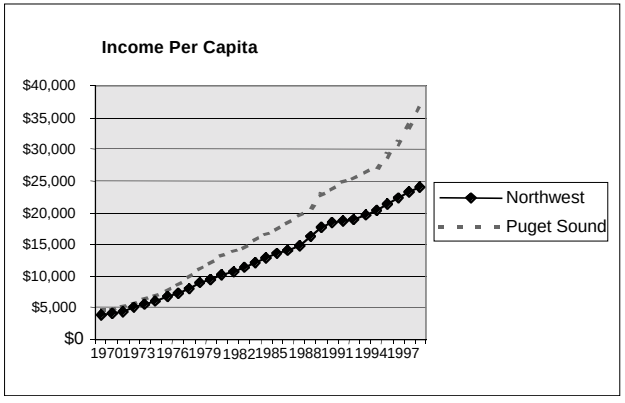

Figure 3: Income Per Capita in the Northwest Region and Puget Sound

1990s. In addition, software/internet companies and the biotechnology sector employ many technical and professional employees who earn high salaries in addition to possibly accruing some stock options. These sectors are notably missing from most of the rest of the state, including the two Northwest counties (Washington Technology Center, 2002). These differences may explain a good deal of the divergence in personal income trends.

The ecological footprint: Implications for Northwest Washington

The ecological footprint construct offers a way to estimate the total ecological impact of an urban population and its economic activities (Wackernagel and Rees, 1996). Wackernagel and Rees define this construct as "the flows of energy and matter to and from any defined economy" and "the corresponding land/water area required from nature to support these flows" (p. 3). These authors define the ecological footprint in practical terms, offering

calculations of how much water and land is required on a continuous basis to produce all the goods consumed by the human population in a region, and to assimilate all of the wastes generated by that population. Given that economic accounting systems were not designed for this purpose, they make a variety of simplifying assumptions to make the exercise tractable using available economic data. Based on these assumptions, these authors calculate that the residents of Vancouver and the Lower Fraser Valley occupied 4,000 square kilometers or 0.4 million hectares in the mid-1990s. However, the approximately 1.8 million residents at that time required a total of 73,000 square kilometers, or 7.7 million hectares of land to support their lifestyle. The estimated ecological footprint of the Vancouver area was 19 times the size of the actual "paved over" territory occupied by the metropolitan area (p. 86).

Using the assumptions Wackernagel and Rees have developed, I estimate the ecological footprint of the Puget Sound area for both 1994, the year Wackernagel and Rees use in their calculations, and update the footprint estimates for both Vancouver and the Puget Sound to 2001 levels in Table 4. Due to a larger population base and a somewhat more resource-intensive lifestyle, the estimated footprint of the Puget Sound is over 80 percent larger than the Vancouver area's footprint in both 1994 and 2001. Vancouver's estimated footprint increased nearly 12 percent from 1994 to 2001, while the estimate for the Puget Sound grew over 9 percent.

Table 4 Estimated Ecological Footprint of Vancouver and the Puget Sound

	Population (millions)		Footprint		
			Millions	hectares	Hectares per person
	111994	2001	1994	2001	
Vancouver	1.1.80	2.01	7.74	8.64	4.3
Puget Sound	2.1.85	3.12	14.52	15.89	5.1

Observations on the footprint and its impacts in the Northwest region

The specific quantitative assumptions made by Wackernagel and Rees can be challenged, but if we assume both that the various technological factors, behavioral patterns, business strategies, and public policy decisions that produce those patterns are relatively stable over time, then we can use the population projections for the Vancouver region and the Puget Sound to speculate on increases in the ecological footprint of these two urban areas over the next three decades. By 2026, the footprint of the Vancouver region will increase to 12.3 million hectares, while the Puget Sound's footprint will increase to 23.9 million hectares. As large as these numbers are, it is worth putting them into some sort of geographic context. The four Puget Sound counties are very large-over 1.5 million hectares. Thus, the estimated ecological footprint is 9 to 10 times the size of these counties. As Wackernagel and Rees argue for Vancouver, the ecological footprint of the urbanized portion of the Puget Sound is much larger than its home territory. If these calculations are anywhere close to reality, both Vancouver and Seattle are "exporting" ecological impacts to other areas. Whether it is municipal garbage that is filling whole canyons in distant rural counties, treated sewage that is sprayed on forest lands as a disposal cum fertilization strategy, air pollution that affects the entire regional airshed, or water pollution that affects marine life, Seattle and Vancouver are having substantial ecological impacts on surrounding regions.

The impacts can also be quite distant rather than "neighborhood" effects. Both of these cities are major participants in the globalized economy. Since the 19th Century, these regions have been exporters of natural resources. In the 20th Century, airplanes and advanced technology products and services were added. However, we also export used computers from this region to be recycled in China by villagers who have limited access to environmental technologies to protect themselves and their neighborhoods as they strip components with hazardous materials from old computers. We export manufactur-

ing jobs and their environmental impacts to low cost labor forces in Third World countries, as well as industrializing countries. The only ski company in the US, for example, is located on Vashon Island near Seattle. After the sale of the company to non-local owners, most of the production of skis was moved to Asia, leaving only a research and development group on Vashon along with the corporate executives. Coffee companies such as Starbucks are part of the image of the new Seattle. Coffee grows in semi-tropical environments and must be imported from other countries to support vendors of "double tall skinny lattes." A number of environmental and workforce issues are associated with these imports.

Within this region of the world, there are also systematic and observable trends in the types of economic activities that get exported from the major cities as their economies evolve towards advanced technology manufacturing and services. There is a natural tendency for large city land prices and therefore building rents to increase substantially as cities get denser, forcing lower value functions to move out of the denser districts to stay competitive. Smaller scale manufacturing often heads for the suburbs, and internet technology is increasing the tendency for back office service functions to follow. Vancouver has been called "the Executive City" by leaders of its Board of Trade, who support the movement of manufacturing and industrial uses to the lower Fraser Valley in order to make room for high rise offices and high rise condominiums along the scenic waterfront of downtown Vancouver. The more affordable housing options and the more cost-conscious retailers catering to that segment of the market also head out into the suburban locations north and south of downtown, as well as quite far to the east. Modeling the phenomenon Gibson warned about a quarter century ago, other residents use BC's excellent ferry system to commute from the Gulf Islands or Vancouver Island itself. The Seattle analogues are Class A office towers and luxury condos in downtown and the adjacent Belltown and Pioneer Square neighborhoods, while mid- to lower-income households head for distant suburbs. This tendency to push certain economic and residential activities out of the core city also exports ecological impacts from the city.

Beyond commuting, there are other existing economic impacts or ties between Whatcom County and the two metro areas. The Bellisfair Mall in Bellingham was built in part to lure Canadian shoppers south of the border, and in its early years upwards of 40 percent of the cars in the mall's parking lots were from British Columbia. More recently, a disadvantageous exchange rate has given the Canadians a strong incentive to shop at home. With the liberalization of trade through the U.S./Canada Free Trade Agreement and the North American Free Trade Agreement, some Canadian firms have used branch operations in Whatcom County as a foothold into the U.S. market, or as a way of escaping tax rules or labor laws they perceive as unfavorable. Influences from the south are more readily seen in Skagit County than in Whatcom. Tulip fields are threatened by encroaching suburban developments as Puget Sound workers seek affordable housing. In Whatcom County, Western Washington University represents a major tie between Bellingham and Seattle since many students come from the Puget Sound.

Robert Lang's review of a dozen or so US metro areas suggests some of the trends visible in Whatcom and Skagit counties are part of a larger phenomenon he calls "edgeless cities" located on the periphery of urban areas (Lang, 2000). His definition of edgeless city plays off journalist Joel Garreau's phrase "edge cities" (Garreau, 1991). Applying Garreau's edge city and downtown definitions to a very rich and detailed dataset taken from real estate industry sources, Lang develops an empirical argument that the semi-structured urban form called edge city by Garreau does not account for very much of the growth of office space in the selected US metro areas he examines. Instead, edgeless places that defy any attempt to categorize or structure are popping up with increasing frequency on the periphery of one metro area after another, mixing residential and office and commercial uses in a very unstructured and space-consumptive manner. Extensive road systems are re-

quired to support this mode of urban development. Difficulty in keeping up with the infrastructure demands leads quickly to traffic congestion, thereby worsening the ecological impacts. This phenomenon can be readily observed in the edgeless peripheries of both Seattle and Vancouver.

The service sector and office-based jobs have been the most rapidly expanding part of the economy in recent years, making the phenomenon very important to the future of North American cities. The jobs are decentralizing rapidly, in hot pursuit of the workforce that has been moving to the suburbs for many years. While the exact patterns are very diverse across a sample of urban areas, in every area Lang examines there has been a significant amount of new office space developed in edgeless spaces in recent years. There is the potential for a labor force in pursuit of a rural quality of life to move even further out beyond this new edgeless urban frontier. This potential brings the issue to the doorsteps of the Northwest region from both the north and south.

Interviews with business leaders in the Bellingham area suggest that the prevailing mindset in Whatcom County is that Bellingham is just too far from Seattle for these spreading urbanization impacts to have any real meaning for Bellingham. Typical comments from these leaders interviewed in the winter of 2002 include statements that the local workforce does not tend to commute to either Vancouver or Seattle, housing prices are lower than in the larger metro areas, the quality of life is high, and traffic congestion is not much of a problem. The problem perceived by these leaders is a weak economy threatened by the loss of manufacturing jobs due to globalization, environmental regulation, and rising energy costs. These leaders are working hard to bring new companies into town based on improvements in telecommunications infrastructure, creation of a local venture capital fund, and close relationships with a number of education institutions to prepare the local labor force for participation in the New Economy of telecommuncations, software development, and internet-based business strategies. While these strategies may be sensible, the perceived immunity to urbanization forces may reflect a misreading of the rate at which the ecological footprints of Vancouver and Seattle are expanding, the ability of those metro areas to export portions of the footprint right into Whatcom County, and certain social consequences of the New Economy phenomenon that may tweak the footprint impact in ways that local residents may or may not appreciate.

Twenty or thirty years ago, few residents of Skagit County would have thought of commuting down to Seattle to find a job, but new housing developments and freeway traffic trends support the contention of business leaders that this is now a reality. If one compares trends in the Seattle area to the larger and more advanced high tech economy of the Silicon Valley, the likelihood of commuters traveling from the Bellingham area south to Seattle, or at least its northern technology-oriented suburbs, seems almost inevitable. Many Silicon Valley commuters are driving in from even more distant communities. Despite the impacts on border crossings of the "war on terrorism," border crossings by commuters from Bellingham to Vancouver may also increase over time as the Vancouver economy expands.

One irony of this situation is that environmental and other leaders persuaded Washington voters to approve growth management legislation 10 years ago. The goal of the legislation was to constrain urbanization, forcing more dense development at certain urban nodes, and linking these nodes with expanded transportation systems. The transportation improvements have been slow to follow despite modest success in increasing density at desired locations such as downtown Bellevue and downtown Seattle. The reality of the local level growth management plans has been to protect rural land uses at the eastern edge of the urbanized portions of Snohomish, King, and Pierce counties, thereby forcing some of the growth pressure to spill north and south. Each Puget Sound county is intensely concerned about its eastern boundary, while the counties at the northern and southern periphery of the urban area are quite interested in new residents and new jobs. This combination of policies may be pushing urbanization north and south as much as

it is forcing it to go up instead of out.

Another impact of technology industry growth and urbanization in the Puget Sound has been the emergence of a new way of thinking about the role and uses of the surrounding rural areas. The cities of the Northwest were built around resource extraction industries – fishing, forestry, and mining. The cities provided a variety of high order services that supported the resource industries located in the rural parts of these states and provinces. However, the resource industries ceased to be a source of job growth at least 30 years ago, and growth is now supported by the expansion of service industries that are themselves exporters – software, financial services, and e-commerce. These newer sectors have brought in new residents with no ties to the resource extraction industries.

When these new residents venture out of the cities for a weekend hiking trip or a summer vacation, many are taken aback by the impacts of resource extraction on the landscape. Whether it is a strip mine or a clearcut, the new urbanites have often retreated back to the city and become strong supporters of environmental policies that have placed many limits on the resource industries. New mines are almost impossible to open up in Washington. Timber companies in both Canada and the United States have had to withdraw from some forested lands to protect environmental assets, and change their forestry practices in many ways to provide a range of environmental outputs other than just wood fiber. A number of scholars have argued that the new residents attracted into this region think about the surrounding region differently than their predecessors. They think of the rural areas as a site for recreation, as a pool of genetic diversity, as a scenic landscape that should be preserved, but not as source of timber, food, minerals, or jobs. For example, University of Oregon economist Ed Whitelaw has repeatedly characterized these preferences of newer Northwest residents as a "2nd paycheck" that provides environmental amenities if forests are left standing (Niemi et al., 1999).

As wealth generation in the New Economy has reached impressive levels, some of these environmentally conscious urbanites have acquired the resources to support their values with significant investments. A number of land sales have been consummated to create environmental preserves and education centers on former timber production lands. For example, Paul Brainerd, the founder of Aldus and creator of the well known Pagemaker application, sold his company to Adobe and used some of the proceeds to acquire a significant forest tract on Bainbridge Island, near Seattle. He is turning that forest into an environmental education center focused on school children. In addition, Microsoft co-founder Paul Allen has assisted environmental groups in several forest land purchases to establish ecological reserves.

Other beneficiaries of the new economy have used their new wealth to purchase a second home near a ski area, fishing stream, lake or mountain view in the rural hinterland surrounding the urban areas. These part-time rural residents have a variety of interesting impacts on the rural places. Their presence is a part of the expanding ecological impact of the urban area. Some rural residents fear they are driving up local real estate prices without providing commensurate support for schools or other locally financed amenities. However, the size of the Baby Boom generation in the US suggests that many more urban residents will become full or part time residents in the rural areas over time and these impacts will increase. In conducting interviews for a variety of projects concerning the impacts of Information Technology, I have encountered semi-retired technology industry leaders who are thinking about launching a second or third career in Skagit and Whatcom counties. As welcome as these new entrepreneurs may be in towns such as LaConner or Bellingham, their presence is also a harbinger of more rapid urbanization influences that will follow.

New strategies needed

These observations suggest the need for leaders in Skagit and Whatcom counties to recognize the growing impacts of the large and growing urban ar-

eas at their northern and southern boundaries. There is no assurance that urbanization will be contained where it now exists. There is no assurance that the economy of Whatcom and Skagit counties will continue to enjoy the benefits or costs of being relatively isolated from the influences that have shaped Vancouver and Seattle. It is time for local leadership to take note of these trends and devise strategies for shaping the growth that is likely to come their way. Strategic goals to consider include preserving desired rural features, providing species protection, and preserving air- and water-sheds while taking advantage of the new job creation and wealth generation possibilities that are implied. Otherwise long term residents of the "inbetween region" may find that the ecological footprint of Seattle and Vancouver has begun to feel like a heavy boot rather than a welcome stimulus to an economically backward region.

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The inverted compact city of Delhi

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Introduction: urbanization and compaction

The compact city offers various claimed benefits (Elkin et al., 1991). First, the high intensity of development reduces geographical spread and thus permits consumption of less land and other resources. Second, the planned higher residential densities offer opportunities for accommodating more people on the same land area and also contribute to greater social interaction. Third, average journey trips become shorter leading to lower fuel consumption and lower harmful emissions. This makes compact cities more energy efficient (McLaren, 1992; Hillman, 1996, Zhang, 2002). Fourth, governments are able to provide basic services more efficiently as transmission wastes are minimized. Ultimately, the compact city planning approach can contribute to the attainment of sustainable cities (Jenks et al., 1996).

This paper demonstrates that the city of Delhi does not enjoy any of these benefits. One reason is that its form is opposite to that of the compact city, i.e. it is the inverted compact city, which has low gross residential densities in the inner areas and high gross densities in the outer areas. Gross densities are at least four times higher in outer areas than in the inner cities. Intensity of development is also low. For instance, there are single or double storey resi-

dential buildings in most of its inner city areas, whilst four to eight storey residential buildings are quite common in the outer areas. Sometimes these outer areas even lie outside the urban area boundary. High-rise residential apartments in the southern parts of Delhi are one such example.

How did this urban form happen? It can be explained by looking at the political events of the first decade of the twentieth century, which led to the unique process of urbanization of the city of Delhi. At this time a statement of imperial grandeur, order and authority was made through the construction of New Delhi. Vast low-density residential areas were developed in New Delhi when the British Government of India constructed its new capital during the beginning of the twentieth century. Lutyens' Delhi was planned to contain merely 140 bungalows (Mehra, 1999: 56). No bungalow would rise above single storey in the heart of the city (King, 1976: 124-125). Furthermore, large spaces are occupied by less dense land uses, such as Second World War military barracks now used as central government offices, and low-rise commercial areas, such as Connaught Place, which occasionally rise up to two storeys high.

The process of urbanization in India including Delhi, took on another characteristic after the country became independent in 1947. Over the last 50 years the free movement of people in a democratic context has resulted in an accelerated rate of rural to urban migration, primarily the result of the search for employment. Rural to urban migration contributed about 30 percent to urban growth between 1981-91 in India (Visaria, 1997: 273). However, this figure was more than 50 percent for the four Indian mega cities (United Nations, 1986a: 9; 1986b: 6; 1987: 2). It is estimated that on average 1,000 people migrated to Delhi every day between 1981 and 1991 (Kumar, 1996: 18). Consequently, the squatter population increased from 493,545 in 1981 to 1,296,720 in 1991, almost 263 percent growth in a decade (Singh, 1999: 12). As most of these people did not have jobs, they could not afford to buy a house. In the desperate search for survival, migrants squatted on whatever land came their way. Having repeated this process year after year, cities have become crowded with squatters and littered with slums. The squatters, particularly, have built low-rise and less compact residential developments in various parts of the city. Most of these settlements contain thatched huts or *jhuggies*. In fact, unauthorized residential developments have slowed down the compact character of the mega cities.

Another feature of Indian urbanization is the illegal sub-division of undeveloped land into residential plots. These kinds of development act as attachments to planned urban areas where vacant undeveloped land is divided into plots and sold to individuals, who in turn construct medium to high-rise buildings. As these developments are neither planned nor authorized, infrastructure is provided at a later stage, leading to the interim use of rudimentary techniques for the provision of infrastructure and the inefficient use of energy. Thus intense development leads to slum-like development, rather than beneficial compact development, as the high intensity of development does not lead to the optimum use of social and physical infrastructure (Kumar, 1999).

Having provided a brief analysis of the process of Indian urbanization vis-à-vis inverted compact city character, a critical review of the compact city policies in Delhi is provided in the second section. The third section identifies prominent density patterns by using the 2001 census data for Delhi. This provides an assessment of the inverted compact city character of Delhi. Major implications of the inverted compact city character are examined in the fourth section. These are in fact negative outcomes of urban sprawl. The fifth section contains some concluding remarks in the form of policy recommendations.

The compact city policies of the Delhi Government

Compact city policy became part of Delhi's city planning in 1990 when the Delhi Development Authority (DDA) made various proposals, including the densification of the existing built form, in the modified master plan. Total land requirement by 2001 was estimated to be a maximum of 24,000

hectares. The DDA formulated five major strategies to achieve this target.

First, it contended that additional land for residential purposes would have to be found beyond the existing city structure. Accordingly, it expanded the Delhi Urban Area 1981 with an additional 4,000 hectares of land for residential purposes.

Second, it proposed that another 14,000 hectare of land required would be met through the densification of the census towns of Najafgarh, Nangloi, Bawana and Alipur, and the construction of the new township of Narela. Planning and design work on Narela Township has been finished and implementation has begun in earnest. However, no intensification mechanisms have been devised for densification in the census towns. According to the Census of India 1991, 'all places with a municipal corporation, cantonment board or notified town area committee' are regarded as census towns. Any other settlement, which does not have these local bodies, must satisfy the following three criteria to be called a census town. First, the settlement must have a minimum population of 5,000. Second, at least 75 percent of the male working population should be engaged in non-agricultural pursuits. Third, the settlement must have a density of population of at least 400 persons per square kilometer (Office of the Registrar General and Census Commissioner, 1994: xi-xii).

Third, it was argued that developed urban land would always remain limited when compared with the requirements of the exploding population's housing and other land related needs. The DDA thus proposed that the remaining land requirement of 6,000 hectares would be met by increasing what it called the 'holding capacity' of the Delhi Urban Area 1981 (Government of India, 1990: 120). This meant that the DDA had inadvertently given the go-ahead to property owners selectively to increase densities by intensification without securing planning permissions. The public knew that the DDA would subsequently legalize these illegal developments. With hindsight, the public got it right.

Fourth, the DDA proposed that in future it would primarily encourage group housing rather than plot development, in order to accommodate more households on the same amount of land. To some extent this policy has been pursued successfully. It is expected that 350-400 persons per hectare gross density will be achieved (Government of India, 1990: 122). Dwarka and Rohini are likely to achieve densities between 150-200 persons per hectare.

The fifth policy was popularly known as the 'containment policy'. The DDA argued that it would strive to create self-contained planning divisions. It was expected that people would not need to make inter-division trips for a majority of purposes including, work, education, leisure and recreation.

A further step was taken in the direction of the compact city when a commission, popularly known as the Malhotra Committee, recently submitted its report to the government. One of the main recommendations of the Committee was that individual owners of plots should be allowed to construct three storey residential buildings instead of the previous provision of two and a half storey development, and four storey residential buildings instead of the previous provision of three and a half storey development (Government of the National Capital Territory of Delhi, 1997: 40). Most of the Committee's recommendations have been accepted by central government. But this policy, in effect, legalized what had already taken place, and the policy was nothing more than a reaction that legitimated planning violations.

The Prime Minister Atal Behari Vajpayee recently became the most ardent supporter of the compact city planning approach when in 1998 he argued in the media for the densification of the New Delhi Municipal Council (NDMC) area. He noted that 'the Lutyens' Bungalow Zone could not continue to exist without basic change in a city where space and affordable housing are scarce' (Mehra, 1999: 56). The Prime Minister's comments immediately led to the establishment of the M. N. Buch Committee. This Committee recently submitted its report to the central Ministry of Urban Development. The report argued that densification of Lutyens' Delhi should not be carried

out for a number of reasons. First, no matter what type of intense development is carried out, it will not substantially contribute to Delhi's housing supply. Second, densification would eat away all the green spaces that the city has. Third, since Lutyens' Delhi occupies a strategic location, it would create housing for the rich and elite only, would not benefit the poor who require most housing. Fourth, permission to build residential flats and apartments would only benefit property dealers and builders, who would be able to earn enormous profits.

Nevertheless, the Committee's findings can be faulted on many counts. First, the Prime Minister's comments should not be taken literally. The basic idea that the Prime Minister conveyed was that intensification of the Lutyens' Bungalow Zone is necessary because of scarcity of prime developed urban land. Why should residential development led by the private sector be considered as the only possibility? Why not other alternative forms of development such as mixed land use or commercial development? Why have partnerships or even government led urban development, been ruled out? It is not entirely out of the question to consider residential development for politicians and bureaucrats in this place, which is so near to Parliament House. This would indirectly help the general public, as it would reduce road blockages resulting from the motorcades carrying politicians from the outer areas to Parliament House. Eating away of the green spaces is not an issue, as only the intensifying of the existing built up areas is being considered. Neither the Prime Minister nor the then Minister of Urban Affairs and Employment Mr. Ram Jethmalani have argued for building on the existing green spaces.

In the second half of 1999 the DDA concluded a design competition. The entries selected for implementation in three proposed residential sites, at Tehkhand, Dwarka and Vasant Kunj, are path breaking. The DDA seems to have accepted the idea of multi-storey housing complexes, which will include the use of the state of the art technologies to provide some of the basic facilities in common areas at each floor. The DDA expects that this change in design will minimize the need to make frequent outdoor (other floor) trips by people living on higher floors. The acceptance of these design ideas should gather further support for high-rise living concepts. At present, preparations are underway to put together the new master plan for the city for 2021. In a seminar held in the middle of October 1999, the DDA once again committed itself to the high-rise residential development.

Overall, compact city policies have been reactive. While the creation of the sub-cities of Dwarka and Rohini could be counted as a success, in general compact city policies have lagged behind actual developments. However, it is also expected that the Malhotra Committee recommendations will further encourage the process of illegal compaction beyond three and half storey residential development. This is contrary to the spirit of compact city development: a coherently thought out city structure based on higher densities and the efficient use of energy, land and other resources. The only hope for the compact city planning approach lies in the fact that DDA continues to strongly support the idea of high-rise, high quality life in the city.

Densities in Delhi and emerging density patterns

Densities in Delhi increase with distance from the central area and continue to do so even at the urban fringes (Fig. 1). The area covered by the New Delhi Municipal Council (NDMC) has one of lowest densities at 50 to 100 persons per hectare. Even lower densities, less than 30 persons per hectare, are found in the Delhi Cantonment area (see Table 1). New Delhi was created by Edwin Landseer Lutyens as a huge single storey 'bungalow zone' to house the British civil servants. After the Indian independence, Indian politicians and senior civil servants continued to occupy these spaces. Change to this built form was thought to be anti-aesthetic.

Figure 1: Gross densities in urban Delhi, 2001

Table 1: Gross densities in urban Delhi, 2001

Name of the Area	Population, 2001	Area (in ha)	Density (pph)
NCT Urban	12,819,761	83,804	153
NCT Rural	963,215	79,766	12
NCT Total	13,782,976	163,570	84
New Delhi Municipal Council	2,94,783	4,274	69
Delhi Cantonment	1,24,452	4,297	29
Delhi Municipal Corporation	98,17,439	139,729	70

Source: Government of India (2001: vii, 54-62). Note: NCT stands for National Capital Territory of Delhi.

The Delhi Cantonment Board was exclusively created as a secluded area for the military. A major part of the Cantonment contains low-rise development, and huge plots, similar to those in the NDMC area, house senior military officers. A large area of land is used for the golf course and other recreational activities. An equally large area is left vacant for future residential development, and at present is used to grow vegetables and grain. However, about one fifth of the Cantonment area has moderately intense development consisting of three to four storey apartments. Because of these uses, Delhi Cantonment area shows the lowest gross densities. In the early parts of this century this area was located outside urban Delhi, but the subsequent rapid expansion of urban Delhi has encompassed both the Cantonment and the NDMC area within central Delhi. Lower densities are also to be found to the west of the Cantonment area, where high value land is put to extensive land use in the form of the central prison, the Tihar Jail. To the southeast and east of the Cantonment area, there are a few villages with a very low density, sometimes even less than one person per hectare (Government of India, 1991: 342-354).

Delhi Municipal Corporation (DMC) has slightly higher densities, ranging between 50 and 100 persons per hectare. This is because this area contains some of most densely populated areas such as Old Delhi and Karol Bagh, with densities as high as 900 persons per hectare. But lower densities in other parts of the DMC area moderate this extra-ordinarily high density. On the other hand, outer areas in south-western and northern parts of the DMC show densities as high as 150-200 persons per hectare.

High densities are also to be found on the periphery of urban Delhi. Some of these areas include the census towns of Tigri, Babar Pur, Taj Pul, Sultanpur Majra, Jaffarabad, Gokal Pur and Sultan Pur. Although only low-rise development was permitted in these areas, over time people violated the building bylaws only in order to accommodate more and more people on the same land area. Today these areas are characterized by intense development.

The Delhi Development Authority in some of eastern Delhi areas planned higher densities. Patparganj, with densities in the range of 200 to 250 persons per hectare, is the prime example of this type of development. Of the development blocks, Shahdara Development Block has the highest density of around 600 persons per hectare. All the census towns of this area have densities more than 225 persons per hectare, most of which is caused by unplanned development.

Nine census towns show the lowest densities – with less than 25 persons per hectare. This is because they were only recently recognized (in the 1991 Census) as urban settlements (see Table 2). These settlements are likely to become intensely developed, and could house many more people in same area. The acquisition of urban status means more funds for infrastructure and development, and multiplier effects bring about intense development and higher population densities. The density patterns have emerged as a result of the interplay of planning policies, and various other political, social and economic factors. These are discussed below.

Planned low rise imperial developments

The lowest population densities and low intensity residential developments can be found in Lutyens' New Delhi, Delhi Development Authority areas in southern Delhi such as Green Park, and in Model Town in the eastern parts of Delhi.The Imperial town planning movement, which gave birth to New Delhi, Model Town and Civil Lines, advocated low rise orderly development with large plot sizes and single storey buildings, with maximum ground coverage of as little as 25 percent of the entire plot area. Lutyens' Delhi is located adjacent to the low-rise planned commercial centre of Connaught Place. In complete contrast to theories that highly accessible areas are densely built and used primarily for commercial purposes, New Delhi is primarily residential, with some sectors having low rise commercial and office buildings. Model Town and Civil Lines are also relatively centrally located, not more than 8 kilometres from the city centre.

Table 2. Gross Densities in Census Towns of Delhi, 2001

Sl. No.	Name of the Area	Population, 2001	Area, 2001 (ha.)	Density (pph)
Alipur Development Block				
1.	Alipur	16,623	855	19.44
2.	Pooth Khurd	8,167	998	8.18
3.	Pehlad Pur Banger	10,548	467	22.59
4.	Bhalswa Jahangirpur	1,51,427	670	226.01
Kanjhawala Development Block				
5.	Bawana	23,095	1,697	13.61
6.	Kanjhawala	8,700	894	9.73
7.	Mundka	43,898	1,189	36.92
8.	Sultan Pur Majra	1,63,716	277	591.03
9.	Nangloi Jat	1,50,371	667	225.44
Najafgarh Development Block				
10.	Roshan Pura	38,580	276	139.78
11.	Binda Pur**		249	
12.	Nasir Pur **		285	
13.	Palam**		849	
Mehrauli Development Block				
14.	Asola	5,002	1,195	4.19
15.	Nangal Dewat	13,168	720	18.29
16.	Malik Pur Kohi**		750	
17.	Rajokri	12,758	864	14.77
18.	Ghitorni	9,123	427	21.36
19.	Yahya Nagar**		822	
20.	Sultan Pur	11,336	286	39.64
21.	Tigri	44,895	105	427.57
22.	Deoli	1,19,432	1,012	118.02
23.	Pul Pehlad	47,336	216	219.15

Sl. No.	Name of the Area	Population, 2001	Area, 2001 (ha.)	Density (pph)
24.	Taj Pul	58,220	122	477.21
25.	Molar Band	39,267	412	95.31
Shahdara Development Block				
26.	Gokal Pur	90,564	232	390.36
27.	Babar Pur	43,364	79	548.91
28.	Jaffarabad	57,460	90	638.44
29.	Patpar Ganj	34,409	149	230.93

Source: Government of India (2001: 54-62).

Note: ** These Census Towns of 1991 have been declassified in 2001 and merged with Delhi Municipal Corporation (Urban). pph stands for persons per hectare

Planned high rise developments

Dwarka, Rohini and Narela in the southwest and west of Delhi have been planned to accommodate higher gross densities. Since the late 1970s, the Delhi Development Authority justifiably felt that Delhi has no more land to accommodate the exploding population, and maintains that densification can resolve the problem of scarcity of developed urban land. Dwarka is particularly important because it is planned to accommodate one million people on 5,645 hectares of land - a gross density of 177 persons per hectare. The DDA has cautiously decided that the private cooperative housing societies, various governments and other organizations, and the DDA itself will build housing in Dwarka in the form of high-rise apartments. As much as half of the net residential area will be developed by the cooperative group housing societies (Office of the Commissioner of Planning, 1992: 2). Most cooperative group housing is built as high as six to ten storeys. Plotted development would be negligible as only 38 hectare land is earmarked for residential plots.

Private sector development in the neighbouring states of Haryana and Uttar Pradesh have further reinforced the trend for increasing densities and high rise developments even beyond the administrative boundaries of the National Capital Territory of Delhi (NCT Delhi). Housing in Gurgoan in Haryana and Gaziabad in Uttar Pradesh is provided, largely by the private sector, in the form of 18 to 20 storey high-rise apartment blocks.

Illegal high rise developments

A new phenomenon of illegal high-rise development on legally allotted plots has recently been observed. Private builders have generated a great demand for residential plots between 165 and 420 square meters. What has happened is quite innovative. An agreement is struck between the owner of the plot and the builder to intensify the development on a plot where low-rise residential development generally already exists. Despite regulations limiting development to three and a half storeys high or 12.5 meters, builders construct up to four or more storeys. The plot owner does not pay any money to the builder. The builder gets one floor in exchange for constructing three to four floors for the owner. This process of illegal apartment building has generated additional dwelling units for the growing middle class of Delhi. This phenomenon is by no means sporadic, and can be found over all plotted development in Delhi.

Unplanned high rise urban villages

Delhi has 369 villages, 170 of which have been incorporated in the urban area (Curtis, 1998: 17). The total population of all urban villages is 600,000, with an area of 1,500 hectares. This makes the gross density of population 400 persons per hectare, which is closer to the higher densities found in Old Delhi rather than those of New Delhi. Villages have higher densities because no planning controls have ever been formulated and implemented in these areas. People have built as high as they could and use has been targeted at those activities, which were most profitable. Planned development was never more than ground plus one in the resettlement colonies, but over time these areas have also become on average a ground floor plus five storeys.

High rise flatted developments

Since local planning authorities have failed to provide adequate housing in Delhi, people have adopted their own ingenious intensification methods. As families expanded and split into separate households, most people living in flats have added one or two more rooms to their existing flats by covering whatever open spaces were provided in the front and rear of the apartment blocks. In the case of plot development, the majority of owners have exceeded the permitted two and a half-storey development within the given height of 12.5 meter. Those who violated these planning norms have built up to at least three and a half storey high. In the 1990s, the government set up a committee to investigate the matter and recommend appropriate changes in the building bylaws. Almost all members on the committee and its various subcommittees came from 'urban landed aristocracy'. Therefore it was not surprising when this committee accepted the violations without any penal action, and recommended others to build three and a half storey high. This committee, however, did not look into development in the New Delhi Municipal Council area, which primarily houses Lutyens' Bungalow Zone.

Low rise squatter settlements

There are 1,100 squatter settlements in Delhi, which are more or less evenly distributed over the city. Notable examples of squatter clusters are Katputli Colony in western Delhi, and the Kalkaji squatter settlement in southern Delhi. With increasing distance from the central area of the city, the number of squatter clusters significantly declines. All squatter settlements are characterized by low-rise development, as *jhuggies* and other precarious structures cannot be erected at more than a single storey. In spite of the fact that the population has large household sizes, densities are quite low. It was estimated that a total of 1,609,609 people lived in squatter settlements in 1997 on 74,800 hectares (Singh, 1999: 12) giving a gross density of 22 persons per hectare.

