Sustainable Urban Development: Definition and Reasons for a Research Programme

13

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13.1 Introduction

The concept of sustainable development is steadily achieving recognition, if not full disciplinary autonomy, becoming the focus of new theoretical and normative reflections. However, the same cannot be said of a more specific field of application of that same concept—the urban environment. In our opinion, this has been hindered until recently by some unresolved problems—of definition, methodology and epistemology—intrinsic in the more general concept, and also by some specificities of the urban case which have not been sufficiently borne in mind.

The research programme recently launched at the Politecnico di Milano[1] aims at directly facing these unsolved problems, and proposes a definition on which later empirical studies and new theoretical elaborations may be based.

As we shall see, from many viewpoints this is not so much a question of establishing new concepts, as of consistently exploiting existing ones or criticizing their improper use.

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13.2 The Specificity of the Urban Perspective

Facing the topic of sustainable development from the point of view of cities looks increasingly crucial. Cities in advanced countries now contain the greatest concentrations of economic and residential activities, and they are consequently the places where most emissions, waste materials and polluting materials are produced and where the highest share of energy is consumed. Moreover, if one of the most important elements in the production of all types of pollution is territorial density—since the capacities of the ecosystem to regenerate natural resources are relatively constant per territorial unit, while the negative impact probably grows exponentially—cities, with their very high density of land use, represent interesting cases.

A second reason for facing the problem of sustainable development by starting from cities concerns the efficiency of intervention. Cities have an important influence on global sustainability (e.g., through the effects of emissions of CO, CO_2 and NOx by traffic on the so-called 'greenhouse effect') but the same causes which endanger global sustainability also have their impact on 'local' sustainability, however defined (congestion, noise, air pollution) Breheny, 1992a. This being so, what has recently been presented as the 'locality theorem' (Camagni et al. 1996) indicates that it is much more efficient to face the problem by starting from a local level (in terms of both effects and of subjects and authorities) than from a global one, where authorities are often absent, polluting sources are remote, interdependencies between the actions of different subjects are higher, and uncertainties regarding measurement of phenomena and causal chains are more striking.[2]

However, although all the above indicates synergies and similarities between the global approach to sustainability and the urban approach, one fact must immediately be made clear: the latter has some strong specificities which mean that the methods and concepts used must be thoroughly revised. If reflection on "global" sustainability undoubtedly focuses on the dynamics of exploitation of natural non-renewable resources, it does not appear mechanically possible to transpose this reflection to the urban environment, as is very often done, since cities are by definition large manufacts, *artificial*—and no longer natural—environments created by man, perhaps his greatest creation.

The historical rise of cities itself by separation and autonomization from the surrounding countryside implies a clear-cut division between activities and professions—those which exploit natural resources and those which do not; the

[2]The validity of the 'theorem' may be justified as follows. The more 'local' the problem (by nature, convention, or policy- maker's choice), the more:

- the identity between polluter and victim increases, and thus the willingness to pay in order to avoid damage;
- in the case of 'a few polluters', the principle 'polluter pays' is easy to apply;
- in the case of 'many polluters', the population is homogeneous, and goals and needs (including environmental ones) are shared to a greater extent.

emergence of social interactions enhanced by proximity, unthinkable in a model of sparse settlements; the development of activities linked to control, culture, art, and social and technological innovation; and the development of values of individual freedom as opposed to the 'ethical life' of peasant families (Camagni 1996b).

The existence of cities therefore already implies a fundamental choice: abandoning a model of life and social organization wholly based on integration between man and nature, in favour of one wholly based on integration between man and man; abandoning production functions based on the factors of land and labour in favour of functions based on overhead capital, information and energy.

There are very important methodological consequences here:

(1) a 'strong' definition of sustainability, implying non-substitutability between natural capital and artificial capital—a definition which is probably the most correct approach in a global perpective (Victor et al. 1994)—cannot be usefully exploited in an urban context, where natural capital (provided, for example, by greenfield land) is replaced by overhead capital;
(2) the close trade-off between economic development and environmental quality, explicitly or implicitly admitted in most discussions on global eco-biological equilibria, can and must be doubted in at least two cases, if we start to analyse cities:
   – cities in the underdeveloped world: in such cities, improved infrastructure and hygienic and cultural conditions linked to economic growth can only lead to improved environmental quality[3];
   – 'affluent' cities, where environmental quality may become a superior or luxury good and a critical location factor for advanced activities, and thus a precondition for further development.

   In both cases, the hypothesized trade-off is clearly an oversimplification of reality, valid for short-term analysis in which a *coeteris paribus* condition is acceptable for all socio-economic variables which generally accompany the historical evolution of society: technology, organization, social values and public policies. However, in the medium and long term, these variables are not constant (Beckerman 1993), particularly in an environment like that of cities, characterized by maximum interaction between those variables and maximum attitude towards change. We may thus think of the evolutionary trajectories of the relationship between environment and economic growth as long-term interpolations between short-term trade-off. These trajectories may show a positive or negative slope or—more realistically, if the above is true—they may vary according to the stages of social development (see the model we call VASE: Value-driven Alternative Sustainability Evolutions; Fig. 13.1).

[3]Some environmental conditions, to achieve which man has long struggled and which still today are considered priority goals in less wealthy societies (e.g., availability of drinking-water and access to health services), are undoubtedly closely and positively connected with the level of development and, at least in the latter case, with the development of urbanization. See empirical evidence collected by the World Resources Institute, with a commentary by Beckerman (1993).

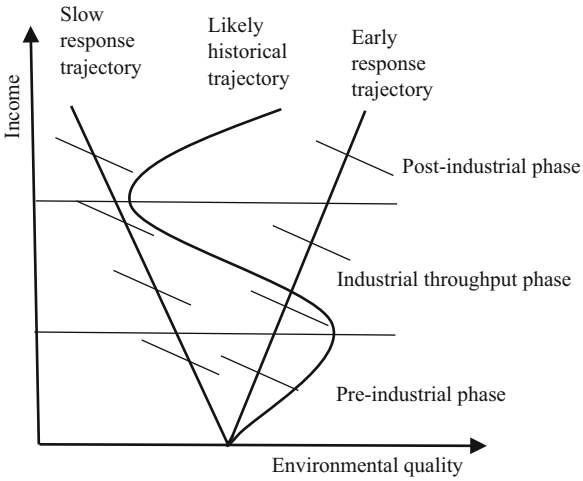

Fig. 13.1 The trade-off between per capita income and environmental quality: the VASE model. Source: Camagni (1996a)

(3) The stronger the focus on local (and urban) aspects of the man/environment relations, the less these relations imply a long, multi-generation, time span in which to manifest themselves and the more it seems justified to refer their effects (also) to the interests of *present* generations rather than (only) of future ones. This allows us to overcome the thorny logical and methodological problems (including problems of moral philosophy) which inevitably present themselves when the interests of future generations are considered[4] and to use the most traditional instruments of analysis of public choices and rational behaviour;
(4) lastly, an approach often followed by some environmentalists who view sustainability as linked to autarchy and respect for the carrying capacity of the local area (with no possibility of trading those capacities in the form of transfers of natural resources or waste from one area to another), appears to be unrealistic in an urban context: cities are by definition poles in the spatial division of labour, nodes of international exchange of immaterial goods, with high contents of intelligence against material goods, with high contents of natural resources, instruments for freeing human activities from the constraints of local resources (why should only Arabs and Texans be able to use cars in cities?).

