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Pathways to Urban Sustainability

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PATHWAYS TO URBAN SUSTAINABILITY

Abstract

The concept of sustainable development has become very much "en vogue" in the past decade. We have also observed a shift in the interpretation of this concept from a global perspective to a mes0 perspective, i.e. a local, regional or sectoral level.

This paper aims to highlight the urban dimension of environmental issues. After a sketch of urban pollution problems and of economic analysis tools, the notion of urban sustainability will be advocated as a meaningful analytical and policy concept. Next, the main focus of this paper will be on a typological approach to urban sustainability issues on ***the basis of three characteristic angles, viz strong and weak sustainability, absolute and relative decoupling and the spatial ecological footprint. Various methodological issues will also be discussed, while the paper will be concluded with some policy perspectives.***

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1. The New Scarcity

In the struggle for survival mankind has been forced to cope with a wide range of challenges such as safety, shelter and food. The last century has witnessed an unprecedented rise in material welfare, so that scarcity in an absolute sense has vanished in many parts of our world. The last part of the 20th century has also shown the emergence of new type of scarcity, viz a healthy environment to work and live in. This new scarcity is reflected in the decline in air, water and soil quality as well as in a genera1 decline in biodiversity. The unpriced nature of many environmental goods makes it difficult to incorporate the environment in the normal calculation schemes of rational market behaviour (see Tietenberg 1995).

It is noteworthy that environmental extemalities are no longer esoteric events in a normal market system; they have even become a dominant feature. The world-wide decay in environmental quality conditions and the gradual depletion of natura1 resources has been a dominant theme for research and public policy during the latter part of the twentieth century. The global interest in environmental matters is partly caused by the increased pressure that a mounting population and increased production exert on the earth's natura1 resource base. In addition, as personal incomes rise and leisure time becomes more freely available in the developed world, concern with more immediate human needs has been accompanied by an interest in preservation and conservation for future generations and for other regions of our world. We observe an increasing interest in quality - next to quantity - as an important constituent of individual and collective welfare in which the environment assumes a prominent position (see for a review also Button and Nijkamp 1999).

Clearly, the issue of environmental degradation will stay with US until far in the new millennium (see for a broad description WCED 1987). Already Plato in his Kritias was complaining about human activity which had turned the landscape of Attica into a skeleton and a wasteland. We also know about environmental regulation in medieval European cities which aimed to control the use of coal burning or the noise annoyance caused by horse drawn carriages. And the early stage of the industrial revolution demonstrated an abundance of urban environmental quality degradation. But in our era the size and the intensity of resource use and of related environmental decay have taken such massive forms that the stability and sustainability of many ecosystems - both locally and globally - is threatened. This has stimulated the launching of the concept of sustainable development in research and

policy making at the end of the 1980s as well as of international research programmes on biodiversity loss and climate change risks during the 1990s and beyond.

This paper aims to highlight the urban dimension of environmental issues. After a sketch of urban pollution problems and of economic analysis tools, the notion of urban sustainability will be advocated as a meaningful analytical and policy concept. Next, the main focus of this paper will be a typological approach to urban sustainability issues on the basis of three characteristic angles, viz *strong and weak sustainability, absolute and relative decoupling* and the *spatial ecological footprint.* Various methodological issues will also be discussed, while the paper will be concluded with some policy perspectives.

2. Environmental Issues

Environmental issues have a surprising diversity, ranging from local to global levels. After the avalanche of interest in global environmental issues (see e.g. the Bruntland Report or the Report of the World Commission on Environment and Development (WCED 1987)), the awareness has grown that many environmental problems have a local origin, while also global environmental decay often manifests itself at a local level. Thus, there is a simultaneous need for local action and global reflection. Consequently, cities may act as focal points for creative environmental strategies (see Brebbia et al 2000, and Selman 1996, 2000).

Several publications in the past decade have demonstrated an alarming decline in environmental quality in cities. Especially in the Third World, several cities are faced with unacceptably low levels of quality of life to the extent that even human health is as stake.

In Europe the situation is in genera1 more favourable, but there is stil1 a reason for serious concern. For example, The Dobrìs Report (see Stanners and Bordeau 1995) provides a convincing evidence that the quality of the environment in Europe is under severe stress. Some illustrative data are contained in Table 1. The current trend in the EU to regard major cities as the new economic engines in a global competitive network economy may reinforce the threats for a healthy urban environment in Europe, in particular as in the long history of Europe numerous cities with an extremely valuable and vulnerable socio-cultural heritage have emerged which deserve strict protection in the interest of current and future generations. The city plays a centra1 role in a complex force field between economic progress, environmental protection and the home of man.

PRESSURES		ENVIRONMENTAL ISSUES	STATE & IMPACT	
Present	*Future*		*Present*	*Future*
😐	☹	Greenhouse gases and Climate Change	☹	☹
☺	😐	Ozone depletion	☹	😐
😐	☹	Hazardous substances	😐	?
😐	😐	Transboundary air pollution	😐	😐
😐	😐	Water stress	😐	😐
☹	☹	Soil degradation	☹	?
😐	☹	Waste	☹	☹
😐	?	Natural and Technological Hazards	😐	?
😐	?	Genetically modif ied organisms	?	
☹	☹	Biodiversity	😐	?
😐	😐	Human health	☹	?
😐	😐	Urban areas	😐	😐
☹	☹	Coastal and marine areas	☹	?
☹	?	Rural areas	☹	-
☹	?	Mountain areas	☹	-

☺ positive development	? uncertain (partial quantitative/ expert analysis available)
☹ unfavourable development	- no quantitative data available
😐 some positive development, but insufficient	

TABLE 1: Europe's Environment
SOURCE: European Environment Agency (1998)

There are several reasons why a well focused environmental policy at the urban leve1 is a valuable activity in the framework of the world wide mission for improving environmental quality.