High rise slums

In 1989 the Delhi Municipal Corporation recognized 22 notified slums. They covered an area of 1,966 hectare and had a population of 1,800,000 giving a gross density of 900 persons per hectare, the highest anywhere in the city (Government of India, 1991: 234). These notified slums accommodated 21 percent of Delhi's total population. Another 5 percent population of Delhi lives in 1,100 small and large squatter clusters all over city. For example, West Zone of Delhi has 324 squatter clusters distributed over 16 wards. Some areas like ward number 26 has no squatter cluster while ward number 66 and 70 have the maximum number of 146 squatter clusters. After looking at the squatter atlas prepared by the NIUA, it was found that the lowest gross densities in west Delhi characterize squatter settlements. Most areas are dotted with single storey huts (National Institute of Urban Affairs, 1997). Delhi Cantonment and New Delhi Municipal Corporation have no notified slums.

Unplanned high rise developments on undeveloped land

As city expanded, rural areas were incorporated in the DMC area. But before the authorities could act, farmers sub-divided agricultural land into plots of varying sizes and sold them at cheaper rates to poor people. Since no development work was undertaken to provide on-site services, the lower prices attracted those who could not afford developed urban land. However, the process allowed for the provision of services such as water, sewerage, drainage, and solid waste collection at a later date when the development has already taken place. This process has proved a hindrance to the implementation of more compact development in the city.

The characteristics of the inverted compact city

From all this it is clear that Delhi is not a compact city; it has few pockets of high density and intense development. Urban Delhi is spread over an area

of 83,804 hectares and accommodates only 12,819,761 population (Government of India, 1991: 49). Its gross residential density comes to a little more than 187 persons per hectare, yet it still suffers from all the ills of urban sprawl including the wasteful use of energy, resources and time.

Travel characteristics

Delhi has 3,323,410 vehicles including 2,169,162 motorcycles and scooters (Government of the National Capital Territory of Delhi, 2000: 167), which is equal to the total number of vehicles found in Mumbai, Kolkata and Chennai. As vehicle ownership has increased, people have tended to live further away from the city centre and to make longer and more frequent trips, creating many problems.

To begin with, the average trip length in Delhi has increased over time. The average trip length, which was 5.4 km in 1970, had increased to 8.5 km in 1993 (Table 3). It has been noted that people wanting to travel from 'Delhi can take as much time from the airport to the central business district' as to fly from Delhi to Mumbai (D'Monte, 1999: 14). The problem is further compounded by the fact that average trip length by the public transport buses has more than doubled from 6.2 km in 1971-72 to 14 km in 1988-89 (Sahoo, 1995: 407). More than half the commuters who still use buses from home to work now make longer trips.

Table 3. Travel Characteristics of the Major Metropolitan Cities, 1993

Name of the City	Trip Length (Kilometers)	Travel Time (Minutes)	Travel Speed (Minutes/Kilometer)
Delhi	08.50	44.34	5.10
Mumbai (Bombay)	12.40	33.37	2.70
Chennai (Madras)	07.30	21.62	3.00
Bangalore	06.70	17.60	3.30

Source: National Steering Committee, India (1996: 48).

A large number and variety of vehicles as well as narrow roads have caused extreme congestion leading to long en-route delays. Average travel time in Delhi was 30 minutes in 1996 (Government of the National Capital Territory of Delhi, 2000: 177) but had increased to three quarters of an hour in 1993. Thus Delhi's commuters spent almost double the time on the road to travel a kilometre than in other mega cities. Furthermore, as a result of the increased number of vehicles and almost the same length of roads as in 1985, journey speeds have come down. The future is not very promising. It is expected that the average vehicle speed on the roads of Delhi will be reduced to 5 kilometres per hour in the next decade (Chakraborty, 1999: 1). This clearly suggests that average trip length and travel time must be reduced. Among the various options, one is to reduce the need to make longer trips, particularly for work. A compact city, with high density mixed land use, could certainly reduce the need to make longer trips.

Geographical size

Delhi has considerably grown both in terms of its geographical extent and population (see Table 4). Between 1951 and 2001, Delhi's area increased by more than three and half times while its population grew by nine times. As a result, densities have increased considerably. Urban Delhi's extremely low gross density of 73 persons per hectare in 1951 rose to 152 persons per hectare in 2001. While city's area increased more than three times between 1951 and 2001, the average trip length doubled between 1970 and 1993. This shows that there is a direct and positive relationship between the geographical area and the average trip length. The larger the geographical area, the longer the average trip length.

Table 4. Delhi's Urban Population, Area and Density, 1951-2001

Sl. No.	Year	Population	Area (in ha)	Density (pph)
1	1951	1,437,134	19,600	73.32
2	1961	2,359,408	32,600	72.37
3	1971	3,647,023	44,600	81.77
4	1981	5,770,000	59,200	97.47
5	1991	8,471,625	68,534	123.61
6	2001	12,819,761	83,804	152.97

Source: Government of India (2001: 15). Note: pph stands for persons per hectare

Furthermore, as the geographical area of Delhi has increased, it has also led to ever longer networks of physical infrastructure and greater wastage of precious resources such as water and power. The current rates of wastage of water and power seriously challenge the sustainability of Delhi. For example, power transmission losses in Delhi rose to an unprecedented 50.2 percent in January 1996. These far exceeded the 7 percent maximum transmission losses permitted by the Central Electricity Authority for intra-city distribution (Raj, 1996: 1).

The difficulty of saving energy is one outcome of urban sprawl over a large geographical area. Energy savings may have been negligible in the case of cities in the developed world; but these savings could be substantial in the cities of developing countries if existing trip lengths were shortened. If a majority of the trips in Delhi could be restricted to planning divisions, the average trip length could be reduced from the existing 8.5 kilometre to 5 kilometre. This would result in the reduction of average travel time from 45 minutes to 25 minutes.

Energy consumption by containment

Vehicular traffic is the largest energy consumer in the metropolis. In order to use energy efficiently, the DDA has advocated a policy of containment at the planning division level. 'Thus the Plan's objective ... has been to provide efficient land use and transportation relationships so as to effectuate containment within the divisions, in order to reduce work and education trips by vehicular modes' (Government of India, 1990: 146).

To achieve the goal of containment at the planning division level, the DDA divided Delhi into 15 planning divisions. Urban Delhi was divided into eight and Rural Delhi into seven planning divisions (National Institute of Urban Affairs, 1994: 1.31). While the policy makers wanted to create multi-nodal city organized around commercial district centres as major employment areas, the DDA has not implemented many of these important projects. Out of 15 proposed commercial district centres, only three have been completed so far. This has led to more passenger and vehicular trips from other divisions to those which have commercial district centres. Similarly, the policy of dispersal of offices, which generate a large number of inter-division trips, has failed to take off.

After 30 years of dithering, the Ministry of Surface Transport of the Government of India has started the construction work on the first phase of a rapid mass transit system. The Metro will serve a good part of Delhi in 2005. This will be a good starting point for an efficient public transport system. The government expects that mass rapid transit system will help to reduce the energy consumed by vehicles, because it will consume only 10 percent of that consumed by individual transport modes. While national and state governments officially stress the significance of public transport to save energy, and thereby reduce harmful emissions, their actions seem to achieve exactly the opposite. One recent example has been the doubling of bus fares by the state government after a 30 percent increase in diesel prices by the central government. The issue of energy savings is therefore much complex than just reducing the number of vehicles on the roads and minimizing trip lengths. It must also include efficient transport technologies and fuel pricing policies.

Not a matter of preference

In the cities of most of the developing countries, including India, the issue is not whether people want to live in houses constructed on plots or in apartments. The issue rather is that people want to live in a house at an affordable cost, no matter whether it is a detached or semi-detached house, or an apartment in a high-rise residential block. India or for that matter Delhi, is no different. According to the National Building Organization, urban India alone had a massive housing shortage of 9.6 million dwelling units in 1991 (quoted in Visaria, 1999: 280). Likewise, Delhi has a housing shortage of 300,000 dwelling units, which means 1.5 million people do not have a house to live in (Government of India, 1990: 5; Central Statistical Organization, 1998: 180). Others have calculated the housing shortage in Delhi at 825,000 dwelling units in 1997 (Gupta, 1995: 211). In this situation it is obvious that people would be likely to move to any kind of dwelling unit.

Most of the flatted development constructed and offered by the DDA is fully occupied. Even these properties command a high price. As developed land in Delhi has become increasingly scarce, the private sector has provided a large number of high-rise apartments for the middle classes in and around Delhi. Entire blocks of apartments are sold out even before construction is completed. Clearly in Delhi's housing market there is a segment of the population that prefers high-rise housing because the alternative is no housing at all.

Quality of life

Few could dispute that the quality of life needs to be improved in the cities of developing countries. In Delhi, the significant quality of life issues include pollution levels in terms of number of accidents on the roads, and safety levels in terms of crime. Delhi is the fourth most polluted city in the world. Most recent estimates reveal that 'at current air pollution levels, one person dies every hour in Delhi because of respiratory and other pollution related diseases' (Narain, 1999: 9; World Health Organization and the United Nations Environment Programme, 1992: 99-106). The primary reason for respiratory diseases is the pollution created by vehicle emissions (Kathuria, 2001). Therefore, every possible step should be taken to reduce this unacceptable pollution. The reduction in the need to travel or the reduction in the need to make longer trips in the city, would greatly contribute to lowering emissions and thus pollution levels.

Delhi has also become one of the most unsafe cities in Asia. The number of crimes and the crime rates have gone up considerably. A total of 61,613 crimes were reported in 1995. This number increased to 70,074 in 1998, an increase of 12 percent (Commissioner of Police, Delhi, 1999: 232-233; also see Sharma, 1998: 3). One reason is that the proportionally smaller number of police officers who have to police a larger area and population reduces their effectiveness in combating and controlling crime.

It is clear that quality of life could hardly get worse than that experienced by the residents of the slums and squatter settlements of Delhi and other cities in the developing countries. The dignity of these people has been stolen in a context of floating human and animal excreta in open drains that contaminate drinking water, and piles of solid wastes breeding flies that cause death and disease. If the effort is made, the quality of life can only improve. Therefore, the central quality of life issue is that of the provision of housing and physical and social infrastructure. The quality of goods and services is a secondary issue at the moment.

Conclusions: some guidelines for the future

This paper has argued that Urban Delhi is an inverted compact city. A policy of 'decentralized concentration' was pursued by the DDA half-heartedly and led to no major gains. But many policy initiatives can be taken to contain urban sprawl and to bring compaction to the city of Delhi.

First, it should be accepted that the compact city planning approach is not merely about attaining high population densities and high intensity de-

velopment. It is also about attaining higher quality of life for its present and future residents. Alexander Maller calls it *structured accidentalness*: 'a congested, liveable urban environment' (Maller, 1999: 131). This is significant because unplanned settlements like slums, can also achieve higher densities and intensities of development, but could merely lead to undesirable congestion. To make compact city policy operative, high-rise private sector development could be permitted only in planned residential areas. This could lead to the intensification of the existing built form as desired for the compact city. But it could be done only to a certain extent, because existing networks, particularly of physical infrastructure, would not be able to support a population beyond a certain limit.

Second, the focus of the compact city planning approach in developing countries will have to be firmly on the urban poor as they are the single largest group and their have been largely neglected. In order to be successful in providing housing and the most basic services to the urban poor, the compact city will have to pass the test of being affordable before being sustainable. Third, the policy of containment at the planning division level should be vigorously pursued and all the commercial district centres should be completed within the next five years. This could greatly curtail the length of journey trips, particularly work, shopping and education trips. But this policy can be realized only if the government was able to attract the large sums of private investment needed for the construction of commercial district centres. Fourth, the Delhi Development Authority should continue with the policy of multi-storey group housing schemes for the future, and private group housing societies should be encouraged to construct more residential developments like sub-city Dwarka.

The case of Delhi, with its low-density centre and denser periphery, is unusual. Nevertheless, the attempts to plan its intensification and deal with its problems may give some pointers to other cities in developing countries.

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Metropolitan delta landscapes

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Introduction

Throughout history, the fertile river deltas have been the most favourable regions for human life. Many of them are strongly urbanised and have developed into metropolitan deltas. In this paper we will compare the metropolitan delta of North-western Europe to others and we will briefly discuss the main spatial planning problems that are at stake.

Metropolitan deltas as specific form of urbanisation

The great metropolitan areas are the centres in which in the 21st century global competition is taking place. The process of global urbanisation will increase, especially in low income countries, that in 1995 contain about 60% of the global population (Ingram, 1997). At this moment there are 20 metropolises with a population of more than 10 million people. If the developing world will follow the urbanisation process that has occurred in Europe and North and South America, it is expected that by 2030 nearly two-thirds of the world's population will be urban (The Economist, 2002).

Throughout history metropolitan areas have developed around centres of government. However, in Europe and South and East Asia due to the presence of large river deltas another type of metropolis can be distinguished, the *Metropolitan Delta*. A metropolitan delta can be defined as the delta of a big river with a large conurbation, sometimes functioning as a port for its hinterland. Urbanisation, industry, infrastructure development, intensive agriculture, nature conservation and water management are struggling for space.

The emergence of these metropolitan areas has been mainly concentrated along great rivers that have formed major transport arteries to the hinterland since time immemorial. In this way it was possible for these societies to transport large loads resulting in larger urban development around these transit ports in the late Middle Ages. In the rest of the Old World the camel was still the main mode of transport and loads of around 150 kilograms were transhipped in the caravanserais, which themselves grew into small trading centres at intersections in the caravan routes. Where even the camel could not gain access people (mainly women) carried small loads from village to village and transhipment locations had no relevance whatsoever. In China and Europe, however, the transit ports became the metropolises, which in one hand were in contact with the rest of the world by sea and on the other hand connecting the hinterland by the river system. On the American continent the European model of metropolitan development was copied following the colonisation of the Dutch, the French and the British (McNeill, 1987).

The Northwest European Metropolitan Delta

The North West European Metropolitan Delta is a poly-nuclear or network metropolis that is developing in the triangle between Lille, Amsterdam and the Ruhr area. It is a new, large, hybrid urban pattern of urban concentration areas, suburban zones and open spaces (Wijermans & van Mansfeld, 2000).

The Northwest European Metropolitan Delta is the area between Lille (France), Amsterdam (The Netherlands) and Cologne (Germany) as shown on this map (figure 1) derived from the Structuurschets Benelux, a common report on spatial planning by the governments of Belgium, The Netherlands and Luxemburg (Van den Broeck et al., 1996).

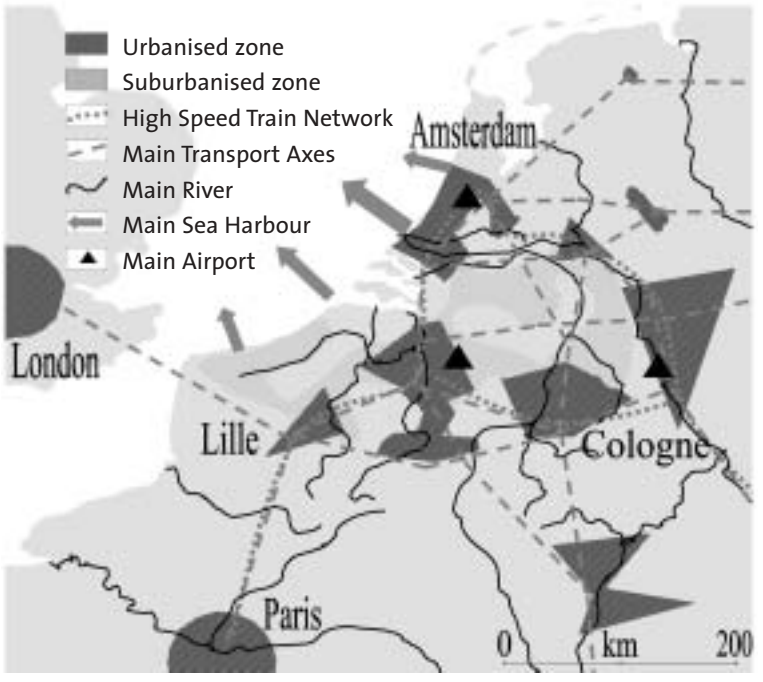

Figure 1: The Northwest European Metropolitan Delta

Although it has its roots in the delta of the river Rhine, since the mid 19th century the ongoing urbanisation is based at least partially on rail and road infrastructure in addition to waterways. These bundles of infrastructure are the backbone of so called corridors in which the North-western European development process is supposed to take place (Verkennis & Groenewegen, 1997). And even though, according to these two authors, the corridor concept

should not be used in retrospective, the metaphor nevertheless offers a perfect description of the development of the small, medium and large sized Dutch cities, from the trade network of the Hanseatic cities onto the development of the Randstad in the last century.

Delta metropolis quantified

In the study of Van Steekelenburg (2001) urbanised areas with a radius of 100 and 300 kilometres were compared worldwide on population density. In this study the North West European Metropolitan Delta climbs to the global top 25 of urban regions, illustrating its highly urbanised identity at the subcontinental level of scale.

Van Susteren (2003) compared the Dutch part of the North-western European Metropolitan Delta (the so called *Randstad Holland*) with 75 other conurbations in the world. The scope of this study, however, was a 30 km radius. The selection of conurbations for this study has been derived from three global rankings. First the world's 25 largest river deltas, as defined by the Times Atlas of the Oceans, have been selected upon their drainage area, which represents the catchment area of the river delta. Secondly the world's 25 largest cities, as defined by the Times Atlas of the World, have been selected upon their number of inhabitants, which represents the world's most urban areas. Thirdly the world's 25 largest air-, sea-, and telecom ports, as defined by IATA, MARAD and Telegeography, have been selected on their performance within the global trade networks, representing the world's largest ports. As a result of this study 15 of the 25 global river deltas could be discriminated as urban deltas. These 15 urban deltas are illustrated in figure 2. As indexes are often used in order to compare relative characteristics, the quantification has been elaborated to the *Deltamet-index*. This index compares the world's top 15 of urban deltas ranked by the quotient of the population density and the total drainage area of the delta. It can be concluded that the Randstad conurbation in the Netherlands can be considered as one

Figure 2: The 15 largest urban deltas of the world.

of the most densely populated river mouths of the 15 studied urban deltas (table 1). Also three compositions of contemporary urban deltas could be distinguished: (i) *Urban deltas* that are heavily urbanised but have no connection (jet) with the global trade network via air-, sea-, or telecom ports (i.e. Dakha, Karachi). (ii) *Delta ports* that are hardly urbanised but have a very important (based on their ranking) connection with the global trade network via air- ,sea-, or telecom ports (i.e. Anchorage, New Orleans) and (iii) *urban delta ports* that are heavily urbanised and have very important (based on their ranking) connections with the global trade network via air-, sea-, or telecom ports (i.e. *Randstad Holland*, Hongkong).

In order to determine the relevance of these delta ports within the global networks Van Susteren developed the *Mainport-index*. This index is based on the combined position in cargo-traffic, air-traffic and ICT-backbone. When the relative position in these characteristics is used in the algorithm, the top 5 of this MainPort-index is Los Angeles, Randstad, London, New York, and San Francisco. When absolute values of cargo-traffic, air traffic and ICT backbone are being used the top 5 is New York, London, Singapore, Los Angeles and Randstad.

Table 1 DeltaCities

Nr.	Riverdelta drainage area (millions km2)		Deltacity at rivermouth Population (millions)		Deltamet-Index (inh/km2)	Ranking*					
						A	B	C	D	E	F
1	Mississippi	3.2	New Orleans	1.0	0.3	-	7	-	-	-	-
2	Nile	2.9	Cairo	10.8	3.7	17	-	-	-	-	-
3	Rio de la Plata	2.7	Buenos Aires	12.4	4.6	10	-	-	-	-	-
4	Niger	2.1	Lagos	13.4	6.4	7	-	-	-	-	-
5	Yangtze	2.0	Shanghai	14.2	7.1	12	8	-	-	-	-
6	Volga	1.4	St. Petersburg	5.9	4.2	-	-	-	-	-	-
7	Ganges	1.1	Calcutta	12.9	11.7	9	-	-	-	-	-
8	Yukon	0.9	Anchorage	0.3	0.3	-	-	-	-	7	-
9	Mekong	0.8	Ho Chi Minh	5.1	6.4	-	-	-	-	-	-
10	Indus	0.6	Karachi	11.7	29.5	13	-	-	-	-	-
11	Irrawaddy	0.6	Rangoon	4.7	7.8	-	-	-	-	-	-
12	Pearl	0.5	Hong Kong	5.5	11.0	-	5	-	22	2	16
13	Brahmaputra	0.4	Dakha	10.9	27.3	15	-	-	-	-	-
14	Fraser	0.2	Vancouver	1.5	7.5	-	-	-	-	-	-
15	Rhine	0.2	Deltametropolis	6.4	32.0	-	2	25	10	15	3
16	Sacramento	0.1**	San Fransisco-B.A.	5.8		-	12	-	9	22	5

***Ranking: A:Megacity B:Worldport C:Air movements D: Air passengers E: Air cargo F. ICT-port**
****other source used (Water Resources eAtlas of IUCN, IWMI, WRI and the Ramsar Convention on Wetlands)**

Planning problems in metropolitan deltas

Metropolitan deltas have similar problems as all big metropolises in the world through time such as poverty, traffic congestion, environmental problems, struggle for space and urban sprawl. Within the specific delta-composition they distinguish themselves by three additional problems: ongoing intensification and extensification of agriculture, complex water management, and last but not least its high biodiversity under threat. Together with urban sprawl, these specific problems of metropolitan deltas occur mainly in what in the Dutch spatial planning jargon is referred to as the green space. Green space means rural areas that in former days encircled the cities and still are present, fragmented and surrounded by the heavily urbanised space of the metropolitan delta. De Geyter et al. (2002) refer to these former rural areas as the negative space. This is because the maps that these authors draw of the negative space are literally the negative of the combined maps of the build environment and the infrastructure, that together make up the positive or planned space. So this denomination also indicates the difference in planning intensity of these areas compared to the urban areas. The negative space can be considered as an integral part of the metropolitan delta because it determines important qualities of the delta as a whole, as will be discussed below.

Agriculture in metropolitan deltas

There is a common misunderstanding that the pioneering role that a country as the Netherlands has played in the development of modern agriculture is linked to the rural areas. In fact it is linked to the urban areas. Historical descriptions even refer to the agro-industrial complex as one of the fundamental pre-conditions of the origin of the urbanised society (Wallerstein, 1980). Within the Northwest European Delta Metropolis there is no question of a marginalization of agriculture (Bethe et al., 1997). Development is taking place rapidly in two directions: intensification and increase of scale, on the one hand, and the development of a pluri-activity agriculture on the other (Van Eck et al., 2002b).

The main strategy can be characterised as intensification and scale increase, spurred by an increase in land prices and leading to a knowledge-intensive, highly specialized and spatially concentrated agricultural sector delivering high-quality products (Rabbinge et al., 1996). Two forms can be distinguished. In or close to the urban concentrations, the metropolitan delta at-

tracts footloose agricultural activities such as greenhouses and intensive pig and poultry production (Van Eck et al., 2002a). At some distance of the urban concentrations the agriculture is more land dependent: dairy farming or the specialised production of vegetables, seeds, bulbs etc (Van Eck et al., 1997). The metropolitan delta offers a combination of locational advantages that are determining the ongoing development of this food production chains into global networks such as (i) high levels of knowledge amongst entrepreneurs and management in agriculture itself and amongst people and firms on their periphery (financial and veterinary services, equipment, maintenance etc.), (ii) good infrastructure and logistics, (iii) direct access to huge nearby markets in the form of many (critical) consumers, (iv) a large pool of cheap labour, (v) a large supply of ancillary and by-products for waste processing and chain management, and (vi) main port function to import fodder and export goods.

The other strategy consists of the development of pluri-activity by the original landowners, combining traditional agricultural with activities that offer a supplement to their income by providing all kinds of services in demand in the rural areas. These services can take many different forms: nature management, landscape management, recreation, care services, regional products, local products sold on site etc. But there are also other options such as a second job completely separate from the running of the agrarian enterprise. A number of beautifully illustrated books cover many of these possibilities (Van Broekhuizen et al., 1997). However the economic impact and the long-term economic sustainability of these forms of pluri-activity tend to be over estimated (Smeets, 2002).

Water management in metropolitan deltas

A variety of water management related problems have always played a very important role in the metropolitan deltas. The levels of surface water in rivers and sea will rise as a consequence of climatic change and are increasing the risks of large-scale flooding within the delta area, especially in the areas below sea level. Elsewhere, especially on the sandy soils, groundwater quantity is decreasing and its quality is threatened. There is consequently a need for an integrated and well-thought design of multifunctional land use in water catchment areas. The importance of water management aspects in spatial planning is expected to increase in metropolitan deltas (Kamphuis et al., 1996; Kwakernaak et al., 1998; Ministerie van VROM, 2001). Moreover, in the case of the Northwest European Metropolitan Delta that stretches across the boundaries of the Netherlands, Belgium, France and Germany this integral approach needs to be transnational. International authorities will have to be set up, based around river basins, to regulate the water systems in order to reduce the threat of flooding but also to promote the economic functions of water, namely transport, drinking water and water for industrial purposes (Ministerie V&W, 2000).

Nature conservation in metropolitan deltas

The natural variety of river deltas is the basis for relative high species richness in its natural ecosystems. Before land reallotment, use of fertilisers and draining, traditional agriculture added to the landscape variety and species richness in general. This explains the fact that in a country as the Netherlands, only covering a small part of the area of Europe a great amount of habitat types in Europe can be found. But in modern times industrialisation of agriculture, together with urbanisation, both important characteristics of the development of metropolitan deltas, have become important threats for biodiversity.

Species conservation and habitat preservation has become an important international issue embedded in international law. Increasingly, nature and landscape management will become integrated into the spatial planning process. Conservation policy now traverses frontiers in a PAN-European approach that attempts to link nature areas and habitats, to prevent the ex-

tinction of species and stimulate their dispersal (Bischoff & Jongman, 1993). The general attitude towards nature conservation is changing from a defensive to an offensive one: economy and ecology are now becoming interlinked. The conservation of semi-natural (small-scale agricultural) landscapes is now considered to be the concern of all land users in the rural areas, not exclusively of the farmers and nature conservation bodies alone. The management of the rural landscape and its intrinsic natural values has also become the concern of water boards, volunteer groups and specialized landscape managers.

Conclusion: Planning of metropolitan deltas needs an integrated approach.

Metropolitan deltas belong to the most important nodes of the global network economy. The Northwest European Metropolitan Delta is the biggest urban concentration in Europe. Important developments concerning the metropolis as a whole (i.e. urban sprawl, intensification of agriculture, nature conservation and water management) are dominant in the urban fringe. The traditional distinction between urban and rural areas is no longer adequate when these characteristic development problems of metropolitan deltas are considered. And these developments show a strong mutual relation. They all compete for limited space and at the same time are part of each others preconditions. The metropolis stimulates development of agriculture that threatens biodiversity that the metropolis wants to preserve. Intensive agriculture demands water management measures that are conflicting with the needs of nature conservation or with measures aiming at preventing flooding. It follows that in the planning process of metropolitan deltas an integrated approach is needed that not only combines traditional urban and rural planning. It has to address the interconnected sectoral problems of urbanisation, water management, and agricultural development etc. at the same time. Other contributions in this book demonstrate the perspectives of such a transdisciplinary approach in landscape research as described by Tress & Tress (2001).

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Impact of land use change in Bangkok Metropolitan and Suburban Areas

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Introduction

Bangkok is one of the fast growing Asian Metropolises and has a daytime population of about 8 million people. The registered population is about 6.5 million in 1.5 million households on the 1,508 square-km area. Bangkok is obviously one of the mega cities. Most industries were concentrated in the Bangkok Metropolitan Region (BMR), where geographical and institutional conditions were most favorable. As cities expand, prime agricultural land and habitats such as forests and water basins were transformed into land for housing, roads, and industry. High economic growth and increased employment opportunities cause substantial influx of labour immigration. The suburbanization has increased with 52% of urban population in 1990, increased to 61% in 1995 and predicted to reach 82% in 2020 (Office of Environmental Policy and Planning, 2002). The changes of land use affected social, economic and ecological conditions. The Bangkok Metropolitan Region is furthermore a large producer of agricultural products, although the share in total output is declining. The explosive growth of Bangkok in the past few decades followed the economic growth of the country. The private activities on real estate and land development had over taken the necessary coordination of the planning officials and the public land acquisition capability of the public administration. The uncoordinated, space squandering character of the housing projects and solely the market forces, which the public authorities seem to be defending the so-called "Public Interest", had driven various forms of land development.

Urbanization of Bangkok

Land use in Bangkok Metropolitan Region has been classified into three zones, the inner city which the main concentration area for government offices, commercial activities, educational establishments, historical conservation areas and living quarters. The urban fringe is the new central business district accommodating outward increase in the numbers of business and commercial activities. Presently, the key government operations and businesses and commercial activities are concentrated in these inner city bounds and it continues to the major employment areas. Intensification of economic activities and continued demand for centrally located sites is the main reason for rise in land price in these locations.

Suburban is the outer part of Bangkok link to the inner city by radial roads northwards and southwards to Nonthburi and Samut Prakarn, eastwards and westwards to Chachoengsao and Nakhon Patthom. Approximately 25% of these suburban areas has been classified as residential areas, a ratio is likely to increase given the continued rise in land prices in the inner city are as well as the deterioration in urban pollution which are the main discouraging factors for middle to upper income level groups to live in the inner city areas. The remaining 75% of the land are utilized for manufacturing and commercial activities while large parts of the land remain under agricultural area. The outward expansion of economic activities together

with the economic and environmental factors is likely to intensify land use in these fringe areas. Though linked with the inner city by expressways and arterial roads, of adequate distributor roads and access roads and leaching development of urban amenities are said to be the prevalent problems of these areas.

Land use change of Bangkok Metropolitan Region and Suburban

In the Bangkok Metropolitan Area, the residential and agricultural areas were decreased (see table 1). The highest increase of the residential and industrial areas have the provinces Nonthaburi and Pathum Thani; the agricultural areas in both provinces were decreased.

Table 1: Percentage of Major Land Use Change during 1980-2001.

Province	% Residential		% Industrial		% Agricultural	
	1980	2001	1980	2001	1980	2001
Bangkok	30.7	22.0	0.1	1.6	54.4	33.0
Nonthaburi	10.0	18.0	0.1	0.9	85.0	70.0
Pathumthani	1.2	17.0	0.2	2.0	90.0	73.0
Samut Prakhan	7.2	8.0	1.5	9.0	80.6	61.0
Samut Sakorn	5.9	6.4	0.2	2.5	70.0	71.0
Nakon Pathom	5.6	9.0	0.1	0.7	92.0	83.0

Source: Land Development Department

Land use related problems of urbanization

The damages in terms spatial forms from the above urban development process are evident in the present land use of BMR, i.e., insufficient road ratio, unsystematic road networks, numerous blind land parcels and an overall low efficiency in pattern of land use. The intensive competition demands that developers build in comprehensive services such as water supply, electricity, garbage collection services, security guards, etc., as part of their marketing strategies. While there are comprehensive services within private housing projects, there have been inadequate efforts in linking up these private housing projects with the broader road networks or to link up with local existing urban systems to which "new communities" are superimposed. A large scale influx of new residents often create an overnight demand for public facilities creating bottlenecks in supply of amenities, waste water and solid-waste facilities. Excessive construction onto only causes pilfering of top soil is observed to be causing damaging results from inundation but construction of these real estate projects often involved filling up natural waterways and canals and altering the former drainage systems causing flooding problems.

In short, urbanization as a result of rapid economic development has many externalities that are reflected in the poor quality of life, congestion of living space, air and noise pollution, problems of transportation and inadequacies of urban services. With the lack of tradition for cost sharing of public utilities and amenities, the burden for provision of these services relied solely on public sector spending.

One major area of concern over un-controlled expansion of urban areas is the loss of agricultural land. Between 1974 and 1984, it has been estimated that urbanization of the metropolitan area resulted in an average loss of 32 square-km per year and between 1984-1989, it has been estimated that an average of 28.80 square-km (Suksawong & Morishita, 2000) per year of agricultural land has been converted to golf courses and residential housing projects. Large scale transfer of prime agricultural land in Nonthburi province has been converted to real estate areas during the economic boom period and the province has become, in effect, the dormitory town for middle to upper income groups, the majority of whom represent the day-time resident of Bangkok Samut Prakarn, agricultural land has been converted into industrial and residential areas. Similarly, in Samut Sakhon: small-scale factories, mini-factories and industrial estates. Not much change in land use has been ob-

served in the case of Nakhon Pathom during the economic boom period since a large area of land has already been converted to industrial areas, commercial and residential areas.

Inefficiency of urban land use is manifested in conflicting patterns of land-use. With weak enforcement of land use plans, it is not uncommon to find mixture of varying types of land use. Along the Pathum Thani's provincial highways for example, industrial factories are located amidst residential areas typically along side the arterial roads. Built up areas follow the transport corridors and areas of emerging economic activities such as the corridor to the designated industrial nucleus in the Eastern Region, the upper Central Region.

Urban sprawls and mushrooming of dormitory towns generally result in increases in average travelling distance, daily travelling hours and travelling expenses. Urbanites have been auto-dependent and energy-intensive society. Such changes not only incur private costs which are absorbed by the households, but they affect the real economic sectors pushing up unit cost of production from various forms of incremental costs mentioned.

Environmental problems from land use change

The problems of urban environment and suburban are due to population growth, economic growth and inefficient management system (Pairoj-Boriboon & Chongprasith, 2003).

Air pollution

Air pollution is one of the most obvious and important environmental problems of BMR, regional cities, and large urban communities which one currently developing and expanding by industrialization and transportation. The Pollution Control Department (PCD) points out that in Bangkok, ambient levels of lead have been reduced significantly, dropping sharply since the phase-out of leaded gasoline that began in May 1991. In addition, sulfur dioxide, nitrogen dioxide, and carbon monoxide level remain steady or have declined slightly, despite significant increases in the vehicular population. This is a result in part from fleet modernization, enforcement of emission standards, reduced traffic congestion, and improvement in fuel quality.

Two other factors have contributed to the improvement of air quality in Bangkok. The installation of catalytic converters, at first only in new vehicles, eventually on all vehicles, has helped to reduce carbon dioxide emissions and to attain standard levels by the year 2000. In addition, to strict enforcement of air pollution regulations, a campaign has been conducted to reduce particulate smaller than 10 microns by requiring construction sites and construction vehicles to be covered and through the phasing out of motorcycles using two-stroke engines.