Not to consider this contradiction explicitly means one of two things: trivializing the approach to urban sustainability by not recognizing its specificity, or squeezing ourselves inside a restrictive theoretical framework, according to which all cities are by definition 'unsustainable'.

[4]See Pasek (1993) for a clever summing up of these problems. I have the impression that reference to future generations often provides a good scientific and political alibi aiming at reducing rather than increasing concern and interest in environmental problems.

In other words, it must not be cities as such to be questioned[5], as some highly relevant new trends which jeopardize their primary role as points of social interaction, creativity and (relative) collective wellbeing. I refer here to the processes of desordered and limitless growth which cities often undergo during periods of economic take-off and rapid industrialization: or to the recent processes of sprawl, variously labelled as 'metropolisation', 'suburbanization', 'città diffusa', 'ville éclatée', 'edge-city development' (Camagni 1994). These processes have made the conceptual distinction between city and countryside empirically ambiguous, leading us towards a non-city and a non-countryside; processes which have above all exacerbated the problem of mobility and energy consumption because they result in a settlement model wholly dependent on the private car. But I also refer to the new processes of 'ghetto development' which are increasing in large cities, due partly to global social transformations and partly to the difficulty (and delay) with which public policies have dealt with the problem.

In conclusion, research on urban sustainability must have as its model of reference not an earthly paradise of eco-biological equilibria, but rather an (albeit simplified) multidimensional archtype, in which the various functions of cities are recognizable: supply of agglomeration and proximity economies, accessibility and social interaction, network linkages with the outside world, in which a maximum of collective wellbeing emerges from positive processual integration among natural environment, built and cultural heritage, economy—and thus employment—and society.

13.3 Which Definition of Sustainable Development?

As is widely known, the concept of sustainable development aims at launching a large-scale political, economic and cultural project harmoniously linking environmental requirements with those of economic development, from a long-term viewpoint. The interests of future generations are therefore explicitly set next to those of present generations, and the processes of economic optimization are constrained by the respect of the limited reproduction capability of the biosphere.

The Bruntland Report of the World Commission on Environment and Development "Our common future" (WCED 1987, p. 9) defined sustainable development as "a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are made consistent with future as well as present needs".

It is no longer worth commenting on some of the criticisms or doubts raised about the program of sustainable development, for example about its presumed ambiguity, its imprecision, its paternalism inherent in the appeal to the needs of

[5]The city has variously been defined as: 'a parasite on the natural and domesticated environments, since it makes no food, cleans no air, and cleans very little water'; a 'cancer' and, as such, a 'lethal illness'; an 'overgrown monstrosity, with gluttonous appetites for material goods and fast declining carrying capacity'. See Haughton and Hunter (1994, chapter I) for a short list and balanced criticism.

future generations when, it is stated, current development is insufficient to resolve the needs of many present generations.

Rather, I would like to stress one element of the definition, because it is often lost in the analysis: the emphasis placed on 'process' and change, rather than on a static objective of optimization of some kind. We are dealing here with the idea of achieving a process of collective learning in which the maximum of synergy between economy, technology and environment is reached and negative cross-externalities among the same three subsystems are minimized. However, as soon as one wishes to proceed from general definitions to more directly operational specifications and thus to better identification of the aims and constraints of the problem, the different proposed definitions become infinitely multiplied and appear as a long sequence of infinitesimal variations on a theme.

Without wishing to go into a detailed analysis, because that is not the aim of the present paper, I have tried here to give a simple classification of these proposals, since greater clarity and some theoretical both seem essential if we are to proceed further.

The first, quite evident, dimension through which to classify the various definitions and which implies a preliminary dichotomy, is that between input-oriented—i.e. non-renewable resources oriented—definitions of production and exchange processes, and output-oriented definitions of those same processes, i.e., linked to the level of wellbeing, utility, income or per capita consumption. We therefore have on one hand definitions based on the need to place restrictions on the use of certain resources in the process of economic development: i.e., not to exceed their regeneration capacity (e.g., fish, forests) or their capability of assimilation of polluting substances—or, in the case of non-renewable resources, of guaranteeing their most efficient use. On the other hand, we have definitions based on the need to guarantee a continual flow of long-term wellbeing, with the implicit awareness that a high level of such wellbeing cannot be reached by destroying natural resources and contaminating the biosphere (Fig. 13.2).

A 'weak' conceptualization of sustainability is generally implicit in the second approach, in the sense that it allows more or less ample substitution between various elements of the utility function or the production function (with the replacement of artificial for natural capital, purified water instead of natural water). Instead, an idea of 'strong' sustainability is generally implicit in the first approach: that is, no reduction in the availability of a non-renewable resource can be compensated by the increased availability of another one.

