Ecological Urban Planning and Environmental Compensation

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1. Introduction

In the last decade there has been a growing concern in planning literature about the environment, in particular the incorporation of concerns such as 'sustainable development' or 'environmental quality'. Evidently, these concerns are now firmly established among the foremost items on the scientific as well as the political agenda. Also at the local level there seems to be a growing recognition of the political need to take account of raising expectations of environmental quality and that urban areas should become more environmentally sustainable. This implies a reduction of both the urban uses of natural resource inputs, including non-renewable energy sources, and the urban production of undesirable outputs of waste and pollution.

As has also been elaborated by Fusco Girard (1994) in his introduction, there are considerable challenges to be faced in developing an urban planning system response to these new environmental concerns. The balance between socio-economic activities and environmental considerations is at the core of the concept of sustainable, or ecological, cities. This issue will be further explored in the next section.

The environmental effects of a new development can be made less severe either by reducing them, eliminating them, or by *compensating* with some other environmental gain. In section three the principle of compensation is elaborated and explained. In theory, different forms of compensation can be distinguished. This is discussed in section four. In section five a number of implementation issues and experiences from Dutch planning practice are discussed. This paper is finished with a summarizing and concluding section.

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2. Towards ecological urban planning

Many environmental issues are essentially urban in origin (see also Gibbs, 1994; Polelli, 1994). Hence, cities have a central role to play in finding solutions to environmental problems. It is in cities where people can develop solutions such as alternatives to resource intensive modes of transport, cost-effective waste recycling, environmentally-friendly technologies and the business opportunities associated with environmental concerns (e.g. Breheny, 1992b).

Especially since the oil crisis of 1973 comparatively much attention has been paid in scientific literature to the relationship between sustainable development and urban form (e.g. see Chinitz, 1990; Breheny, 1992a). In particular energy consumption and urban form has been addressed (e.g. see Owens, 1986). At the building scale, the insulation benefits of terraces of houses or flats relative to other forms of dwelling have been considered, as well as the merits of layouts and orientation in making optimum use of solar gain and microclimate conditions. Emphasis is also given to the design of urban forms to minimise the need for travel. Much theoretical work has been evoked by the oil crisis of 1973 (e.g. see Keyes & Peterson, 1977; Rickaby, 1991). There is also some empirical evidence that high urban densities, i.e. reduced travel distances and good public transport, do correlate with lower fuel consumption (e.g. see Newman & Kenworthy, 1989).

In planning practice, however, most attention seems to be limited to experiments with buildings, especially the use of indigenous building materials. Several towns and cities in Europe as well as in the United States are now experimenting with 'ecological urban planning' (e.g. see Beatley & Brower, 1993). Well-known examples in those cities in the US are Boulder (Colorado), Portland (Oregon) and Seattle (Washington). In Germany, no doubt the leading country in Europe in the field of 'ecological urban planning', good examples can be found in Berlin, Wiesbaden and Tübingen (Greiff, 1992). Dutch examples are mostly found in small towns, such as Alphen aan de Rijn (Ecolonia), Drachten (MorraPark), and Delft (Ecodus). In these projects much emphasis is paid to the use of socalled 'sustainable building materials', and - to a less extent - to design more or less self-contained neighbourhoods with green fields for the purification of water, small-scale facilities for waste disposal, and recycling.

Ecological urban planning means broadening the paradigm of classical physical planning. More emphasis should be paid to relationships between the built environment and the surrounding natural eco-systems. Ecological urban planning still concerns the ways in which the built environment is designed and managed, but decision-making now also focusses on objectives for natural resources, energy, waste and pollution and their implications for buildings and transport.

As is illustrated in Table 1, many of these objectives have a direct relationship with the behaviour of individual households. Evidently, most households live in urbanized areas. Since households will always be net consumers of resources, drawing them in from the world around them, urban areas are major degraders of the environment. Only in a few cases we may conclude that there is a low involvement of households, for instance with the objective to create a more concentrated urban development served principally by public transport, or the objective to have a reduced emission of pollutants. This is especially appropriate for industry, power stations and transport. Although the replacement instead of depletion of good-quality topsoil has more to do with the implementation of building processes and the behaviour of developers than with individual households. The same holds for the production of energy from renewable sources, such as sun, wind, tides and waves, which is not under control of individual households. The other objectives of Table 1 can all more or less be influenced by the behaviour of households. Obviously, this makes a study of the interrelations of household metabolism and their environment very intriguing.