Noise pollution

Noise pollution is still a continuing problem in many cities in Thailand, especially Bangkok Metropolitan Administration. The major sources of noise are from vehicles, which generate traffic noise. Noise standards were established in 1997; Environmental Noise Standard as a 24-hour average shall not exceed 70 decibel (dBA). The maximum ambient noise level shall not exceed 115 dBA.

As the traffic has been the major cause of noise pollution, the areas adjacent to main roads in Bangkok indicated noise levels exceeding the Standard of 70 dBA on every single day, and was higher than 80 dBA in many areas posing a potential of hearing loss and mental disorder to those who have long term exposure. The 24 hour average noise level in the areas adjacent to minor roads was between 60.4 and 78.4 dBA, with 20% of the measurements exceeded the standard limit. Governmental and academic places in Bangkok had 10% of all measurements exceeded the Environmental Noise Standard, and the average was in the range of 64.4 to 75.8 and 52.1 to 87.7 dBA respectively.

Noise levels monitored in other provinces exceeded the General Ambient

Standard around 40% of time, and the average ranged from 50.6 to 81.4 dBA. It was found that noise levels in the areas of governmental facilities, academic and residential places were lower than that in Bangkok. Regional governmental offices showed no effect from noise pollution. The noise level in academic institutes was between 55.0 and 74.8 dBA, with 95% of time within the standard, except Na Phralan Area in Saraburi Province which is near a highway junction of heavy trucks.

Solid waste

Solid waste quantity from communities in BMR increases 24% from 2001 to 2002. BMA hired a private company collected the solid waste from BMR and transfer to the landfill or dump site. Problems from a lack of solid waste disposal land and opposition from the public has intensified every year.

Water pollution

The water quality of the lower Chao Phraya river (km 0-62) from the river mouth in Smut Prakarn to Amphoe Muang Nonthaburi, the water quality was in deteriorated state. Sources of pollution in the lower Chao Phraya River originate mainly from domestic waste, and the lower Chao Phraya flows through higher density urban areas.

Pollution control management

The government has announced a clear policy to "expedite the prevention and remedy of pollution problems in water, air, noise, toxic and solid waste, by using the pollution pay principle." Current pollution problems which can result in direct and indirect impacts to the public health, are receiving major priority and interest from the general public, particularly, the private sector, which fully cooperates in solving the problems. Pollution control management from the past to the present has been improved and revised in terms of personnel, low, budget, setting up organizations and promotional measures in various areas, to meet changing world conditions, which include pollution problems. Waste utilization, one measure to solve this problem, is to reduce and make beneficial use of the waste. There were more reports in the reductions and recycling of waste in terms of research, and public campaigns to disseminate know how and business operation.

Wastewater Management Authority

It has been known about water quality in the Chao Phraya River. Clear water now turns into fouled water. Presently, waste quality is becoming increasingly more deteriorated, particularly in the lower Chao Phraya or in the BMR area. Who will be responsible for the protection, correction and revitalization of the water quality in the Chao Phraya River and return it to the good condition like in the past, the Wastewater Management Authority WMA) was established, as a state owned enterprise. The duty of the WMA is to provide wastewater management service, beginning with the lower Chao Phraya river basin, because it has the most critical wastewater problem. To carry out this duty, suitable wastewater treatment technology will be utilized, including the introduction of a waste management method to make it economical. Another important operating plan is to allow full public participation in WMA (Jarupongsakul & Yoshihiro, 2000).

Utilization of Waste

During the past ten years, there have been many initiatives introduced to make better use of municipal, industrial and agricultural wastes. For instance, recyclable materials trade, markets for recyclable material, waste-for-eggs scheme, waste donation scheme, organic waste for composting, liquid fertilizer production, good smell waste and handicraft from left over materials.

The Root of Thai Environmental Law

At the United Nation Conference on the Human Environment on 5-16

June 1972 in Stockholm, Sweden, 1,200 representatives from 113 countries around the world united for the first time to discuss and find solutions for the environmental crisis by founding the United Nations Environment Programme (UNEP). Governments world-wide, including Thailand, took immediate legislative and administrative actions. In Thailand, the Enhancement and Conservation of National Environmental Quality Act B.E. 2518 (NIQA B.E. 2518 (1975)) was enacted and the Office of the National Environmental Board was founded in the same year.

The NIQA B.E. 2518 (1975) was amended twice, in 1978 and 1979, to include the following details: 1) to appoint the National Environmental Board and the Office of the National Environmental Board as government bodies in charge of management of the environment; 2) to set environment quality standards; 3) to state that, for certain project of activities, environmental impact assessment (EIA) is compulsory; and 4) to assign the Prime Minister to be in command during emergencies so as to prevent or mitigate anticipated environmental impact and/or damage.

Conclusions

Urban development in the future will have to recognize the need of public participation right from the policy formulation and planning stages. The planning authorities should understand and accept their limitations and start to empower the local people. Top down planning and large centralized project doesn't lend them to public participation. Public hearing and public negotiation is not public participation. It has to be an integrated public policy. Project framed with this new approach will be sustainable and permanent, as they will ensure constant stakeholder involvement's.

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Approaches to plan and manage metropolitan landscapes

Overconsultation breeds contempt: Lessons in participatory watershed planning from the Lake Pontchartrain Basin of Louisiana, USA

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Introduction

Though the watershed-scale management philosophy is espoused by the United States (US) Environmental Protection Agency (EPA), this type of holistic management is difficult to enact in the decentralised political structure of the USA. Political jurisdictions under a decentralised system are small – on the scale of counties or parishes – and are usually sub-watershed rather than supra-watershed. To further complicate matters, no fewer than 22 government agencies in the USA share responsibility for water and watershed management (National Research Council Committee on Watershed Management 1999). With so many jurisdictions and agencies, there are many barriers to joint management. Even simply sharing data is difficult.

The people of the Lake Pontchartrain Basin, in Southern Louisiana, have been engaged in dialogue about the reparation of their ecosystem for the past 40 years. It has been man-made development that has caused most of the problems – building canals, levees, bridges, houses and infrastructure to control the environment – and this same culture of construction permeates the restoration efforts. Restoration is further hampered by the dependence of the Louisiana economy on the oil, construction and shipping industries, that are responsible for much of the wetland destruction and vulnerable to it. Political and cultural sensitivity is required in order to make changes in these inhabited ecosystems. The agencies working in the Basin have been successful at attracting government funding but the restoration efforts have fallen prey to fragmentation of intent. Cooperation has not been required due to the amount of funding supplied – there has been no need to stretch dollars. Research, in particular, has not been feeding into any decision-making framework, and parallel efforts have been arising between universities, government and non-government agencies.

A restoration task on the scale of the Pontchartrain Basin, like those of the Chesapeake Bay or the Everglades, requires an over-arching structure to coordinate the individual research and restoration efforts. Otherwise, the true power of interdisciplinary and transdisciplinary collaboration eludes the process. With a fragmented approach, there is a duplication of effort, especially in expensive establishment tasks. As an example of this inefficiency, three different geographic information systems (GIS) databases of spatial layers and monitoring projects on the Basin have been compiled within the space of two years (Johnston et al., 2002; Sherren et al., 2002; Cothren et al., 2001) and a fourth is being planned (Conner ,1999). High level project coordination is essential to ensure that: a) The research that is funded through the program fits back into a 'hole' in the knowledge base, and b) The information gleaned from public participation is available to all projects, rather than each sub-project undertaking their own consultation campaign.

The management funding of the Chesapeake Bay Program, run out of the National Oceanic and Atmospheric Administration, is US$2.75 million dollars a year (Chesapeake Bay Program, 1997); a similar investment in the Louisiana coast is recommended, and a similar management mandate is required.

It is now popularly accepted that public participation is necessary in planning processes, and all sides of negotiation processes are aware of how to be involved. However, these processes threaten to cause fatigue amongst the participants due to the frequency with which they are consulted, and the minimal effect they seem to have. Public participation seems to be considered a panacea for the confrontational resource management environments of the past, rather than a source of valuable insight. Overconsultation creates among participants a cynicism of both the process and the organisers. They must wonder "We've already been through this; why don't these government departments / academics / politicians talk to each other?" Consultation must be carefully managed and focused or else managers will appear to be crying wolf, and to have little respect for the time of the participants.

It is also somewhat unfair to continue to ask the public for solutions merely because the only ones managers can think of are too expensive financially or politically. In the case of the loss of barrier islands and wetlands that protect from storm surges, this is a rare case where the ecological problem also puts lives at risk. There really is no solution to the ecological and economic problems in the basin that can allow business as usual, but the political cost of making the decision to 'abandon ship' and relocate inhabitants would be devastating. The impression could be formed by an observer that the constant studies are merely an expensive stalling measure.

This paper aspires to inform about the history of restoration and public consultation in the Basin and suggest alternative methods for managing the funds available for maximum benefit to decision-making. An introduction to the Basin will be presented, including its environmental challenges, its way of life, and the agencies active in restoring it. A survey of past and present restoration efforts will be made, with more detailed discussion given of recent public participation sessions. Lastly, recommendations will be made regarding framework structures that could be adopted to guide restoration in the Basin.

The set

The Lake Pontchartrain Basin is an urban estuary whose tributaries and distributaries (excluding the tidal effects of the Pearl River, which forms the border with Mississippi State) cover all or part of 5 counties in Mississippi state and 17 parishes in Louisiana (see figure 1). Though it is called a lake, Pontchartrain is open to the Gulf of Mexico via the Rigolets Pass, and is the middle in a chain of three linked shallow bays that lie along the margin of the deltaic plain. The Mississippi River, which drains half the landmass of the United States (roughly 200,000 km^2), and some of Canada, passes within 15 kilometers of all the lakes. Due to the flood-control levees flanking the river, however, its only interaction with the Pontchartrain Basin (until its terminus) is at the Bonnet Carré Spillway and the Caernarvon freshwater diversion. Otherwise, its watershed is completely separate.

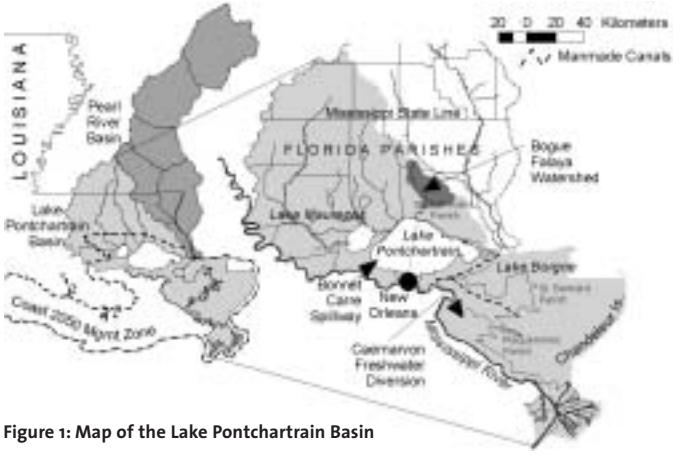

Figure 1: Map of the Lake Pontchartrain Basin

In this paper, the watershed is considered to be comprised of four major zones: a) the city of Greater New Orleans; b) the Florida Parishes to the north, c) the marginal deltaic plain Lakes themselves (Maurepas, Pontchartrain and Borgne), and d) the barrier islands, sounds and wetlands to the south, referred to here as the Delta. Each of these zones present different challenges.

New Orleans is a city claimed from swamp. In 1699, the Choctaw Indians showed the French the shortcut channel they used to to avoid navigating the dangerous, meandering route of the River delta. This navigable channel, now called Bayou St. John, ran through the wetlands from Lake Pontchartrain to within a four kilometer portage of the Mississippi River, and quickly became a popular shipping route. The townsite was established in the gap between the shortcut and the River and eventually grew to fill the marshy area lying between the River and the Lake. Over time, both water bodies were leveed to protect the town from river flooding and from storm surges entering the Lake from the Gulf. The swamps were drained for construction, and an extensive network of canals and pumps were established to remove rainwater from the town. As the levees denied the town the sedimentary nourishment usually supplied by floods, the sediments beneath the town began to settle. Today the town sits in a bowl – at most points lower than the water level of both lake and river – putting additional strain on the floodwater pumps as they have to pump uphill (see figure 2). Greater New Orleans, now a city of about a million people, is clearly vulnerable to floods and storm surges. In addition, both shores of the River between New Orleans and Baton Rouge (the state capital) are lined with oil refineries and experiencing urban sprawl, making the potential risk even greater.

In 1956, a twin-span bridge was built across the centre of the Lake from New Orleans to the Florida Parishes that are located on the Upland Pleistocene Terraces to the north. The bridge made St. Tammany Parish a commutable distance from the city and, combined with high crime rates in metropolitan New Orleans, resulted in many of the wealthy moving there to live

(Beall et al., 2001). The area was ill-prepared for the growth, with little sewage infrastructure and no zoning plans in place (Sherren et al. 2002). The unchecked urban expansion in the area is one of the major challenges faced by the Basin, and has resulted in poor water quality in the tributaries of the lakes due to nutrients, metals and fecal coliforms. Swimming is restricted in the Lake itself, and fishing is restricted on some of its tributaries (Louisiana Department of Health and Hospitals, 1997).

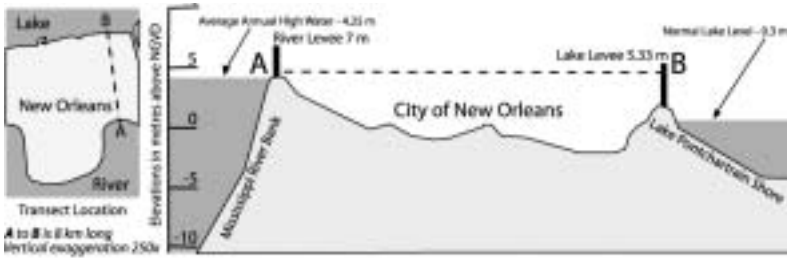

Figure 2: Profile of New Orleans from Lake Pontchartrain to Mississippi River
(adapted from New Orleans US Army Corps of Engineers).

In the lakes, the freshwater systems of the north merge with the saline waters of the south. Man-made channels such as the Mississippi River Gulf Outlet (MRGO) and the Inner Harbour Navigation Canal (INHC) have increased the infiltration of sea water to the lakes and the brackish marshes. After the great flood of 1927, a spillway was constructed leading from the River to Lake Pontchartrain. The Bonnet Carré Spillway was opened in 1937 but has only been opened approximately once every decade since then (Addison, 1999). In addition to flood control, the spillway does aid in returning fresh water to the system. The Lake was dredged for shells to use as fill material, a practice that seriously affected the turbidity of the water, but this practice was halted in 1990. Still, submerged aquatic vegetation (SAV) has declined over 50% due to nutrient increases in the lake, armoring of the

shore, hurricanes and changes in salinity. This loss of fish and shellfish nursery and shoreline stabilising vegetation affects both the environment and the economy (Penland et al., 2002).

South of New Orleans, as the Mississippi enters the Gulf of Mexico, you enter the deltaic plain consisting of wetlands, delta lobes and back-barrier sounds protected by the barrier islands such as the Chandeleur chain (Penland et al., 2001). The levees around the River prohibit sediment recharge to this area, causing the marshes to subside and be reclaimed by the Gulf. The Caernarvon freshwater diversion was constructed to remedy the loss of sediment and freshwater to the system. The most common oil and gas exploration methods in the area involve substantial dredging to clear boat access for core samples to be taken. Breaking up the marsh in this manner increases the edge exposed to the wave action of the Gulf and of passing boats, exacerbating the problem. Increased salinity also causes habitat changes; freshwater marsh and cypress swamp are replaced by brackish and saltwater marsh. The imported South American nutria, thriving in the area, also erode the stability of the marsh by eating the root systems. The net loss of the coastal wetlands and barrier islands leaves the inhabited areas unprotected from large storm surges off the gulf. Coastal wetlands are disappearing at a rate of roughly a hectare per hour, or between 65 and 90 km^2 every year (Conner, 1999).

The players

The actors in this landscape drama are an ensemble cast, including agencies (both government and citizen-run) and industry.

The Industry

The industry of southern Louisiana is inexorably linked to its ecosystems. Primary industries reign, as does the subsequent shipping industry accessing the Mississippi via the port of New Orleans. The oil industry in the coastal zone produces US$37.4 billion dollars a year, including 21% of the nation's annual natural gas output (Conner, 1999). In the drained land that does exist, there is farming of citrus and pecans and some sugar cane, but fishing, shrimping and oyster-farming pay the wages of most residents of the rural areas in the basin. Trapping rights for alligators and nutria are licensed and fill in the gaps during off seasons. Louisiana is the primary producer of oysters in America and most of those come from the oyster beds in Plaquemines Parish (T. Mitchell in Gros, 2003). Oyster-beds are very susceptible to changes in salinity, and freshwater diversions from the Mississippi River, designed to return freshwater and sediments to the marshes in that area, have initiated a very litigious environment of compensation to the established oyster farmers in the area.

The agencies

The restoration of the Basin has involved a number of agencies, both government and non-governmental, and has achieved some real successes on the ground (Penland and Maygarden, 2002). The following is an introduction to some of the groups that have been involved, the acronyms for which will be encountered elsewhere in the paper. More detail on these and other organisations can be found in Sherren et al. (2002).

The Coalition to Restore Coastal Louisiana (CRCL) is a non-profit organization that has been a driving force behind the government adoption of many recent wetland protection measures. They have also been influential in publicizing water quality issues in the Basin, such as industrial groundwater extraction and wastewater pollution. Primarily, however, it is the Louisiana Department of Natural Resources (LDNR) and the United States Army Corps of Engineers (USACE) that control restoration projects in the coastal wetlands of Louisiana.

The EPA and their state-based colleagues, the Louisiana Department of Environmental Quality (LDEQ), are responsible for maintaining the quality

of water resources in the Basin and disseminating funds for research and restoration by universities and community groups. The Louisiana Department of Health and Hospitals (LDHH) performs many monitoring programs, and is responsible for declaring boil-water and shellfish advisories in the Basin.

The Lake Pontchartrain Basin Foundation (LPBF) was founded in 1989, funded by the EPA, in response to the need for a concentrated effort to restore the estuarine system as stated in the document 'To Restore Lake Pontchartrain' (Houck, Wagner and Elstrott, 1989). This high-profile group has increased public awareness of the water quality problems in the Lake, and has been successful at attracting funding for restoration projects. Another citizen group, Citizens for a Clean Tangipahoa (CFACT), made real progress, resulting in the Tangipahoa river being the only of the Lake's tributaries to have experienced improved water quality in the past 20 years following their involvement in the LDEQ's Nonpoint Source Pollution program.

The dialogue

Many scientific studies have looked at the problems facing the Basin (Kenwood et al., 1996) and a conference series on the topic called 'Basics of the Basin' is held bi-annually at the University of New Orleans. Despite 'trial and error' management, the studies *have* improved the science and helped to identify the types of projects that are likely to work.

Overview of past and ongoing restoration efforts

In 1995, the LPBF released a Comprehensive Management Plan (CMP) for the Basin, developed under funding by the EPA. Its contributors exhaustively and systematically catalogued the threats to the Basin by sewage, agricultural and urban runoff, saltwater intrusion and wetlands loss. That process began in 1991 with meetings of experts and invited members of the public, and concluded with recommended action items. The CMP report listed a number of recommendations to solve the cumulative impacts on the Lake's water quality, specifically involving sewage and agricultural runoff, stormwater runoff, saltwater intrusion, and wetland loss (Lake Pontchartrain Basin Foundation, 1995).

These recommendations have served as a 'road map' for the LPBF over the past 5 years, with some of the smaller-scale listed items being addressed or implemented (Lake Pontchartrain Basin Foundation, 1995). Education programs have addressed urban runoff, wetland loss and water quality in the Lake for both adults and students. On-the-ground habitat restoration projects have tackled submersed aquatic vegetation (SAV), shoreline stability, and stormwater treatment using wetlands. The LPBF has also been a part of the development of several wastewater management plans and infrastructure improvement plans, the construction of livestock waste lagoons, and weekly water quality monitoring (Penland et al., 2001). These are real tangible improvements but without a real management mandate, the LPBF is limited to this scale of success, despite a close relationship with the Regional Planning Council (RPC).

The EPA Total Maximum Daily Load (TMDL) process sets targets for the allowable amount of a pollutant that a water body can receive without impairment. Though the Basin has the largest number of impaired streams of any basin in Louisiana (55 out of 83 are impaired, most for multiple pollutants), they are not scheduled for completion until 2006. This delay in addressing the problem is a result of the severity of the issue and the lack of data available, and is an indicator of how difficult the task will be (Hindrichs, 2001).

Section 404 of the Clean Water Act is designed to regulate the discharge of dredged and fill material into waters of the United States. Activities that are regulated under this program include fills for development, water resource management (i.e. dams and levees), infrastructure (highways and airports), and conversion of wetlands to uplands for farming and forestry. Under this section, the USACE and the EPA jointly administer a wetland permitting program including general (less significant effects) and individual permits. Only

the individual permitting process includes a public notice and hearing process. It is debatable whether this process is protecting the wetlands in the Basin from aggressive development, as the permits do not appear to be adequately scrutinised.

The Coastal Wetland Planning, Protection and Restoration Act (CWPPRA) (also called the Breaux Act, signed in 1990) supports and funds coastal wetlands restoration projects in Louisiana. It is a joint federal and state initiative. The CWPPRA program, operating under a 'no net loss' philosophy where any dredging material must be used to create new land elsewhere, has succeeded in creating approximately 5500 hectares of wetland since 1994 (United States Geological Service National Wetlands Research Centre, 2003) roughly covering a square area measuring 7.5 km on each side. Methods used include beneficial use of dredged materials, sand mining for deposit on barrier islands, and vegetation planting. This is an expensive approach to the problem, considering the rate of loss.

Coast 2050 is a joint effort of CWPPRA, the CRCL and the Louisiana State Wetlands Conservation and Restoration Authority (1998). It is a strategic plan for coastal Louisiana developed in 1998 after a series of 65 public meetings throughout coastal Louisiana, and has the cooperation of many local, parish, and state agencies. Efforts are currently underway to develop the first projects for implementation, one of which is the LCA, discussed later in this paper.

The US Army Corps of Engineers manages the CWPPRA funding, and is determined that the solution lies in more construction. Notwithstanding that the existing levels of urbanisation, economic infrastructure and human interference to natural ecological flows are clearly responsible for the problem. Using the Corps approach, the Coast2050 program predicts the real cost of restoring the coastal wetlands in Louisiana will be US$468 billion over the next 30 years (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998), and success is still not guaranteed.

Case in point: Piecewise watershed analysis

Having given a survey of past and continuing projects, what follows is a more detailed account of an individual project, demonstrating how piecemeal endeavours can fail to address the entirety of the problem due to the lack of a management mandate or framework. Additional details on the work can be found in Sherren et al. (2002) and Sherren and Forsyth Maygarden (2002).

In 2000, the EPA funded a watershed management project to be administered by the LPBF. The contract was given to the Coastal Research Laboratory (CRL) at the University of New Orleans' Department of Geology and Geophysics. The laboratory has a well-established relationship with the LPBF, and is one of several interdisciplinary research laboratories at UNO working in the Pontchartrain Basin. The CRL is a self-sufficient research and consultancy group that depends on 'soft money' due to the academic funding model of the University. The CRL project team was comprised of several research associates working in isolation, discouraged from collaborating with other departments or universities to form a larger process as that would involve a sharing of the funds. The goal of the project was twofold: 1) To revisit the management planning process by taking advantage of modern technological advances, and 2) To use a holistic watershed philosophy rather than focusing on individual dischargers or water bodies. However, there was no real management mandate, an absence that – coupled with the exclusivity of the process – was a great handicap to the achievement of the project.

In September and October of 2000, meetings were held in four regional areas of the basin facilitated by Lee Wilson and Associates (LWA). Participation was by invitation only, though the net was cast much wider than the academic community alone. Summaries of the concerns voiced at those meetings were developed by LWA and the CRL to serve as the foundation of the new watershed-wide management plan. The problems were found to be region specific, but provided no new information for those working on the project. However, the sessions produced many good sources of information for the

monitoring project database produced later.

The project team developed a set of criteria in-house to prioritise the critical issues in the Basin from minutes of the public meetings. The most pressing concerns were determined to be, 1) storm surge protection and drainage control, 2) bacterial contamination due to high fecal coliform counts, 3) wetland loss, 4) high nutrient levels and resulting hypoxic zones, and 5) metal levels in water. As many agencies were tackling the wetland loss/land subsidence problem, it was decided that initial investigations would be into water quality concerns. Water quality standards were compared to available monitoring data to establish the status quo of a case study system, the Bogue Falaya. Results indicated that the concern regarding fecal coliforms and nutrients were well founded, whereas metals were no longer a major concern in this area (though sample frequency for metals was low and more sampling may have yielded different results) (Sherren et al., 2002).

The intent was to perform a build-out analysis with the Soil Water Assessment Tool (SWAT). The effect on water quality of development plans for the area, generated by the project team and also by the New Directions 2025 process, would be tested using the SWAT model. The council and the LPBF both suspected that it was the lack of zoning controls, sewage facilities, or regulation and education regarding the construction and maintenance of personal septic systems that was the source of the fecal coliform problem, but they desired scientific proof. However, modelling is rarely as useful for determining the cause of a problem as on-the-ground surveys. Data on septic system locations and package plant effluent conditions have to exist in order for that detail to be incorporated to a model, and no such information exists for the Florida Parishes. The EPA funding ran out following the current state calibration of the SWAT model. The calibrated model was supplied as a final deliverable of the project but either the skill set or interest did not exist for the build-out scenarios to be run. This experience seems typical of small projects working in isolation of a larger framework.

The next act

In 2002, the Pontchartrain Restoration Act (first signed in 2000) received a commitment from the US Congress of $20 million dollars a year for the restoration of the Basin. Administered by the Lake Pontchartrain Basin Foundation, the monies were split into two pots: $3 million went to the LPBF for the construction of on-the-ground restoration projects, and $17 million went to academia to fund further scientific research. The universities already working in the area were asked to decide between themselves how the money would be disseminated. There was no higher process established to which the research teams would be answerable. Several University of New Orleans departments, including Geology and Geophysics, Biological Science and Computer Science, formed the Pontchartrain Institute for Environmental Studies (PIES), as an internal body to receive and disseminate funds from the PRA. Though a great boost to academia, the money may not have the impact it could have if there was a single management mandate or a governing collaborative framework. The American Congress has delayed the release of the PRA funds due to the expense of the Iraq war effort, and this temporary shortage of funds has improved the level of collaboration within PIES.

This year, the Coast2050 program has undertaken a new two year study, the Louisiana Coastal Area or LCA (the full name is Louisiana Ecosystem Restoration – Comprehensive Coastwide Ecosystem Restoration Feasibility Study). Once again, the Corps is at the helm, and a very extensive public participation campaign is planned. The first set of four meetings were held in February 2003 in towns all along the Lousiana Coast, with more planned throughout the project duration. Transcripts of a meeting held in Belle Chasse, during that first round, indicate that the public is interested, passionate, yet sceptical of another process (Gros, 2003).

Recommendations

Watershed management projects should spend some of their funding on

an overhead structure to guide restoration efforts. This structure can reside in a government agency, but the office location should not define the methods. If the custodianship of a project is given to the beavers, all you'll get for your money is dams: avoiding this singular focus requires a strong committee with an openness to all ideas. To make best use of the funds, you also need a common environment for the inputs from committee expertise, research, and public meetings to reside during the quest for management decisions. The difficulty of managing contentious and oft-studied areas is finding a way of integrating information into a common model or framework for decision-making purposes, not a lack of information itself. Business models such as multi-criteria analysis or Bayesian decision networks may be flexible enough for these purposes, and are able to be integrated into existing adaptive management frameworks. Such pragmatic models can also help to prioritise the funding of new research. Finally, a real mandate for change must exist. This requires the involvement of industry as well as the public. In many cases, it is balancing economic and environmental agendas that is the largest hurdle.

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Modelling approaches for metropolitan landscapes

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Introduction

Before humans with all their technical opportunities started to affect the earth's surface, natural ecosystems dominated the pristine landscape. Natural processes such as ice movement, flooding, erosion and sedimentation shaped these untouched landscapes. Over the past millennium, these conditions have increasingly changed by a growing population in order to improve the safety of life and the production of food and goods. Natural disasters have been controlled by technical solutions. Dikes protected houses, wetlands were reclaimed for agricultural production, erosion was prevented and an organised rural landscape with its profits arose. This landscape has a mix of cultural and natural functions and purely agricultural, semi-natural and natural ecosystems were present. Total biodiversity was even higher than in the original untouched landscape. Especially over the past century, human population could grow exponentially due to innovations in health care, chemistry and agriculture. This resulted in the growth of cities, especially in areas close to water such as wetlands, rivers and deltas. In these urbanising regions some natural ecosystems were left but land use was mainly agricultural to support the expanding human population.

This brings us to the present point of development at many locations in Western Europe. Suburbs and satellite towns arose, including a network of roads towards the city centres. Companies and industry show a tendency to move out of the city centres towards accessible locations along the main transportation axes between the cities. These tendencies turned the surrounding rural landscape into metropolitan landscapes. Nowadays people living in busy cities wish to relax and recreate in green and healthy environments. They started to value the cultural landscapes and natural ecosystems surrounding the cities. They urge their local, regional and national governments to protect what is left of these areas after the autonomous expansion of urban infrastructure. However, these governments are also held responsible for providing adequate housing and transportation facilities and conditions for economic development. To regulate this increasing pressure on use of the available land, spatial planning for these metropolitan landscapes must be directed to a sustainable mix of socio-economic developments and ecological and cultural needs.

However, simultaneously taking into account economic, social and ecological needs in spatial planning is a tedious task, due to the vast amount of knowledge to be incorporated on spatial-temporal land use developments from the different sectoral fields, the difficulties associated with integrating different sectoral knowledge and the difficulties in communicating scientific expert knowledge to spatial planners.

Models may help in this complex task. They combine scientific theory and data in a precise and rigorous way and may serve as an integrated and explicit set of hypotheses of how the system works. This contribution presents an overview of developments in modelling urbanised landscapes over the past two decades and a look ahead to the developments expected for the coming years. We will illustrate this by using examples from our own work carried out in the Netherlands which is primarily focused on landscape ecological modelling.

Basic elements: modelling of sectoral relations

The simplest model describing a landscape attribute is a map with physical conditions, such as soil types or elevation classes showing the main differences in a region. Modelling of hydrology is a next step in describing spatial aspects of physical and chemical conditions in the landscape. Through flow of surface water and groundwater, matter and energy are transported from one place in the landscape to another. The basic laws followed by the flow of water are derived from the law of gravity and the principle of continuity. Gravity induces water flow from higher elevations to lower elevations or, in the case of groundwater, from high groundwater pressure to low groundwater pressure (figure 1). The velocity of the flow is determined by differences in elevation or water pressure and the resistance to flow in river

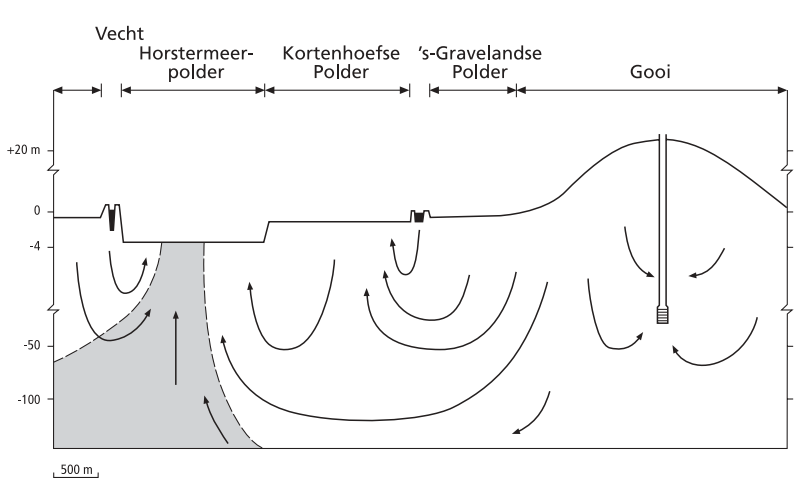

Figure 1: Example of the output of a sectoral model concerning hydrology (after Schot, 1991; Wassen et al., 1996).

channels and groundwater aquifers. The concept of the hydrological cycle implies that the amount of water on earth stays constant and a water drop over time just moves through different storages of water, such as water vapour, clouds, precipitation, surface water, groundwater, ice and seawater. Water balance approaches may be used to determine the amounts of water stored in each compartment at a certain place at a certain time during this dynamic process. In addition to modelling water flow and quantities stored in the different compartments over space and time, water quality aspects may be added. This might include the transport of dissolved solids, mixing of different water types, dissolution and precipitation of minerals, adsorption and desorption, etc.

Ecosystem modelling integrates the physical conditions in the region, such as soil, hydrology and chemistry, with the development of the vegetation or fauna. A wide range of models is possible: prescriptive versus descriptive, mechanistic versus correlative, spatial versus non-spatial, etc. Each of these categories has specific purposes, advantages and drawbacks. In most cases knowledge of spatial relations on a landscape scale is a bottleneck for modelling ecosystems in a landscape ecological context. At the same time these relations are of utmost importance. For wetlands spatial relations via flow of groundwater and surface water are important. In the present generation of hydro-ecological models such as DEMNAT (Witte at al., 1993), ICHORS (Barendregt et al., 1993) and MOVE (Latour & Reiling, 1993) these relations are not incorporated. For an overview we refer to Olde Venterink & Wassen (1997). Especially for animals the spatial arrangement of the suitable ecosystems is important: animals need a minimum area for the populations to survive (in relation to food quantity, territories, etc). The spatial matrix of the areas where the species can live is in that way important, especially in fragmented landscapes. Here the meta-population theory is to be applied in modelling attempts (Hanski & Gilpin, 1996; Vos et al., 2001).

Integration of sectoral spatial models

In the early 1980's, Dutch citizens called for a halt to the deterioration and disappearance of nature and ecosystems. Governments at all levels got the task to find solutions in complex disputes about conservation and restoration of nature, in such a way that other functions are not frustrated. The main question was therefore to optimise land use in such a way that a certain area could fulfil the demands of several users. In the scoping process for optimising multi-functional land use integration of different sectoral models in a spatial explicit way appeared to be very helpful. We will illustrate this integration of sectoral spatial models with three examples: (1) the combination of agriculture, water management and nature restoration in the Dommel river basin, (2) drinking water abstraction and nature restoration in the coastal dunes, and (3) economical development, recreation and agriculture in the Vecht river plain.