The second dimension through which we have classified the different definitions—the second dichotomy—may be found in the type of underlying rationality. On one hand, we have proposals based on what has been called 'substantive' rationality, definable according to Herbert Simon (1972) as rationality which presupposes the possibility of behaviours which are always appropriate for the achievement of particular goals in the presence of definite constraints: the decision-maker does not commmit errors, either ex ante or ex post, at least not systematically. This is a rationality subtended mainly to neoclassical economics, implying the availability of perfect information, perfect knowledge of constraints and outcomes of decisions, and unlimited computational capacity. On the other

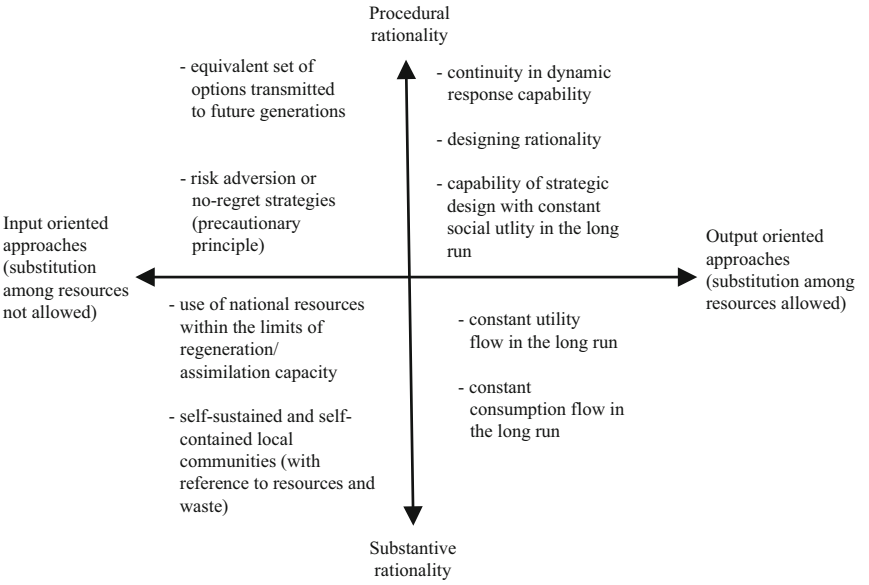

Fig. 13.2 Alternative approaches to sustainable development

hand, we have proposals based on another type of rationality, elaborated initially in social psychology, based on the analysis of more realistic cognitive processes in situations characterized by imperfect information, uncertainty and complexity: 'procedural' rationality, defined not so much according to the ends-means-decisions consistency as on the correctness of reasoning and of a process of information collection and processing. The evident uncertainty lurking behind every economic choice—in the quantity and appropriateness of information, the availability of a strong causal link in predicting effects, the possibility of complex or chaotic outcomes due to non-linearity of relations, or the difficulty of governing choices and other people's reactions—has led social scientists (and social actors) to become increasingly interested not so much in identifying optimal choices as in ways of identifying them by means of the construction of conditional scenarios, planning, consensus construction, and minimum-risk decision-making.

Inside substantive rationality (Fig. 13.2, bottom) are the definitions of sustainability of Solow (1986) and Pezzey (1989), both based on observations of output and open to substitutability among factors, which identify it in a non-decreasing level of per capita consumption or utility in time (bottom, right)[6]. But proposals of the opposite sign may also be included, all aiming at establishing

[6]Solow indicates the conditions necessary for such optimal allocation of resources in an intertemporal sense, and in particular the so-called Hartwick condition: that rents produced as a result of the exploitation of natural non-renewable resources (natural capital) should be invested in reproducible activities capable of replacing those resources.

constraints on the exploitation of resources. Pearce (1988) identifies sustainability as the exploitation of natural resources which does not exceed their regeneration capacity, or as the rate of polluting emissions which does not exceed the rate of assimilation of the ecosystem in question.[7] Then there are the various ecologistic proposals for creating local self-sustained and self-contained collectivities, in which resources are exploited within the limits of their local capacity (Magnaghi 1990). In all these cases (bottom-left in Fig. 13.2), there is no uncertainty regarding the measurement of the phenomena or the outcomes of actions, and no analysis of the social costs of drastically restrictive measures (or on the distribution of such costs).

On the other hand, proposals which fully account for uncertainty, for risks deriving from the irreversibility of many choices in the environmental field and of the possibilities of strategic learning by actors during the development process, belong to the framework of procedural rationality. Of those oriented towards control of inputs (top-left side), we find the significant works of:

- Pearce et al. (1989), who suggest strategies of a safe minimum standard of conservation and of risk aversion;
- Vercelli (1994), who proposes a strategy of conservation of natural resources with the aim of leaving open the largest number of options to future generations, while waiting for a learning process which would progressively illuminate the real relations between economic development and the evolution of the biosphere. In this case, sustainable development would allow us to leave future generations a set of options at least equal to those we have now—options which could have value in that they might in the future allow changes in strategy as and when new information made such changes necessary;
- Froger (1993) and Faucheux and Froger (1995), who propose a combination of the two previous approaches, in the form of a decisional procedure which, following Simon, introduces intermediate sub-goals (in time), tangible and capable of being measured and evaluated, to replace global, intergenerational, abstract goals. This procedure aims at the avoidance of irreversible processes when exploiting resources (the precautionary principle) and guarantees an 'initial' state which is transmitted to the next generation allowing the maximum number of alternative options.[8]

[7]It is interesting to note how Pearce's concept of sustainable development has evolved over the years towards the former view based on output. In Blueprint 3, devoted to measurement of sustainable development, Pearce states that 'sustainable development is economic development that lasts' and that 'it is continuously rising, or at least non declining, consumption per capita, or GNP, or whatever the agreed indicator of development is' (Pearce 1993, pp. 7–8).

[8]Properly examined, this seems to be the most revealing interpretation of the definition of sustainability contained in the Bruntland Report, which speaks of development 'to meet the needs and aspirations of the present without compromising the ability to meet those of the future' (WCED 1987, p. 40), rather than the 'substantive' interpretation of 'intergenerational equity' which implies precise prediction of the needs, values, preferences and technologies of future

Very similar, but based on the capacity to find solutions rather than on the need to keep open resource-exploiting options, are proposals (top-right side in Fig. 13.2) which view sustainability as:

- a continual capability of change and response (Camagni et al. 1998);
- a capability of creative adaptation, of 'designing rationality' (Vercelli 1994);
- a continuous capability of strategic design guaranteeing at least a constant flow of long-term collective utility.[9]

Clearly, the proposals shown on the left of Fig. 13.2 are more stringent and probably more consistent from the viewpoint of the conservation of resources, since they directly control their exploitation. However, in view of the use these definitions have in an urban context, we prefer the proposals on the right of Fig. 13.2, since we see in the good overall functioning of a city a superior goal with respect to the conservation of some specific resources located in the territory of that city. Within the latter proposals, we prefer those in the upper quadrant, which reflect attention on processes rather than directly on results, on collective learning rather than on predefined goals.

A different dimension and therefore a possible new dichotomy through which to classify definitions and approaches to sustainability may be the often stressed distinction between approaches based on market economic behaviours and approaches implying a clean break with existing institutional organization and reference to a new ethic. On one hand, we find those who believe that "the proper use of environmental resources is more a matter of economics than morals" (Dorfman and Dorfman 1972, Introduction) and, on the other, those who believe that ethical values must guide the actions of people and of governments in directions which respect the environment.