Facing the intensified spatial claims which can sometimes be counteracting as well, an appropriate understanding of the relationships between environmental quality and household behaviour is very important in order to construct and reconstruct urban neighbourhoods within the framework of sustainable and liveable spatial structures.

The creation of more sustainable urban areas, however, will not be an easy task. The dominant urban trend in the post-war years in almost all European countries has been the ongoing decentralisation of households and jobs away from the larger cities to small towns and villages.

Possible Objectives of Ecological Urban Planning	*Household Involvement*		
	Strong	Modest	Low
More concentrated urban development			n
Higher proportion of mobility via public transport	n		
More balanced use of public transport	n		
Greater local self-sufficiency in non-speciality foods, goods and services	n		
Shorter journeys to work and for daily needs	n		
Reduction of emissions of pollutants			n
Improvement of air, water and soil quality		n	
Reduction of waste streams		n	
Greater use of 'closed cycle' processes	n		
Greater recovery of waste materials through recycling		n	
Increased biological diversity		n	
Increased biomass (trees etc.)		n	
Replacement groundwater reserves		n	
Replacement good-quality topsoil			n
Greater use and production of renewable materials	n		
Reduced consumption of fossil fuels	n		
Increased production of renewable energy			n
More energy efficient buildings	n		

Table 1. Some objectives of ecological urban planning and their relationship with individual household behaviour.

The implications of this trend are difficult to accept, since it seems to conflict with most objectives of ecological urban planning. At least it suggests for a large share of households a definite rejection of urban living. As is also argued by Breheny (1992c), a prescription of high-density compact city structures in order to arrive at more sustainable urban areas is therefore unrealistic and incapable of successful implementation. What must be developed in pursuit of larger environmental quality is a set of distinctive policies, attuned to the varying household conditions and spatial potentials. The argument advanced in this section is that this calls for a better understanding of household behaviour in relation to environmental quality as well as administrative and procedural arrangements that are commensurate with the task to arrive at sustainable spatial systems. An important question in this respect is how to deal with environmental losses caused by planning improvements? Can environmental losses be compensated, and - if the answer is yes - how should this environmental compensation be organised? The next sections seek to identify the significance of environmental compensation as a planning tool to cope with situations where trade-offs have to be made between a desirable physical or socio-economic development and the equally justified aim to prevent environmental degradation.

3. The principle of compensation

'Compensation' is the act of compensating, to give something as recompense for harm, damage or loss. Compensation has mainly been an object of study in cost-benefit analysis (e.g. see Dasgupta & Pearce, 1972; Schofield, 1987). Well-known is the so-called Kaldor-Hicks rule. This rule indicates that a proposal is acceptable if the gainers can compensate the losers after implementation and still remain better off. It is also called a 'potential Pareto improvement', since the compensation may make the proposal acceptable to all parties concerned. According to a Pareto rule a proposal will represent a social improvement if someone can be made better off without making someone else worse off. In practice this will seldom be true, given that proposals generally involve gains and losses. The idea behind the Kaldor-Hicks compensation is that the losses will be sufficiently compensated such that at the end there are only gains.

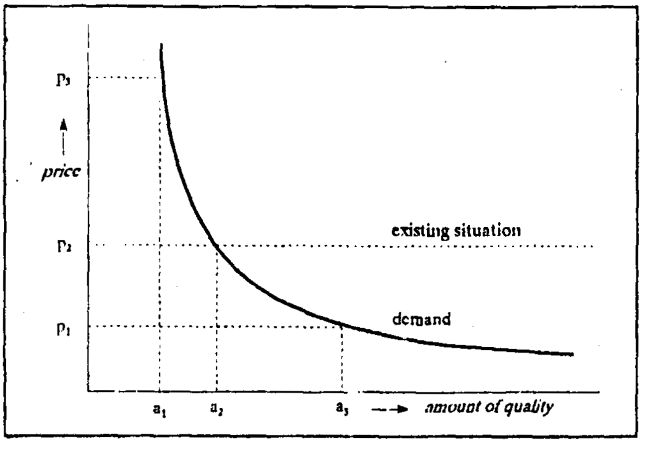

Figure 1.*Environmental Quality as an Aggregate Identity*

Environmental compensation is strongly related to the concept of *environmental quality*. This is a multidimensional notion of the ecological value of an area, or perhaps more precise, an individual's surroundings (see also Voogd, 1994). Figure 1 shows a (hypothetical) demand curve for environmental quality. Suppose the existing level of environmental quality can be maintained at price p_2, then any degration of quality less than a_2 will be unattractive since the loss of value (for instance p_3) is larger that the price paid for maintaining the existing situation (p_2). Environmental compensation implies according to this paradigm that the loss of environmental quality of, for instance, a_2 - a_1, must be compensated by an environmental 'investment' related to p_3 - p_2 in order to maintain the existing level of environmental quality.