Land use in the catchment of the river Dommel

Up to the 1950's, brook valleys in the catchment of the river Dommel (in the Netherlands and Belgium; 1350 km^2) were famous for their meandering streams and marshy grasslands. Large-scale anthropogenic activities have left only a few patches of these ecosystems scattered in a matrix of intensely used agricultural grounds. Other reasons for decline were groundwater abstraction, eutrophication and improvement of the discharge of surface water. Restoration scenarios have been formulated in close co-operation with regional policy actors, including e.g. reduction of groundwater abstractions, finishing effluent discharges of waste water and restoring natural stream properties (Verkroost et al., 1998).

Hydrological modelling was performed with MODFLOW and STREAMPLAN generating output such as average groundwater levels, stream flow velocities and saprobic state. These models were coupled to a GIS, facilitating the connection with the ecological decision tree models ALNION and

ECOSTREAM (Olde Venterink et al., 2001; Pieterse et al., 2002). The results from these modelling exercises were used to evaluate the ecological consequences of several future land use and water management scenarios. At the same time the costs of the scenarios were calculated (Kwakernaak et al., 1999).

The final cost-benefit analysis of the scenarios showed for instance that the ecological gain is not per se proportional to the abiotic change. They also showed that some restoration measures have only local impacts whereas others have a regional impact. Most important the models showed explicitly that politicians or nature managers have to choose for certain nature targets which they would like to restore, since it is not realistic to assume that certain changes in land use or water management are beneficial for a range of wetland ecosystems.

Drinking water abstraction in the coastal dunes

The abstraction of groundwater from the dunes in the Netherlands solved the huge health problem of drinking water contaminated with bacteria and viruses in the 19th century. In these dune areas rain water naturally infiltrated in sandy soils and pathogens were killed during their underground stay, making it a good alternative to the use of abstracting drinking water from polluted canals and lakes. The abstraction increased and since the middle of the 20th century it appeared that the health profits also raised a problem since the large-scale abstractions used the entire natural supply with precipitation water and consequently the water tables in the dunes fell down for meters. This resulted in intrusion of salty sea water and dessication of characteristic wet dune slacks. This problem was partly solved by the infiltration of river water in the dune area and by the pumping of deeper groundwater. Infiltration of river water however led to eutrophication of the nutrient-poor slack ecosystems and moreover the water tables did not recover to the former level.

At the beginning of the 1990's, an integrated hydrological model was developed for the area belonging to the Water works of Amsterdam (50 km^2), since the importance of the wet dune slack ecosystems was recognised (nowadays confirmed by the Habitat Directive of the EU). Three dimensional modelling of the hydrology was performed and the consequences of abstractions for the local phreatic levels in the dune slacks could be predicted (Olsthoorn, 1995; Olsthoorn & Kamps, 1998). A spatial evaluation of the consequences for local water tables and the ecological consequences was performed with a relatively simple expert judgement model. The evaluation of a dozen future development scenarios learned that some re-allocation scenarios guaranteed the production of a given quantity of drinking water while dune slack ecosystems were not suffering anymore from dessication (Geelen et al., 1995; Geelen, 2001).

This integrated research learned us that reallocated drinking water abstraction and nature restoration can be combined. The sophisticated hydrological model and the simple ecological model were in combination a helpful tool for defining a sustainable future for drinking water production and ecosystem restoration. Still improvement of especially the ecological model is needed to take away a number of uncertainties. A specific benefit of this case was that with assistance of the models decisions were taken and practical measures were realized for stimulation of the ecological value of the dune slacks.

Ecological - economical evaluation of wetland management in the Vecht river plain

The Vecht river plain, located between the cities of Amsterdam and Utrecht, comprises an area of some 150 km^2. The entire river plain consists of polders, areas in which water levels are artificially controlled by means of ditches and by discharge of excess water through pumping. Roughly half of the river plain is used for dairy farming while the remaining part consists of lakes and wetland nature reserves. The nature reserves are of international im-

portance owing to the presence of fens and bird species. During recent decades, however, a marked decline in species numbers and occurrences have been observed.

Hydro-ecological analyses and modelling clarified the causes of these changes (Barendregt et al., 1992; 1993; Schot et al., 1988; 1991; Wassen et al., 1989; Witmer, 1989). Most wetlands are supplied by groundwater seepage at one end, which originates from a sandy ridge bordering the river plain. The seepage water flows through the wetland and subsequently infiltrates at the other end as a result of low water levels in adjacent agricultural polders. The spatial patterns in vegetation composition in the wetlands are found to be closely related to the flow and quality of groundwater and surface water.

The next challenge was to define options for restoration in such a way that the regional economical setting was taken into account (Turner et al., 2000). Since nature is a non-monetary value we have chosen to merge an ecological and an economic study into a scenario study. The scenarios included the present condition and the stimulation of agriculture, nature or recreation in the whole of the river plain divided into 60 sub-regions. Integrated spatial modelling with stimulation of a specific type of land use explicitly made visible the consequences for other functions via chemical and hydrological changes. At the same time the economic modelling of the same scenarios was performed (including feed backs to chemistry), enabling us to compare and evaluate the results of both lines (Figure 2).

This study (van den Berg et al., in press) showed the benefits of a truly economic-ecological integrated approach, starting from the definition of the scenarios, followed by a (connected) spatial modelling of hydrology in groundwater flow, surface water chemistry and ecological responses (van Horssen et al., 1999) and a spatial modelling of the 60 defined sub-regions according to the economic development (van den Bergh et al., 2001; Turner et al., 2003).

An important problem to be solved was the evaluation of the final results of both ways of modelling. The net present value of the region from the economical modelling could be expressed in Euros (compared to present land use, stimulation of agriculture adds 175 million; stimulation of nature costs 225 million; stimulation of recreation adds 1900 million). The ecological evaluation needed performance indicators for processes, structure and resilience in a spatially explicit way. The final evaluation was performed in the software package DEFINITE (Janssen & van Herwijnen, 1994), indicating that the optimal land use change should be sought in stimulation of recreation (van den Berg et al., in press)

Figure 2: Scheme with the integrated economic-ecological research in three steps: the definition of the special scenarios for all aspects, the integrated modelling itself, and the evaluation of the final results
(source: van den Bergh et al., 2001).

Integration of models for regions

The three examples above show that the combination of different (spatial, sectoral) models was realised in such a way that they could be applied together for clarifying the consequences of changes in land use or water management on several functions. However, still the modelling approach is sec-

toral which implies that the models are developed separately first and coupled later in a GIS. This implies that for instance feed backs between hydrological, economic and ecological processes are largely ignored. Also the search for optimal solutions is hindered by this approach. Scenario studies only allow for evaluating a limited number of future options.

Land use change models: functions taken into account

Although the integration of sectoral spatial models had successful applications, the socio-economic processes which are the driving forces of land use change were not explicitly included in the previous models. What was lacking was an integration of socio-economic and landscape ecological models. Land use and land cover change models explicitly consider the drivers of socio-economic change and their effect on land use. Models of land use change are tools to support the analysis of the causes and consequences of changes in order to better understand the functioning of the land use system and to support land use planning and policy (Veldkamp & Lambin, 2001; Verburg et al., in press). These models are useful for disentangling the complex suite of socio-economic and biophysical forces that influence the rate and spatial pattern of land use change and for estimating the impacts of changes in land use. Furthermore, models can support the exploration of future land use changes under different scenario conditions. Summarising, land use models are useful and reproducible tools, supplementing our existing mental capabilities to analyse land use change and to make more informed decisions (Constanza & Ruth, 1998).

Numerous land use models are available, developed from different disciplinary backgrounds, such as statistical and econometric models, spatial interaction models, optimisation models and integrated models (Briassoulis, 2000). Examples from the Netherlands are the Environment Explorer (de Nijs et al., 2001) and the 'Ruimtescanner' (Scholten et al., 2001). The purpose of these models is to simulate the effect of policy options on the future land use and the quality of environment. Output is given by maps showing the distribution of different types of land use for certain points in time. The next subsection will present a more detailed description.

The Environment Explorer

The Environment Explorer (LOV, LeefOmgevingsVerkenner) is a spatial, dynamic model in which social, economic and ecological activities and land uses are modelled in an integrated way (de Nijs et al., 2001). Its primary goal is to explore policy alternatives in relation to the quality of the environment in which the Dutch citizens live, work and recreate. It integrates the results of both autonomous and policy developments and evaluates them on the basis of social, economic and ecological criteria.

The LOV uses cellular automata techniques to simulate spatial processes. The driving forces behind these spatial processes are economic and demographic developments based on national growth figures for agriculture, industry, trade, services, recreation and population. The model works with grid cells of 500 by 500 meter resolution. In total 16 land use functions are discerned, e.g. agriculture, industry, housing for living, nature, water, recreation. The Netherlands are thus represented as a mosaic of hundred of thousands of squares together displaying patterns in land use (figure 3). The transition of a grid cell from one land use type to the other is based on the supply and demand of land at a certain moment in time. The attractiveness for an actor to occupy the cell in the next time step is a function of the physical suitability and the accessibility for the desired function. The opportunity to actually occupy the cell is determined by the ruling policy concerning restrictions with respect to land use functions.

Figure 3: Example of a land-use map (resolution 500 m) for the Netherlands from the Environment Explorer
(source: Nijs et al., 2001)

Visualisations for communication: from science to policy

In the foregoing sections it was shown that models may be used to simulate processes that affect the landscape. These models may be either sectoral and stand-alone, i.e. simulating only hydrology or ecology, or more integrated when different sectoral models are coupled or explicitly integrated like land use change models. To take into account the outcome of these models to achieve sustainable urbanised landscapes, the results need to be communicated to spatial planners. As they are non-experts in the different scientific fields involved, ways must be found to get across the main and essential information from the models. Maps are useful for this purpose as they graphically display the model results in a geographic sense which intuitively appeals to most people, especially planners. As such, maps function as a common language or *geographic esperanto* between different disciplines. In this way a number of barriers may be avoided which exist between the different disciplines as a result of different theoretical concepts, research objects, methods, etc.

The rise of Geographic Information Systems (GIS) from the early 1980's facilitated the integration of knowledge from different disciplines affecting landscapes. Databases which contain geographical references (x,y-coordinates) of the variables could be explored rapidly using GIS to display visually in maps the spatial distribution of the variables (e.g. Burrough & McDonnell, 1998). Standard functionalities like overlaying and buffering helped to delineate areas with actual or potential conflicts or converge. By comparing maps from different periods in time insight is obtained in the temporal changes in spatial patterns. By using animations and 'fly-through' techniques even more appealing ways of communicating information on spatial-temporal landscape developments are provided by modern GIS.

Contemporary developments in GIS and Geo-ICT are in the area of Planning Support Systems (PSS), defined as a range of computer-based methods and models into an integrated system that can support the planning function (Harris, 1989). They bring together the functionalities of GIS, models and visualisation, to gather, structure, analyse and communicate information in planning. They differ from GIS in the sense that GIS can be regarded as general-purpose systems for the handling of geo-referenced data, while PSS are specifically focussed on the task of application (Geertman & Stillwell, 2003). This implies handling of non-spatial data as well as the modelling, design and analysis of dynamic spatial data and information. As such, PSS take the form of a Spatial Decision Support System. PSS will pay particular attention to long-range and strategic issues and may be designed explicitly to facilitate group interaction and discussion, while SDSS are generally designed to support shorter-term policy-making by isolated individuals and by business organisations).

Future outlook: recent developments

Over the coming decade in the area of modelling urbanised landscapes we will witness the rise of Multi Agent Models (MAM) or Multi-Agent Simu-

lation (MAS). An agent may be viewed as an "object" that possesses a degree of autonomy and of cognitive ability (Doran, 2002). An agent is a system that tries to fulfil a set of goals in a complex dynamic environment. Examples of agents may be citizens, animals, military, actors in a policy process, etc., which respond to attributes of their environment (e.g. Ligtenberg et al., 2001; Batty et al., 2003; Parker et al., 2003). Multi-agent systems can be defined as a set of agents inter-acting in a common environment, able to modify themselves and their environment (Ferrand, 1996). In active-walker models, agents change the landscape on which they walk and the landscape changes the agents in that it directs them where to walk (Batty, in press).

One innovating aspect of multi-agent simulation is that agents from different sectors (e.g. farmers, tourists or fauna) may interact and effects from one sector on the others may be evaluated. In this way modelling of different socio-economic and natural systems will definitely become more integrated. Another innovating aspect is that the dynamic behaviour of agents will be implicitly taking into account in the models. Dynamics are no longer deduced from comparison of maps of equilibrium states at certain points in time, but these maps will now depict the state of systems at certain points in time of ongoing dynamic processes. Finally, multi-agent models will change the way we look at spatial-temporal patterns, from a top-down approach in which we see macro-scale patterns which we try to explain by using knowledge about processes at the micro-level, to a bottom-up approach in which we simulate processes at the micro-level in a dynamic way and then watch the macro-scale patterns that emerge from this.

Another development which will gain increasing attention is prescriptive modelling. This allows a step from traditional descriptive modelling, used to analyse spatial-temporal developments in the past and projecting the trends deduced to simulate future developments, to prescriptive modelling in which multiple goals set for a desired future are input to models which will produce output indicating possible alternative ways to reach (all or part of) the goals set. One way of achieving this is by combing GIS with heuristic techniques like genetic algorithms, simulated annealing, neural networks, etc. (e.g. Kirkpatrick et al., 1983; Ingber & Rosen, 1992; Vink & Schot, 2002). Basically, optimisation involves matching the supply of facilities such as schools and shopping centres, or environments such as woods or wetlands, to the demands for these by humans, fauna or flora. Various objective functions may be optimised, e.g. maximise the number of hectares of open space or buyers within a 1 km radius from your shop, or minimise distance, travel time or costs. Developing such optimisation models within GIS provides powerful visualisation facilities for display and manipulation, giving immediate intuitive evaluation capabilities which a wide range of non-technical users and decision makers can relate to (Batty & Densham, 1996).

A third development which will receive increasing attention is the communication with stakeholders. Policy processes in general and especially spatial planning are becoming increasingly participatory or interactive which implies policy makers involve stakeholders in the process of policy making in order to obtain more public support for the final outcomes (Driessen et al., 2001; Geertman, 2002). If models, GIS or PSS are used to support the spatial planning process, they must be understandable for policy makers and stakeholders alike. These computer based systems should offer the possibility for stakeholders to bring in their own wishes and confront them with the wishes of others. The systems will then indicate where the aspirations of different stakeholder groups converge or clash. Optimisation techniques as described above may subsequently help the process of finding a compromise which is acceptable to all parties involved. This whole interactive process may be supported by group support systems like 'electronic boardrooms' or by web-based open GIS and PSS systems (Batty & Densham, 1996; Schot & Dijst, 2000).

Discussion

Our review of the development in modelling metropolitan landscapes showed that in less than two decades considerable improvement was achieved. Novel conceptual and technical developments are promising an optimistic view for the future of modelling metropolitan landscapes. We expect that top-down modelling in which complexity is added during the modelling process will meet with bottom-up approaches in which an increasing understanding of detailed processes allows for aggregation and generalisation.

Coming back to the three principal points of attention that we raised in the introduction allows for drawing some conclusions. The first topic was about the vast amount of knowledge and data needed. We want to emphasize that modelling reduces and simplifies reality and a model's value is determined by its ability to realistically represent certain features of reality. Moreover, we have to accept that not all the required information will be available to describe every component of the system. So scientific knowledge is incomplete and we cannot be sure that we are really modelling the relevant processes. Even if we assume we know the relevant processes and know how to model them, the next bottle neck is the data. Generally, the more complex models become, the more data they need. Modellers frequently do not realize on forehand the data need of their models leading to models which are hard to run which subsequently hampers their applicability (OldeVenterink & Wassen, 1997; Batty, in press). Especially the mechanistic bottom-up approach frequently leads to a disappointing applicability, since the models are complex and require much data (Wassen & Verhoeven, 2003). We advice modellers to make a compromise in the scientific completeness of a model for the sake of applicability.

Our second point of attention was the integration of sectoral knowledge. This point touches on the mono-disciplinary – multidisciplinary – interdisciplinary dilemma. In our view models may facilitate the communication between scientists since they may help to overcome differences between the different disciplines as a result of different theoretical concepts, research objects, methods, etc. In environmental sciences the urgent need for interdisciplinary approaches to solve complex environmental problems has led to a long track of trial and errors. Decisive factors for success in interdisciplinary research are a.o. awareness of scale discrepancies, trust in each others scientific capabilities, open-mindedness and professional coaching of the cooperation process (Schoenberger, 2001).

The third topic was the communication of scientific knowledge to spatial planners and managers. The traditional view on the role of science in the policy process is to provide politicians and policy-makers with unbiased and objective knowledge without entering into their debates (In 't Veld, 2000). In this view science should develop verified, validated and calibrated models. However, such an engineering approach to policy making is criticized by others who advocate a more flexible and adaptive approach. Nowadays, transdisciplinarity is pushed forward as a means of how the community can participate effectively in what appears to be a science-centered decision making process (Tress et al., 2001). Several approaches were developed aiming at improved communication between researchers and stakeholders and decision makers. Embedding the construction and use of Decision Support Systems in an open participatory process was already recognized as a potential solution to the problem some decades ago (Holling, 1978). A meta analysis evaluating a large number of studies focusing on environmental issues in multi-functional landscapes showed that success was highly correlated with a participatory approach (Wassen et al., 2003). Of course it is important to keep in mind that spatial planning is partly a non-rational process influenced by public opinion. The scientific knowledge from the modelling exercises is for that reason sometimes poorly incorporated in the final decision by the policy makers. In this respect one may argue the extent to which scientific knowledge matters at all in the policy process but, definitely, there is a need to improve the spin-off from modelling excerciese in policy (Vonk, 2003; Couclelis, 2003; in press).

We conclude that there is an ongoing process of exciting model developments improving our understanding of metropolitan landscapes. However, metropolitan landscapes are multi-functional and the inherent dynamics of each of the functions gives raise to a complex dynamic system. This makes predictability of metropolitan landscapes difficult and makes them hard to plan and manage. Recently, the need for participatory approaches is recognized and much effort is put in the communication with policy makers and stakeholders enhancing the acceptability of the models developed.

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Planning nature conservation in Dutch metropolitan landscapes

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Introduction

Evaluations of Dutch nature management policy show that the implementation of this policy is behind schedule (Milieu- en Natuurplanbureau, 2002). In this context the policy document 'Nature for People, People for Nature' (Ministry of Agriculture, Nature Management and Food Quality, 2000) outlines a number of problems: "With our current policy, we are unable to realise the national ecological network of the quality required, in time. The creation of ecological corridors between nature areas in particular has been difficult. An evaluation of current nature management policy documents shows that our approach to nature is very complicated and does not always have the envisaged effect at other levels of government".

The Netherlands (figure 1) is the most densely populated and urbanised country in the EU. Land is a scarce commodity, particularly in the west, where the rate of urbanisation is highest (Van der Valk, 2002). Urban growth also impacts the southern and eastern regions of the country, particularly along the traffic arteries connecting the Netherlands to Belgium and to Germany.

Figure 1: Dutch metropolitan landscapes

Towns, cities, suburbs, woods, farmland, horticulture, roads, parks and business parks merge into an urban field, the metropolitan landscape (Albers & Boyer, 1997; Daniels, 1999). A metropolitan landscape encompasses built-up areas and open spaces situated within the urban sphere of influence. The impact of the metropolis is extensive since, due in part to increasing mobility, accessibility (i.e. travel times) rather than distance has become a determining factor (Simmonds & Hack, 2000; Hajer & Zonneveld, 2000).

Scarcity of land for urban land uses exerts a constant threat for the remaining farms, woodlands and nature reserves. In the "war" on land the balance of economic interests and environmental/spatial quality is subject to

fierce debate among stakeholders (Healey, 1997). As a result of the relatively high demand for space for 'profitable' purposes such as living, working and transport, areas become built-up and fragmented with infrastructure, the shortage of land intensifies in general and, consequently, the price of land goes up. Such spatial consequences of the metropolitan landscape negatively impact the 'less profitable' uses that traditionally dominate open spaces, including nature areas.

Open spaces are perceived by residents as important ingredients for the quality of life in the metropolitan landscape. There is a growing tendency to spend public and private funds for the acquisition of land and development rights in open spaces. In the Netherlands so called green funds are an emerging phenomenon. One example is the 'green fund scheme' for the open space of Midden-Delfland between the cities of The Hague, Delft and Rotterdam. The Midden-Delfland green fund is the result of a financial agreement between the urban municipalities of The Hague and Delft and the rural municipality of Schipluiden. The aim of this agreement is to preserve and enhance the open agricultural landscape of Schipluiden (http://www.schipluiden.nl).

This demand for open space in the metropolitan landscape opens up opportunities for nature conservation and nature development because physical space is required to protect and expand existing nature areas. Furthermore, the mutual proximity of these areas and the connections between them are essential for the survival of certain populations of flora and fauna (Opdam et al., 1985; Opdam et al., 1995; With et al., 1996).

In this paper, we relate Dutch nature management policy with principles of spatial planning. The paper clarifies planning principles with regard to the metropolitan landscape and demonstrates how this knowledge can be used to improve the effectiveness of nature management policy. We will reflect on the bottlenecks in nature management policy and provide solutions. We draw on empirical data from two case studies.

The first case study addresses nature development, more specifically the development of ecological corridors. In 1998, the province of Gelderland commissioned a study into the possibilities for creating ecological corridors. As part of this study, 40 extensive interviews were conducted with various parties involved in two specific regions (Van Ark & Beunen, 1998). The second case study focuses on nature conservation, more specifically the implementation of the EU Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive). Sanderink (2003) conducted a study into the main causes of problems arising during planning processes and projects ensuing from the Habitats Directive. For this study 11 extensive interviews were held with governmental and non-governmental organisations involved in projects that were frustrated by European nature conservation legislation. For an extensive description of the backgrounds, the methods and the results for both cases we refer to the original research reports, respectively Ark & Beunen (1998) and Sanderink (2003). In this paper we focus on the most relevant results.

Case studies

Nature development: ecological corridors

Dutch nature management policy is largely based on the ideas laid down in the Nature Policy Plan (Ministry of Agriculture, Nature Management and Food Quality, 1990), of which the development of the national ecological network is a central feature. This heralded the transition in nature management policy from a passive conservation policy to an active development policy (De Jong, 2000). The national ecological network comprises key areas, nature development areas and ecological corridors (Ministry of Agriculture, Nature Management and Food Quality, 1990), which have been mapped out. The Nature Policy Plan introduced the 'ecological corridors' concept as a strategy to give significant impetus to the fragmented nature areas in the Nether-

lands. The idea is that joining areas of nature enhances the sustainability of various populations of flora and fauna. In the 1990s, the Ministry of Agriculture, Nature Management and Food Quality mapped out a number of ecological corridors in the Nature Policy Plan. The provincial authorities, municipal authorities and water boards largely included these corridors in their plans. In addition, these lower tiers of government mapped out many other regional and local ecological corridors. Consequently, the concept of ecological corridors became a commonly used concept, although it was often – and still remains – unclear what the line on the map specifically entails. Despite the fact that all these organisations mapped out the ecological corridors, the creation of ecological corridors lags behind the schedule laid down in the Nature Policy Plan (Milieu- en Natuurplanbureau, 2002).

The case-study revealed that many players are involved in the creation of ecological corridors, including municipal authorities, water boards, farmers, private land owners and many interest groups. From the interviews we concluded that none of the parties was averse to ecological corridors. On the contrary, many were, each in their own way, planning and realising ecological corridors. The interviews demonstrated that these parties represented a wide range of objectives and interests and often held widely varying views of ecological corridors. Some of the interviewed parties were interested in co-operating in creating hedgerows, bushes or ponds because they appreciate the elements of an ecological corridor as part of a scenic landscape. Others were interested in subsidies for nature management on their property as an additional source of income. However, these non-ecological views often do not meet the ideas policy makers have about ecological corridors and vice versa. In developing the ecological corridors concept, attention was paid primarily to ecological aspects, including the scope and development of areas and the required space between them. This approach was included in concrete plans to create ecological corridors. This governmental view is difficult to link with the ideas other parties have about ecological corridors. The approach has little chance of successfully creating ecological corridors since it offers few opportunities to generate the regional support and resources required. On the contrary, the interviews revealed that this sectoral, one-sided, approach caused many land users and owners (farmers in particular) to view this land claim as a threat, due in part to any subsequent effects of nature development on current or future (agricultural) use. As a consequence, substantial investments and a great deal of persuasion are required to achieve any results.

Nature conservation: Habitats Directive

The implementation of European nature conservation legislation (European Commission, 1992) caused problems for public and private activities in the Netherlands, like construction of new buildings or expansion of infrastructure. Following appeal, the national courts annulled various decrees since they were inconsistent with the European Habitats Directive. As an additional problem, individuals have made spurious use of the Directive in an attempt to stop certain developments (Van den Top & Van der Zouwen, 2002). The resulting publicity has made nature conservation legislation a key topic of debate. No one is happy with the current situation (RLG, 2002; VNO-NCW, 2002). Various projects have unnecessarily encountered roadblocks. The fear of coming against similar situations with new projects has increased resistance to nature conservation legislation. The legal jostling frustrates the spatial development of other uses and undermines support for nature conservation.

The study of these conflicts revealed that the problems are not so much caused by the legislation as such, but rather by its implementation and the communication and knowledge exchange related to it. In many cases, the courts annulled decrees since the requirements of the Habitats Directive were insufficiently taken into consideration due to a lack of attention, knowledge or awareness. Reasons for such annulments include the argument that it has not been sufficiently proven that the project has no significant effects, that

no research had been conducted into the effects or that the lack of reasonable alternatives has not been convincingly demonstrated. It is not so much nature conservation legislation that causes the problems, but the fact that in decision-making processes the Habitats Directive often was not taken into consideration. By ensuring that, if necessary, the requirements of the Habitats Directive figure prominently in planning processes, most of the bottlenecks currently encountered can be avoided. After all, "there is not any a priori prohibition of new activities or developments within Natura 2000 sites; these need to be judged on a case by case basis" (European Commission, 2003, p. 2).

Nature management policy in a planning perspective

If it concerns spatial issues, nature management policy should be regarded as a subject of spatial planning. From an analytical perspective, spatial planning comprises spatial arrangements as well as organisational and procedural arrangements (Van Ark & Hidding, 2002). Questions on spatial arrangements address the actual, physical object and primarily involve substantive knowledge and spatial concepts. The approach of Dutch nature management policy focuses largely on these spatial arrangements. However, ecological expertise, technology and methods alone are not enough to successfully implement nature policy. This also requires knowledge of the administrative aspects, of the way in which the decision-making process is conducted, of procedures and organisational structures and of the role of the parties involved in the entire process. The characteristics of the metropolitan landscape require a specific approach to spatial planning. Each use of space is tied to certain players who all have their own objectives, such as water management bodies, farmers, nature management bodies, home owners, etc. The various land uses fall under different policy areas, including nature management policy, agricultural policy and water management policy.

The traditional planning approach entails the development of plans by the upper tiers of government and the implementation of these plans by the lower tiers of government, which then must garner support from private individuals and organisations. However, in many instances, both the ability for the higher tiers of government to direct the lower tiers of government and the influence the government has on private individuals and organisations is limited. This can be attributed to both a lack of resources or authority on the part of the various tiers of government and the fact that they lack the specific knowledge, local and otherwise, required to develop effective plans. For this reason, coalitions are required in such situations since players can only consider their own competence during the planning process (Mastop, 1987). In some ways, the government fulfils a double role. On the one hand, the government must, in fulfilling its responsibilities, establish certain preconditions (i.e. objectives). On the other hand, the various tiers of government – each with their own competencies – must define the possible options in collaboration with other public and private parties. Consequently, in many instances, the interdependence of the various tiers of government and other parties means that government can only exercise control within networks (Goverde & Tatenhove, 2000). Although the government certainly continues to play a unique role, owing to its specific authorities and democratic legitimacy, it can no longer be viewed as a central player.

Due to these interdependencies, policy development and decision-making are more than ever negotiation processes, conducted not only between government and third parties, but increasingly between the various tiers of government (De Roo, 1999). Accordingly, attention must shift from the organisation of government competencies and policy tools and measures, known collectively as 'government', to less formalised practices of 'governance' (Healey, 1997; Hajer & Zonneveld, 2000; Janssens & Van Tatenhove, 2000). This gives rise to other forms of collaborative partnerships. Moreover, it means that planning processes become more important than (official) planning documents (Janssens & Tatenhove, 2000). Obviously, laying down options at certain moments in a planning document (i.e. plan, vision, policy doc-

ument, etc.) may still be important. However, these planning documents are only part of a more comprehensive and long-term cyclical planning process (Mastop, 1987). This demands a new way of thinking. It not only requires another modus operandi, but particularly a review of the role of the various public and private players in the decision-making process.

The approach of nature management policy in The Netherlands is characterised by a traditional planning approach, meaning a hierarchical approach, based on governmental plans. Furthermore, this approach is sectoral oriented, because it mainly focuses on the ecological aspects. This approach puts a strain on the collaboration between the government and the stakeholders involved because the policy goals cannot be linked with the goals and views of other parties. Both cases illustrate this. The sectoral approach entails the risk that the necessity of and possibilities for combining the objectives of other parties will not be recognised (Van Ark & Beunen, 2002). Nature policy in metropolitan landscapes requires a different planning approach than the hierarchical planning approach. Involving the stakeholders in the decision-making processes can help to generate knowledge, provide the needed resources and legitimacy of plans (Hajer & Zonneveld, 2000).

The sectoral and hierarchical control by the Dutch government, particularly with regard to nature management policy, is not in line with the need to integrate the various spatial claims and the fact that, in many instances, various parties, including the various tiers of government, are interdependent. This approach is one of the key reasons why the creation of ecological corridors has encountered so many problems. Traditional plans often do not dovetail with the views and requirements, spatial and otherwise, of other players. It is advisable to consider ecological corridors in a broader context to enable co-ordination with the objectives and interests of the other parties. Planning the ecological corridors requires that the higher tiers of government take a more reserved approach (controlling the main lines).

The implementation of the Habitats Directive has revealed that problems largely arose due to the fact that the directive was insufficiently taken into consideration in the decision-making process. When the requirements of this directive are sufficiently taken into account during the planning process, these problems can largely be avoided. Investigating and limiting as much as possible the possible negative impact on nature from the start enables the parties involved to properly consider the various interests and take a well-considered decision regarding the developments that are or are not wanted. Involving the various interest groups from the start not only brings additional knowledge to the table, but also creates broader support for decisions and, consequently, reduces obstructions, which may take the form of legal procedures.

Conclusions

There is a lack of space for nature development and conflict is arising more frequently between nature and other spatial claims in metropolitan landscapes. Yet, urban claims attach growing importance to certain qualities of open space, including the presence of nature. The implementation of current Dutch nature management policy entails a number of bottlenecks, which are due in part to the fact that the characteristics of the metropolitan landscape are insufficiently taken into consideration in nature management policy. A review of the situation in the Netherlands demonstrates that nature management policy focuses primarily on spatial arrangements (for example, the creation of the national ecological network) and generally overlooks the importance of organisational and procedural arrangements (planning approaches and procedural concepts).

Nature management policy is formulated to guarantee the preservation of biodiversity. Particularly in metropolitan landscapes, which are characterised by competing demands for space, it is vital to generate and maintain sufficient support for nature conservation and development. In general, more attention should be paid to the decision-making processes and the role of

other (public and private) stakeholders and their goals and views. Each situation requires a different planning process as each development issue has its specific objectives, domains and players. Taking into account the requirements that metropolitan landscapes set for both the spatial arrangements and the organisational and procedural arrangements, enables the formulation of feasible nature management policy, which responds to the complexities of these decision-making situations.

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New planning concepts and regional cooperation: Responding to the challenges of new urban landscapes

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Transnational work on metropolitan landscapes

Our metropolitan regions are facing rapidly changing urban patterns. New qualities of the urban structures in European metropolitan regions are evolving, that may be seen as a new type of urban (or metropolitan) landscape. This paper draws on a two years' transnational study project that was carried out within the framework of the European Union Interreg IIC-Programme from 1999 to 2001. Partner regions in the project "New ways for sustainable development of urban landscapes" – in short "New Urban Landscapes" – were the European Metropolitan Regions London, Amsterdam / the Deltametropole, Rhein-Ruhr, Rhein-Main, Rheinpfalz, Saarland and Luxembourg (NUL 2001). Though very different in size, character, and actual development features, they are all facing new and comparable challenges for their spatial development.

The Interreg-Programme is part of the European Regional Development Fund (ERDF) of the European Union, dedicated to fostering transnational co-operation and exchange between local and regional actors with relevance for regional, including spatial, development. Interreg offers co-financing (usually up to 50 %) for co-operation in given meta-regions; the New Urban Landscapes project was carried out in the North West European area (EU, 2003; NWE, 2003)

The main goals of the Interreg-Project New Urban Landscapes were

- to understand the evolving features of new urban landscapes, as well as the driving forces of their development;
- to identify the development potential of our urban landscapes;
- to formulate conceptual planning answers (instruments and planning processes)
- to transfer findings to other urban regions,
- to make a contribution to the European spatial and sectoral policies,
- to promote professional exchange and establish professional and personal networks on an international level.

In 2003, the partners continued their successful transnational work going into the implementation phase of the project, now running under the European Interreg IIIB-Programme and the title "Sustainable and Accessible Urban Landscapes" (Saul, 2003). The following paragraphs should therefore be taken as a report on work in progress.

New Urban Landscapes – a new understanding of metropolitan regions

Development of urban landscapes in North West Europe

Metropolitan regions in North West Europe face fundamental and rapid structural changes which have a far-reaching effect upon cities and landscapes. These social and economic changes also result in a change in the

traditional concept of European cities. Cities merge physically and functionally with the surrounding countryside, hence transforming the city into an urban region. The process of continuous physical and functional sub-urbanisation also coincides with more complex, inter-related socio-economic changes. These manifest themselves in a new meaning of urban, sub-urban and peripheral, rural space. It seems we are dealing with a different, new type of urbanised landscape, which has its own definition and qualities of spatial structure and design.

The inter-related merging of city and landscape, of built up, "red" and open, "green" environment, is the central feature. Core city and urban fringe, centre and periphery, city and landscape, town and country, these dichotomies of classic cities and landscapes are fading, and a new polycentric, fragmented, and patchwork feature of urban landscape evolves (BBR, 1998).

This understanding of new urban landscapes is a heuristic model and a descriptive concept, based on the discussion of our experiences in the partner regions but reflecting a wide range of current academic discussions: studies on suburbanisation, suburbia and urban sprawl (Keil, 1994; Bose, 1997; Brake et al., 2001), post-modern geography and planning (Allmendinger, 2000; Soja, 2000), peripherisation and the Edge City concept (Rusk, 1996; TOPOS, 1996; Phleps ,1998), the suburbia – post suburbia discussion (Aing, 1999), the German concept of the "Zwischenstadt" (the in-between city, describing the urbanised periphery) (Sieverts, 1997), and the discussion about "Americanisation" of spatial patterns of European metropolitan regions (Müller & Rohr-Zänker 2001).