I have not used this type of interpretation and classification, because I believe it is erroneous and leads to useless dichotomies. If we wish to anchor ourselves to an operative approach and thus avoid palyngenetic analyses and proposals which risk making a myth out of the environment or 'the territory', neglecting existing society and above all failing to indicate actors and forces for possible radical change; if we also carefully analyse the ways in which the market can or cannot achieve certain goals imposed politically or ethically by society, then we must conclude that there is only one possible pathway—that of a market oriented by a shared ethic.

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generations. The idea of defining short-term subgoals referring to the passage between the current and the next generation is the 'temporal' counterpart of the strategy of definition of a limited 'spatial' horizon in which to define sustainability, described above as the 'locality theorem' (see note 1). Both cases imply problems of uncertainty and imperfect information from the standpoint of procedural rationality, attentive to the achievement of at least 'satisfactory' goals.

[9]By 'capability of strategic design', we mean not only the capability of constructing long-term strategies but above all that for implementing them by means of participatory planning, based on negotiation and persuasion, as indicated by the recent experience of strategic planning applied by public planning agencies. Cf. Gibelli (1996).

This is not a question of inventing new definitions of 'markets' or economic mechanisms, but of accepting what, after Karl Polanyi, is no longer a debated point.[10] The market is a social formation: it operates and works within a series of rules, criteria, definitions, and values defined by society and human beings. According to Polanyi (1944), "a market economy can only function in a market society"—a society which in particular defines the rules of some 'particular' markets, in which factors, not goods, are exchanged. Polanyi indicates three markets: labour, land and money. We would like to add a fourth: that of non-renewable environmental resources. These 'particular' markets can only operate inside clearly visible social and institutional rules explicitly defined by national collectivities. In the same way that, over the centuries, society has applied to itself increasingly more stringent rules for the labour market, today society is dictating rules for the exploitation of natural resources, in parallel with growing perception of the value of those resources. In this sense, we agree with René Passet (1994) when he observes that "l'éthique frappe à la porte de l'économie".[11]

Ethics must allow two types of corrections to market functioning, through state action: in internalizing externalities and in considering the long term (or the interests of future generations), two well-known cases of market 'failure'.

The difficulty is both analytical and political. But an attempt may be made to resolve the problem on the political sphere by the voluntary action of 'good actors' in a 'good simulated market' in which we can morally take care of our long-term future. In the case of non-renewable environmental resources, we must discount the future at relatively low interest rates, lower than those currently in force on the market. Excessively low rates would mean considering all future generations as equal to existing ones, thus limiting consumption to a subsistence level for these latter; social discount rates too near to current private ones would imply rapid exhaustion of resources.

So we must create a 'good market' (Veca 1993) which, environmentally speaking, transmits a far larger number of signals than the short-sighted market of individual ethics but which in any case avoids extensive public regulatory intervention which will inevitably come into conflict with the equally costly risk of 'government failure'—due to insufficiency of information, non-selectivity of

[10]'The exceptional discovery of recent historical and anthropological researches is that man's economy is generally immersed in his social relations' (Polanyi 1944).

[11]Another problem not faced here is that of deciding wheher new behaviour respecting the environment may derive from the standpoint of traditional moral philosophy, which we could call anthropocentric, or whether 'for a sustainable society ... different systems of preferences, values and use of scientific knowledge ... will be necessary' (Bresso 1993, p. 25), i.e., a new ecocentric ethic. Although it seems right to state, as many have done (e.g., Norton 1984; Turner 1988) that the framework of traditional reflection on ethics must be extended, I agree with Heister and Schneider (1993) that, if 'environmental ethics is a question of deeper insight into humanity's own place in the universe, of more human self-respect and, derived from that, of more respect for all creation, ... then, however, environmental ethics is anthropocentric', and there is no need to claim, explicitly or implicitly, any special rights of nature for itself, requiring special behaviour by man.

regulatory instruments, difficulty in applying and checking regulations, arbitrary distribution of intervention costs.

13.4 Sustainable Urban Development

Various kinds of definitions and approaches also show up when we apply the sustainability model to cities. In this case, instead of classifying them, we prefer to review some of their contents and directly make some choices, sometimes of method, sometimes of simple subjective preference.

Level of Analysis: Local, Transborder, Global
The sustainability of urban development is proper to all three levels of environmental problems. Our proposal, completely subjective, is analysis of local effects: sustainability must be evaluated in terms of its effects on local collectivities, in the awareness that a city launched on a 'locally' sustainable path is one which actively participates in reducing global negative effects.

Goals
The priority variable must be the long-term wellbeing of the local population, linked to the prosperity of the city as such. In abstract, a city is a great economic, social and cultural value, subjected to the continual risk of being annihilated by a series of negative feed-backs due to its spontaneous development and by prevailing short-term signals and decisions. The wellbeing of the population includes not only needs connected with economic and material wellbeing, but also ones connected with cultural and professional growth, identity and sense of belonging, access to the environmental and cultural values of the city.

Environmental Resources in the City
Today, these represent one of the most powerful instrumental variables for city development and wellbeing. However, they have often been considered as the sole goals of the sustainable city and treated alternatively in a purely abstract or sectoral way. In particular:

– theorizing territorial autarchy, in which human activities are limited by the availability of local physical and environmental resources (White and Whitney 1992) does not appear to be acceptable: any city and any model of social division of labour and complementarity between city and countryside would be judged as non-sustainable;[12]

[12]It is not by chance that these authors also believe that the pre-modern city is not perfectly sustainable ('quasi- sustainable'), on the basis of its need to provide itself with water and food, sometimes from distant regions. Even Plato identified in colonialism an intrinsic characteristic of the city, obliged to 'go to war' every time its population exceeded a certain threshold and tertiary activities prevailed over agricultural ones (see Camagni 1996b, p. 6). Today, relations between

– the concept of carrying capacity, understood as "the maximum population that can be supported indefinitely in a given habitat without permanently impairing the productivity of the ecosystem upon which that population is dependent" (Rees 1988, p. 285; White and Whitney 1992, p. 9) is an essential concept, although it must be used with greater caution than is generally the case. This is because its measurement depends on the size of the supporting territory, which is chosen subjectively and which changes according to the problems involved. It also depends on available technologies, scale economies in treating waste and wastewater, and type of activities carried on in the city;[13]
– lastly, we must remember that urban environmental resources are often artificial and therefore expandable at a certain cost (e.g., urban biomasses).