Environmental compensation is clearly a *utilitarian* concept, since it starts from the assumption that harm or damage can be compensated. This is, of course, a debatable point of view, especially if the damage concerns a resource that is seen as "unique". Environmental compensation is based on at least three important *assumptions*:

a) environmental quality is a compound identity;
b) this identity can be assessed, directly or indirectly;
c) the underlying environmental resources can be substituted without affecting this identity.

Let us explore these assumptions in more detail. The first assumption relates to the complex nature of environmental quality. As is discussed elsewhere (Voogd, 1994; Jingke & Voogd, 1994), many relevant dimensions of environmental quality can be distinguished, such as beauty, security, vitality, diversity, amenity, health, functionality and, of course, sustainability. Clearly, each dimension can again be unravelled in many variables, which makes environmental quality an intricate multidimensional notion.

The second assumption is essential if environmental losses need to be compensated by environmental gains. Evidently, in order to be sure that the net effect of the loss and compensatory gain is positive some kind of an assessment is needed. The kind of assessment depends on the form of compensation. This will be discussed in more detail in the next section.

The third assumption is also critical for environmental compensation. Three different *forms of substitution*, which often coincide in practice, can be distinguished:

a) spatial substitution;
b) temporal substitution;
c) resource substitution.

Spatial substitution implies that an environmental loss somewhere in a spatial system is at the same time replaced by an environmental gain elsewhere such that the environmental quality of that spatial system remains at least the same. A critical issue here is of course the definition of the spatial system, especially its geographical boundaries. It also affects geographical equity within the system.

Temporal substitution involves the acceptance of a time-lag between the environmental loss and its replacement of an environmental gain. The basic idea behind temporal substitution is that re-created habitats usually need some time to mature. A critical issue in planning practice is that the probability of occurrence of future environmental gains is lower than the probability of occurrence of environmental losses. It may also induce intergenerational inequity.

Resource substitution means that an environmental loss at a particular place is replace by an environmental gain at the same location. It implies a restructuring of the environmental, without negatively affecting environmental quality. In other words, resource substitution assumes that the location of losses and gains is a perfect match. An interesting point of debate is the interpretation of notion 'resource substitution': does it imply the reconstruction of the *substance* of environmental resources that are lost, or does it mean a replacement of the *value* measured in utilitarian terms? Evidently, the choice of interpretation will depend on the circumstances: in some instances, e.g. if global ecosystem health is at stake (greenhouse effect), only an exact reproduction of environmental resources must be considered. In other situations a replacement of substance may be impossible, e.g. in the case of perceived environmental risk. In that case a value replacement is all that rests.

Evidently, temporal substitution can also be seen, if the time dimension is omitted, as a form of resource substitution and/or spatial substitution. This will be further denoted as *physical substitution,* i.e. the replacement of an environmental loss by means of an environmental gain irrespective its geographical location or timing.

Physical substitution can be *substance-oriented,* i.e. the substitution of an environmental resource by a similar resource (e.g. the replacement of a forest by creating another forest), or it can be *value-oriented,* i.e. the substitution of an environmental resource by a different resource (e.g. the replacement of a dry 'green' ecological system by a water-related ecological system).

4. Forms of compensation

In Table 2 four different forms of environmental compensation are being distinguished by means of two angles of incidence: viz. whether or not mitigation of negative effects is pursued, and/or whether of not physical substitution is aimed at. At least four different types of reconciliation then emerge. If no mitigation and no physical substitution is considered, then monetary compensation is the only way left. From a traditional economic perspective money is seen as an appropriate instrument with which to compensate because it is a standardized entity. Obviously, a counter argument can be very well given if monetary compensation is applied to environmental damage. Suppose there are two small neighbouring countries A and B. In the north a polluted river goes from A to B and in the south another polluted river goes from B to A. Of course, government A complains about the pollution from B and vice versa. They decided to compensate each other for this pollution with 10 billion dollars, which made both happy, but did this really solve their environmental problem?