Challenges and opportunities for spatial development

This spatial development certainly presents us with numerous serious problems – among them loss of open land, high financial and ecological costs, more traffic, low aesthetic qualities, and social problems. However, it seems that planners could benefit from understanding the new patterns and learn to work with them. We need to work towards a pro-active approach to deal with the causes, effects and qualities of the new urban landscapes.

At the same time it seems necessary that planners get involved in a future-orientated political discussion beyond making plans and designing projects, in finding approaches of managing the social, economic and political processes needed. For beyond changing physical urban forms and functional relations, these new patterns have severe consequences in the dimensions of administrative and political structures, leading to a need for governance network systems, identity and the representation of the polycentric urban region (Kloostermann & Musterd, 2000).

Innovation in local and regional planning is required. We have identified three distinct, but interconnected ways of necessary changes in planning policy (NUL, 2001:17-33):

- *New planning concepts* are needed to respond to the new tasks focussing on the importance of open and public space and a better quality of life in urban areas. This point is discussed in greater detail in the next paragraph.
- *New planning methods* reflect the managerial changes in planning policy. Planning should be more implementation-orientated, integrating strategic and project development; this needs regional management structures. Informal planning is progressing; public-private partnerships and intergovernmental co-operation is gaining momentum, and requires formal procedures. As a paradigmatic new instrument reflecting these changes, a basic regional land management system was developed within our Interreg-project. It includes the early identification of available land, its targeted development and a long-term protection of regionally important open spaces. It is based on a regional co-operative, i.e. voluntary basis. This cannot be discussed here in detail.
- *New planning processes* focus on co-operative planning. This is the institutional and process-oriented response to the challenges resulting from the changes towards new urban landscapes. In planning theory and practice, there is general consensus about the necessity to create a new "planning

culture". Planning in partnership (or co-operative planning) in our sense is a special and comparatively demanding form of co-operation. Implications of such planning are discussed at the end of this paper.

These "new ways" have to be seen as a triad of interrelated principles, none of which is able to tackle the problems and tasks of new urban landscapes alone. These changes are not newly invented; they are part of an already ongoing deep change in European planning culture. However, these innovations are only of real value to spatial planning in a multitude of interconnected combinations, considering the overriding principles of *social compatibility* (Polése & Stren, 2000). The need to find a common and generalized approach to this issue led us to a process-led notion of sustainability (NUL, 2001:15f).

New planning concepts: Design and development of urban landscapes

From our studies and transnational exchange, as well as findings from planning literature, some general principles were developed to guide planning concepts within the new urban landscapes context.

Greater recognition must be given to urban open spaces, as development resources for urban landscapes. The potential of the open spaces is not being taken full advantage of. Public spaces are a key to urban living, but are neglected or even ignored in current urban development. Open and public spaces are given a new role in the development perspectives of urban landscapes (Hajer & Reijndorp, 2001; Kornhardt et al., 2002).

The borders between open spaces and built-up areas are fading and a complex topography is developing. A characteristic of new urban landscapes is a fusion of open spaces and built-up areas. Innovative concepts aim at achieving close functional and structural integration of these elements upgrading the structural qualities in terms of revitalising core urban, peri-urban and suburban areas.

Urban landscapes necessitate a regional perspective to spatial planning and regional strategies. Spatial "visions" can help create awareness of the regional dimension. Agglomerations have crossed political and administrative borders and achieved a regional dimension. It is important to promote awareness for urban regional perspectives in order to develop adequate steering procedures. A common "vision" for the urban region should be used as an orientation framework for planning and political dealings. The understanding of a more integrated urban landscape and its regional dimensions makes it clear that spatial development must be firmly embedded in integrated overarching concepts and needs to be increasingly strategic and project oriented. The necessity of the regional dimension is a new and not yet sufficiently solved challenge.

A new interpretation of the "urban park" on the regional level is needed. Networks and tangible spatial coherence are used to avoid the fragmentation of the urban landscape. A possible starting point is the Regional Park concept, notwithstanding the multitude of interpretations of this concept. The fragmentation of the urban landscape results in a patchwork of urban fields; their open spaces lack tangible connectivity or positive structural quality. A spatial link through "green corridors", theme routes or "green transport plans" therefore could form the backbone for coherent development of urban landscapes. Important places and new nodes can be integrated into the context of the surrounding landscape, especially in a "green" infrastructure. By a reinterpretation of the "urban park" virtual space, built-up spaces, areas awaiting conversion of use, relics of the (industrial) past, artefacts of modern urban life, unplanned open spaces and "nature" are integrated into a single and coherent concept; thus Regional Parks allow us to achieve tomorrow's urban landscapes. The differing elements and spatial uses of the urban landscape are brought together in new contexts. The resulting "park" landscape depicts functional, spatial and historic coherence, as is seen in the urban region.

Multi-functional use is becoming a characteristic for structural quality of

the urban landscape. Functionally specialised spaces dedicated to a single use should no longer be predominant in complex urban landscapes. As a result of social change a pluralistic society with a variety of lifestyles is emerging. The corresponding diverse and multi-faceted leisure activities, characterised by increasing individuality and mobility, make it necessary for facilities and places to adapt steadily to changing spatial behaviour. Spatial interpretation increasingly follows individual and diverse patterns. These aspects suggest a multi-functional opening up of places and spaces.

The combination of cultural heritage and new design provide opportunities for regional identities. The development of new structural qualities demands creativity and innovation, as well as the ability to adapt to the demands of a post-industrial society. The individual regional profile is closely linked to the cultural (and historic) fabric of the area and has to assume the appropriate identity. At the same time it is necessary to find a new semiotic of urban patterns for contemporary life making specific use of cultural heritage and new design. New methods of communication and marketing would be appropriate; "trademarks" and labels for a new "design" of the urban landscape could contribute to raise awareness and convey regional identity. Major determining factors as to whether a regional identity policy will be successful are acceptance and accessibility in everyday life in terms of individual interpretation of space.

*Changing places is changing lives is changing places... socially open spaces are the starting point and a prerequisite for social sustainability. (*Social) accessibility and availability are decisive criteria for socially open spaces, in which people can express their needs and lifestyles. These places have to meet the increasing communication need of the urban (network) society and promote exchange between the different social networks.

Evidence: three examples for planning new urban landscapes

Three examples show the broad range of different types of metropolitan regions in Europe: the small-scale agglomeration in the Saarland (Germany), the large-sized metropolitan area Rhein-Ruhr (Germany) and the global city London. They also differ greatly in their current situation in matters of economic performance, social aspects and administrative and planning organisation. Nevertheless they present similar basic patterns of new urban landscapes and tasks for spatial development.

Saarland: Saar Regional Park

As an old industrial region in transition and a conurbation with constant migration losses, Saarland is seeking a new forward-looking identity (Figure 1). The central task is to restructure vast areas of the urban landscape to meet the increasing demands of a post-industrial society, creating attractive space for new urban uses. To support and manage this large scale restructuring process, the Regional Park Saar as a new spatial planning instrument covering the whole conurbation has been introduced.

The Regional Park will have the task of pursuing an over-arching concept for the development of a high quality urban landscape. As for the vital role of public space the challenge is to change existing under-developed green spaces and abandoned mining and industrial areas into new key nodes and points of reference for future urban landscapes.

Figure 1: The urban landscape of the Saar agglomeration (Source: agl 2002)

The concept will demonstrate how structural changes in times of limited funds can be implemented successfully by tapping into regional and local resources. An action and project-oriented programme will focus on projects with a regional dimension and relevance, develop a homogeneous design for urban landscape development, and contribute to innovative forms of regional management.

The main idea is to create an informal co-operation platform for regional partnerships as a flexible approach to guide and accompany structural changes to the conurbation. In doing so the Regional Park aims at the implementation of governance networks beyond traditional administrative structures reflecting the scope of action of regional and local players and combining their resources within joint projects on a regional scale. This process should build on existing – also cross-border – partnerships in the Saar-Lorraine border area, as well as in the SaarLorLux Euro region.

On that basis a discussion has to be initiated on a new spatial vision for the urban landscape using the ideas, creativity and commitment of the local stakeholders and the public on a regional level.

As a regional pilot project Saarkohlenwald has been chosen. This vast forest is part of the wood and mining axis throughout the Saar conurbation (see figure 2), a green backbone of the urban region that provides a sharp contrast to the neighbouring coalescences.

The Saarkohlenwald project provides opportunities of showing how to create new urban parks with regional relevance by finding innovative solutions from the conurbation's traditional forestry and mining heritage. This demonstration project aims at integrating different uses and local projects in an overall spatial vision towards re-gaining public space and a new regional coherence by re-inventing the green peripheries. The challenge is to change existing peripheral landscapes and under-developed spaces, into new key nodes and points of reference for the future landscape. These development resources offer the chance to realise regional potential and create – with comparably simple means – new, unique and characteristic situations and landscapes. Furthermore, it offers a test bed for project-based governance structures and planning in partnership approaches.

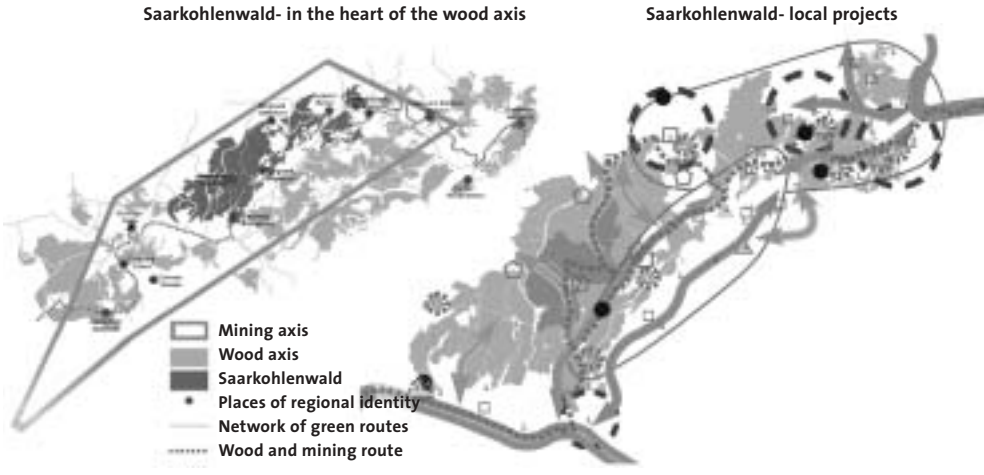

Figure 2: Saarkohlenwald – a regional project (Source: agl 2002)

Rhein-Ruhr: Urban Landscape Emscher 2020 – transformation of the Emscher System

The Emscher region is part of the old industrial heart (the Ruhr Region) of the German state Nordrhein-Westfalen (figure 3). With the economy changing to post-industrial patterns, this long term project, scheduled to finish by 2020, transforms the open sewerage system of the river Emscher and its tributaries into a river and creeks again, as naturally as possible and as an attractive part of a new urban landscape. Following the construction of a completely new underground sewer along the Emscher, the Emscher valley

Figure 3: Urban Landscape in the Ruhr Region (Source: Emschergenossenschaft)

and its surroundings will be retrieved for urban, natural and recreational uses.

In this area, from 1989 to 1999, the International Building Exhibition – IBA Emscher Park – was a major initiative for a large scale restructuring and revitalisation of the urban region, and an example of new models of regional policy (TOPOS, 1999). IBA was initiated to overcome the far reaching problems of economic and social change in the post-industrial era. In the centre of the IBA was the vision of a reconstruction of urban landscape, by creating the Emscher Landscape Park (KVR, 1996). The objective to regenerate the river Emscher and its surroundings is part of this concept, tackling economic disadvantage, improving both natural and man-made environments, and raising local living and working conditions. Alongside this, a key long term project is to create a new east-west axis along the Emscher, as the backbone for the Landscape Park. If the accessibility and usage of open spaces is used to their full potential then quality of life is improved.

The process is managed by the Emschergenossenschaft, a public-private partnership organisation responsible for the sewerage and flood control of the Emscher. Within the Interreg IIC-project, the Emschergenossenschaft began successfully to build a platform for a co-operative planning process, leading to a regional agreement on the future planning process of the Urban Emscher Landscape. This process, known as emscher:dialogue brings together all local and regional stakeholders, covering the full length of 60 km of the river Emscher from Dortmund to its mouth at Dinslaken, and the urban landscape adjacent to some 350 km of today's' sewerage canals, to be the rivers and creeks of tomorrow. Thus the project will positively affect about 2.4 million people. During the Saul-project, running till 2006, this dialogue will not only be continued, but also extended to involve the public into the process.

The next step taken was a large international planners' competition, aiming at finding a pool of ideas for planning and designing the urban landscape of the new Emscher. Future tasks include binding these strands of work together assisted by a planners' experts group, charged to carry out the process of developing a Master plan, emscher:future. The goals of the open, dynamic master plan are:

- define and plan the design and the sewerage system;
- planning and construction of the new river and creeks, including flood control and design of the mouths of the tributaries;
- additional urban and landscape initiatives in the adjacent areas;
- giving further impulses to cities, investors, planners, and inhabitants for responding to the new qualities of the river Emscher, and to integrate these in the larger framework of the whole Emscher Landscape Park.

London: Lea Valley Regional Park

The expanse of London and the population density, combined with extensive travel times reflect the pressures on land in this metropolis. Due to the extent of the London metropolitan area, open space resources are manifested in many different ways, such as inner urban, outer urban and metropolitan edge locations (20 % dense inner urban land, 38 % outer urban [suburban] land and 42 % open land). In all cases open space needs to be accessible to residential and business communities and visitors.

As a conurbation of dramatic contrasts, with great wealth and acute

deprivation existing cheek-by-jowl in many areas, it has equally great contrasts of fine historic parks in central London, and seriously neglected parks, degraded public spaces and damaged land throughout Greater London. Its greenbelt was established in the first Greater London Plan in the 1950s, and remains largely protected by planning controls; but for much of the population, it is remote and inaccessible in terms of people's everyday lives. However, the quality of London's open spaces directly affects its World City status; this is the starting point for a new open and green space policy.

One example for this new policy is Lea Valley Regional Park. The Lee Valley Regional Park was established by statute in the 1960's. It stretches north-south along the river Lea from Hertfordshire to the Thames. The park's 4,000 hectares comprise rivers, reservoirs, nature conservation areas, brownfield land, marshes, indoor recreation, and sport. Rail lines run the length of the linear Park area with a number of small stations; but these are frequently vandalised and unwelcoming, and despite signage from the stations, the physical pedestrian and cycle routes from them to leisure and green space opportunities are often obscure, unpleasant and a deterrent to the public. Projects will improve station environments and safety, and create attractive routes to leisure areas with better public facilities within the framework of a green transport plan.

Lea Valley represents post-industrial new urban landscapes which are often divided up and cut through by roads, railway lines, housing and industrial buildings. Branding and labels are increasingly important in consumer societies, but parks have failed to develop appropriate forms of public representation. One main question is, how to represent a coherent whole to a public used to unified landscapes?

Another task arises from the direct neighbourhood of the Lea Valley Park to the Thames Gateway area, which is designated to become a high priority area for economic development of London and the South East, and even beyond. The southern end of the Lea Valley Park is Leamouth, the confluence with the Thames, opposite the Millenium Dome and just down river from Canary Wharf. Today it is dominated by derelict or partially used sites providing minimal business and employment growth. In the future it could become a unique inner city urban quarter based on a mixed use development approach. The community access project will engage local people in designing and implementing aspects of new access and interpretation arising from capital investment work being resourced from other public funding.

One of the main future tasks is to determine how co-operative planning processes can be more effective at strategic levels, involving public-private-voluntary sector partnerships, and how to engage communities more meaningfully in local partnerships. Until now, the statutory character of the Lea Valley Authority fosters a communicative mode of planning with the adjacent local governments. But an opening up for a wider partnership type of planning should be explored. Moreover a regional strategy to integrate open and green spaces into a regional concept seems necessary. A first step to this has been done by the Greater London Authority by creating an informal platform, called the London Parks and Greenspaces Forum, which is a direct outcome of recommendations of our Interreg IIc-project. The coming London Spatial Development Strategy highlights the importance of urban green spaces, and will create a cohesive open space policy covering Greater London.

Co-operative planning and regional governance for new urban landscapes

Why is co-operative planning necessary?

Together with new planning concepts and new managerial planning methods, we identified co-operative planning (or planning in partnerships) as a third necessary innovation to cope with the challenges and opportunities of new urban landscapes. Again, this change of course is ongoing (Selle, 1994;

Kestermann, 1997), but it seems, at least in the context of our project regions, it might be fostered. This especially holds true for the involvement of the communities on the regional level.

The two sides of co-operative planning, which are partnership-building with organized actors on the one side, and involvement of the public, the communities on the other side, show some common trends regarding their necessity, as well as common tasks and difficulties for initiating and managing them. Of course, these two sides imply quite different methods and instruments, which cannot be discussed in this paper in detail.

Our concept of co-operative planning draws on a wide range of academic literature, dealing with the "argumentative or communicative turn" in planning (Fischer & Forster, 1993; Selle, 1996). Thinking further, the deliberative mode of consensus-reaching planning alone cannot be seen as sufficient. It must be linked with an institutional view, as is discussed in a politological framework regarding the changing role of the state to a "co-operative state (Benz, 1994), as well as with the concept of "collaborative planning" (Healey, 1997; Harris, 2002). Thus the importance of the actors and the actors' constellations, their potentials for acting, and the specific situation and tasks come more into the foreground. Perhaps differing from Healey's understanding, the term co-operative planning is used here to describe an organized form of collaboration, which affords a clear "arrangement" between actors in a planning arena, defining their field of co-operation, their aims and goals, their organisational structures, and their modes of processing. This makes the participants of the co-operation to partners, which is the reason for our British colleagues to prefer the term planning in partnerships. Of course, co-operative planning on the regional level also can heavily draw on the concept of regional governance and empirical studies on regional co-operation (Hamilton, 1999; ARL, 2000; OECD, 2001a, b, c).

General trends make partnership planning unavoidable, which are briefly listed here:

- continuous enlargement of the field of action and functional spaces,
- increasing significance of the regional level with regard to the consecutive processes of globalisation, regionalisation and localisation,
- the resulting complex and interwoven topography of urban landscapes,
- the diminishing power of administrative and political bodies to tackle the challenges of future spatial development,
- the pluralisation and fragmentation and thus growing diversity of society – with increasingly varied stated requirements,
- the change in values and the process of individualisation,
- increasing democratisation, and new stakeholders entering the political arena,
- a movement towards the vision of sustainable development.

The phenomenon of new urban landscapes causes complex cross-sectoral tasks, demonstrating the limitations of traditional institutions and demanding partnership approaches on a regional level. No single stakeholder is "responsible" and no-one is in a position to act alone. Problems overlap in terms of space and content; they need an integrated, inter-sectoral approach. Solutions are often not immediately obvious at the beginning and have to be found jointly in the course of the planning process. Thus only regional governance structures seem to be able to cope with those challenges.

It is not only the pressure of complex problems, acting as 'push factors', which promotes the trend towards increasing use of planning partnerships: it is also promoted by their opportunities and potential, working as "pull factors". There are opportunities to overcome barriers to action, limitation of decision and implementation risks, by all stakeholders pulling together, the pooling of resources resulting in possible rationalisation and synergy effects. Partnership frequently presents the only opportunity to overcome stalemate situations and to enable a decision to be taken.

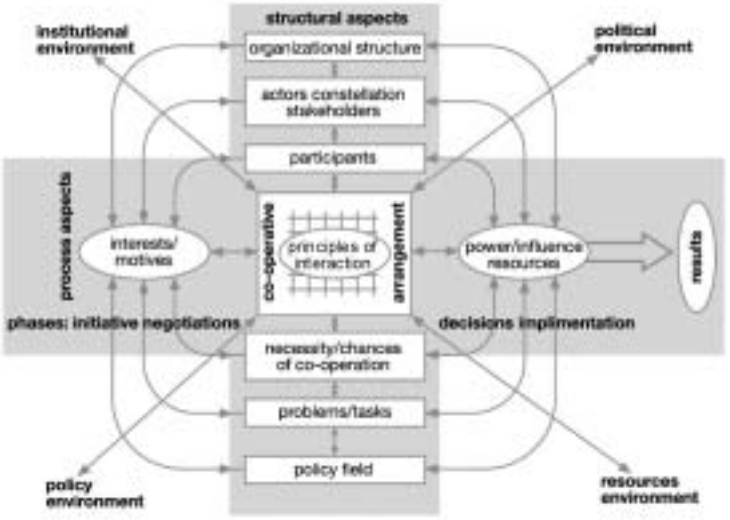

Figure 4: A conceptual framework to understand partnership planning.
(Source: Rainer Kestermann, ILS-NRW)

How to manage partnership arrangements

Two fundamental conclusions can be drawn from our Interreg project work:

• There is no ideal way of establishing and running a partnership. Each case is different, requiring tailor-made solutions, reflecting among other factors the individuality of the people participating. In the end, the involvement and motivation of people and their willingness to become active on behalf of an organisation are essential factors for a partnership to function properly.

• The partnership management should aim to achieve an open, dynamic process and must be able to deal with a number of typical dilemmas in a productive and flexible manner. This is only possible in a joint learning process.

As a consequence, no solution-oriented consulting seems to be fruitful. Therefore a conceptual framework (see figure 4) has been developed, highly based on Benz (1994). It intends to facilitate a process-oriented consultation. The model demonstrates in its simple form of a cross the inter-action of structural elements (on the vertical axis) and process elements (on the horizontal axis). The structural elements on the one hand comprise the organisational structures of each field of action (in the upper part), as well as the structure of the tasks to be fulfilled (on the lower vertical axis). With the process elements shown on the horizontal axis, a significant role is played by the interests and motives of the (potential) stakeholders as well as the available resources which the stakeholders are able to bring to the table. At the intersection of the structural and process elements is the special partnership arrangement. In short, this arrangement has to consider three factors: the specific description of the goals and tasks, the agreement of organisational partnership structure, and the establishment of any specific principles of conduct within the partnership. In the end, a partnership does not develop from a clean sheet. The relationships between the political arena within which the partnership is operating (shaded grey in the diagram), and the outside world is of crucial significance, and can and must be shaped by the partnership management.

This model illustrates the complexity of initiating and managing co-operation; all of these issues have to be hit and thought of together. It should be used for systematically finding the right questions - maybe with the help of an outside consultant -, they are to be answered by the participants in the relevant arena themselves. The idea is, having worked thoroughly through all these issues, and having given your specific answers, you will finally have found your adequate co-operative planning arrangement. Of course, this is a dynamic figure. During the co-operation process, you will have to keep the model in mind, and changes will be probably necessary.

Conclusion

To cope with the challenges and opportunities of the emerging new urban landscapes and the resulting complex tasks, planning needs an innovative evolution. New planning concepts and co-operative planning are inevitable; they need to be completed by managerial methods. Evidence from our work in the Interreg project, both conceptual as practical, shows that these changes need to be taken on a regional level; but this level reveals special difficulties that have to be explored further. Following the stakeholder concept, the involvement of the public, business and voluntary sectors aims at creating the institutional capacity of a regional governance system. Our findings fit to the undergoing trend towards a new planning culture, showing the emergence of new, complex planning tasks, new (collective) actors and actor constellations, together with new modes of planning and planning procedures. The necessity and advantages of activating participation and involvement procedures of local and regional communities are also evident, though more efforts will be needed especially on the regional level.

Going beyond the scope of regional co-operation, our experience also allows to postulate the effectiveness of transnational co-operation for studying and solving similar tasks in different European metropolitan regions. Finally, on European level, international co-operation is needed to secure the adoption of our findings on new urban landscapes, which should be reflected by the European spatial and sectoral policies, and their documents, such as the European Spatial Development Perspective (EU, 1999).

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Spatially explicit risk analysis: A new solution to contamination problems in the Metropolitan Delta

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Introduction

The Metropolitan Delta in North West Europe (further referred to as the Metropolitan Delta) can generally be characterised as densely populated, with high claims on land use. Due to changes in demography, economic prosperity and time expenditure of people, there is an increasing demand for areas for nature conservation/development and for recreational use. Such areas should optimally be located nearby urbanised areas in order to create a better balance between urban development and the open countryside or nature areas. However, since space is scarce in the Metropolitan Delta, it is not always feasible to allocate areas which are optimal suitable to nature development or recreation. More often, nature development and enhancement of recreational functions will need to be achieved in conjunction with other functions, or in areas with currently low-quality functional land use, which may be upgraded. An example of multifunctional use is the development of

natural areas in floodplains in The Netherlands and Belgium, which have a prime function in flood control (see for instance Grift, 2001). Examples of possible changes in land use are for instance the regeneration of brownfields, which used to be industrialised areas (see for instance De Sousa, 2003).

Although both solutions, multi-functionality and changes in land use, appear auspicious, there is a major drawback which may hamper the development of natural and recreational areas, namely the occurrence of contamination in the soils. Not only the former industrialised areas, like the brownfields, but also other areas within the Metropolitan Delta have been contaminated by human activities. For instance, in The Netherlands, Belgium and Germany large areas in the catchment area of the river Rhine and Scheldt are polluted by a wide range of chemicals, like heavy metals, PCBs and dioxins (Hendriks et al., 1995; Vandecasteele et al., 2003). Other patterns of contamination are located near for instance smelters where elevated levels of heavy metals can be found (Janssens et al., 2003; Nahmani & Lavelle, 2002) or municipal waste incinerators which may be sources of air-borne dioxins (Domingo et al., 2002).

In order to assess the risks that such contamination may pose to the successful development of natural areas, specific methods have been developed, based upon ecotoxicological knowledge, e.g. knowledge on the effects of contaminants on the functioning of organisms. Currently used methodologies are based upon state-of-the-art expertise on assessing ecotoxicological risks. Within these methodologies, the problems of contamination in spatial planning are defined in a scientific, ecotoxicological framework, which primarily results in a limited set of options when risks of contamination are present: either a change of the planned land use function (loss of prime objectives of the initial planning process) or remediation of the contamination (requires vast budgets and is as such mostly not feasible). Besides the fact that these risk assessment methodologies only result in a very limited set of options to solve the problems, they may even more be of limited use in spatial planning processes because they hardly acknowledge expertise from other disciplines that are relevant in spatial processes. For instance geographers, social or economical scientists or spatial planners are currently not directly involved in the process of risk assessment (lack of inter-disciplinarity) but neither are other relevant stakeholders in the planning process, like for instance farmers, local inhabitants, (local) authorities (lack of trans-disciplinarity). Such lack of inter- and trans-disciplinarity may limit the possibilities to reach a balanced solution (see Tress et al., 2003). Hence, currently the development of natural, but also recreational land use nearby urbanised areas within the Metropolitan Delta is hampered by the lack of proper tools to assess risks of contamination, that are inter- and trans-disciplinary, and that are focussed on feasible solutions, related to the *a priori* defined planning objectives.

In the current paper a new conceptual outline for the ecological risk assessment of contamination will be addressed, which will result in an increased inter and trans-disciplinarity of the process, and which is more focussed on reaching a solution in dealing with the contamination problem. This concept is focussed on a relatively small scale of planning, 10s of km.

Conceptual outline

To enhance the potential role of ecological risk assessment in the planning process, we need to extend the procedure in two ways. In the first place, risk assessment has to be spatially explicit, taking into account the spatial structure of the landscape (landscape ecotoxicology, see Johnson, 2002). Such a spatially explicit risk analysis of contamination includes the spatial distribution of contaminants within the area of interest, and combines this with spatially explicit uptake of the contaminants by organisms acting on different spatial scales, based upon their exploitation patterns of the habitat. A presupposition of the concept is that besides its presence also the habitat usage pattern of an organism is determined by the configuration of the land-

scape (see for instance Powell & Steidel, 2002; Bélisle et al., 2001).

In the second place, hooks are required that link the outcome of the risk assessment, for a given landscape, to habitat manipulation measures modifying the habitat exploitation patterns in a way that minimises contact between organisms and contamination, and so minimises risks of the contaminants. In the planning process, a landscape that does not meet acceptable risk criteria (standards) can be modified and evaluated again, in an iterative approach (figure 1). The set of potential manipulation measures depend on the state of the landscape, the outcome of the risk assessment, and on constraints and priorities set by the stakeholders.

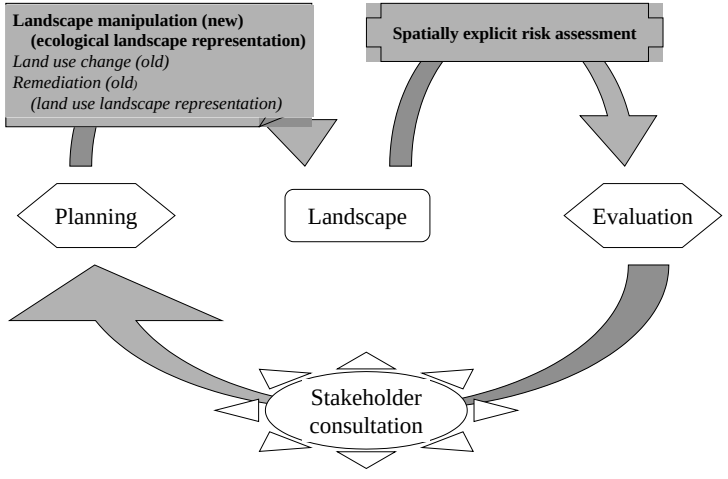


Figure 1. Schematic overview of the spatial planning process involving the spatially structured risk assessment (SSRA). The process of spatial planning results in some actions in order to minimise risks of contaminants of which landscape manipulation is only possible with the aid of a spatially explicit risk analysis. The resulting landscape plan can be evaluated with the SSRA, and when the risks are still unacceptable consultation with the stakeholders can result in alteration of the panning process.

In the a single top-predator species, or some selected species, with their food chain are selected for detailed analysis. Top-predators are chosen because they are located at the end of the food chain, they are in general prone to bio-accumulative contaminants like PCBs and cadmium and so vulnerable to risks of contamination, and furthermore they act at a similar spatial level as spatial planning processes. The selection of the species is based upon their place within the ecosystem, structurally and functionally, and when possible, it should be selected as such that it can be assumed that minimising the risks for the selected species, and its food chain results in minimising risks in general for the 'planned' ecosystem (Fleishmann et al., 2001).

The concept of the SSRA is relatively simple: it is aimed at minimising the contact between organisms and contaminants by spatially structuring the landscape so that the organisms will not forage at contaminated sites. For a SSRA, different types of information and tools are needed, which will be discussed in the following section. The SSRA can be applied at different phases in a decision process (Janssen, 1992). It can be applied in the development phase, aiding in optimising the design or it can be used in the selection phase, in order to evaluate choices. In an iterative process between stakeholders and scientists conducting the SSRA different scenarios can be assessed. Such a cyclic approach ensures the inter- and trans-disciplinarity of the process. This will be addressed later.

Information required for SSRA

When applying the concept to a certain case, information from different sources is needed. The planning process is the primary driving force in the concept. Based upon the outcome of this process a detailed analysis of the risks that contaminants may pose can be performed. In the following sections this will be illustrated by a hypothetical case.

The SSRA has to integrate information from different scales. Not only the scale of the planning is of concern, but also the specific characteristics of

the selected species and the scale of the variability of the contamination patterns also influence the scale at which the SSRA may be applied. The example that is presented appears to be at a very small scale, but the concepts are also applicable at larger scales.

Information of the planning process

In a spatial planning process, a major input for the SSRA is a map with actual or hypothetical landscape configuration (figure 2). The map may reflect the outcome of the deliberations between stakeholders. These maps will contain the information on the habitat configuration that is planned, on the types of land use that are planned and so on. All this spatially explicit information is needed in the further steps of the process.

Information on spatial variation contaminants

In urbanised and rural areas contamination levels vary spatially. This may be due to several factors and processes. For instance, in river floodplains contamination levels vary with the rate of flooding. In areas with frequent flooding and sedimentation of particles the contamination levels are in general high (Middelkoop, 2000). In more urbanised areas the spatial patterns of contamination may be more related to human activities, like for instance dumpsites or contamination plumes in ground water due to a leakage. This spatial variation in contamination patterns can be mapped in a GIS driven system (Kooistra et al., 2001), and can be entered into the SSRA framework as a digital map (figure 3). The required level of spatial detail depends on the scale at which the planning process takes place, and on the degree of spatial variability of the contamination patterns. For further details on the mapping methods see Kooistra et al. (2001).

Information on spatial variation of organisms

The next step in the SSRA requires definition of habitat maps for the species in the relevant food web. These species may operate at different spatial scales. At the smallest scale we may predict the presence of species, e.g. earthworms, and their population density, applying simple habitat suitability models and other (statistical) models relating a-biotic conditions to density (Morrison et al., 1992). At the larger spatial scale, referring to organisms more towards the end of the food chain, spatially explicit resource exploita-

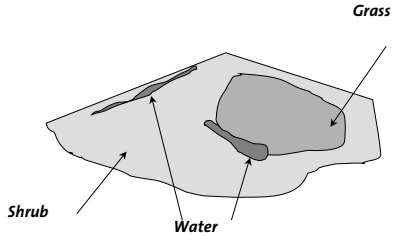


Figure 2. Example of possible outcome of a planning process in a hypothetical case-study in a certain area.

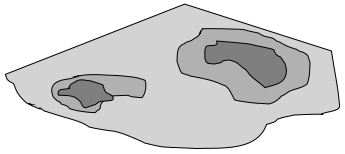


Figure 3. Example of possible spatial distribution of contamination in a hypothetical case-study in a certain area. The darker coloured areas contain higher levels of contamination.