First, there is the obvious reason that most production, consumption and transportation activities in a country take place in cities or urban areas. It is noteworthy that in most countries the leve1 of urbanisation is stil1 increasing, not only in prosperous regions but also in less favoured regions. Thus, a clear focus on urban quality of life may enhance the effectiveness of resource and environmental strategies in many countries.

Next, decentralisation of environmental and resource policy has become a major device in current policy-making in most Western countries. The city is of course a natura1 institutional decision unit in this context, as it covers a well focused study area without running the risk of a heterogeneous policy structure with many horizontally organized planning agencies (and related competence questions). Thus, the involvement of one identifiable decision-making agency at the urban leve1 is of major importance and may enhance the institutional effectiveness of environmental and energy planning.

A related obvious advantage may be direct local involvement, based on a bottom-up strategy for new environmental management and energy saving programmes (for instance, in the case of district heating). This may increase the support of the genera1 public for changes in resource use, consumption or life styles.

Finally, in terms of efficiency of data gathering and/or availability, the city is usually a more suitable statistical unit providing systematic data sets on environmental, energy and socio-economie indicators.

The prominent role of the city in environmental policy has recently received much attention from Europe's politicians and citizens, not only from the viewpoint of urban quality of life, but also from the perspective of employment creation. It is increasingly recognized that the challenge to improve the urban environment presents also an opportunity to create new jobs (sometimes coined as "green jobs" or "eco-jobs"). Especially since the rise in unemployment in many European cities , we have witnessed many initiatives aiming at reconciling environmental and labour market interests.

It is increasingly believed that in the new economic conditions at the turn of the millennium, where ICT and network configurations exert a prominent influence, a world-wide opportunity may emerge, in which social, economic and environmental objectives may be fulfilled. After the doomsday publications of Rachel Carson (1962) on "silent spring", cities may turn into sources of "vital spring", provided an effective balanced urban policy is

pursued. Several interesting and convincing illustrations of such urban policies can be found in a recent publication of the International Institute for the Urban Environment (IIUE 1999).

3. Lessons from Economics

Environmental decay has put forward many challenges to economics. Unlimited growth is no longer uncritically accepted. Economic development is only assumed to bring about positve welfare benefits, if unnecessary waste is avoided, if pollution does not exceed the natura1 regeneration capacity, if non-renewable resources are saved to the maximum degree possible, if essential resources such as urban, water, air or soil quality are kept in a sufficient quality and if biodiversity is maintained. From an urban perspective, policy objectives related to preservation of cultural heritage, maintenance of sense of community (the "civic society") and ensuring safety may have to be added.

It is noteworthy that much of the early interests of the last century centred around public health in dense urban agglomerations. As social-medical knowledge on how diseases spread developed, urban authorities in particular sought to improve the local environment by edicting measures on e.g. sewage control and clean water supply to reduce the diffusion of germs and infection. This trend much later, led to a portfolio of policies embodied in various initiatives of clean air legislation to reduce local atmospheric pollution that causes smog and other harmful effects. Wealthy societies, and the better-off within poorer societies, with the time and resources to expand, became concerned with the built environment and with shaping nature in ways that they found aesthetically pleasing. Over the centuries this has led to specific patterns of landscapes in the countryside and the provision of parks and gardens in urban areas. This has created a genera1 concern with quality of life, in addition to dependence on resources and environment, with a particular view to the city.

It is surprising that the social sciences were latecomers in studying issues of environmental quality and nature. Of course, there are early examples of social science research on environmental and resource issues, for instance, by nineteenth century scientists like Malthus and Marx. But it lasted until the 1960s and 1970s before the urgency of environmental degradation and resources depletion had become so widely recognized that various social science disciplines started to develop a pathway for environmental research. This does not mean that in some disciplines never any attention has been given to resource and environment issues. On the contrary, in particular in economics we observe a long

standing interest in resource scarcity, in relation to agricultural land use and mineral use. The Physiocrat thinking in economics even advocated that nature - in particular land and water - was the real source of economic wealth. But this early interest in resource use was mainly instigated by the (positive) productive contribution of physical resources to economic efficiency. Only a few economists in the first part of the twentieth century recognized the 'unpriced scarcity' nature of the environment and of many resources (notably Marshall and Pigou). They introduced the concept of 'externalities', which meant that the social value of various goods and services, including nature and the environment, is not - or not insufficiently - reflected in market prices, so that a socially undesirable use of these goods and services will result. This may be the result of myopic behaviour of selfish people or of the public good nature of various resources that are not controlled by property rights or proper regulation (see for an overview Nijkamp and Van den Bergh 2000).