		physical substitution	
		no	yes
mitigation negative effects	no	*monetary reconciliation*	*spatial reconciliation*
	yes	*project reconciliation*	*full reconciliation*

Table 2. *Some forms of environmental compensation*

Evidently, monetary environmental compensation is only morally admissable if the money is used for physical substitution of the losses by compensatory projects. Monetary compensation in this sense can be particularly appropriate for environmental losses where the geographical location doesn't matter. An example is carbon dioxide, a well-known greenhouse gas. In principle the emissions of CO2 can be compensated all over the world. Monetary compensation in one country can then be a means to arrive at physical substitution (e.g. the planting of trees) in another country. In this sense, monetary reconciliation evolves into spatial reconciliation (see Table 2). However, the physical substitution, such as the planting of trees, in itself may have important redistributive effects.

Hence, monetary compensation can be seen as an intermediary step to arrive at resource compensation at any or a particular location. Compensation for environmental damage can also be sought in the project itself, i.e. by imposing environmental improvement and mitigation measures on the project. This will be called project reconciliation. It implies both the reduction and even the elimination of undesirable impacts of the project (see e.g. Buxton, 1990). Finally, both project reconciliation and physical substitution can be pursued. In this case all possible measures, both mitigation and resource substitution, are taken to create an environmental gain. This will be denoted here as full reconciliation. In practice this usually implies the application of mitigation measures and the physical substitution for residual environmental damage that remains after mitigation has been applied (see O'Riordan, 1988).

The classification of Table 2 can be refined in different directions, for instance by including the temporal dimension (temporal substitution). Another interesting distinction of compensation, made by Goodin (1989), is between *means replacing compensation* and *ends replacing compensation*. 'Means replacing compensation' implies that one can recompense by providing alternative means to pursue the same ends. An obvious example is a lump sum of money to compensate for the loss of income because of the loss of a job. 'Ends replacing compensation' on the other hand provides equivalent satisfaction but by different ends. For example, a lump sum of money to compensate noise nuisance. According to Goodin means replacing compensation is 'morally superior'. However, as has been shown before, environmental compensation inevitably spans both means- and ends- replacing forms of compensation.

5. The implementation of environmental compensation in planning practice

In Table 3 an overview is given of a number of projects in the Netherlands, in which compensation principles are applied. This overview is based on a research project carried out by the Faculty of Spatial Sciences of the University of Groningen (see Kuiper, 1993). It

Examples of projects with compensation	*Form of environmental compensation*		*Geographical location*	*When was compensation planned?*	*When was compensation implemented?*
1. Dike enlargement	physical	substance oriented	project location	integrated in planmaking phase of project	during and after project implementation
2. Highway RW 11 - east	physical	value oriented	project location	integrated in planmaking phase of project	during project implementation
3. 380 kV power line	physical	destruction of power line elsewhere	within regional plan	integrated in planmaking phase of project	after project implementation
4. Town expansion Parkzoom	monetary	Dfl 2.5 mil.	project location (co-financing)	before implementation of project	after project implementation
5. Town expansion Oostburg	monetary	for each house	municipality	before implementation of project	unclear
6. Golf court in Heerde	physical	substance oriented	region	integrated in planmaking phase of project	during project implementation
7. Waste disposal plant	physical	substance oriented	region	integrated in planmaking phase of project	after project implementation
8. Land reclamation Meeslouwerpolder	physical & monetary	substance oriented/ Dfl 800.000	provincial restoration fund	integrated in planmaking phase of project	after project implementation
9. Gelderland mineral workings	monetary	for each hectare	provincial restoration fund	before implementation of project	before project implementation
10. Maasvlakte lake	monetary	Dfl 4 mil.	unclear	before implementation of project	after project implementation
11. Carbon dioxide emissions	physical	value oriented	global	during implementation	during project implementation
12. Tropical wood	monetary	Dfl 100/m³	national fund	before implementation of project	before project implementation

Source: adapted from Kuiper (1994).

Table 3. *Practical experiences with environmental compensation in The Netherlands*

shows that the preferred form of compensation in practice will depend on a number of factors, such as:

- *the geographical context*

In an area with a high population pressure, a reduction of nature will often be considered as much more important than a similar reduction in a less population region. In general one may say that the societal appreciation of environmental quality will differ from place to place, depending on their physical and environmental characteristics.