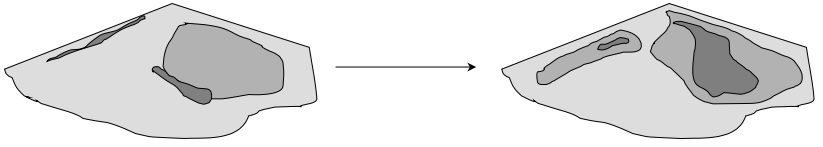


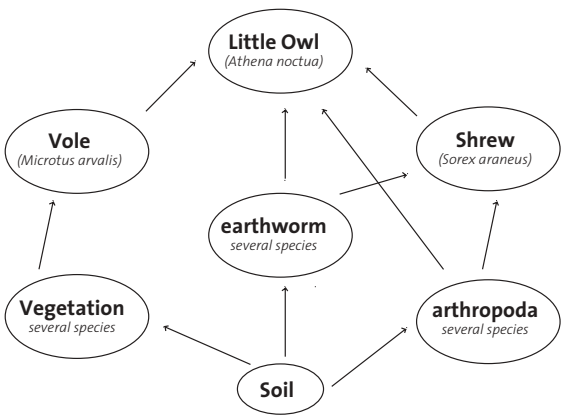
Figure 4. Example of a hypothetical derivation of a habitat suitability map from a vegetation map. It should be noted that this is very simplified, different types of information may be needed (for instance vegetation cover, groundwater level, depending on the species of interest)

tion models are required, predicting which part of the specific landscape is exploited, and which food resource is consumed (figure 4). This information is essential, as it is part of the solution strategy to modify this spatial exploitation pattern, directly through manipulating food resource availability or indirectly by landscape changes affecting behaviour, e.g., removing shelter, etc.

Information on food-web relations

Contaminants are taken up by organisms through several routes. Uptake of for instance heavy metals by earthworms is dermal (Ma et al., 1998, Vijver et al., 2003), while uptake of contaminants in higher, terrestrial organisms, like for instance birds is mainly through dietary uptake (Drouillard 2000, Lovvorn & Gillingham, 1996). Depending on the food-web relations, different routes of contaminant uptake by predators can be distinguished. For instance for the little owl (*Athene noctua*), the food-web interactions in Dutch floodplains is depicted in figure 5 (Groen, 1997). Assessment of such food-web interactions is essential in order to quantify the uptake of contaminants by predators through food uptake.

Figure 5. Food-web interactions of the little owl (Athene noctua) in Dutch floodplains (cf. Groen, 1997)



Instruments required for SSRA

Models

Different types of models will be used in a SSRA. In this section we will not provide a detailed technical picture of the models, but a brief overview with possibilities and limitations of the use of these models will be given. Three types of models will be used in the SSRA: (i) models describing and analysing the spatial variability of the contaminants (spatial interpolation models), (ii) models used to construct habitat suitability maps for the species of concern (habitat suitability models) and (iii) models that address the transfer and accumulation of contaminants through the food-web (bio-accumulation models). The use of these models allows for the assessment of risks in hypothetical and realistic cases. In the planning process, many different potential situations are created (scenarios); being able to evaluate these scenarios is the crux of the SSRA. The models are used in a hierarchical fashion (each model building upon the output of a lower level model) and require high quality data-input (to avoid uncertainties to proliferate through the chain. Therefore, the models need to be validated in case studies, and furthermore each application in a certain case requires research effort in order to generate the data needed. Therefore the application of the instrument, and its ongoing development and fine-tuning may demand some research effort. Nevertheless, it may still be cost-effective because other solutions to deal with ecotoxicological risks e.g. remediation of sites or changes in planning priorities are even more costly or undesirable. Furthermore, those solutions generally do not incorporate stakeholder's participation.

Decision support system (DSS)

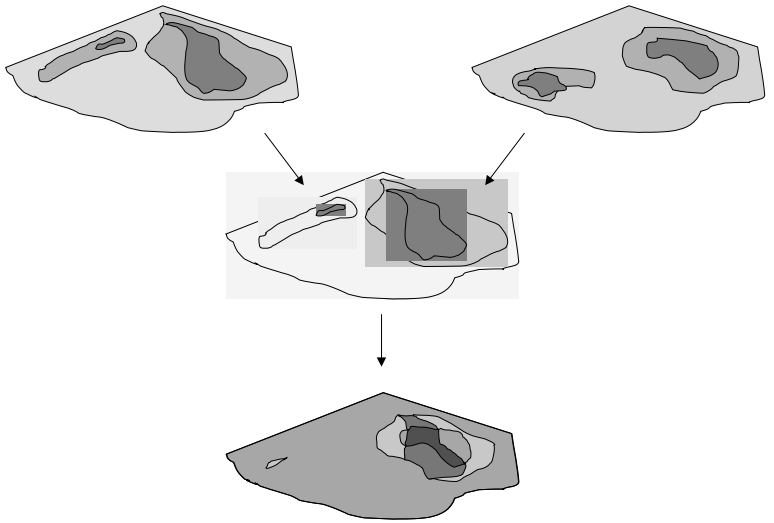
In order to facilitate the iterative process between risk-assessors and other stakeholders a system is needed that consists of a framework that incorporates all models, and a graphical user interface through which the risk as-

sessor and the other stakeholders can communicate with the models. Within the decision cycle such a decision support system (DSS) will assist during the planning phase to translate policy decisions into the actual implementation of measures, but it may also serve to evaluate established plans. It will enable to explore *a priori* several spatial planning alternatives, and to evaluate resulting effects on risks that contamination poses to wildlife. By applying the DSS the evaluation of the success of planned measures will take place early in the decision cycle, namely in the planning phase. Current methods only allow evaluation of risks after implementing of measure, e.g. monitoring of risks in the evaluation phase. Such an *a priori* evaluation of measures will result in a more effective implementation of planning measures and also allows that other main stakeholders are involved. When risks of contaminants are still to be expected in the newly defined configuration of the landscape, the consultation with the other stakeholders iterates once more, until a spatial configuration is defined that is not only acceptable to the stakeholders, but also with acceptable ecotoxicological risks. This will be addressed in the following section.

Assessment procedures

The procedure within the SSRA is an iterative cycle, in which the stakeholders supply the outcome of the planning process, formatted in maps, after which the scientific co-workers assess the risks. When the risks are unacceptable a new iteration will take place. The core of the risk assessment is relatively simple. From the maps containing the information on the habitat exploitation by the different species (based upon the maps of the planning results) and the spatial variability of the contaminants, a risk map is extracted by means of overlaying the contamination maps with the habitat exploitation maps (figure 6). For this overlay process GIS based algorithms can be used. This risk map is used to assess and value the risks of the contaminants.

Figure 6. Extraction of the risk-map as a combined overlay of the maps on the spatial variability of the contamination patterns and the habitat exploitation by the organisms.



Average Daily Intake (ADI) of contaminants by the species of concern can be calculated using the information on the contamination patterns, habitat exploitation of the organisms and the food-web models. Such ADI can be compared to known standards of ADI's at which no risks on effects are to be expected.

If the risks are acceptable, the SSRA can be concluded. If not, the SSRA allows for a cyclic approach in which the stakeholders can be consulted. The stakeholders can formulate news plans based upon their own needs and requirements, but combined with the information resulting from the risk assessment performed earlier (figure 1). This should lead to a change in the spatial configuration of the plans. How this planning process is managed is not of direct concern of the SSRA, only the outcome of the process is of impor-

tance. The maps of the new planning outcome can be entered in a new iteration of the SSRA and the risks of the contaminants can be assessed again. These iterations can take place until the risks of contamination are acceptable, and the resulting plans are thus the outcome of a combined effort of spatial planners and ecotoxicological risk assessors.

Relevance for the Metropolitan Delta

As said earlier the Metropolitan Delta can be characterised by high population densities, together with a high degree of urbanisation, which transforms rural and urban systems into large metropolitan areas connected by large infrastructure networks. Furthermore, agriculture systems have been intensified considerably in the last decades. These factors resulted in a deterioration of the availability of areas for natural development, but also for recreational use. This has been recognised at national level, but also at European level. For instance in The Netherlands it has been identified that nature development is fragmented, and considerable amount of areas should be devoted to nature development and the development of the Ecological Main Structure (RIVM, 2002). At European level this recognition has resulted in the adoption of the Natura2000 initiative. However, such recognition in policy plans does not automatically result in the fact that claims for space to realise these policy aims, will be complied with. Still, the interests of other stakeholder in the process need to be considered, so the spatial claims for nature development are likely not to be located at the optimal locations.

The approach that is presented here, needs a high degree of information input, e.g. data on spatial variation of contaminants, knowledge on habitat exploitation of organisms. Part of this information is generic available, but part will need to be collected case by case. This restricts the use of the concept to cases in which the collection of data is affordable, although it should be noted that for instance in The Netherlands information on contamination levels is legally needed by the owner transfer of land. Due to the intense character of planning processes in the Metropolitan Delta, and the high (financial) stakes that are involved, it is likely that the benefits of the concept in increasing the stakeholder participation and thus resulting in a better process in dealing with contamination problems, outweighs the extra efforts needed. This should also be viewed in relation to the fact that by applying these concepts it may be possible to redevelop contaminated areas that were formerly not dedicated to nature development or recreational use due to lack of proper risk-assessment tools.

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Cost-benefit analysis in interactive planning processes

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Introduction: the whys and wherefores of this article

A plea for an integrated approach

Pressure on space is increasing incessantly. Especially in areas such as metropolitan deltas, which are both physically vulnerable and attractive for development, the demand for space exceeds supply. The need for multiple use of space is therefore growing. This requires interactive planning.

Much has been written about how to hold landscape dialogues with stakeholders in the region concerned. However, mostly the costs and benefits of the development plans to society are only computed in the final stage of the planning process. The Agricultural Economic Research Institute (LEI) argues in this article for integration of a cost-benefit analysis (SCBA) in interactive (regional) planning processes. The emphasis is on areas where multiple use of space is seen as a prerequisite for development of the region.

LEI vision and experiences

According to LEI, SCBA should be an essential part of the planning process. Firstly, it avoids time and money being spent on elaborating a plan, which is not beneficial to society. Secondly, it helps to prevent unwarranted enthusiasm for inauspicious plans among participants in the landscape dialogues. This will frustrate public support for the rest of the process and for similar processes in future. LEI already has some experience in integrating SCBA in regional-planning processes. Moreover, the institute increasingly applies interactive methods in its research. These now are the ingredients in the processes we propose in this article; combining SCBA and interactive planning.

Structure of the article

This article consists of four parts. The first part discusses the growing demand for space, the concept of multiple use of space and changes in planning approaches. The second part focuses on the theory and practice of interactive planning and brings to notice the knowledge and experience of LEI in this field. The third part considers the whys and wherefores of methods to assess the feasibility of plans. Available instruments and models are discussed in terms of their usefulness to regional development. Next, we report on the first steps of applying SCBA in regional planning processes. This is based on the experiences of LEI in two regional projects. These case studies illustrate the proposed integration between interactive planning and SCBA. The fourth en last part of our plea introduces the 'ideal' type of integration. Recommendations are put forward on how best to apply this integrated approach. The article ends with concluding remarks and reflections on further research.

Background

The growing demand for space

Let us illustrate the growing demand for space in view of the situation in the Netherlands. In a sense the Netherlands form a single metropolitan delta. It is also one of the most densely populated countries in the world. We illustrate the phenomenon of the growing demand for space with some Dutch data (CBS, 2003). The first half of the 20th century was characterised by a rapid population growth. In 1900 the country counted about five million inhabitants. Only 50 years later this number was doubled. In the year 2003 more than 16 million people live on the 34,000 square kilometres land of the Netherlands; this means some 480 per square kilometre, far more than the 150 of a hundred years ago (CBS, 2000). This increase becomes even more impressive if one realises that the land area itself has grown by 6 % since 1900, due to land reclamation. If this had not been the case nowadays there would have lived over 500 people per square km. Furthermore, the expectation is that the population will number 17 million in 2030.

Multiple use of space as a solution

All these people want to live, work and recreate. At the same time, people demand more space for themselves (a big home with a garden) than in the past. Moreover, it is not only the growing quantitative demand for space that needs attention. More and more, the qualitative aspects of space become important. For example, people attach a growing value to a living environment that is diverse and ecologically sustainable. This changing demand is closely connected to the increased prosperity in the past decades, which has also led to more time for leisure activities. In this light there is also a growing demand for space for outdoor and nature-related activities, which affects the value of the functions of space and therewith land-use patterns.

It is clear that due to this growing and increasingly diverse demand for space, the allocation of space becomes more complex. Multiple use of space is therefore a concept that must be taken seriously in regional planning processes. Policymakers embrace this concept also, because multiple use increases spatial quality (Van Vliet, 2000). An important aspect of multiple use of space is the number of dimensions that is studied. The traditional approach is two-dimensional: projected onto the base area. In our approach, the combination of functions is the issue. This approach is not new, of course, but became popular again in recent decades. Nowadays, multiple use of space not only concerns the combination of functions. It is seen as a collective term with the aim to achieve spatial quality. Habiforum (the Dutch knowledge network for multiple use of space) employs the following dimensions of multiple use of space (Van Vliet, 2000): a) an intensified use of space, for example clustering of facilities; b) combination of functions; c) utilising the third dimension (for example building underground); d) dimension of time (the fourth dimension): functions change on the basis of day and night, day of the week and by seasons.

Interactive instead of a hierarchical planning

The concept of multiple use of space requires a more interactive and regional type of planning than traditional spatial planning with its strongly top-down approach. This doesn't imply, however, that the *process* needs no leading actor. One actor (preferably at regional level) should be responsible for the process. This role has to be accepted by the other actors, who focus on the content of the planning process. After all, which form of multiple use of space is most suitable depends on the characteristics of the functions that are combined, the specific regional situation and the demands and desires of local actors (stakeholders and shareholders).

In the case of multiple use of space, more people and organisations are involved in the process. Furthermore, the difficulties in the planning and application of projects where multiple use of space is under discussion, become overt on a regional scale. This was in 1998 one of the conclusions of the first part of the research programme of Wageningen University and Research Centre (WUR) called 'New concepts for integral use of space'. Another conclusion was that case studies are a necessary and fertile instrument to get a better control of the problems of integral use of space. Case studies are necessary because every situation is unique. A general instrument for integral or (in other words) multiple use of space is therefore out of the question. Interaction between actors, physical situation and various developments demand specifically regional solutions. However, to arrive at specific solutions, most of the time the same instruments and methods can be used.

The conclusions described above match with the recommendations of the Dutch Scientific Council for Government Policy (WRR), which recently gave the initial impetus for spatial planning to be better linked with social dynamics, for example the growing demand for space (WRR 1998). In their report, attention is focused on strengthening integral planning and the forming of social coalitions on a regional scale.

Interactive planning

More freedom for the decentralised government

Earlier we mentioned the need for a more interactive and regional type of planning in case of multiple use of space. A top-down planning method, which dominated spatial planning in the Netherlands especially in the decades after World War II, is no longer satisfactory. The advice of the Dutch Scientific Council for Government Policy (WRR, 1998) about 'strengthening integral planning and the forming of social coalitions on a regional scale' is included as an assumption in the most recent Dutch Note of Spatial Planning (VROM, 2001). The advice is expressed as follows: 'The decentralised govern-

ment will get more freedom to give shape to their own spatial development policy' (VROM, 2001, p. 260).

In the next section we answer the question from which methods we could learn to achieve a more interactive and regional type of planning. Thereafter, lessons are presented from pilot studies in which such planning is applied and in which multiple use of space is developed.

Theory about interactive planning

In the literature, several methods and models are described that can be used in organising an (interactive planning) process. In the following we focus on three methods that are helpful for the development of a planning process. These are the Soft Systems Methodology, the Knowledge Creating Process and the approach of the interactive process as a negotiating process.

The *Soft Systems Methodology* from *Checkland* consists of six phases. It uses the experience of a particular situation as problematic as its point of departure (Checkland, 1989). The actors must define this problem in detail (phase 2). When this is clear, in the third phase one can design several models, which represent a desired image. In the fourth phase, the models are compared and possibly adapted to the real situation. The formulation of desired states of affairs is the aim of the fifth phase. In the last phase one must take action to improve the situation.

Nonaka and Takeuchi see the conversion of knowledge as driving force of the *'Knowledge Creating Process'* (Nonaka & Takeuchi, 1995). The first phase in their method is called 'socialisation' and consists of sharing experiences. In the second phase ('externalisation'), the tacit knowledge from the first phase must turn to explicit knowledge by means of pictures or metaphors. After that, the explicit knowledge from the different sources is joined (system knowledge). In the fourth and last phase, the 'new' knowledge is made familiar: the explicit knowledge becomes tacit knowledge. Now the cycle can start again with the 'new' tacit knowledge as input in the socialisation phase.

Finally *Leeuwis* sees an interactive process as a negotiating process. His method is useful in conflict situations. He distinguishes seven tasks. First there are the selection of the participants, the investigation of the problems in relation to the context and the investigation of the relations. The aim of the second task is to come to an agreement about the organisation of the process. After that, participants must analyse the conflict situation together in task three. Task four is called 'joint-fact-finding': actions are formulated. Task five is to steer towards an agreement. This is followed by communication between the representatives and their constituencies. The seventh and last task consists of monitoring the agreements that are made about implementation.

It is, of course, also possible to combine methods. For example, the insights of Leeuwis about how to deal with a conflict in a process and the perceptions of Nonaka & Takeuchi about the role of knowledge can be integrated in the theory of Checkland. For instance, one can apply the fifth task of Leeuwis ('steer towards an agreement') in the sixth and last phase of Checkland ('taking action to improve the situation').

The theories described above are used in the development of techniques in processes where multiple use of space is called for. The next two sections focus on this development.

The concept of 'multiple use of space' in interactive planning processes

The experiences described here and in the next section, concern pilots of regional planning processes in which multiple use of space was an important issue. This is a logical restriction because the concept of multiple use of space makes special requirements of a planning process. This was made clear in the pilot project 'Multiple use of space in the south-western part of the Netherlands', which is part of the afore mentioned research programme of WUR called 'New concepts for integral use of space' (Projectteam Zee en Land, 2001).

It may not come as a surprise that projects where multiple use of space is an issue, are complex. In the pilot project therefore, three crucial aspects of a successful application of the concept of multiple use of space are mentioned (Projectteam Zee en Land, 2001). In the first place, 'knowledge innovation' is very important. Because of the integrated approach and the multiplicity of actors involved, a good organisation of the various types of knowledge is crucial. In the second place, public support and participation are essential. To arrive at successful and widely accepted plans, the integration of knowledge with the participation of regional actors, is necessary. The third crucial aspect is a modular approach in combination with evaluation. In case of complicated spatial topics, working with one comprehensive solution is not realistic. It is better to work with modules.

These aspects can be applied in the process through so-called Communities of Practice (CoP). Habiforum defines a CoP as an organisational and work form and most of all as a learning environment of interested actors. The aim is to arrive at innovative concepts of multiple use of space. The lessons that were learned from pilot project 'Multiple use of space in the south-western part of the Netherlands', described above are applied in a pilot project called 'Sea and Land in Multiple use'. The next section pays attention to this pilot.

Experiences with the application of the concept of multiple use of space

The pilot project 'Sea and Land in Multiple use' was carried out by the Dutch Department of Public Works, the National Planning Service, Alterra and LEI. In 2001, several workshops were held to examine the opportunities of multiple use of space in the process of improving the spatial quality of the south-western region of the Netherlands. The intention was to create a feasible basis for a regional CoP in which the desired projects could be stimulated and refined. In the pilot project the perceptions of Nonaka about the importance of knowledge creation were used: during the process, a process manager, and also a knowledge manager played an important role in the coordination of the planning process. Elements from the Soft Systems Methodology (Checkland) and Leeuwis' method can also be recognised.

The planning methods in the project were worked out on the basis of four case studies. These case studies linked to realistic policy options of different forms of multiple use of space. Five steps can be distinguished: 1) Fact finding by the project team. This step also included the defining of the problems encountered in the region; 2) A first workshop with participants from the relevant provinces, municipalities, regional Directorates of the Ministry of Transport, Public Works and Water Management, NGO's (for instance, Southern Agriculture and Horticulture Organisation, Environment Federation Zeeland) and national experts. The aim was to formulate desired states of affairs (this bears comparison to the theory of Checkland for example); 3) Elaboration of the desired states of affairs by the project-team. In this phase attention was also paid to planning the rest of the process; 4) A second workshop: the implementation phase with similar participants as in the first workshop. How feasible are the projects? For every case a final project was made. A final project is for example (an intention for) an agreement to establish a 'real' CoP (this bears comparison to the theory of Leeuwis for example); 5) The follow-up of the project, the transfer to the regional shareholders and stakeholders. In this phase it is discussed how the various projects could be put into action in the region.

As was mentioned earlier, the intention of the pilot project was to create a feasible basis for a regional CoP. During the project this is translated into a renewed and more aggressive approach for the development of a National Landscape in the south-western region that is announced in the most recent Dutch Report on Spatial Planning Policy (VROM, 2001). In the workshops (high tech) computer models were used to facilitate the interactive planning process. We had to conclude that the participants did not use these new techniques effectively. They seemed to be scared to add their information directly to the planning aided models. A facilitator had to do the actual input. Another result was that the participants' output of the workshop did not have

the right format to be used in land use models that estimate future land use. The input requirements of this software did not match with the 'language' of the participants.

Research on the feasibility of plans

Insight in consequences of spatial decisions

Space can be used in many ways. We distinguish production space on behalf of economic development, living space and the strategic stock of nature and landscape (Reinhard et al., 2003). These three elements are related to each other. Development in one element (for example industrial production) has inevitable consequences for the other elements (for example landscape). In policymaking the various forms of spatial utilization must be considered carefully. Therefore, it is necessary to gain insight into social and other consequences of certain decisions. In other words: the costs and benefits of the decisions must be clarified ex ante, through a process known as appraisal. The following section discusses several methods and models to support this process. Next, the experience of LEI in applying social cost-benefit analysis in regional planning processes is described. This will take place by means of two case studies. The methods and experiences presented are the beginning of a first attempt at integration between interactive planning and cost-benefit analysis. This attempt is described in the last section of this third part of the article. Which combination of methods seems the best? In the next and last part of this plea the exercise will be further developed.

Appraisal theory

This section briefly describes three methods of integral appraisal. We pay attention to the method of multi-criteria analysis, social cost-benefit analysis and finally, cost-effectiveness analysis. Social cost-benefit analysis values effects in monetary units, whereas the other two do not. Other appraisal methods are also frequently used. Most of them focus just on certain aspects. For example in the Netherlands an environmental impact assessment (EIA) is a requirement for projects that affect the environment. In the EIA the proposed project has to be compared to the alternative that least affects the environment.

Multi-criteria analysis (MCA) is a general method to approach problems of choice. The aim of MCA is to investigate a number of alternative choices in the light of multiple criteria and conflicting objectives. A ranking of the alternatives can be made on the basis of their suitability. MCA starts from different, explicit criteria of judgment. It is also possible to give one criterion more importance than another. There are three different approaches in MCA: cardinal methods (use of quantitative criteria scores), qualitative methods (use of qualitative scores) and mixed data methods (use of quantitative and qualitative scores). The basis of these methods is the same. The following steps can be distinguished: 1) determine the set of alternatives; 2) formulate the criteria on which the alternatives are judged; 3) determine the scores of the alternatives on the criteria (these are called the criteria scores); 4) standardize the criteria scores (value between zero and one); 5) determine the importance of the criteria (assign weights); 6) link the criteria scores to the weights; 7) from a large amount of scores, formulate an overall mark. As with all models, MCA has some disadvantages: there is as risk that certain aspects are expressed by multiple criteria, while other aspects are not specified, thus introducing hidden weights. Moreover, the importance of the criteria can vary from one person to another and it can change in time.

Social cost-benefit analysis is based on welfare economics (in contrast to MCA). It estimates the project's contribution to welfare. In any SCBA, several stages must be considered. The social benefits of a project consist of the extra benefits the project yields with regard to the original situation. 'Benefit' is a concept from economic theory and can be described as 'that which indi-

viduals experience during the use of goods and services and what they try to maximize' (Eijgenraam et al., 2000). The essential steps are: defining the project, identifying impacts which are economically relevant, quantifying physical impacts, calculating a monetary valuation, discounting, weighting and sensitivity analysis. Focusing on society as a whole makes is possible to select a project on the basis of his contribution to social goals. A second difference with MCA is that it is expressed in terms of money. This enables weighing of the different effects. These two points are the most important arguments for choosing to integrate SCBA (and not another integral method like MCA) in planning processes on a regional scale. MCA has the advantage that policy makers can more easily understand it, because this method can be explained quickly. A SCBA is more expensive than a MCA. The distribution of the costs and benefits over the population is not incorporated in a SCBA, while income distribution might be a policy objective. For a comparison of MCA and SCBA the reader is referred to Reinhard et al. (2003). For infrastructure projects the so-called OEEI (Research on the Economic Effects of Infrastructure Projects) guidelines have been developed. Since April 2000 the Netherlands government declared these guidelines compulsory for projects with a spatial dimension of national importance.

In *cost effectiveness analysis* (CEA) different projects (measures) are compared that generate the same outcome. Because the result of the projects that are being compared is identical the project with least costs for society is preferred. These social costs are computed according the social cost benefit analysis. The main difference with SCBA is the fact that benefits are not expressed in monetary values.

In the first part of the article we mentioned the growing demand for nature and recreation facilities as a result of increased prosperity. In combination with the circumstances of multiple use of space, this requires certain conditions of SCBA. The benefits of land uses as recreation and nature for example, must be incorporated in the social cost-benefit analysis. The services provided by recreation facilities, landscape and nature are not traded in a market: they are external effects and therefore the valuation of these land uses is more complicated. In case of multiple use of space the costs can be computed easily but the benefits is mostly not a simple summation of the benefits of the underlying functions. In the SCBA these problems have to be solved. In the case of nature development, for example, it deals with an increase of enjoyment in living and recreation and income from the timber sale. Some goods can be traded in the market, and can therefore easily be assigned a price. However, if this is not the case (like nature and clean air), the benefits must be estimated by means of valuation methods. Often external effects are treated as p.m. (pro memory) in the costs benefit balance.

A first attempt at integration

Apart from the concept of multiple use of space in planning processes (which was described in the second part of the article), LEI also has experience with processes where SCBA is integrated in the planning process in one way or another. We focus on two case studies to illustrate possible ways of applying SCBA in interactive planning processes. In the first case study, we focus on the definition of desired images in Checkland's sense. This was necessary because the development situation was blocked and a final common view was far from being reached. In the second case study, there was a completely different situation. A large number (10) development scenarios were given, but the difference between them in terms of social welfare was unknown.

The case of *reopening the Apeldoorn Canal* illustrates the interactive use of SCBA in designing alternative development models. The Apeldoorn Canal is an early 19th century waterway in the centre of the Netherlands that once opened up the eastern rim of the Veluwe region for economic development. Due to several reasons, the connection fell into disuse and finally in 1972 the canal was closed completely for navigation. In recent years however, local au-

thorities, leisure investors, nature conservators, water companies and protectors of industrial heritage became aware of the high potential value of the Apeldoorn Canal, albeit from different perspectives. Many studies, surveys, models and development plans were published. The central issue was reopening the canal for navigation, in particular for recreation vessels. It was evident that interests diverged and a simple solution was not easy to be found. Only a balanced combination of functions attributed to the canal and its immediate surroundings could possibly lead to a sustainable solution with increased social welfare. In this case SCBA was applied in an interactive process to facilitate the discussion about an optimal mix of functions.

The process consisted of seven steps. In the first step the researchers defined two preliminary alternative models, based on elements mentioned in the available studies of the Apeldoorn canal. In the second step, the most dominant effects of both models were identified and those effects that could be assessed in monetary terms were calculated. In other words: in this stage a first and quick SCBA based on rough data was done. These results were given feedback to the advisory group of the study. The discussions in the advisory group then gave rise to amendments on both models. In the third step, we reformulated the two models by changing the amount of several elements or by adding or deleting certain elements completely. With this input, we recalculated the effects in order to have a more realistic SCBA than in the second step. The fourth step of the interactive process consisted of a creative session in the form of a workshop with a group of about 20 specialists in the functions concerned, like recreation businessmen, forest managers, waterboard managers, consultants for tourism, Chamber of Commerce, etc. The participants were invited as private persons, not as representatives of an organisation. The objective of this workshop was to see if new elements could be added to increase the social cost-benefit balance of the respective models. Besides, we expected to find out whether elements from both models could be combined in order to construct a new, third model. Among other things, the output of the second SCBA was used as input. The result of the session was that a surprisingly large common basis of both extreme models could be defined.

Following the workshop, we again performed an SCBA starting from the once again reformulated models. Although this was intended to be the fifth and last step of the project, the interactive process did not stop. Even the draft report of the study containing the results of this SCBA stimulated the parties involved to reconsider the functions and in particular the volume of some of the elements. One lesson from this study is the need for frequent feedback between researchers, clients and other participants. Another conclusion is, that the position of SCBA as a facilitator of the process must be clear beforehand to all parties involved. None of the regional authorities was the direct commissioner for the project, which was presented and carried out as a methodological (but not theoretical!) study. This fact greatly enhanced the involvement of the participants in the workshop.

The case of the *inundation of the Horstermeer Polder* is an illustration of the use of SCBA identifying an optimal development model and facilitating the process of finding new alternatives of spatial design. The Horstermeer is a polder in the vicinity of Amsterdam. Due to its low position in comparison to the neighbouring hills, groundwater flows into the polder. This water has to be pumped away permanently in order to have the place habitable and to make it possible to practise agricultural activity. Almost 50 % of the area is used for keeping dairy cattle.

The regional authority, the Province of North-Holland, wishes to enlarge the nature area in its territory. This could be done by inundating about 40 % of the Horstermeer polder and converting it into wetlands, at the same time relieving the water problem. Inundation of such a large area was considered a major intervention in the natural environment, for which an environmental impact assessment (EIA) had to be performed. The scope of EIA is primarily environmental and not aimed at optimising the social cost-benefit balance. It was therefore decided that in addition to the EIA, an SCBA would be per-

formed. Originally, the various alternatives distinguished in the EIA were taken as input for the SCBA. Seven alternatives were taken into account, along with the so-called autonomous development scenario. For each alternative, an SCBA was carried out. The results of this process were reported to the client of the study. Until this moment, there was no interactive process. But since the project has not finished yet, this may yet come about. One main conclusion so far is, that SCBA itself is a useful method to find the optimal model, but the differences between the models are too small for SCBA to have an added value as compared to simple financial cost-benefit analysis.

At the same time, however, the inhabitants of the Horstermeer realised, that partial inundation of their polder might be a sub-optimal solution. Supported by the government-sponsored Habiforum Knowledge Network for Multiple land use, the inhabitants of Horstermeer developed two far-reaching models. In these models, known as the "mirror project", the polder was completely redesigned. In sessions with the inhabitants and the client for the EIA study, the researchers identified the essential elements of these models, both in quality and quantity. Local representatives could provide some key indicators. With this input, an SCBA for the mirror project models was performed, in which a clear contrast between the models appeared.

The lesson learned from this application of SCBA is that the discussion between researchers, clients and other participants should focus on two or three clearly distinctive models. Too much detail should be avoided. On the other hand, key indicators used in calculating effects have to be available and well documented.

From both cases, it becomes clear, that information about the social effects of spatial development plans should come from two sources. On the one hand, the regional stakeholders, who have their visions and opinions about the development as a whole as well as detailed information about one or two specific functions. On the other hand, there are the researchers who must have at their disposal methods to manage the process and general data and key indicators. With respect to this latter fact, both parties are aware of the concept of multiple land use, but adequate data are scarce. For example, in the Apeldoorn Canal case the aspect of combining drinking water and navigable water are examples of the second and fourth dimension of multiple land use as distinguished by Habiforum (Van Vliet, 2000). In the case study very different data sources had to be combined and a balancing could only be made indirectly.

In general, this poses the problem of reliable data for combinations of functions, be it in space, time or otherwise. Almost all monitoring systems are still concerned with unique, non-interacting functions, e.g. added value for agricultural activities or even valuation of nature areas. The fact, that one plus one might be larger than two yet cannot be derived from basic data.

Towards an ideal type of integration

Soft System Methodology as leitmotiv

For the ideal integration of interactive planning and SCBA the stages of both processes must be intertwined. Interactive planning focuses on the participants, their problems and communication. These elements do not exist in SCBA; because it computes welfare for society as a whole (all stakeholders), it assumes that the problem is identified (and shared) and that the project with the largest contribution to welfare is preferred. Public support and distribution of the benefits over the community are not part of SCBA, but are prerequisites for an interactive planning process.

Now what method of interactive planning seems best for the integration with SCBA? In the first part of our plea, we described the theories of Checkland, Nonaka and Takeuchi and Leeuwis. In our opinion, the theory of Checkland is the most suitable basis for integration with SCBA. This is because we embrace the idea that actors discuss the desired states of affairs among

themselves in several stages of the planning process. This approach is also successfully applied in the pilot project 'Sea and Land in Multiple use' which was quoted earlier in this article. The Soft System Methodology is therefore used as leitmotiv for the 'ideal model' of interactive (regional) planning processes, which is presented below (see also figure 1). As mentioned before, Leeuwis' insights about how to deal with conflict in a process and the Nonaka & Takeuchi perceptions about the role of knowledge are also useful in this respect.

From problem definition to a first project balance

The problem definition is the crucial first step that in the process; it must be defined by the regional actors (phase 2 in the Soft Systems Methodology). If the stakeholders and shareholders are not familiar with the current situation, joint fact finding is necessary to create a shared starting point for the planning process. These joined facts can be used to define the default situation, to compare the effects of projects. Thereafter several models are designed which represent a desired image. But one important aspect of the desired situation is, of course, the benefits gained by the transition to this new situation. However, these benefits are not clear from the beginning. The costs and benefits tied to a certain land use (for instance arable land) can be added to the designed plans. If the planning process is aided by a Sketch GIS application (Van Deursen) the costs and benefits of every form of land use can be easily attached to the desired situation as drawn in the plan. The goal is to start a discussion with the stakeholders about the direction in which to look for a solution of the problems encountered in the region. The summation of these costs and benefits provides a first impression of the financial and social feasibility of the plan. This information on the costs and benefits of a project is important if the budget for solving the problem is limited or when the project with the surplus benefits is selected. To calculate this first project balance a database of average costs and benefits of all relevant land uses must be available, for instance based on previous studies.