Thus, a sustainability program based on the non-exchange of carrying capacities between territories does not seem to be a valid proposal, if by this physical exchange of resources (or of waste products) more efficient territorial processes are achieved.[14]

We thus come finally to a definition of the sustainability of urban development. In our opinion, we can define sustainable urban development as a process of synergetic integration and co-evolution among the great subsystems making up a city (economic, social, physical and environmental), which guarantees the local population a non-decreasing level of wellbeing in the long term, without compromising the possibilities of development of surrounding areas and contributing by this towards reducing the harmful effects of development on the biosphere.

Let us consider the single elements of this definition in turn.

It is *a process,* nourished by collective learning and by capacities for the resolution of conflicts and for strategic design, not the application of an optimal model defined once and for all.

city and non-city are manifested in less violent forms of commercial relations with advantages to all parties.

[13]To state, as Rees (1992) and Alberti (1994, p. 23) do, that if the world population were capable of living within the limitations imposed by regional capacities, the net result would be global sustainability, appears to be a completely subjective view, in two senses: first, the consumption of land surface required by such a model would be extremely high, given the reduced density it would impose on settlements; second, it is not a question of 'not being capable' of living in a diffuse way but of the fact that such a model does not appear to be the most efficient one, from the viewpoints of productivity and interaction between people—otherwise, the world would already be a different place.

[14]It does not seem relevant to include among the arguments of sustainabiliy the absence of unequal exchange, in terms of value, among various territories, as it is proposed by White and Whitney: it is true that the terms of trade which penalize the countries of the South result in a waste of natural resources, but this problem, from the theoretical viewpoint, is not very different from the problem of the right pricing of scarce resources, and is a different and greater problem, from the political viewpoint, than that of the sustainability of local development.

The various systems making up the city (economic, social, physical—built and cultural heritage—and environmental) must be considered together and in their dynamic interactions (externalities, feedback, increasing returns, synergies). We cannot just put different aspects together and expect them to add up to a proper sum. We must take up an evolutionary approach characterized by full consideration of the complexity involved, with its components of non-linearity, cumulativity and irreversibility.

Operatively, sustainable urban development is pursued by maximizing the area of integration between the various subsystems and by minimizing the effects of idiosyncrasies and negative cross-externalities among them (Fig. 13.3). For example, the high population density of a city should represent an opportunity for achieving scale economies in transport, reducing per-capita energy consumption for heating, allowing advanced forms of district heating, in public illumination, etc. The city allows to maximize access to a differentiated labour market, to education and health structures, and to occasions for social interaction. Again, thanks to the high density of land-use, it can (potentially) guarantee good access to a wide range of values embodied in its historical, cultural and environmental heritage. On the other hand, the cases of air and water pollution depending on the same high density

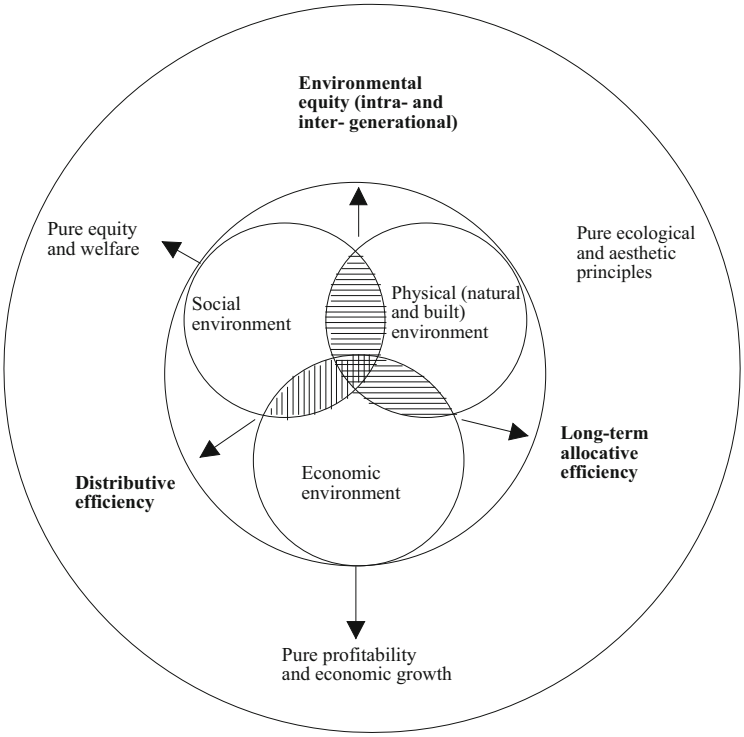

Fig. 13.3 The locus of sustainability principles and policies. Source: Camagmi 1996a; Camagni et al. 1996

of land-use and cases of depletion of the historical heritage due to growth requirements (or to neglect caused by lack of growth of local income) stand as witnesses to the existence of negative externalities which must be controlled and minimized.

Integration between the regulatory principles of the various subsystems is required in order to achieve the preceding goal. Private efficiency, social equity, aesthetic quality and ecological equilibrium are valid principles and policy goals in each single sphere, but they are partial and antithetical and do not lead to sustainability. On the contrary, we must aim (Fig. 13.3) at:

- *a long-term allocative efficiency* by internalizing social costs and constructing a 'good market' which can properly deal with environmental externalities and assess future benefits and not only immediate ones;
- *distributive efficiency*, by allowing the maximum number of inhabitants to exploit and enjoy the services, benefits of agglomeration and variety of available options offered by the city. This does not mean constructing the city of equality, which is a condition neither necessary nor sufficient for sustainability, nor a city without conflicts. On the contrary, the city must play host to diversity, must defend, integrate and reproduce it, must guarantee non-discrimination, permeability and vertical mobility for its population, turnover of élites, and maximum access to opportunities. The sustainable city is not a conflict-free city but one which knows how to manage its conflicts;
- *environmental equity*, in both inter- and intra-generational senses. Once again, this means not so much, and not only, producing environmental values, but guaranteeing access and enjoying them to the entire population, both present and future. The element of equity refers to the environmental element in two main senses. One: many environmental policies may be costly and imply greater sacrifices for the less wealthy classes (e.g., a carbon tax or a private car tax weighs more heavily on them, since the share of their income destined for mobility is greater). Two: as many environmental goods are typically located on physical space, some potential users may be excluded from enjoying them.