The real interest in environmental issues started essentially in the 1970s when the growing recognition of a worldwide environmental decay and of severe resource depletion (in combination with a population explosion) received an unexpected but welcome support in the oil crisis. This sudden event was complemented by the First Report to the Club of Rome ("addressing the limits to growth"), which was based on a conditional scenario analysis with a systems dynamics model of the world. Although the scientific contents of the latter study left much to be desired - as a result of conservative information on resource availability and insufficient incorporation of negative behavioural and technological feedback mechanisms - it created a shock effect among social scientists. This gave rise to an intensive debate between growth optimists and pessimists (Daly and Townsend 1993). This also marked the beginning of the social science interest in environmental sciences. Economists constructed abstract models of economic growth and resource use (Dasgupta and Heal 1979) and developed a theory of environmental policy for correcting environmental extemalities (Baumol and Oates 1998).

Economists and psychologists began to investigate how people value environmental change, environmental policy and ecosystem management, by using stated preference and revealed preference methods (Hanley and Spash 1993). Demographers started to investigate the relationship between resource scarcity, population growth and migration. Decision theorists tried to develop new tools for policy-making that were more tuned to the often qualitative and unpriced nature of environmental goods (such as multicriteria and multi-

objective decision tools). Many disciplines worked together in integrated modelling and assessment, addressing both ecosystems and global scales (climate). Finally, statisticians got involved in the formidable task to develop new statistical data that would map out and monitor energy use, environmental deterioration and the like. So in some twenty-five years time here has been an explosive interest among social scientist in environment and resource issues (an extensive review can be found in Van den Bergh 1999).

It should be noted that there are many ways for a simultaneous analytical treatment of economics and environment. Since the 1960s a great many attempts has been made to link the economy to the ecology (Costanza et al. 1997). An important contribution to the integration of economics and ecology began simply with a reflection on the principles of the materials balance for resources (extracted or collected, transformed, consumed and emitted) and on the need to take account of an economic viewpoint of such processes (Ayres et al. 1999). Several attempts have also been made to build economic and social accounting systems that could incorporate the measurement of economic welfare and performance together with the measurement of environmental indicators and performances. The integration of economics with ecology has also been approached from the viewpoint of land-use - where economic and ecological processes have the most disruptive effects - and of urban environments. In addition, the interaction between economic and ecology bas been dealt with for situations with global risks and uncertainties.

We may thus conclude that environmental economics has become a centra1 discipline in economic sciences. In a few decades time, an overwhelming amount of research efforts and research findings on environment and resources issues can be observed. Environmental science has become a rapidly evolving field with a strong social science component. Environmental and resource economics has generated many insights about environmental policy design, natura1 resource transboundary pollution issues, and international agreements and policy coordination. In conclusion, resource and environmental economics has created a breadth and depth of scientific insights into the new scarcity. Both theoretical and empirical knowledge in the field has been generated in a surprisingly rapid pace. Its multidisciplinary orientation has offered a great strength to the task of environmental economics to attack complex and topical policy issues on the human environment.

A final question is however, how important has economics become as a discipline for understanding complex urban quality of life issues? Of course, the genera1 lessons form

environmental economics apply also here, but the city is a particular type of spatial organisation which deserves a dedicated analytical approach on sustainable human settlements. In particular, the economics of density in urban areas needs a more thorough investigation, as the city is not only the source of much environmental decay, but also the stepping stone for the solution of many environmental problems as a result of the positive economies of agglomeration (a phenomenon already studied earlier in the form of so-called Marshallian districts). These issues will be further outlined in the next sections in the framework of the sustainable city concept.

4. Sustainable Urban Development

Since the publications of the Bruntland Report in 1987, the concept of sustainable development has become centra1 in mainstream policy thinking all over the world. A continuation of current trends would erode the basis for a balanced development. Thus, environmental and resource policy is a field that is full of conflicts and paradoxes. And there is no simple panacea available. A complex issue is sustainable environment and resource management in the interwoven nature of the new scarcity question. Resource use leads to pollution, while abatement of pollution requires additional resource use. Clearly, technological innovation (e.g. recycling) or environmental management strategies (e.g. ISO 14001, Emas) may help to alleviate some of these problems, but with a rising population (mainly as a result of in-migration) and rapidly rising consumption and mobility levels it will be extremely difficult to achieve a sustainable development over a time scale involving many human generations. Furthermore, resource and environment issues may manifest themselves at local or regional scales, but they are also part of a globally interwoven ecosystem. Consequently, the 'new scarcity' has clear spatial and tempora1 horizons which extend far beyond the current leve1 of thinking and acting.

Against this background the concept of sustainable development has become ***'en vogue'.*** Although this notion has already a longer period of existence, it became a fashionable topic after the publication of "Our Common Future" by the World Commission on Environment and Development (WCED). The Commission called attention for the need to consider our planet as an integrated social, economic, ecological and politica1 system which needs collective initiatives and actions in order to ensure continuity under changing conditions.

Clearly, the report called for further policy action. The Rio Summit (1992) aimed to offer more concrete guidelines by suggesting a redistribution of (natural) resources between developed and developing nations so as to offer equal access to all citizens of our world and a communication/participation strategy between all stakeholders in global sustainable development planning (including local actions). As a consequence, the global Agenda 21 had to be accompanied by a Local Agenda 21 pinpointing the aim that local authorities should achieve consensus on a mission statement for sustainable development action at the local level.