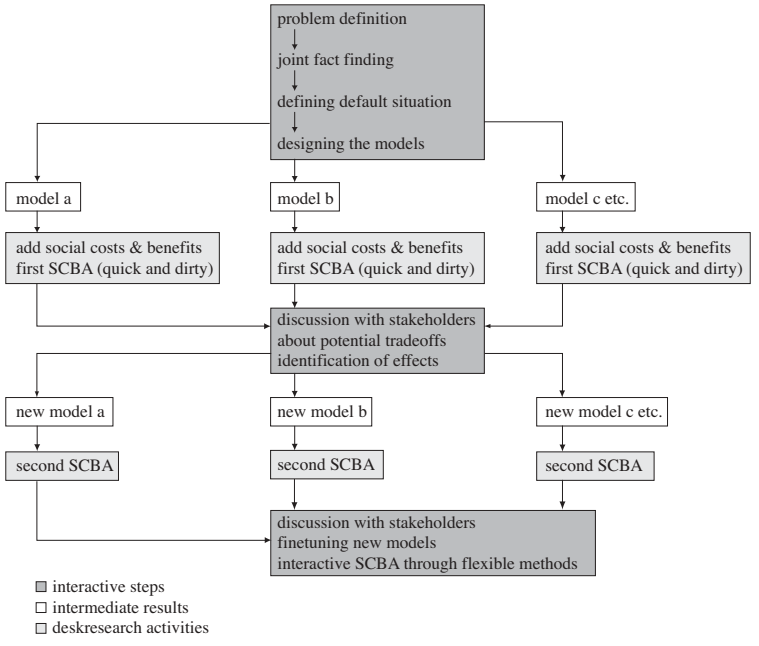

Figure 1: A planning process with the integrated approach

Using SCBA results in the discussion

The results of this first project balance can already lead to changes in the desired situation. This first cost-benefit analysis is a 'quick-and-dirty' method because interaction between the different land uses is not taken into account. Thus the exact location of a specific land use does not matter for the project balance. The results can be used to start a discussion among the various actors about the potential tradeoffs in the plan - for instance, building houses versus creating nature reserves. The role of this first cost-benefit analysis in the planning process is to create consensus about the direction of the

plan. Therefore it is essential to identify the effects of the plan in a group session. Although a long list of potential welfare effects exists in literature, it is necessary to analyse with the group of stakeholders and shareholders what effects are important in their context. This identification of relevant effects (relevant to the goals of the actors) is essential because it makes the impact of the plan clear to all and it facilitates the group process. The different goals of the actors are related to the impact of the plan, new coalitions may emerge. This session based on the first SCBA results also improves the acceptability of the final SCBA.

Refining the plan

In the next phase the plan is being refined. The land uses are located more exactly on the map. Again the costs and benefits are computed but now the relation between land uses is taken into account. For instance a recreational facility adjacent to a city generates more benefits than one located at a larger distance from that city. Houses located on a lakeshore are more valuable than houses without any water in the vicinity. At this stage also multiple land use is defined as a solution to fulfil as many demands as possible in the plan. The benefits of multiple land use are quite difficult to determine. Due to the interaction between multiple land uses at the same location, aggregate benefits are not simply the sum of the separate benefits. Often information about the magnitude of this interaction is not available. To minimise this negative interaction actors can make arrangements based on the local situation. An interactive process of planning the locations and computing the project balances will generate a plan with a higher project balance. In this phase two or more alternatives are defined. It is important that the argumentation of these plans is described well.

The exact project balance of these alternatives will be computed afterwards, based on more exact information on the region. If the exact balance differs significantly from the results of the second phase the researcher can advise changing the plan slightly to improve the project balance while still following the argumentation of the actors.

Advantages and circumstances of the approach

One of the advantages of this approach is that the actors get acquainted with the simple version of the cost-benefit method. This improves the support for SCBA of the final project. This approach also provides information for discussing the essence of the plan in the first phase before the plans are elaborated in detail. It also provides the stakeholders and shareholders with information about the feasibility of the plan at an early stage. Another advantage is that SCBA focuses on the benefits to society as a whole and not to specific groups. The distribution of costs and benefits could also be provided in addition to the standard SCBA to improve the acceptability of the approach and results for specific groups.

Concluding remarks

Combining SCBA and Soft System Methodology

We note the growing demand for space and need for more spatial quality. In areas where the demand for space exceeds supply (for instance in metropolitan delta areas), multiple use of space is seen as a solution for potential problems. We state that the concept of multiple use of space requires an interactive and more regional type of planning. The theories of Checkland, Nonaka & Takeuchi and Leeuwis can be used as input for interactive planning processes. If multiple use of space is at stake in these processes, three aspects must not be forgotten: knowledge innovation, a modular approach and public support. To create this support and to avoid time and money being spent on elaborating plans that are not beneficial to society, it is important that the costs and benefits of plans are clear early in the planning process. We postu-

late that social cost-benefit analysis is the most suitable method to achieve this.

We present an 'ideal' method for interactive regional planning processes (figure 1). This method is based on a combination of theories (Soft System Methodology) and experiences of interactive planning processes with appraisal theory (social cost-benefit analysis).

Points of special interest

The essence of our method is the fact that SCBA is performed at various stages of the process, based on the input of interactive sessions. The problem must be clear and the actors have to support the planning process to solve the shared problem. This approach allows improvement of the plans towards the desired developments. Fine-tuning of the plans in a final stage can also be based on an interactive session in which SCBA is calculated instantaneously. This step requires a very flexible SCBA model, which is prepared for the region. An important requirement is that all stakeholders and shareholders have to participate from the beginning. A situation where some actors stand aside and only become active when their own interest is threatened (the nimby effect) should be avoided. This also poses certain requirements for the interactive process; it should be quite simple to allow all actors to understand and to participate actively. A first quick-and-dirty SCBA shows the playing field, but for the remainder of the process a pre-arranged solution is not allowed. Although most aspects and stages of our method have been tested, new experiences might demand adjustments to our method.

Reflections on the future

An import issue for future research is how to get output of interactive sessions suitable for use in CBA models. Otherwise, it is also possible that adaptations to the standard CBA method (or a combination with another method like MCA) must be developed to reach the desired integration. Possibly the concept of articulating goals into a 'SMART'-schedule can facilitate combining appraisal and interactive policymaking. An accepted set of indicators for the costs and benefits of various land uses is necessary. Combining GIS facilities and SCBA models and a module to divide costs and benefits over the relevant actor groups will be a valuable extension of the SCBA instrument for interactive planning.

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Hydropolitan: An interactive tool for hydrology management in metropolitan deltas

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Introduction

A common issue of metropolitan deltas is the location in an estuary. Such a location has advantages: the soil is fertile, there is an abundance of fresh water, and it is near the sea, which offers a good trading location – reasons why densely populated metropolitan deltas exist all over the world. An estuary is a wet area, and in natural circumstances, the sea and rivers tend to flood regularly. If urban areas are developed in such an area, hydrological problems are bound to occur that must be solved, otherwise people get wet feet and wet houses. Therefore it is very important that physical planners involved in the development of delta regions understand the hydrological situation with its physical limitations. They should also be aware of the (technical) possibilities to make river deltas a saver place for inhabitants.

Why an interactive tool?

Planners need the help of experienced hydrologists to solve problems in metropolitan deltas. For an effective co-operation with hydrologists, planners and other actors in the planning process need to have a basic understanding of the hydrology, to search together for the best development plans and the best solutions for a delta region. The interactive tool "Hydropolitan", explains *hydro*logical problems and possible solutions of a metro*politan* delta, using simple pictures instead of complicated formulas, with Rotterdam and its surrounding area in the western part of the Netherlands as a sample area. The purpose of our tool is to offer an attractive means for non-hydrologists to develop the required basic understanding of the hydrological problems and solutions of metropolitan deltas. No models have been used to create the pictures: they are photomontages and drawings that are easy to grasp, based on sketches made by an experienced hydrologist. The scale of the pictures is indicative of the problems to be visualised, and is not necessarily accurate.

We hope that planners and other persons involved in the planning of metropolitan deltas will benefit from our tool. But we also hope to gain more insight in "hydropolitan" problems and solutions conceived in other countries by encouraging participants to put comments in the comment boxes of the tool. The tool is a website, so people from all over the world will be able to visit our tool and to add their comments through the Internet (http://cgi.girs.wageningen-ur.nl/Hydropolitan/index.htm).

Why this article?

In this article we would like to offer our readers an innovative way to discuss scientific issues between scientists and non-scientists, in this case between hydrologists and non-hydrologists, and discuss the usefulness of such a tool. At the same time we describe several problems and solutions given by the tool, to explain with what problems a metropolitan delta like the Rotterdam area is confronted, and what kind of solutions are already applied or

Figure 1: Location of Rotterdam in the delta of the rivers Rhine, Maas and Waal, as shown in the Hydropolitan website. *Source:* Netherlands Substratum as contained in the Vijfde Nota Ruimtelijke Ordening (Fifth Policy Document on Town and Country Planning), 2001, Ministry for Housing, Regional Development and the Environment

Figure 2: The home page of Hydropolitan: the buttons enable one to zoom in on problems and solutions in different areas around the Rotterdam metropolis

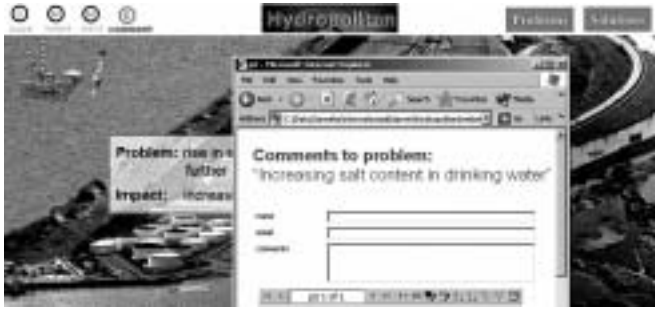

Figure 3: Possibility to add comments in Hydropolitan

are in discussion. This issue is becoming more urgent in view of the expected global rise in temperature, causing the sea level to rise with an increasing risk of flooding as a consequence.

How does the tool work?

After accessing the Hydropolitan website, an introduction on the purpose of the website is given as well as some instructions on how to operate the tool. Also a map is shown indicating the location of the Rotterdam area within the delta of the rivers Rhine, Maas (Meuse) and Waal (figure 1).

After clicking on the rectangle indicating the Rotterdam location, an overview picture is shown of the area of Rotterdam. It is a digital photomontage depicting a "condensed" visualisation of the area (figure 2).

This overview picture is the "home" page of the *Hydropolitan* website. By clicking on one of the buttons the tool zooms in on that area and explains the problem and its impact with animated pictures and a text box. Next, the visitor is invited to look at the solutions to the problem at hand. The picture gradually changes into a new situation that shows the new landscape when the proposed solution(s) is/are applied (e.g. the construction of a dam to avoid inundation). By clicking on "home" the visitor returns to the overview picture, where he/she can choose another problem to be visualised. The visitor is also invited to read or add comments to this solution. First a text is shown explaining the problems and solutions in more detail than in the pictures. Next the visitor is asked whether he or she wants to add any comments (figure 3). These comments are stored in documents that can be read by other visitors when looking at the relevant problem and solution.

Hydrological problems and solutions in the delta metropolis of Rotterdam

This paragraph describes several clusters of problems, impacts and solutions that are explained in the Hydropolitan tool, with some of the appropri-

ate pictures. Note that the scale of the pictures is indicative of the problems, and is not necessarily accurate.

Problems and solutions related to drinking water

As the metropolis of Rotterdam grew, so did the demand for drinking water. Clean, fresh water was available in the dunes, so the city started to extract water from the dunes. As a result, the water table in the dunes fell, causing a decline of upward seepage in the inner dunes (figure 4) and a decline in nature conservation value of the inner dunes, as was reported e.g. by Bakker et al. (1981).

The first solution that was actually applied by the drinking water company in the Rotterdam area, was to infiltrate river water in the dunes, to keep the water table in the dunes from lowering rapidly. However, this caused the quality of the groundwater to decline, causing disturbance of the natural habitats in the inner dunes and the further decline of nature conservation quality. The drinking water company finally decided to stop the extraction of drinking water from the dunes, and use rain water (stored in reservoirs) and river water for drinking water instead. As a result, the water table in the dunes and upward seepage in the inner dunes has been restored (figure 5).

But now a new problem is arising for the use of river water as drinking water. The Intergovernmental Panel on Climate Change (2001) states that the average global temperature is expected to rise 2 to 4 degrees in the next 100 years. And according to Verbeek (2003) the temperature is rising in the Netherlands even more rapidly than was expected because the prevailing wind direction is shifting from west to south west, bringing warmer winds.

As a consequence, the sea water is expanding and the ice in the pole regions is gradually melting, especially in the South Pole, causing the sea level to rise. The rise in sea level is expected to be between 45 to 110 cm in the next 100 years, and this will cause further intrusion of salt water into the rivers, resulting in a higher salt content in drinking water that is extracted from rivers.

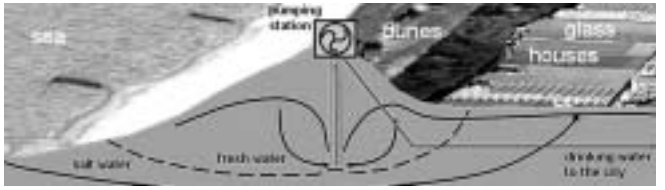

Figure 4: Fall of water table due to extraction of drinking water in the dunes

Figure 5: Restoration of water table and upward seepage in inner dune belt after stopping drinking water extraction in the dunes

Figure 6: Solutions to avoid salinization of drinking water due to rising sea level

We propose several solutions to this problem that can be combined (figure 6).

Firstly, air can be pumped through a perforated pipe on the river bed. This will generate an upward water flow which will push the salt water back towards the sea. This technique is actually in use near docking locks to prevent the intrusion of salt water upstream, but is not yet implemented in the Rotterdam area.

Next, the intake points for water can be allocated further upstream, as has been done in the past. And lastly, drinking water reservoirs can be constructed (as was actually done near Rotterdam, when drinking water was no longer extracted from the dunes).

Problems and solutions related to pollution and rising sea level

Besides the extraction of drinking water from the dunes, there is another factor contributing to the decline of upward seepage in the inner dunes and the related decline in nature conservation value. *Bulb cultivation* is a major economic activity in the Netherlands. The sandy soil along the inner dunes is very suitable for bulb cultivation, so many bulb fields are situated there. However, the drainage of the bulb fields causes fresh water from the dunes to seep into the bulb fields, thus lowering the water table in the dunes and causing a decline of the upward seepage in the inner dunes. Moreover, the pesticides that are used in bulb cultivation pollute the surface water. Both problems cause a deterioration of the aquatic ecosystems and a decline in quality of the terrestrial ecosystems in the inner dunes (figure 7).

Van Bakel et al. (1999) propose to re-allocate bulb cultivation to less vulnerable sites. For the restoration of upward seepage in the inner dunes, one might consider the construction of a water basin along the coast. Such a water basin could be a *tidal lake*, offering at the same time an alternative "green" energy source instead of oil. More pollution caused by oil spills in the sea due to accidents during oil extraction from under the sea bed or by oil

Figure 7: Lowering of water table and pollution of surface water in the inner dunes, due to use of pesticides in bulb cultivation, causing deterioration of aquatic and terrestrial ecosystems.

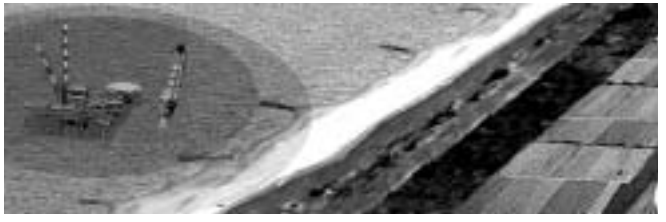

Figure 8: Oil pollution causing death of sea birds and marine organisms

transport causing the death of sea birds and marine organisms (figure 8), can then be avoided. On the Dutch coast, the tidal differences in sea level are not sufficient for tidal energy alone. Ina Klaasen (1981) reported that a Dutch researcher (Lievense) suggested using additional energy from *wind turbines* to fill lakes. By keeping the water level in a lake high, a buffer is created so that the water level can be lowered to create energy on demand (figure 9). The feasibility of tidal energy is currently under review. A drawback of a tidal lake is de fact that it contains salt water, which will cause a further increase in salt content of the groundwater in the surrounding area. Fresh water preservation will have to be sought elsewhere (e.g. by reservoir management upstream of the rivers, as is explained in the next section).

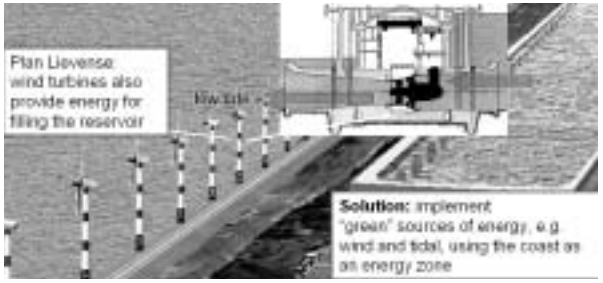

Figure 9: Construction of a tidal lake and wind turbines as green sources of energy, to avoid oil pollution. Since present bulb cultivation will have to make room for the tidal lake, lowering of the water table in the dunes and pesticide pollution will also stop. The dam will decrease the risk of flooding due to sea level rising.

Constructing a *dam along the coast* (figure 9) decreases the risk of flooding due to the rising sea level. Practically the whole western part of the Netherlands lies below sea level (1 to 7 m). Therefore, the greatest danger of the rise in sea level will be the erosion of the coastal zone, causing flooding of one of the most densely populated areas in Europe. One might consider improving the sustainability of the dunes, but the safest solution is to construct a retaining dam along the coast. By adding a road or train to the dam, travelling times in the coastal area will decrease significantly.

Unfortunately, this dam and the proposed "coastal energy zone" will affect the scenic beauty and cause a decline of the nature conservation value of the dunes, although mitigating measures might be applied (e.g. avoid visibility of the dam by hiding it behind higher dunes). The wind turbines will likely cause the death of many birds. That is one of the reasons why many environmentalists as well as politicians oppose against the construction of vast amounts of wind turbines, especially along the coast. The construction of a retaining dam along the coast is not yet considered as a serious option, but in the coming decades it will certainly be a subject for discussion.

Problems related to wetlands and river management

Natural deltas are characterised by wetlands with a rich nature. In the Rotterdam area only a few fragments of wetlands remain. The nature conservation quality of these fragments declines gradually, due to downward seepage caused by the drainage of (lower) neighbouring pastures. Most pastures in the western part of the Netherlands are situated on peat soil, where drainage causes soil subsidence and land level decline, mainly through mineralization of the soil. This process has been going on for a long time, and will not stop until firmer soil is reached underneath the peat layer. The subsidence of the soil causes damage to the foundations of buildings in the area, and pumping costs for drainage are high. These costs are expected to increase even more due to the ongoing global climate change, which will result in a rise of precipitation and higher peak levels of rivers, and thus the need for more pumping capacity (figure 10).

In the past, the pumping capacity in the Dutch peat areas has frequently been increased, and might be considered again. However, the only really sustainable solution will be to cease using peat soil for agriculture and instead choose other forms of land use which allow seasonal variation in water level and salt content, e.g. wetlands. By expanding the wetland areas, soil subsidence will cease and seepage from the existing fragments of wetlands to lower pastures will stop, resulting in an increase of nature conservation quality. To avoid damage to buildings it might be considered to modify building techniques on peat soil: e.g., place buildings on pillars or on floating islands. This "living on water" will also make the implementation affordable (figure 11).

One of the ways to create new wetlands is the expansion of *river flood plains.* Over the past centuries, many areas that were originally part of the flood plains have been embanked, not only in the Netherlands, but also in neighbouring countries, causing high-peak river water levels after heavy precipitation upstream. The ongoing climate change will result in an increase of

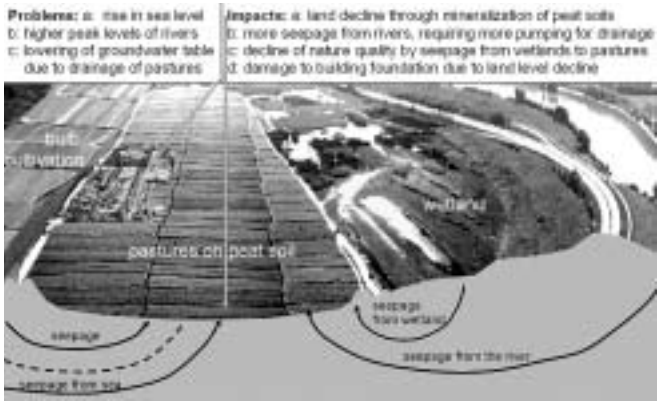

Figure 10: Soil subsidence causing land level decline due to drainage of pastures on peat soil, resulting in high pumping costs, the decline of wetland quality and damage to buildings

Figure 11: Expansion of wetlands/flood plains as a sustainable solution to stop further land subsidence and to avoid flooding of the rivers in view of climatic changes

precipitation (6 % to 12 % expected in the next 100 years), and higher extremes in precipitation (expected rise of 20 % to 40% in the next 100 years according to the Intergovernmental Panel on Climate Change, 2001). This means we can expect higher risks of overflowing river banks and flooding of the enclosed areas in the future.

Raising the river banks or dikes is one option, but a more sustainable solution is restoring or creating new flood plains. If necessary, roads along the rivers should be constructed on pillars to allow wider flood plains (figure 11). Additionally, it should be considered to retain more water upstream by modifying the land use, e.g. extensive grazing, that allows regular high water tables and flooding in extreme circumstances. An additional option is the construction of reservoirs that can be filled during high-peak water levels of rivers. This water can later be used in summer to increase the water discharge of rivers, ensuring transport on water and sufficient availability of water for agriculture during dry periods.

At the moment serious plans are being made to increase flood planes and several plans are actually being implemented, as has been reported by the "Commissie Noodoverloopgebieden" (2002). There are also plans for the construction of water reservoirs and the allocation of areas that are allowed to flood in extreme circumstances.

Discussion

This section discusses the usefulness of the Hydropolitan tool and presents ideas for future research.

Visualisation technique

When we presented the tool during the conference of the International Association of Landscape Ecology (IALE) in Darwin (July 2003), the reactions of potential visitors were positive. They liked the visualisation technique, us-

ing simple pictures to explain complex problems and solutions. They thought the tool to be unique and innovative, bridging the gap between science and society.

Linkages between different solutions

One of the participants of the IALE conference, a hydrologist, missed a clear insight into the interactions between the different solutions. He wondered what the influences would be of one particular solution on the other problems and solutions. We admit that these inter-linkages are not obvious while using the tool only briefly, as each problem and its solutions is viewed separately. In the text that explains the problems in more detail (which can be viewed through the "comment button"), the linkages between the different problems and solutions is expressed by referring to other problems and solutions. For example, in the text explaining the solution to the problem of declining quality of wetlands due to seepage to drained neighbouring pastures, it says: "The most sustainable solution is therefore to cease agriculture and expand the wet nature areas... This solution might seem drastic, but in the next problem you will see that many lower pasture areas in the western part of the Netherlands are not very suitable for agriculture anyway, due to soil conditions."

How the different solutions fit together is also presented after clicking the problem button in the middle of the city of Rotterdam. First the risk of inundation of the city of Rotterdam is visualised (figure 12a). Then the picture zooms out to illustrate the additional risk of oil pollution (figure 12b). After clicking the solution button the image gradually changes into a (quite technocratic) landscape of the future of the whole area, in which all the solutions are incorporated (figure 12c).

Scientific validity of the tool

While creating the tool, we had some discussions with the hydrologist of

Figure 12: Presentation of the problem of increasing risk of inundation (a), zoomed out to the whole area adding the problem of oil pollution (b), and presentation of all solutions incorporated into one future landscape (c)

our team on the accuracy of the pictures. He would have liked more detail in the pictures, staying more in line with the hydrological reality and the way hydrologists usually visualise hydrological situations (e.g pictures generated by software offered by the hydrological internet site http://www.waterloohydrogeologic.com/software/visual_modflow_pro/index.htm). However, that meant that a lot of details needed to be added to the pictures that were not directly relevant to the problems to be visualised. We were afraid that these details would only confuse non-hydrologists, and would distract the viewer. So we decided to focus on the relevant hydrological lines and arrows, and leave out the rest. For the same purpose parts of the pictures are oversized and many presentations are exaggerated (e.g. figure 12). Although the hydrologist in our team accepted this (reluctantly), others might argue that our pictures are not scientifically correct.

As mentioned earlier, another point of discussion is the fact that no models have been used to support the creation of the pictures; they are merely based on sketches made by an experienced hydrologist. Scientists might therefore argue that our pictures are not scientifically valid, and that the presented solutions are not proven to be realistic or even effective. We must admit that this is true.

However, the purpose of our tool is not to give an accurate, hydrologically correct answer to the presented problems. For that purpose hydrological models have been (and are being) developed with which hydrologists try to predict impacts of technical solutions in relation to climatic change. But the results of these models are only comprehensible to highly specialized scientists or engineers. Our tool on the other hand is meant to be used by non-specialists, people who are involved in the planning process. It would therefore be a major challenge to combine both and link these scientific models to visualisation tools that would convert the model outputs automatically into comprehensible pictures. Current three dimensional visualisation tools offer the technical possibilities to make accurate, detailed pictures of model outputs; these kinds of tools are offered on the Internet (e.g: the earlier mentioned website on waterloohydrogoelogic software). The major challenge will be to make these pictures less technical, emphasising relevant issues and leaving out less relevant details.

Benefits of our tool

We hope that tools like *Hydropolitan* will stimulate discussions between hydrologists and non-hydrologists, in order to find good planning solutions. We do not pretend that our tool presents the only, or the best solutions for the problems of metropolitan deltas. For example, we are aware of the fact that, if the temperature and the sea level will consistently rise in the next few hundred years, the only sustainable solution might be to move all inhabitants of the lower western part to the higher eastern part of the Netherlands, giving the western part back to the sea.

So, the solutions presented in the tool apply only to this century, not beyond. But we do not particularly like the technocratic landscape that we propose as a solution for this century in the area of Rotterdam. Of course measures might be considered to improve the scenic value, but we hope others, hydrologists or non-hydrologists alike, will help us to find better solutions for our area. That is one of the reasons why we have installed the tool on the Internet (http://cgi.girs.wageningen-ur.nl/Hydropolitan/index.htm). Visitors can help us finding better solutions by filling in their comments in the tool. But we also hope that our tool will stimulate people all over the world to find creative solutions for their own metropolitan deltas.

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Sustainable land use planning and valorisation of the natural and cultural resources in the metropolitan area of Milan (Italy)

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Premise

Rural areas are attracting increasing attention at both political and social levels thanks to ever-greater recognition of their multi-functional nature. Alongside the traditional productive role associated with agriculture, rural land is destined to satisfy the growing demand for residential settlements in "green areas", activities associated with leisure and the pleasure of nature and the landscape, the relocation of industrial and service enterprises.

Over the last 15-20 years, much of Europe has, in fact, witnessed the spread of a phenomenon known as "rurbanization", characterized by:

I) an increase in the movement of the population from urban to rural areas, a movement partly motivated by a reaction to the chaos and pollution (atmospheric and acoustic) of the cities and the attraction of an accessible rural environment considered to be more "livable";

II) the relocation of numerous urban industrial and service enterprises, in particular those capable of exploiting information technology, to green suburban and rural areas where more land is available at a lower cost.

In this context, the government of rural land (planning, design and management) requires the adoption of new instruments (in the form of procedures, methods and techniques) in order to tackle the challenge posed by development (that must be sustainable) and to safeguard and enhance the resources present. These considerations are particularly valid with regards to the rural land of the Lombardy region, characterized by new situations such as rapid urbanization that has transformed the rural landscape and the transformation of agriculture under the pressure of technological development and the EU policy trends, but also by the mature awareness that productive activities must increasingly take into consideration questions of environmental impact if natural resources and the landscape are to be safeguarded.

The new challenges that must be met in the development of Lombard rural areas may be delineated as follows:

I) the valorization of the resources present in the territory;

II) the development of a balanced land use policy that counters the tendency towards an "uncontrolled" urbanization of rural areas;

III) the development of efficient agriculture that is competitive while sensitive to environmental concerns.

In this context, the Lombardy Region's Agriculture Department has activated a series of initiatives designed to provide efficient support for projects concerned with the safeguarding and valorization of rural areas, with particular attention being paid to the use of agricultural land and the control of land use transformation (increasingly necessary within the rural areas closest to the cities and subject to strong pressures towards urbanization).

Objectives of the study

This study falls within the ambit of one of the "strategic projects" comprising the Lombardy Regional Development Program, specifically the Sal.Va.Te.R Strategic Project (Safeguarding and Valorization of Rural Areas). This project, promoted by the Agriculture Department's Rural Environment and Forestry Policies Service, has the following basic objectives:

I) the development of operational proposals regarding:

a) the planning and management of rural areas

b) the use of water and soil resources

c) the development of forms of agriculture with positive and significant environmental and landscape aspects;

II) the realization of innovative projects with regards the canal network with positive effects on the landscape and the rural areas.

The objective of the present study is that of defining a "Master Plan for the Valorization of Rural Peri-urban Areas" that identifies the diverse vocations of the rural areas in view of its sustainable development. This is as provided for by the legislative decree relative to the provincial land use plans (Lombardy Region D. Lgs. 267/2000, LR 1/2000) calling for the evaluation of the "vocations" of the provincial territory.

Case-study area

In order to develop and fine-tune the methodology most appropriate for defining a "Master Plan for the Valorization of Rural Peri-urban Areas" identifying its diverse vocations, we decided to set up a "pilot project" in the area traversed by the *Naviglio Martesana*, one of the most important of the Lombard canals (Figure 1). The case-study area comprises 13 municipalities directly traversed by the canal, plus part of the Municipality of Milan, for a total area of around 130 km^2. While presenting a number of examples of partial landscape degradation, the Martesana area, distinguished by the vicinity of the city of Milan, is rich in elements of value from the historical-cultural, agricultural and natural points of view, all of which may represent opportunities for the development and upgrading of the area.

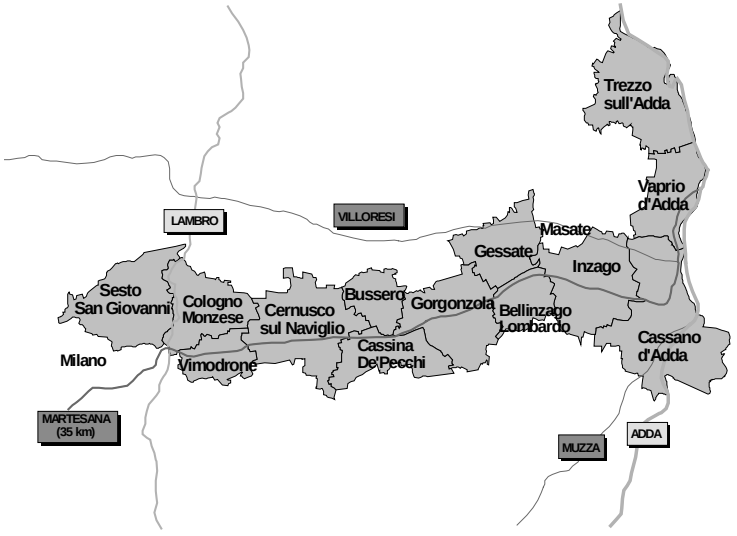

Figure 1: Case-study area

The case-study area presents a highly diversified landscape: along the canal axis, from west to east, one sees a passage from the Milanese urban form to one defined by the nuclei of the agricultural plain with the progressive thinning-out of the major commercial and recreational services, but also a greater visibility/accessibility of the agricultural landscape. In this context, the *Naviglio Martesana* appears not only as a positive aspect of the agricultural landscape, but also as an element of "green" continuity between the diverse settlement systems.

Lastly, the presence of the canal and its towpath makes the "Martesana system" a "greenway". The term "greenway" may be interpreted as a system of interconnected linear territories that are planned, designed and managed in such a way as to obtain benefits of a recreational, ecological and histori-

cal-cultural nature, situated along natural corridors such as the banks of water-courses and coasts or along disused railway lines, towpaths and country roads. Greenways respond to the demand for improved utilization of the territory by favoring "environmentally-friendly" circulation along a system of routes dedicated to non-motorized traffic and capable of linking the population with the landscape resources (natural, agricultural, landscape and historical-cultural as they may be) and with the "life centers" of the urbanized settlements, in both the urban and rural areas.

Methodology

The conceptual framework adopted for the present study (Figure 2) involves:
I) an initial phase of *analysis* and *evaluation* of the landscape resources and the opportunities for and restrictions on development;
II) a second phase identifying the diverse *values* of the rural areas (a concept associated with the intrinsic characteristics of a portion of land and expressing its potential);
III) a conclusive phase evaluating the *vocations* of the territory; that is to say, the propensity for each individual portion of land to perform a determined role and thus "follow" a determined development plan.

Analysis and evaluation of the resources of the rural landscape

The initial phase of the study had the aim of establishing a suitably in-depth body of knowledge regarding the landscape reality of the case-study area appropriate to the objectives of the study itself. The first step that had to be taken was to compile an adequate database regarding the characteristics of the area that were of use in defining the "Valorization Plan". To this end, it was felt that a direct survey of both land use and all the territorial resources/characteristics of interest was required. The direct survey was necessary in order to supplement the information already available as this was in-

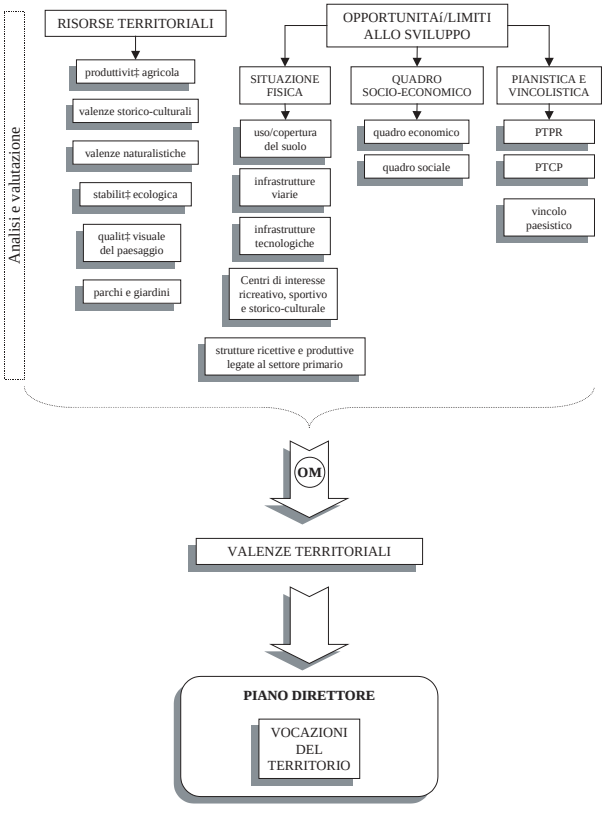

Figure 2: Conceptual structure of the study

sufficient for the application of the chosen methodology. Before proceeding with the direct survey, we had to develop a clear and comprehensive system of classification that would on the one hand permit a simple and unequivocal survey phase (avoiding problems of interpretation for the surveyor in the field), and on the other would provide for a broad-based description of the landscape situation in such a way as to allow the creation of the most com-

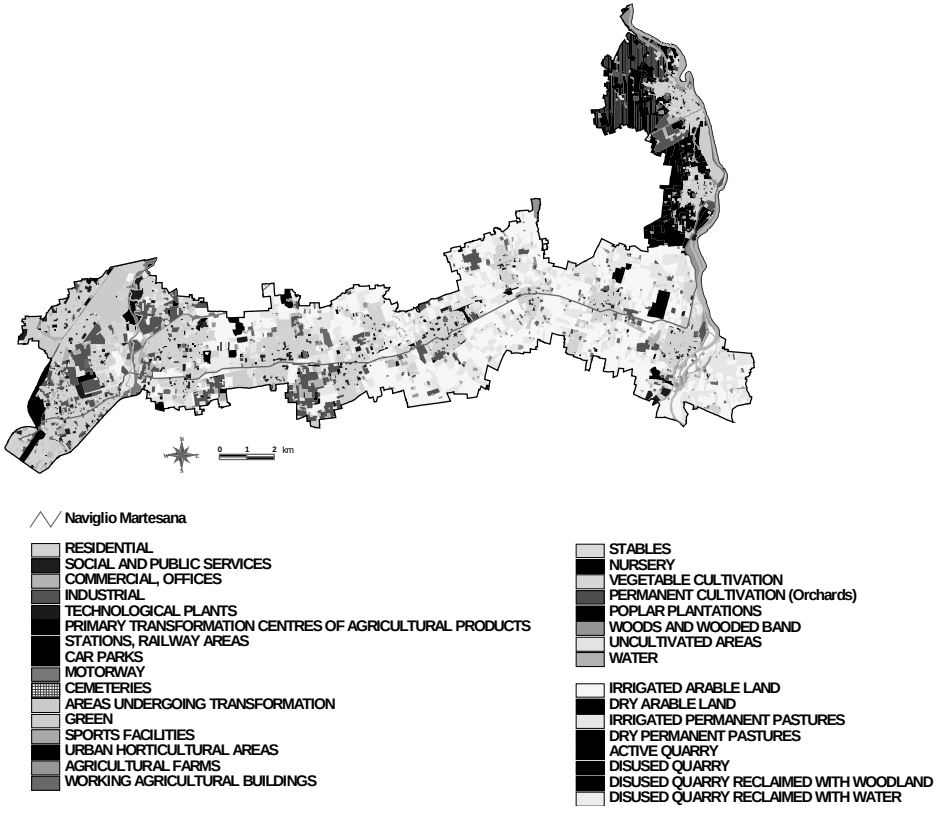

Figure 3: Land use map

prehensive database possible. Moreover, the classification system needed to lead to the creation of a database structured so as to be suitable for the constitution of a GIS (Geographical Information System).