The new regulatory principles we propose here are therefore less ample than the pure principles, but they are more selective and above all potentially compatible. The concept of equity emerging from this framework, understood both in the sense of access to environmental goods and of equal opportunities for the population, gives a long-term guarantee of greater potential development for the city and thus does not contrast with the concept of long-term efficiency. The same may be said of policies more directly oriented towards the environment which, although they imply short-term costs, provide long-term locational advantages and thus further possibilities of development.

There are three contexts in which the problem of urban sustainability arises and may be faced in a normative sense:

– technology;
– territory and urban form;
– life-styles and organization of social work.

In these three cases, we can distinguish between short-term and long-term goals and policy interventions. In the short term, the path towards sustainability implies to intervene on demand, the overall supply conditions remaining constant by definition; therefore it implies input substitution and energy saving in the production process (the overall structure of that process being equal), and changes in mobility models (locations, residential and productive, being equal). On the other hand, in the long term, interventions may involve technologies and urban form, profoundly changing the ways in which the city and its activities function. As we can see, the characteristics of technologies and those of the territory and how it is exploited mirror each other faithfully (Table 13.1).

A major difference between the two cases is worth underlining: while in the case of technologies the same elements that push towards energy saving in the short run (e.g., a rise in energy prices) at the same time address research and investment towards clean and environment-friendly technologies in the long run, as decision agents are the same, viz. the individual private firm, the same cannot be said about settlement patterns. In this latter case in fact:

– long-run evolutions of urban form depend heavily on public decisions and regulations, and are not just on individuals' choices;
– private decisions about residential locations are heavily intermediated by the real estate and construction industries, whose decisions about supply location only marginally depend on sustainability considerations;
– total private costs of individual mobility represent only one factor in residential location decisions, and only a huge rise in these costs could determine a visible reversal of the residential dispersion trend;

Table 13.1 Objectives and tools of sustainability policies

	Short term	Long term
Technology	Input substitution: – Incentives for energy-saving – Energy tax – Tradeable emission rights	Technological change: – Incentives to R&D for renewable technologies – Regulations on polluting technologies
Land use	Changes in mobility patterns: – Road pricing, parking pricing – Car pooling – Traffic calming – Incentives to intermodality	Changes in urban form: – Polycentric city – Transport / land-use integration – Incentives for environmental values in periurban areas
Life styles and habits	Reduction of polluting habits: – Incentives to bicycle use – Attractiveness of public transport – Incentives to recycling and selected disposal of solid waste	Ecological lifestyles: – Teleworking, teleshopping – Flexible working time – Renewable technologies for heating

– social costs of mobility on private cars are higher than private costs, but they do not alter private decisions unless they are internalized through a public decision.

All this explains why long-term considerations about urban form are often overlooked and even contrasted in current theoretical debate and common planning practice (Rydin 1997).

More complicated is the third context of habits of the population and of organizational models, since public intervention must, for obvious reasons, be exerted more indirectly and delicately. We cannot generically condamn Western life-styles, with their individualism, competition and consumerism, as 'simply not sustainable'.[15] What is essential is a system of prices and taxation which discourages products with ascertained negative environmental impact. In this case too, we can distinguish between the short term, in which we must restrict the use of transport means and goods with a strong environmental impact and the long term, in which civic and organizational culture proposes or imposes new models of living, working and moving about (tele-work, except for some antisocial aspects which have restricted its use until now; recourse to neighbourhood services; revitalization of city districts with the aim of creating a 'city effect' and a new sense of solidarity);

Given the characteristics of immobility and long duration of the urban physical capital, the problems of irreversibility and the cumulative effects of decision-making on urban growth must be carefully considered. Policies for sustainable cities are ones which require high capability for predicting synergy and feedback effects, high capability of anticipating spontaneous processes, and use of a precautionary principle. As for the temporal dimension of phenomena, we can say that, more than is the case of the natural environment, cause-effect and interaction relationships among the three subsystems occur quite rapidly, and we can easily assume as our planning horizon a time span compatible with the persistence of the current generation.

13.5 Sustainable Urban Development and Urban Form: Structural Analysis

This research programme aims at analysing the links between the morphological, structural and functional aspects of cities and the sustainability of their development. Attention will therefore be paid to a set of elements pertaining to the form and functioning of urban territory.

The territorial characteristics which we believe have an impact on long-term urban performance are, in decreasing order (of generality and aggregation):

(1) the absolute dimension of the city: economies and diseconomies of agglomeration and various phenomena of dynamic efficiency are linked to the absolute

[15]See the otherwise excellent article by Blowers (1993), p. 7.

dimension of a city, in the same way that, on the purely environmental level, the perception of congestion phenomena are connected to the absolute dimension (OECD 1995). Two recent econometric investigations about the relevance of size in determining both economic and environmental efficiency of cities in Northern Italy confirm an U-shaped relationship as far as costs are concerned ('overload effect'), and an inverse U-shaped relationship as far as urban benefits are concerned ('city effect'), with optimal size respectively indicated in 50,000 inhabitants and 300,000 inhabitants (Capello 1996; Camagni and Capello 1997);[16]

(2) land-use density which, coeteris paribus, reduces the energy required for heating (size being equal, a single-family house consumes about three times as much energy as an apartment: Owens 1992, p. 82), for lighting (it is instructive to recall that the metropolitan area of Milan, which embraces 44% of the population of Lombardy, only consumes 33% of the energy for public lighting, 38% for domestic use, and 31.8% of the total amount of electric energy required for all purposes), and for transport (in densely populated cities, the percentage of use of public transport for personal movement is higher, and bicycles are used more (OECD 1995; Newman and Kenworthy 1989). Clearly, in densely populated cities, availability of and access to parks and green areas is reduced, so that we are faced with a problematical trade-off here;

(3) city form: its compactness, the configuration of its peripheral areas and its parks and green areas. Although these elements are difficult to measure, they nevertheless become elements central to wellbeing, urban efficiency and sustainability. They have recently been the focus of a passionate debate, mainly following publication of the EC's Green Paper on the Urban Environment (EEC 1990) which clearly indicated compact urban forms as the most favourable. Apart from some controversial statements (like that of Breheny 1992b, who speaks of 'obsession')[17], and referring to 'compactness' in a sensible fashion, it would not be an exaggeration to state that ample consensus has been reached on the fact that strategies of 'concentrated decentralization' like those long implemented by Danish and Dutch planning, which result in various forms of polycentrism and reinforcement of the 'urban effect', with their large areas of

[16]These relationships hold in a condition of coeteris paribus; a translog production function reveals us that these thresholds may substantially increase, enlarging the "optimal" city size, when cities show an increasing share of advanced tertiary functions and increasing network linkages with external territories.