In retrospect, the issue of sustainable development - both globally and locally- has become the dominant policy paradigm in the last part of the 20th century. It calls for attention and policy action regarding our current lifestyle with its high resource depletion, decay of environmental quality and increasing socio-economie disparities. The 1992 UN Conference on Environment and Development (the Rio Conference) pinpointed several strategic policy needs and resulted in Agenda 21 which claimed "*Human beings are at the centre of concern for sustainable development. They are entitled to a healthy and productive life in harmony with nature*".

It was increasingly realized however, that such an ambitious goal should be fulfilled in close cooperation with local stakeholders. This awareness has led to the formulation of the Local Agenda 21 (1997) where a plea is made for dedicated local actions that are needed to combine a reduction of environmental decay with an improvement of local socio-economie conditions in both industrialized and Third World countries.

The European version of Local Agenda 21 is coined the Charter of European Cites and Towns Towards Sustainability. It regards sustainability as a creative, balance-seeking process extending into all areas of local decision-making. It states that sustainable development helps cities and towns to base living patterns on the carrying capacity of nature, while seeking to achieve social justice, sustainable economies and environmental sustainability (see also Mega 1999).

The implementation of such strategies needs of course a proper design and use of measurable policy and achievement indicators. This is also recognized in Agenda 21, where it is claimed that: *"Indicators of sustainable development need to be developed to provide solid bases for decision making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems*". Such indicators would be measurable,

comparable, transferable, informative, signalling (e.g., early warning systems) and acceptable for policy choices. Ideally, policy choices should be based on realistic information, while the relevant indicators would have to be geared towards urban sustainability policies.

It should be recognized that the tasks placed on the shoulders of cities are immense, but it ought to be stressed as well that cities are in a unique position to develop proper sustainability strategies through the agglomeration advantages originating from their geographical synergy. A few figures may illustrate this point.

Cities are in absolute terms huge consumers; for example, an average European city of one million inhabitants consumes on an average daily basis approx. 320.000 tonnes of water, 11 .500 tonnes of fossil fuels and 2.000 tonnes of food. Urban sustainability strategies may then be helpful in increasing the urban efficiency in consumption and in reducing the negative extemalities. Cities may use their historica1 creative potential to cope with such problems and to develop new opportunities based on leaming principles, through which the city can reach a sustainable evolutionary pattem by deploying flexible resilience and adjustment strategies.

Thus, urban sustainable policies are to developed at the dynamic edge of various - sometimes conflicting - objectives on the city and its population. An illustration of the multidimensional complexity of such sustainability policies can be found in Figure 1.

A major challenge to modem cities is the need to ensure economic, social and ecological sustainability now and in the medium and long term future. Economies of scale may erode the quality of the urban living environment and the social stability base of the cities, so that a well-tuned effort has to be made to reconcile environmental demands with economic goals of the city. This task is once more important in a dynamic network environment instigated by the ICT sector, through which a trend toward mega-cities may emerge (see Brotchie et al. 1999).

It should be added that traditional urban economic theories have studied the balance between agglomeration economies and diseconomies mainly by means of land use models in which scale advantages and congestion play a critical role. In a recent article (see Verhoef and Nijkamp 2001) this issue has been analyzed more thoroughly by incorporating also environmental externalities, based on elements of endogenous growth theory. Clearly, the economic analysis of sustainable cities stil1 deserves further extensions - both theoretically and empirically -, while also the policy analysis for favouring urban sustainability needs a further deepening.

Since cities are world-wide experiencing a process of rapid change, the question is how to ensure continuity in change; in other words, how to use the valuable elements from the past (e.g. culture, science, entrepreneurial spirit) as the basis for a promising future? This development of resilient behaviour does not come about automatically, but certainly requires an effective sustainable city policy. This will be discussed in the next section.

Fig. 1

5. Sustainable City Policy

Doomsday prophets have often argued that cities would necessarily go through a process of self-destruction beyond a critical size of population or economic activity, but surprisingly enough cities have shown a high degree of resilience in coping with the great many burdens resting on the city's shoulders. Clearly, scale economies may for a while be overshadowed by diseconomies (e.g. social instability, unrest, decline in business, criminality), but most cities have managed to continue their existence. Even cities which were sometimes regarded as hopeless urban areas such as Pittsburgh or St. Louis have shown remarkable signs of recovery and sustainability. In recent years, the notion of urban sustainability has become rather popular, but its meaning is rather vague.

It has been argued in Finco and Nijkamp (1999) that an environmentally sustainable development of a city can only be attained by initiating appropriate policy strategies. On this subject much literature can be found, which focuses on the design of concepts or frameworks needed for such policies. It is clear that initiatives in various cities world-wide differ strongly in the adoption and implementation of such concepts, because each city has its own specific geographical, politica1 and environmental setting. Nevertheless, genera1 integrative concepts and evaluation procedures may be developed which can serve as guidelines for many cities undertaking sustainability initiatives. A broad survey of such concepts can be found in Selman (1996), while an overview of policy strategies can be found in OECD (1995). Although it is likely that environmental quality problems may become more severe with urban size, there is no clear evidence that urban size as such causes environmental decay. According to Orishimo (1982) it is not the sheer city size, but rather the implied land use, the transport systems and the spatial layout of a city which are critical factors for urban environmental quality.