The classification we adopted is based partly on our own experience and on the analyses of certain official systems, including those adopted by ISTAT (the Italian Central Institute of Statistics) during the General Agricultural Census conducted in 1990, by E.R.S.A.L. (the Regional Body for Agricultural Development in

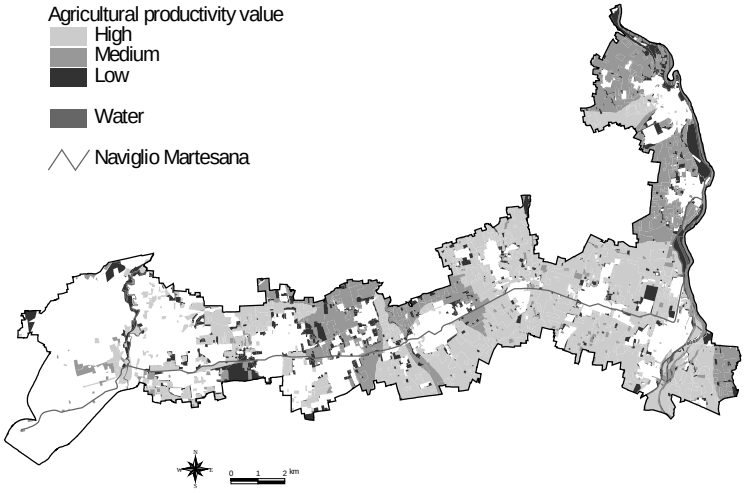

Figure 4: "Agricultural productivity value" map

Lombardy) for the preparation of the 1:25,000 scale land use map, and by the Lombardy Region in the vectorial database of the Regional Technical Map. The classification system adopted required the survey of the classes of land use recorded in Table 1 from which the land use map in Figure 3 was derived. The database obtained from the direct survey was integrated with the pre-existing data (already available in digital form) from the Lombardy Region's vectorial Regional Technical Map (water courses and bodies, roads and railways, altitude and municipal boundaries) and from the ERSAL's Soil and Land Use Capacity maps.

The data collected and organized within the GIS were processed in order to obtain, according to the methodology adopted, information regarding the principal landscape resources. These resources were evaluated through the application of certain fairly well established protocols (e.g. *Agricultural Productivity* and *Ecological Stability*) and others specially developed for the purpose (e.g. *Visual Quality of the Landscape*).

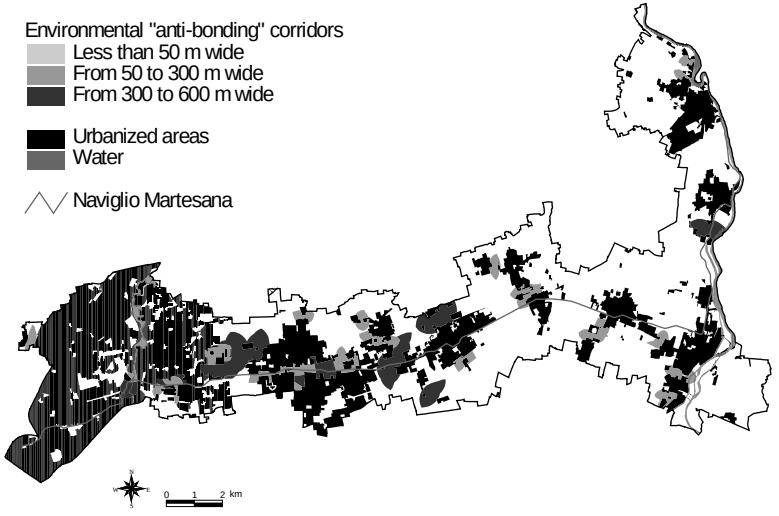

Figure 5: Ecological "anti-bonding" value map

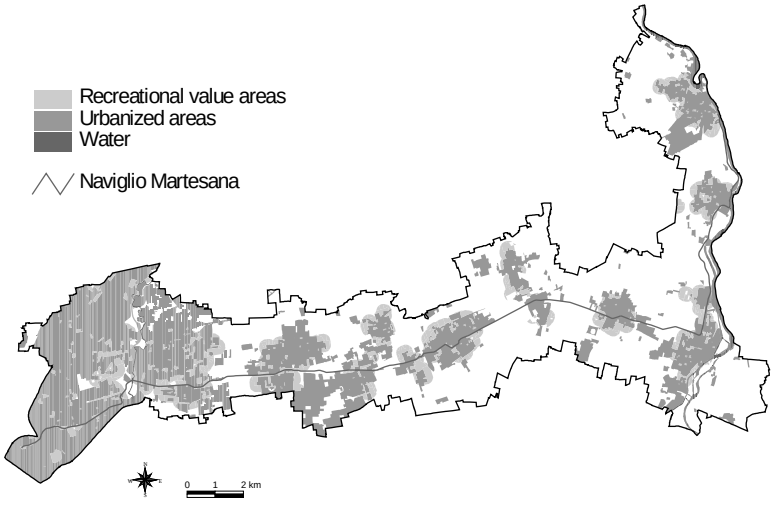

Figure 6: Recreational value map

Identification of values within the rural territory

In accordance with the general objectives of the Sal.Va.Te.R. project and the regional authorities, we subsequently identified the diverse values of the rural areas through purpose designed protocol.

Agricultural productivity value (Figure 4), derived from the thematic overlaying and successive processing of the information relating to agricultural productivity and the presence of irrigation systems, this protocol identifies areas of low, medium and high agricultural productivity;

Ecological "anti-bonding" value (Figure 5), a protocol identifying the zones within the case-study area that contribute to the formation of "environmental corridors" that avoid the bonding of urban centres and the creation of a "built continuum". On the basis of the available bibliography, these areas have been divided into three classes:

I) areas in which there are *less than 50 meters* between urbanized areas ("residual" areas), to be safeguarded only where they form part of broader corridors;

II) areas in which there is a corridor of *less than 300 meters but over 50 meters* ("alarm" areas) to be preserved. In these areas new building should be avoided as they are already below the minimum threshold;

III) areas in which there are corridors of *between 300 and 600 meters* ("attention" areas) in which particular attention should be paid in the case of new building to avoid slipping below the minimum threshold.

Recreational value (Figure 6), this protocol identifies the green areas that, located within the vicinity (250 meters, on the basis of the existing literature

on the subject) of residential zones, constitute a resource in the form of an area for everyday recreational activities such as jogging, walking, cycling and so on. These areas are particularly interesting from the point of view of the development of a network of greenways: thanks to their location, in fact, they could "accommodate" greenways that would be heavily used due to the vicinity of residential centers and would have a high linkage potential.

Identification of the vocations of the rural areas

The concept of a "territorial vocation" is a recent development. The Italian State Act No. 142/90 (today "incorporated" within the Legislative decree of the 18th August 2000, No. 267, "Consolidated Act of the laws regarding the disposition of the Local Bodies") states that the Province must prepare and adopt a PTCP (Provincial Territorial Coordination Plan, a sort of Provincial land use Plan) that "determines the general landscape policies and indicates [...] the diverse destinations of the landscape in relation to the prevalent vocation of its parts".

Table 1: Elements surveyed

RESIDENTIAL AREAS
Large-medium blocks
Large-medium blocks with own green areas
Small blocks
SOCIAL AND PUBLIC SERVICES
Church
School
Hospital and health services
Cinema, theatre
Library
Town hall
Social club, oratory
Post office
COMMERCIAL, OFFICES
Commercial, offices
Commercial, offices with owngreen areas
INDUSTRIAL, SMALL BUSINESSES
Industrial, small businesses
Industrial, small businesses
with own green areas
TECHNOLOGICAL PLANTS
Dump
Water treatment center
Differentiated reclamation center
Electrical energy
Other plants
PRIMARY TRANSFORMATION CENTRES
Dairy
Cured meat products
Other centers
STATIONS, RAILWAY AREAS
Metro stations
Railway stations
Railway/metro service areas
CAR PARKS
AREAS UNDERGOING TRANSFORMATION
GREEN AREAS
Significant private green areas
Public, equipped green areas
Public not equipped green areas (open space)
Green areas along the roads
Green areas associated with social services
Green areas for sports
CEMETERIES
SPORTS FACILITIES
HORTICULTURAL AREAS
AGRICULTURAL FARM NUCLEI
WORKING AGRICULTURAL BUILDINGS
Cowshed, shelter
Barn
GREENHOUSES
Permanent greenhouse
Semi-permanent greenhouse
STABLES
NURSERIES
VEGETABLE CULTIVATIONS
PERMANENT CULTIVATIONS (Orchards)
POPLAR PLANTATIONS
PERMANENT PASTURES
Irrigated permanent pastures
Dry permanent pastures
ARABLE LAND
Irrigated arable land
Dry arable land
WOODS
WOODED BANDS
UNCULTIVATED AREAS
QUARRIES
Active quarry
Disused quarry
Disused quarry reclaimed with woodland
Disused quarry reclaimed with water
MOTORWAYS
LAMBRO RIVER
Extra-urban context
Urban context
ADDA RIVER
Linear Elements
Commercial axes | Single tree rows along roads within the urban context | Double tree rows along roads within the urban context | Single tree rows and linear green areas within the extra-urban context | Double tree rows and linear green areas within the extra-urban context
Depending on the element surveyed, the following information was added: historic building or green area (in use or abandoned), type of cultivation (corn, wheat-oats, soya, fallow, other crops)

It is interesting to note that in Italy we have more than 8000 municipalities grouped in 103 provinces and in 20 regions. For example, the Lombardy Region has more than 1500 Municipalities grouped in 11 Provinces. The Lombard Regional Act No. 1/2000, again relating to the functions of the PTCP, states that it must contain "the indication of the general vocations of the landscape with regard to the broad areas". This is the logical consequence of the evolution of the concept of "landscape planning" that has always tried to place the future development of a territory in relation to its "intrinsic capabilities".

With regards to the present study, "territorial vocation" is understood to mean the "innate inclination", the "intrinsic leaning" of a certain portion of land towards a certain future development. It is felt that true "territorial development" (that can only be sustainable) can only be achieved when that certain portion of the territory is oriented towards a form of development that fully responds to its vocation. This "intrinsic leaning" derives from the package of resources present in the territory, understood in terms of quantity and quality.

On the basis of the analyses conducted previously we tried to identify for the case-study area:

I) *areas with a productive agricultural vocation* in which the resources present made the area particularly favorable to the productive activities associated with the agricultural sector (Figure 7);

II) *areas with an ecological vocation*, to be safeguarded or dedicated to activities with no negative environmental impact (Figure 8);

III) *areas with a recreational vocation*, in which the package of resources present render them particularly suitable for the development of recreational activities (Figure 9).

The identification of the territorial vocations was based on the EPP methodological approach ("Environmental Preconditions Plan", a method developed by the authors in 1998): the resources and the values identified in the preceding phase were evaluated through the use of a dual input "relational diagram" (Table 2). The diagram indicates the areas with vocations for the various types of development on the basis of the presence of resources (at times on the basis of their quality and quantity).

The union of the three vocational maps produced Figure 10, identifying those areas with a single vocation (productive-agricultural, recreational, ecological) and those with multiple vocations: productive-agricultural and recreational, productive-agricultural and ecological, recreational and ecological, productive-agricultural, recreational and ecological. The areas with a single vocation leave no doubts as to the appropriate form of development, whilst with those areas with multiple vocations incompatibilities may occur. For example, in those areas with both a productive-agricultural and an ecological vocation, the development of intensive agricultural practices would involve the exploitation of just one of the resources present. Where the ecological vocation is associated with a recreational potential, careful selection of the activity to be developed may allow for the optimum allocation of the resources identified. The development of greenways certainly represents an appropriate example. The areas with recreational and productive-agricultural values may also suggest the development of activities not associated with traditional agricultural activities but which instead move in the direction of the new role for the primary sector promoted by the EU (agricultural tourism, educational programs, direct sales of local products and so on).

Conclusions

The completion of the present study allows the following conclusions to be drawn. First and foremost, it has been demonstrated that the methodology used and the evaluation procedures developed are appropriate to the definition of a Master Plan for the valorization of rural peri-urban landscape, as required by the Sal.Va.Te.R. project. Secondly, the Master Plan developed

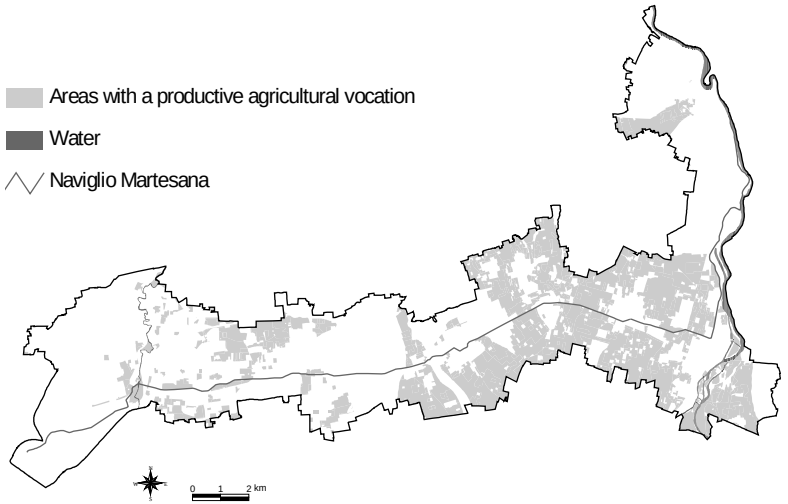

Figure 7: Areas with a productive agricultural vocation

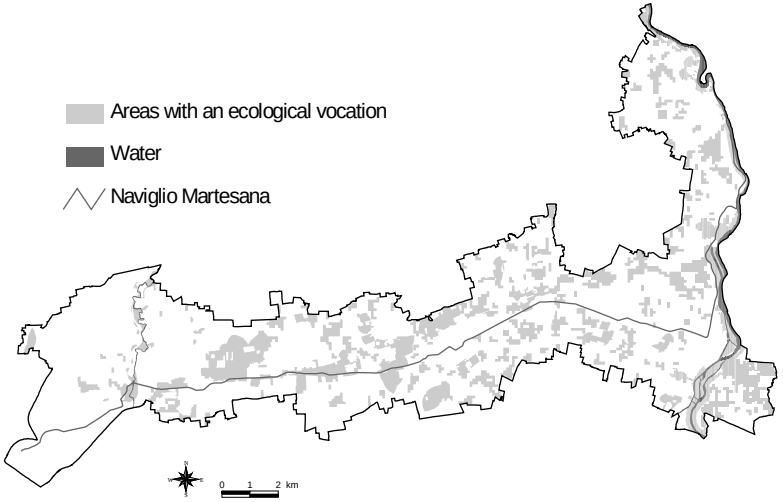

Figure 8: Areas with an ecological vocation

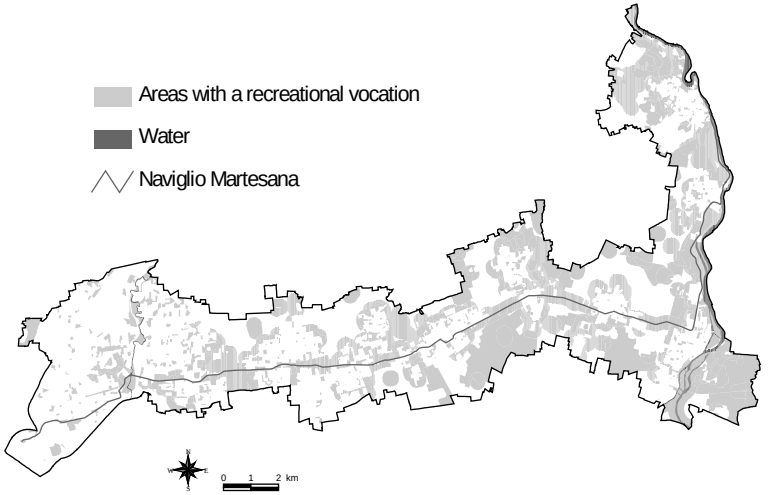

Figure 9: Areas with a recreational vocation

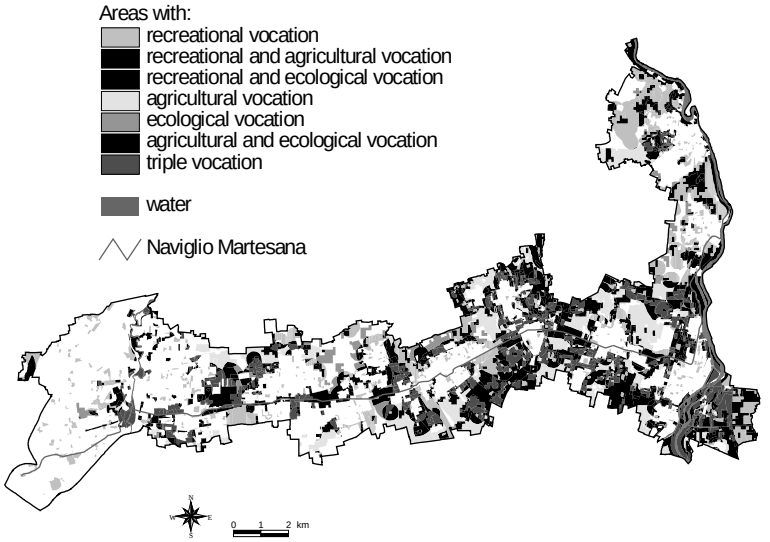

Figure 10: Synthesis of the landscape vocations

Table 2 "Relational diagram" for the identification of the landscape vocations

	VOCATIONS		
RESOURCES	PRODUCTIVE AGRICULTURAL VOCATION	RECREATIONAL VOCATION	ECOLOGICAL VOCATION
AREAS WITH PRODUCTIVE AGRICULTURAL VALUES (from the map of productive agricultural values)	Areas with a HIGH productive agricultural vocation		
ECOLOGICAL STABILITY (from the map of ecological stability)			Areas with a high density of ecological stability elements
VISUAL QUALITY (from the visual quality map)		Areas with a HIGH visual quality	
ELEMENTS OF RECREATIONAL INTEREST (from the map of elements of recreational interest)		Areas within the 250 m. BUFFER ZONES	
RECREATIONAL VALUE (from the map of recreational values)		Areas with a recreational value	
ECOLOGICAL "ANTI-BONDING VALUE (from the map of areas with an ecological "anti-bonding" value)			Areas with an ecological "anti-bonding" value
NAVIGLIO MARTESANA		Areas within the 250 m. BUFFER ZONES	
ADDA RIVER		Areas within the 250 m. BUFFER ZONES	Areas within the 150 m. BUFFER ZONES (Law N° 431/85)
LAMBRO RIVER		Areas within the 250 m. BUFFER ZONES	Areas within the 150 m. BUFFER ZONES (Law N° 431/85)
AGRICULTURAL FARM NUCLEI		250 m. BUFFER ZONES	

may provide the bodies responsible for land use planning and management (the provincial authorities, municipalities, park authorities) with a useful support for their decision-making. The identification of "landscape vocations" in fact allows the resources of the rural areas to be valorized and safeguarded against improper exploitation.

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Epilogue


ART GALLERY
AT END OF THIS STREET

Metropolitan landscapes: Contours of an emerging concept

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Introduction

Several chapters in this book discuss aspects of planning metropolitan landscapes and related questions from either a research or planning perspective. The authors themselves are landscape researchers and planners with a broad variety of academic and practical backgrounds. The underlying assumption of this final chapter is that landscape research and planning have different ways of understanding the concept "metropolitan landscapes". Therefore, problems may arise when using "metropolitan landscapes" as both a research concept and a planning concept. Whereas the first asks what constitutes a metropolitan landscape and how does it function, the latter postulates a need to react to existing problems within metropolitan landscapes.

This chapter reflects on the different meanings and usages of the term "metropolitan landscape" in the context of research and planning. It is based on the contributions to this volume, as well as on current literature and impressions from participation in the scientific meetings in Bellingham and Darwin that gave the kick-off to this book. If planning is to benefit from research and vice versa, such reflection is imperative. It is crucial to know what role landscape research can play in planning metropolitan landscapes and how concepts from the planning of metropolitan landscapes can be used in landscape research.

The introductory chapter to this book raised the questions of whether *metropolitan landscapes exist* and whether *we can plan them*. Both questions characterize the difficulty of planning metropolitan landscapes because the underlying assumption is that metropolitan landscapes do physically exist and that they can be defined and planned. Many researchers and planners would agree that metropolitan landscapes exist. However, when asked for criteria to define and delimit them, answers are sparse. In a planning context, the existence of metropolitan landscapes is not the question of concern; rather, the focus lies on discussing and solving problems that occur within an area called the "metropolitan landscape". Therefore, the statement that we can "plan" metropolitan landscapes may find broad agreement too. For planners, however, disagreement might arise concerning the best way to organize a metropolitan landscape. From the perspective of landscape research, the need to plan something requires clarification of exactly what is to be planned and for what purpose, in order to define the possible alternatives.

Approaches to metropolitan landscapes

For a purposeful application of landscape research, the notion of metropolitan landscapes has to be discussed in relation to other concepts, such as urban landscapes and rural landscapes but also urban areas and metropolitan areas. This discussion shows the degree to which the metropolitan landscape concept adds a new quality to the existing terminology and illustrates the concept's potential advantages and disadvantages.

The term 'metropolitan landscape' is seldom found in current landscape research. A full-text search of several landscape-related journals brought up

almost no hits for the term. One of the few recent references to metropolitan landscapes is found in Flores et al. (1998) and Zhang et al. (in press) who, however, use the term as synonymous with "urban landscapes". Metropolitan landscapes in both papers refers to the administrative boundaries of a metropolitan area, in these particular cases, the New York City metropolitan area and the Shanghai metropolitan area. Definitions of the term "metropolitan landscape" are not given.

Similarly, the authors in this book provide few definitions of the metropolitan landscape that fully explain the phenomenon. However, based on the ways the concept is used in the chapters four categories of definition can be constructed. Metropolitan landscape is used (1) as a synonym for urban landscape, (2) as an agglomeration or administrative area of a city or city region, (3) as a large supra-regional area and (4) as a term for all space that is under the influence of urbanites and urban spheres. These categories do not reflect the precise meaning of metropolitan landscape as it is used in the contributions. Rather, they summarize general differences that also come to the fore in current landscape research literature.

Metropolitan landscape as a synonym for urban landscape

One way of using the metropolitan landscape concept is as a synonym for "urban landscape". "Metropolitan" then means the same as "urban". Hartz & Kestermann (2004), for instance, in this volume use "metropolitan" as synonym for "urban". Schot et al. (2004) also introduce metropolitan landscape in this way, in opposition to rural landscapes. We may ask then whether the terms "metropolitan" and "urban" derive from two different academic traditions. Or is the term "urban" rooted in research whereas "metropolitan" is used more in spatial planning? In fact, in landscape research literature the term "urban landscape" is used and defined far more often than the term "metropolitan landscape". Breuste (in press), for instance, defines urban landscapes as the existing landscape of urban settlements and their surroundings especially that marked by urban land-use forms and not limited by administrative boundaries.

Studies of urban landscapes have generated increasing interest in landscape research. This relates to the growing importance of urban areas and the migration of populations into urban locales (Tjallingii, 2000). Urbanization can be expressed as the proportion of people living in urban areas (Antrop, 2000, in press). It is a complex process including changes in housing, lifestyle, transportation and employment patterns. So far, the process of metropolization has not been described; the extent to which it would differ from urbanization is left open. If "metropolitan" has meaning other than "urban" then this difference should be made explicit and the process of "metropolization" described accordingly.

Metropolitan landscape as an agglomeration or administrative area of a city or city region

A second way of using "metropolitan landscape" is in the sense of "metropolitan areas". Here, "landscape" serves as a synonym for "area". In fact, the literature on landscape research, as well as that from urban and planning research, deals with the attribute "metropolitan" far more often in the context of a metropolitan "area" than a metropolitan "landscape" (see studies from Brabanente et al., 2002; Bunnell et al., 2002; Gibson & Abbott, 2002; Kam Ng & Hills, 2003). Also Antrop (2004) defines in his contribution to this volume the qualities of a metropolitan area, not a metropolitan landscape. He refers to a metropolitan area as an agglomeration associated with a large city.

A second aspect of this understanding of metropolitan landscape is its relation to the administrative boundaries of a city region. Williams (1999), for instance, examined the challenges that major city regions face in coping with the dynamic progress of societal change. In this study of metropolitan governance and spatial planning, Williams (1999) referred to the metropolitan area of cities such as Manchester, Melbourne and Toronto and not to the con-

cept of the metropolitan landscape. Flores et al. (1998) define metropolitan areas as high-density central cities that have been losing their regional share of population and economic activity, surrounded by expanding rings of suburbs of considerably lower housing density and high per capita rates of resource consumption. In this volume, Hartz & Kestermann (2004), Kumar (2004), Senes & Toccolini (2004), Sherren (2004), Sommers (2004) and Tonmanee & Kuneepong (2004) also refer to the metropolitan area in the context of large cities—such as Vancouver, Seattle, New Delhi, Bangkok, New Orleans and London—and their administrative or surrounding area. So, where reference is made to the metropolitan area of a specific city, in some cases the actual administrative boundaries of the city are meant while in other cases the related urbanized area exceeding the administrative boundaries is being referred to.

Metropolitan landscape as a large supra-regional area

A third way of looking at metropolitan landscapes is as large supra-regional areas comprised of several urban centres that share common socio-economic or physical conditions and problems. Jacobs (2004), Roos-Klein Lankhorst et al. (2004), Smeets et al. (2004), Van den Brink & Baveco (2004) and Woud et al. (2004) refer in this way to areas where global competition takes place and classify them, for instance, due to their location along major rivers as metropolitan "deltas". An example from this book is the Northwest European Delta Metropolis, a construction that Van der Valk (2002) describes as an urban field and that comes close to what Antrop (2000) defines as urban networks.

The definition of metropolitan landscapes as supra-regional areas is clearly on a different spatial scale than the first two categories of definition mentioned above. It would be helpful to derive criteria that clearly define the common denominator of such an umbrella concept to make it more useful for research.

Metropolitan landscapes as a continuum of urban-influenced space

The fourth definitional category for the concept of metropolitan landscape is based on the perceived dissolution of the split between urban and rural. In this understanding spatial development has blurred the boundaries between rural areas and urban areas, thus the clear-cut division between them no longer exists. Landscape research has broadly discussed the urban-rural divide. "Urbanity" was introduced to contrast with its opposite, namely rurality. Yet the characteristic "urban" can only be attributed meaningfully as long as there is something that is "not urban". Urban means town or city and refers to both the built-up agglomerations and to the way of life (Antrop, 2000). Urbanization then describes the process of transformation from one characteristic to the other, from rural to urban. It means the migration of populations from rural to urban areas.

However, studies have also shown the opposite trend: migration from urban to rural areas (Paquette & Domon, 2003; Ryan & Hansel Walker, in press). Then the question arises of whether the urban area is spreading into the countryside by the migration of urban dwellers or whether the rural area is consolidating by attracting new residents. Both processes are part of urbanization. For more details on the debate on the functional change of rural areas see Murdoch & Pratt (1993), Halfacree & Boyle (1998), Ilbery & Bowler (1998), Marsden (1998) and Antrop (2000).

The process of migration from rural to urban and urban to rural is thus diminishing the classical urban-rural divide. More and more formerly rural areas are under the influence of urbanity, and more and more rural elements can be identified within urban settings. In this interpretation, the term metropolitan landscapes proposes a new way of illustrating land-use changes in both urban and rural locales. All space that is under the influence of urbanites and urban spheres is considered to be a "metropolitan landscape" that, for instance, would stretch over areas the size of large parts of Europe or the

United States. Fushtey & Quayle (2004) describe in their chapter the metropolitan landscape as everything that is out there and can be seen, felt, heard and smelt, as part of our public realm that is defined by politicians, business people and advocates. Beunen et al. (2004) describe the metropolitan landscape as an urban field encompassing built-up and open areas within urban centres. However, these authors specify neither the scale of the metropolitan landscape nor criteria by which to define it. The concept thus seems well suited for debate in spatial planning and policy, because it describes a state of development that is beyond the former urban-rural divide and includes a time-related aspect of urban area development. The problem with this usage might be that it could become a buzzword that in fact has little meaning for research, since it is impossible to distinguish it clearly from other landscapes.

Metropolitan landscapes: A new focus for landscape research?

So why bother at all? Could the metropolitan landscape concept provide a new focus for landscape research? Has landscape research paid too little attention to urban and metropolitan areas in recent years? Is it a neglected research field?

In fact, urban and metropolitan areas are on the research agenda of several disciplines, among them landscape ecology, urban ecology and geography as well as policy and planning sciences. Antrop (2000) observed that most studies on urban areas have been done by urban planners, designers, economists and social scientists. This has proved an obstacle to the study of urban areas from a landscape ecology perspective. For landscape ecology the study of urban areas constitutes new territory. Rivalry between different academic domains, along with limited knowledge of other disciplinary perspectives, might have prevented joint research efforts in the past, but obviously this has started to change.

Currently, landscape research is broadly engaged in research on urban areas. Recent studies address urban planning questions and analyse, for instance, ecological networks and ecosystems in urban areas (Hostetler, 1999; Savard et al., 2000; Cook, 2002) and urban land cover and land-use changes (López et al., 2001). Others present a framework for ecological thinking in regional planning of urban landscapes (Flores et al., 1998) and identify landscape-ecological zones to support urban planning (Löfvenhaft et al., in press). Studies discuss the benefits of conserving greenery for the purpose of urban architecture and planning (Ong, 2003), investigate the degree to which knowledge about climate is used in urban planning (Eliasson, 2000) and develop new planning concepts for mega-cities (Yokohari et al., 2000; Jim & Chen, 2003).

The challenge in applying the concept of the metropolitan landscape in landscape research may lie in understanding what constitutes a "landscape". This is an ongoing debate. Are cities part of a landscape? Do landscapes start on the fringe of urban areas? Does a landscape constitute urban and rural areas together? Can landscapes be divided into rural, urban or metropolitan? Some authors, such as Kühn (2003), discuss the concept of landscapes in opposition to cities or as connectors between cities. For them cities are not necessarily parts of the landscape. Yet others regard urban areas as an aspect of a landscape (Antrop, 2000).

Nonetheless, it is widely accepted that landscapes emanate from different realms, such as the material, the social and the mental (Naveh, 1995; Hobbs, 1997; Tress & Tress, 2001). Agreement also exists that the integrating power of such a conception of "landscape" benefits both landscape research and planning activities (Makhzoumi & Pungetti, 1999). All landscapes—covering metropolitan, urban and rural areas—are shaped by humans and nature, which create a specific environment for living, housing and other natural and cultural demands. In the words of Rodiek (2003), even in a metropolitan and highly impacted area, the landscape persists.

In consequence, the discussion of a supposedly new concept, such as the

"metropolitan landscape", needs to be embedded in existing debates in landscape research as well as in other fields. It would be constructive if such debate could clarify the metropolitan landscape concept so that it eventually adds a new quality to the existing research concepts of "landscape". Further research is needed to determine what this quality could be.

Conclusion

This chapter presented four different ways of using the concept of metropolitan landscape: as a synonym for "urban landscape", as equivalent to an agglomeration or administrative area of a city or city region, as a large supra-regional area, and as a term meaning all space that is under the influence of urbanites and urban spheres. These meanings vary enormously. All four leave questions open, mostly because their differences with existing concepts are not yet clear. Some are more suitable for research, others for planning. Bringing them together is difficult, if possible at all. But relating them to existing concepts and making their meaning more explicit will foster the debate on and application of the concepts.

Clear-cut answers to our introductory questions of whether *metropolitan landscapes exist* and whether *we can plan them* proved elusive. An attempt to answer the first question is to admit that 'we are not sure what metropolitan landscapes are' and to the second question 'but we feel a strong need to plan these areas'. Hopefully, this chapter has contributed to the ongoing discussion, which should be continued in landscape research and related fields. Although research focuses on various aspects of urban environments, the term "metropolitan landscape" is hardly applied as yet. As the contributions to this book show, many different concepts exist side by side without detracting from one another. If the emerging notion of the "metropolitan landscape" is to develop into a unifying concept for both research and planning, more effort must be made to clarify the term and criteria are needed to distinguish it from other types of landscapes.

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Imprint

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