[17]Refusing density and urban compaction as generators of energy savings in private mobility and substituting them by increased fuel prices and public transport availability on the basis of an econometric analysis (as in Breheny et al. 1997) does not apparently lead to sound results: the latter variables in fact mainly impinge on per-capita energy consumption through residential location choices and consequently through urban density and form. In practice, all the mentioned policy tools—namely density regulations, transportation investments and energy prices—have to be utilized together by planners.

public parks and gardens (like the English 'green belts' or 'fingers' flanking more heavily urbanized areas of German and Scandinavian planning) do represent an efficient territorial meta-model of reference.[18]
The comprehensive survey by OECD (1995) and a recent Report on European Cities (Camagni 1997) show that successful 'best practice' policies, to be preferentially extended to other cities, involve:

- revitalization of city centres (to the point of 'retrofitting' centrality and urban effect where previously no centre existed, as in Reston, Virginia, a suburb of Washington, D.C.);
- policies for polynuclear reorganization and for creation of 'urban villages' (like in the Finnish planning experience);
- policies of urban 'containment', already tested twenty years ago in the United Kingdom and now extensively re-applied, especially in America (see recent plans for Vancouver, British Columbia; Ontario, Canada; Davis, California; and Portland, Oregon);
- attempts to implement integrated transport/land use planning by locating huge mobility-generating activities at the major nodes of the public trasportation networks (the policy 'the right business at the right place' of Dutch planning), possibly in a central location (Portland, Stockholm, Toronto, Vienna, Copenhagen);
- and the increasing resistance to the opening of suburban hypermarkets which is currently felt in France, Holland, the United Kingdom, and now also America;

(4) mixing of land-uses. One of the elements generating maximum expansion of the demand for mobility is the functional specialization of various areas of cities, connected to the historical practice of zoning. Integrated territorial structures are now becoming more popular (possibly hosting activities vertically integrated along production filières: see Camagni and Gibelli 1992), in which most of the demand for mobility is self-contained. However, the problem is extremely complicated and subject to long-term trends which in any case lead towards expanded mobility flows. Labour market catchment areas are extending, as a result of the fragmentation of functions and professionalization; even 'life basins', for reasons of amusement and leisure time, culture or work, are widening; the increasing women participation rates and the increasing number of family units in which two people both have jobs also breed this trend. Only for low-quality jobs is it possible to think in terms of local labour market basins. For all these reasons, many town planners do not see many alternatives to the old model of monocentric cities or high-density working locations, served by efficient public transport in the direction of satellite residential areas (Lacaze 1993; Camagni 1994).

[18]Breheny proposes a 'multipli-city', a polycentric model in which non-excessive regional density accompanies an important urban effect: see Breheny and Rookwood (1993).

All previous elements and relationships have to be assessed in a dynamic perspective. In fact, the overall urban system is in a state of evolution and, as already mentioned, the public decision-making process must be constructed as a dynamic process, of learning and dynamic interaction.

The urban system moves on the basis of (and thanks to) phenomena of feedback, synergy, cumulativity, network externality, increasing returns and indivisibility, i.e., non-linearities which generate all kinds of possible outcomes—explosive development, sudden catastrophic leaps, chaos—and above all irreversibility. The case of the choice of a private transport mode, cumulatively reinforced by residential location choices generating a dispersed and sprawling settlement pattern are typical in this respect. Non-coordinated individual choices, often taken under a prisonner's dilemma condition, do not necessarily lead to collective wellbeing and do not allow corrections as far as they imply non-reversible use of land resources.

13.6 Some Preliminary Conclusions

This paper aims at supplying an initial theoretical and methodological framework for a long-term innovative research program, highlighting the specificity of the problem of sustainable development when applied to an urban environment.

A city is by nature a manufact, an almost entirely artificial object, constructed by man for historical goals of socialization, synergy, increase of knowledge and social wellbeing. A 'weak' concept of sustainability, which permits ample substitutability between production inputs and utility function inputs, is almost impossible to avoid. When considering the problem in its entirety, we must combine the socio-cultural, economic and environmental elements which all go towards the construction of that complex set of relations we call a city.

Of course, this does not mean that we must simply add up different aspects, different goals and different principles of analysis and intervention (principles of equity, efficiency and environmental equilibrium), as is often done. We believe we must revise these traditional principles, elaborating three new ones: the principles of long-term allocative efficiency (integrating economic and physical environments), distributive efficiency (integrating economic and social environments), and environmental equity (integrating social and physical environments, and aiming at maximizing access to environmental values in intra- and inter-generational senses).

Another characteristic of our approach is that of assuming fully a dynamic viewpoint, consistent with the intrinsically dynamic and interactive nature of phenomena connected with the sustainability of development. This implies:

– consideration of dynamic interactions among the above three environments—in the form of positive and negative feedback and effects of synergy or idiosyncrasy;

– full consideration of uncertainty as an essential background element, in turn requiring an approach to problems based no longer on substantive but on procedural rationality (in Simon's sense);
– consideration of the intrinsic uncertainty in cause-effect relations pertaining to sustainability and of the degree of effectiveness of intervention policies indicates a partly subjective and partly objective choice for our research program. This choice is to limit analysis, in spatial terms, mainly to the local scale (hypothesizing that the global level too gains from any improvement in lower-level conditions) and, in temporal terms, to a long period which embraces mainly the current generation (in the conviction that feedback effects important for the urban environment abundantly manifest themselves over a thirty-year period). This choice limits the interpretative uncertainty of territorial processes, increases the normative efficacy of interventions, and avoids the problem—economically and philosophically intriguing—of how future generations are to be represented around the table of present decisions.