Policies addressing sustainable development of cities should, therefore, cover multiple fields like urban rehabilitation, urban land use, urban transport systems, urban energy management, urban architecture and conservation policy, and urban cultural policy. Measurable indicators including minimum performance levels and critical threshold levels will then have to be defined, estimated and used as forecasting tools so as to improve awareness of sustainable development issues of modern cities. Local authorities will have to share their tasks with all other actors in the urban space (including the private sector) in

enforcing and maintaining these critical thresholds. It goes without saying that urban sustainable development is a process rife with conflicts and incompatibilities (cf. also Lombardi 1999). Commitment to a strict environmentally sustainable urban development by key actors in a city is necessary for a successful implementation of sustainability policies. In doing so, also economic (market-based) incentives are desirable in order to increase efficiency and to cope with the negative factors of modem city life. Failure to develop an effective balanced urban development policy will reinforce urban sprawl and will highlight inner city problems to a much larger area. Environmental-benign urban policies may, on the other hand, attract new investments, favour urban employment, and hence contribute to an increase in quality of life. The successfulness of such interventions depends clearly on three major background determinants:

- *institutional factors* (management and organisation of the urban energy sector, public-private modes of cooperation etc.);
- ***attitudes** and **behaviour** of citizens* (life styles, mobility pattems, environmental awareness etc.);
- *urban structure and **morphology*** (population density, urban form, transportation networks etc.).

Local authorities have the possibility to exert both a direct and indirect influence on these determinants. The question whether a given urban development is sustainable or not is co-determined by the targets set by policy-makers. There is not a single unambiguous urban sustainability measure, but a multitude of quantifiable criteria which may be used in an empirical test. A necessary condition for implementing an effective planning system for urban environmental management geared towards maintaining sustainability is the development of a system of suitable urban environmental indicators (see OECD 1978). Such indicators, which should represent a balance between the necessary quality of information and the costs involved, would have to be related to economic, social, spatial and cultural dimensions of the city. The OECD has drawn up a long list of elements which are decisive for urban environmental quality and which would have to be included in such an indicator system. Examples are: housing, services and employment, ambient environmental nuisances, social and cultural concerns, etc. However, it appears to be extremely difficult to operationalize such an indicator system. This means that precise empirical evidence on urban environmental

quality and on the implications for both household and firm behaviour is not always available or accessible.

A final remark in order here. Cities are not static phenomena, but are always in a state of flux. Urban life is dynamic. Living cities will go through fluctuating patterns of creative destruction. They need to revitalize and to innovate in order to survive in a competitive economic game, but they also need to maintain or restore their heritage from the past in order to remain attractive poles for residential and business purposes ('the liveable city'). This also means that cities would have to develop ecological innovations in order to reconcile conflicting interests (see Capello and Nijkamp 1999). Urban policy-makers tend to become increasingly change-managers seeking for innovative opportunities to regenerate city life. Their strategies are not based on blueprint planning concepts or fixed target approaches, but on adjustment and flexibility based on resilience principles from social biology.

The evaluation of sustainable urban policies presupposes the identification and measurement of relevant indicators. An illustrative listing of such indicators can be found in the above mentioned Dobris Report (see Stanners and Bourdeau 1995). In a more analytical way the OECD (1994) has developed the so-called PSR[1] (Pressure-State-Response), model while the International Institute for the Urban Environment (IIUE 1995) and the World Resources Institute (WRI 1995) have proposed the so-called ABC (area-basis-core) indicators list. Such approaches can be very helpful in identifying the driving forces of urban sustainability, while they may also be extremely helpful in pinpointing the relevant criteria to be considered in comparing alternative urban sustainability plans, e.g. by using interactive evaluation methods

In the past decade, many modem assessment methods have been developed in order to offer a methodological perspective for procedural types of decision-making in which various quality aspects are also incorporated. Many of these methods simultaneously investigate the impacts of policy strategies on a multitude of relevant criteria, partly monetary, partly non-monetary (including qualitative facets). They are often coined 'multicriteria methods' and are also known as 'multi-assessment methods'. Such methods offer a great potential for the development of a balanced multidimensional policy for a sustainable city.

[1] The PSR model has been changed by EEA (the European Environment Agency) in DPSIR model (Driving forces, Pressures, States, Impacts, Responses).

6. Analytical Issues in Urban Sustainability

The city is the home of man and it is thus a natura1 step to link the global environmental change discussion to urban development policy. Clearly, doomsday prophets have spent much time on building an image of the world where environmental deterioration would herald an apocalyptic scenario. It is surprising to note that in many parts of the world we have seen a recovery of threatened ecosystems and environmental quality conditions as a result of active policy intervention, technological progress and behavioural change. It seems as though economic growth is not necessarily at odds with environmental sustainability. And this applies of course als0 to cities.

Environmental sustainability is often distinguished into weak and strong sustainability. "Strong" refers to the idea that every component of the environment and nature has to be maintained, with "Deep ecology" as its most extreme proponent. Weak refers to a change that makes some environmental components worse off, provided that the overall net balance is stil1 positive. The distinction relates to ethica1 positions as well as views on the possibility of substitution (as opposed to complementarity) between nature (or environmental goods and services) on the one hand and socio-economie artefacts on the other hand. The question of weak and strong environmental sustainability is also co-determined by the degree of disaggregation of the environmental system under consideration, by the geographic scale at which environmental problems are studied, and by the time horizon (see Turner 1999).