- *the nature of the affected environment*

Their is some clear evidence from planning practice that the societal appreciation of environmental quality does not necessarily coincide with the degree of ecological variety and richness. Well-known are the many cases where town extensions have been forced by public opinion to occupy 'ecologically rich' meadow areas rather than destroying an 'ecologically poor' forest area. Evidently, ecological richness not always coincides with a high landscape appreciation by public opinion.

- the relative costs of compensatory measures

If a physical compensation of an environmental impact is less expensive that mitigating the impact, then one should expect spatial reconciliation, i.e. an environmental project elsewhere, to be the principal compensation strategy. Otherwise, project reconciliation or full reconciliation will probably be pursued.

- the institutional context

The extent to which a project initiator is liable to pay environmental compensation for the damage it causes is a root issue, underpinning arguments about technical feasibility and the relative costs of mitigation and physical substitution (e.g. see Cowel, 1993). Once an act of environmental damage is rendered subject to liability, a decisionmaking procedure has to be entered to decide whether or not an offer of environmental compensation is acceptable, and if so, what form it should take. Compensation therefore also depends on the way it is formally included in physical or environmental planning laws.

6. Some concluding remarks

There is clearly a need to assess the social and ecological distribution effects associated with environmental compensation, including the distributive choice implied in maintaining the status quo (e.g. see Nijkamp, 1986). However, the search for precise 'transformation rules' to aid the assessment of acceptable compensation may turn out to be a quest for the holy grail (cf. Cowell, 1993). Value-changes, political pressure, scientific information and the recognition of new environmental problems all interact and constantly encourage the reassessment of the boundaries of 'acceptable' uses of the environment.

Planning practice suggests that a proper environmental compensation procedure may be structured in a number of steps:

1. Define primary project and its environmental impacts

A proper project definition is necessary to obtain a good insight into the environmental damage.

2. Define relevant geographical boundaries

This is necessary to be able to define, among others, the 'uniqueness' of the lost values. Evidently, the damage of a nature area of European importance is much more severe than a nature area that is only 'unique' in a municipal setting.

3. Determine relevant mitigation measures

There are two basic ways of solving the contentious issue of environmental pollution - by eliminating it at source by better design, and by separating the pollution from the people affected. The latter approach falls very much within the province of the planning profession, which can reduce the impact by improved techniques of location and layout in respect of roads, airports, industry, schools and housing. The setting of standards, the use of pollution protractors, the zoning of land use activities with an appreciation of pollution, and the introduction of pollution control areas, could all assist in ameliorating the situation.

4. Determine residual environmental degradation

Mitigation measures are usually not sufficient to make a new project acceptable, since it will never repair the original situation. This implies that some thinking needs to be done which environmental properties have to be re-created.

5. Determine physical substitution possibilities

The best way for reasons of equity as well as efficiency is to re-create environmental values in the project area. If this is not possible, for instance due to a lack of space, alternative solutions have to be found. The latter may create an undesirable time-lag between the loss of environmental values and the 'gain', and it may also increase the risk that nothing worthwhile will happen on the long run. In order to guarantee future compensation, often monetary compensation is used as an intermediary step to create sufficient funds. The shadow-project approach can be used to arrive at an estimation of the compensation costs (e.g. see Klaassen, 1973).

6. Determine rules of implementation

The polluter pays principle (PPP) has been widely used, including as justification for planning gain (see Pezzey, 1988). This should be institutionally arranged. Environmental compensation could then take the form of either physical improvement projects, financial contributions to such projects, or services of environmental benefit deemed commensurate in some way with the environmental losses incurred. Given that the business sector is not necessarily an expert in environmental improvement projects, one might expect capital payments and commuted sums for environmental maintenance to be the norm.

7. Redefine project including compensation

Given PPP and the fact that compensation should be part of the decisionmaking process concerning the primary project, it will be necessary to redefine this project including the compensation measures and project.

Evidently, environmental compensation is not a technical act, but a political process. What matters is the *acceptability* of the proposed environmental compensation. Acceptability should include determination of the suitability of all re-distributions implied by the compensation process. Just because, in strict terms, equivalent compensation is not possible does not mean that agreements cannot be reached over the appropriate balance between substantive and value-based equivalencies. What matters is that all the important parties to a negotiation feel that their interests have been compensated adequately.

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There aren't abstracts in english language and in french language because they aren't furnished by the Author; so we are sorry.

Il n'y a pas les résumés en englais et française pas evoyés par l'A.; nous Vous prions de nous excuser.

Mancano i sommari in lingua inglese e in lingua francese non forniti dall'autore; ci scusiamo vivamente di ciò.