References

Alberti M (1994) La città insostenibile. In: Alberti M, Solera G, Tsetsi V (eds) La città sostenibile. F. Angeli, Milano, pp 15–62

Beckerman W (1993) The environmental limits to growth: a fresh look. In: Giersch H (ed) Economic progress and environmental concerns. Springer, Berlin, pp 3–23. (in Giersch)

Blowers A (ed) (1993) The time for change. Town and Country Planning Association, London, pp 1–18

Breheny M (ed) (1992a) Sustainable development and urban form. Pion, London

Breheny M (1992b) Sustainable development and urban form: an introduction. Pion, London, pp 1–23

Breheny M, Rookwood R (1993) Planning the sustainable city region. Town and Country Planning Association, London, pp 150–189

Breheny M, Gordon I, Archer S (1997) Can planning for a more compact city secure sustainable levels of urban travel in the London region? ESRC London Seminar, Department of Geography, University of reading, January

Bresso M (1993) Per una economia ecologica. La Nuova Italia Scientifica, Roma

Camagni R (1994) Processi di utilizzazione e difesa dei suoli nelle fasce periurbane: dal conflitto alla cooperazione fra città e campagna. In: Boscacci F, Camagni R (eds) Fra città e campagna: periurbanizzazione e politiche territoriali. Bologna, Il Mulino

Camagni R (1996a) Lo sviluppo urbano sostenibile: le ragioni e i fondamenti di un programma di ricerca. In: Camagni R (ed) Economia e pianificazione della città sostenibile. Bologna, Il Mulino, pp 13–51

Camagni R (1996b) Principes et modèles de l'économie urbaine. Economica, Paris

Camagni R (1997) Cities in Europe: globalisation, sustainability and cohesion, in European spatial planning. Presidenza del Consiglio dei Ministri, Dipartimento per il Coordinamento delle Politiche Comunitarie, Il Poligrafico dello Stato, Rome, pp 93–179

Camagni R, Capello R, Nijkamp P (1996) Sustainabile city policy: economic, environmental, technological. In: van den Meulen G, Erkelens P (eds) Urban habitat: the environment of tomorrow. Technische Universiteit Eindhoven, Eindhoven

Camagni R, Capello R (1997) Increasing returns to scale and urban location costs: an econometric analysis of their determinants. In: Paper presented at the 37th congress of the European Regional Science Association, Rome, Aug 1997

Camagni R, Capello R, Nijkamp P (1998) Towards sustainable city policy: an economy-environment-technology nexus. Ecol Econ 24(1):103–118
Camagni R, Gibelli MC (1992) Alta tecnologia e rivitalizzazione metropolitana. Franco Angeli, Milano
Capello R (1996) Rendimenti urbani e risorse ambientali: una stima delle esternalità ambientali nella funzione di produzione urbana. In: Camagni R (ed) Economia e pianificazione della città sostenibile. Bologna, Il Mulino, pp 53–81
Dorfmann R, Dorfman N (1972) Economics of the environment. W.W. Norton, New York
EEC (1990) Green paper on the urban environment. Commission of the European Communities, Bruxelles
Faucheux S, Froger G (1995) Decision-making under environmental uncertainty, Cahiers du C3E n. 95-2, Paris
Froger G (1993) Les modèles théoriques de développement soutenable: une synthèse des approches methodologiques, Cahier du C3E n. 93-19, Paris
Gibelli MC (1996) Tre famiglie di piani strategici. In: Curti F, Gibelli MC (eds) Pianificazione strategica e gestione dello sviluppo urbano. Alinea, Florenz, pp 15–54
Haughton G, Hunter C (1994) Sustainable cities. Regional Studies Association, Jessica Kingsley Publishers, London
Heister J, Schneider F (1993) Ecological concerns in a market economy: on ethics, accounting and sustainability. In: Giersch H (ed) Economic progress and environmental concerns. Springer, Berlin, pp 25–48
Lacaze J-P (1993) L'urbanisme entre mythe et réalité. Actions et recherches sociales 1:21–30
Magnaghi A (ed) (1990) Il territorio dell'abitare. F. Angeli, Milano
Newman PW, Kenworthy JR (1989) Gasoline consumption and cities: a comparison of U.S. cities with a global survey. J Am Plan Assoc 55(1):24–37
Norton BG (1984) Environmental ethics and weak anthropocentrism. Environ Ethics 4:17–36
OCDE (1995) Urban travel and sustainable development, Paris
Owens S (1992) Energy, environmental sustainability and land-use planning. In: Breheny M (ed) Sustainable development and urban form. Pion, London, pp 79–104
Pasek J (1993) Philosophical aspects of intergenerational justice. In: Giersch H (ed) Economic progress and environmental concerns giersch. Springer, Berlin, pp 49–63
Passet R (1994) Le développement durable: d'une remise en cause à l'émergence de la responsabilité intergénérationnelle. In: C3E-METIS International symposium on Modèles de développement soutenable: des approches exclusives ou complémentaires de la soutenabilité? Mimeo, Paris, 16–18 Mar 1994
Pearce DW (1988) The sustainable use of natural resources in developing countries. In: Turner RK (ed) Sustainable environmental management: principles and practice. Belhaven, London
Pearce DW, Markandya A, Barbier E (1989) Blueprint for a green economy. Earthscan, London
Pearce DW (1993) Blueprint 3—Measuring sustainable development. Earthscan, London
Pezzey J (1989) Economic analysis of sustainable growth and sustainable development. Environment Department Working Paper 15. The World Bank, Washington DC
Polanyi K (1944) The great transformation. Holt Rinehart and Winston, New York
Rees WE (1988) A role for environmental assessment in achieving sustainable development. Environ Assess Rev 8(4):273–291
Rees W (1992) Ecological footprints and appropriate carrying capacity: what urban economics leaves out. Environ Urban 4(2):121–130
Rydin I (1997) Sustainable development and urban form. In: Paper presented to the international conference on sustainable planning of periurban areas, Bologna, March, forthcoming at Il Mulino, Bologna
Simon H (1972) From sustantive to procedural rationality. In: Mc Guire CB, Radner R (eds) Decision and organization. North Holland, Amsterdam
Solow R (1986) On the intergenerational allocation of natural resources. Scand J Econ 88(1):141–149

Turner RK (éd) (1988) Sustainable environmental management: principles and practice. West View, Boulder

Veca S (1993) Convivere con la competizione, l'innovazione e la solidarietà. Progetto Cultura Industriale, Milano, Assolombarda

Vercelli A (1994) Sustainable growth, rationality and time. In: C3E-METIS International symposium on Modèles de développement soutenable: des approches exclusives ou complémentaires de la soutenabilité? Mimeo, Paris, 16–18 Mar 1994

Victor P, Hanna E, Kubursi A (1994) How strong is weak sustainability? In: C3E-METIS International symposium on Modèles de développement soutenable: des approches exclusives ou complémentaires de la soutenabilité? Mimeo, Paris, 16–18 Mar 1994

White R, Whitney J (1992) Cities and the environment, an overview. In: Stren R, White R, Whitney J (eds) Sustainable cities, urbanization and the environment in international perspective. Westview, Oxford, pp 8–51

World Commission on Environment and Development (1987) Our common future. Oxford University Press, Oxford