It is noteworthy that sometimes a distinction is made between very weak and very strong sustainability. For an illustration of various possibilities we refer to Table 2. A third analytical issue which deserves more attention in the debate an sustainable development is the geographical scale. This has two aspects. In the first place, we know that at a smaller geographical scale there are normally more uniform pattems and less countervailing developments, so that it may be easier to achieve (strong) sustainability.

Furthermore, it ought to be recognized that in a relatively smal1 area the claim on external resources may be higher, so that a situation of local sustainability may be achieved but to the detriment of other areas. This issue is termed in the recent ecological literature the 'ecological footprint' (see Wackernagel and Rees 1996) and adds, of course, to the complexity of spatial sustainability policy. It also has important implications for urban policy, as it prompts the question whether the competence of urban policy is limited to its administrative borders or may extend to the rest of the world. Of course, it ought to be recognized that in an

open economy the gains of trade will always favour shipment of goods between different regions (trade is normally more beneficial than self-production), but the environmental distributive consequences are often overlooked. The combination of the three issues discussed in this section will be incorporated in a systematic classification scheme in the next section.

VERY WEAK SUSTAINABILITY	WEAK SUSTAINABILTY	STRONG SUSTAINABILITY	VERY STRONG SUSTAINABILITY
Economic efficiency criteria	Efficiency and equity criteria	Bioethical criteria and constraints	
Neo-classica1 economics paradigm	Ecological system functional diversity	Non anthropocentric intrinsic value; rights- based approach, environmental "trump" cards	
Individualism: rational self-interested consumer	Systems perspective: ecosystem "health" and "integrity", total system value> total economic value (TEV)	Preferences not appropriate basis for valuation	
Fixed preferences/values	Individualism and collectivism: consumer and citizen motivations	Citizen motivations as a distinct and separate category	
Marked-based resource allocation and valuation	Endogenous preferences: psychosocial and cultural theory variables	Keep "markets" out of the environment	
Anthropocentric instrumental value in nature	Expressed and revealed preferences. Focus group testing of contingent valuation surveys	Expert opinion	
Marginal/discrete environmental change and its valuation	Anthropocentric intrinsic value	Contingent valuation surveys as opinion polls	
Revealed preferences via markets; household production function; travel costs; hedonic pricing	Benefits transfer: validity/ reliability testing protocols		
Positive rates of time discount	Multiple policy goals; trade off analysis, risk analysis, lifecycle assessments	Deliberative processes: citizen juries, consensus conferences etc.	
Total economic value (TEV) concept (private values)	Standards/regulations; critical natura1 capital; uncertainty and irriversibilities; precautionary principle conditioned by cost-effectiveness		
Near infinite economic capita1 substitution possibilities via technical progress	Integrated assessment process		
Economic welfare significant component of social welfare			

TABLE 2: Spectrum of overlapping sustainability positions
SOURCE: Turner, 1999

7. A Typological Framework

Local Agenda 21 means that cities are not passive victims, but have to show flexibility by adjusting their sustainability policies to challenges and opportunities. Consequently, they have to identify, explore and select choice options which –despite their complex and conflicting multidimensionality- aim at a balanced development under changing external conditions. The policy strategies supporting or enhancing urban sustainability may be varied in nature; they may range from the introduction of advanced environmental technologies or market incentives to strict land use and zoning policies or information campaigns. In general, a portfolio of different possibilities seems to be the best guarantee for sustainable urban development in a dynamic environment.

An important question to be addressed here is which generalizable or transferable lessons may be derived from limited sustainability experiments on only a few cities. The problem is that the range of choice for a sustainable urban policy is vast, so that essentially an extensive comparative case study research based on multiple experiments would be needed. This is a task for beyond the scope of this paper, but it may be interesting to offer a taxonomic framework through which individual sustainability strategies for cities can be assessed.

This urban sustainability typology will be based on three complementary analytical angles, which will successively be described by a decomposition analysis. These angles which were already discussed in previous sections are:

- strong versus weak (un)sustainable development; this distinction has become rather fashionable in the ecological economics literature.
- absolute versus relative (de)coupling (or (de)linking); this distinction has also become 'en vogue' in many recent environmental science studies.
- local versus supra-local sustainability (the issue of *ecological footprints*); the latter issue has generated much interest in recent years because of its geographical connotation.

First, the distinction between weak and strong sustainability will be addressed. The traditional viewpoint on strong and weak sustainability refers to the question as to whether substitution between different sustainability constituents is allowed for. If all sustainability components (e.g. natura1 capital, air quality etc.) are having a positive development sign, then we speak about strong sustainability. If some of them have a negative sign, but if the overall aggregate impact on welfare is stil1 having a net positive sign, the situation is termed 'weak sustainability'. In the present case, a more precise distinction can be made. The relative change in economic performance of a city is denoted by E and the relative change in its ecological performance by M. Assuming that urban welfare is composed of economic and ecological performance measures, the following classification (see Table 3) for the relative change in urban welfare (W) can be made:

• strong sustainability (ss):	$W=E+M>O$	with $E>0$ and $M>0$	
• weak sustainability (ws):	$W=E+M>O$	with $E>0$ and $M<0$	or
		$E<0$ and $M>0$	
• weak unsustainability (wu):	$W=E+M<0$	with $E>0$ and $M<0$	or
		$E<0$ and $M>0$	
• strong unsustainability (su):	$W=E+M<0$	with $E<0$ and $M<0$	

Table 3: A classification of weak and strong (un)sustainability

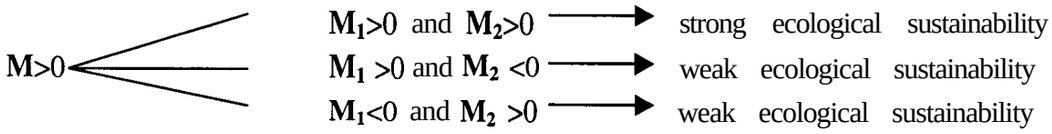
This classification is for a single area (e.g., a city) and we may offer an exhaustive presentation of the various combinatorial possibilities. These possibilities can also be classified in the following table (Table 4):

	M>0	M<0
E>0	ss: w>o	ws: W>0
		wu: W<0
E<0	ws: w>o	
	wu: w<o	su: W<0

Table 4: A synthetic classification table for types of (un)sustainable development

It is clear that an aggregate performance measure for **M** and E is not always very realistic. The ecology comprises many biotic and abiotic systems, which may change rather independently from each other. In many cases urban policy makers are facing a choice situation with substitution (or compensation) between different components of the urban ecology. The only way to solve this problem would be to adapt an applied welfare perspective, in which all constituents of urban welfare **(E** and **M)** are simultaneously incorporated.

So far we have assumed that the E-system and the M-system are uniform in the city. If they are composed of two heterogeneous subsystems, the above framework has to be extended. The urban economy and ecology can then each be subdivided into two distinct subsystems, indicated by E_1 and E_2, and M_1 and M_2, respectively. This means that we can now extend the typology in Table 4 by considering also intra-economie and intra-ecological sustainable development. This may be illustrated by the following 'sustainability tree' for the urban ecology:



The same can be done for the economic subsystems, **El,** and E2, of the city. By integrating next the various combinational possibilities in Table 4, even a more extended classification table may be constructed which incorporates many more options for urban sustainable development. Such a taxonomic table may act as a useful analytical tool to classify and map out urban sustainability initiatives.

In the second place, another important issue to be addressed is the context of urban sustainable development in the distinction between absolute and relative *(de)coupling* or *(de)linking*.

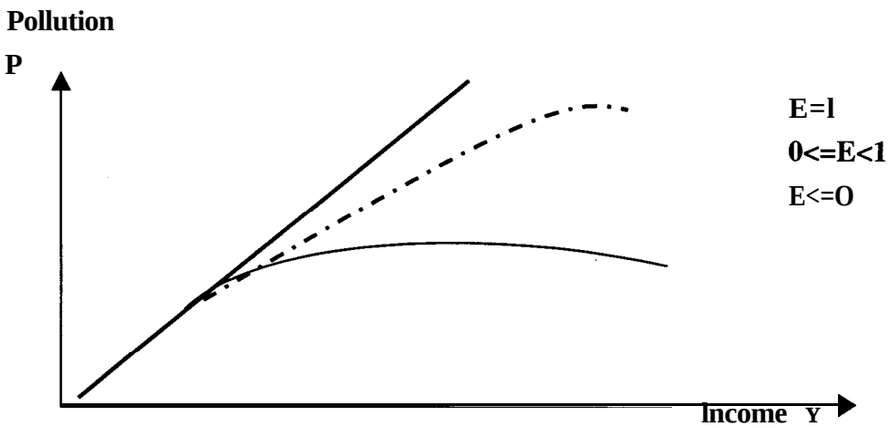


Figure 2: Green Kuznets Curve (EKC) with absolute vs. relative (de)linking

This issue has generated much debate in the recent environmental literature in the context of the so-called Kuznets-curve (Kuznets 1955; Heintz and Verbruggen 1997). The question at stake here is whether the link between economic growth and environmental quality is in the long-run positive or negative (see Figure 2). Relative decoupling means that this link is less than proportional, while absolute decoupling means that more growth may lead to environmental improvement. This is analytically represented in the typology of Table 5, where absolute decoupling (AD) means: **E**>0 and **M**>0 (i.e. the left upper quadrant).The same applies to the ws and wu cases in the left lower quadrant (Table 4). The case of relative decoupling (RD) means that $-1 \leq M/E \leq 0$, which is a special case of the right hand side of Table 4. Hence the following table can be derived integrating

sustainable development cases with decoupling cases, where the right hand column represents the coupling (C) or linking case.

	M>0	-1<M/E<0	M/E< -1
E>0	AD	RD	C
E<0	AD	RD	C

Table 5: A classification table for types of (de)coupling

This table may be particularly useful to make a distinction between various types of growth initiatives for the city. Some of them may - in absolute or relative sense - lead to an improvement of the urban quality of life, while others may have an opposite effect. The overall effect on urban sustainability then depends on the mix of growth efforts, which can be represented by means of the above decompostion analysis.

Finally, spatial demarcation will be concisely addressed in terms of local versus supra-local sustainable development. This issue has mainly been instigated by the *ecological footprint* discussion. The main idea is that a city may be able to achieve a sustainable development (strong or weak), but that this achievement may be detrimental for its surroundings or for other regions. This means that the issue of urban sustainable development may be a cast in a much broader spatial context of land use, depending on the question whether one wantsto address local or supra-local sustainability.

For example, by making a distinction between the city c and the surrounding region **r, we** may create an enlarged table for the relevant types of (un)sustainable development (see Table 6).

	Mc >0	Mc <0	Mr >0	Mr <0
Ec >0				
Ec <0				
Er >0				
Er <0				

Table 6: A classification table for types of (un)sustainable development in case of ecological footprint of the city.

An important question in the debate on ecological footprints is whether next to ecological interactions also economic interactions in space may occur, which may have a welfare enhancing effect and hence may serve as compensations for ecological damage elsewhere. This question would need to be resolved by means of a genera1 spatial

environmental-economie equilibrium model. An extensive review of those problems can be found in Finco and Nijkamp (2001).

The three analytical angles discussed above can now be visualised in a triangular form (see figure 3). The above typology, it is acknowledged, is stil1 rather general. A fully articulated classification scheme would involve the construction of a more detailed table with a view to the success conditions for urban sustainability policies in different cities. In this framework a meta-analytic case study experiment might be deployed with the aim to derive generalizable or transferable policy lessons. Methodological expositions and empirical examples on such approaches can be found in van den bergh et al. (1997), capello et al. (1999) and florax et al. (2001).

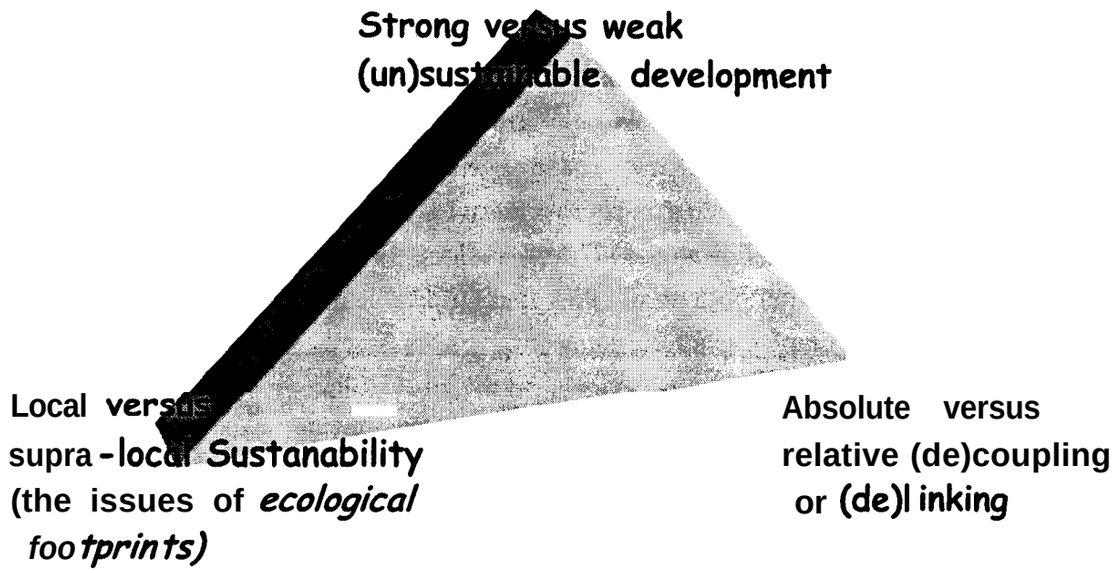


FIGURE 3: A new triangular typology

After this broad taxonomic exposition a few reflective remarks are still in order. The above typology aims to offer a systematic mapping of all relevant spatial-economie and ecological forces at work in achieving urban sustainability. It is also clear that such a presentation needs extensive spatial and time-series data on both economic and environmental indicators. Furthermore, an ambitious modelling effort would be needed to generate a consistent representation of all linkages between the various indicators used. Equilibrium analysis may be helpful in this context, but this is no doubt a long lasting effort. And finally,

the translation of the above mentioned analytical findings into concrete and effective policy measures is a great scientific challenge for environmental scientists.

8. Urban Sustainability Revisited

The world-wide interest in sustainable development has not left the city untouched. On the contrary, it has placed the city in the centre of the sustainability debate. The vivid discussion of the need for sustainable development has made clear the need to recognize once more that the city is the home of the modern man.

The city is the theatre of social cohesion and dialectics. It is the cradle of civilisation and the temple of cultural, economic, technological and scientific progress. In a modem network society (see Castells 1996) the city acts also as a nodal centre for both global and interlocal connectivity of flows (material and non material). Urban economics, in particular, has made an important contribution to our improved understanding of urban agglomeration advantages as the driving forces for city formation and city growth. Clearly, in a dynamic world the specific roles and functions of cities may change and lead to fluctuating performance patterns of cities depending on their competitive behaviour and policy response (see e.g. Blackman 1995; Button 1998; Edwards 1997 and Pacione 1997). But such evolutionary patterns do not erode the overall position of cities as centripetal and centrifugal geographical concentration points in a complex space-economy.

Is the city able to fulfil the high expectations and the great many requirements put on its shoulders? This is a challenging question. We have witnessed convincing examples of very successful and pro-active urban sustainability policy initiatives. So the opportunities are there. There are also glaring example of failures. So the threats are there equally as well. In many cases of urban development policy, the final success (or failure) will be contingent on a close interplay of all stakeholders from the viewpoint that urban sustainability is a *sine qua* non for the survival of the city in the upcoming network society.

Note: Though this paper is the result of joint research, the first author is mainly responsible for Sections 6-8.

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FIGURE 1: The locus of sustainability principles and policies
SOURCE: Camagni et al., 1998