Environmental protection and the sustainable city

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ABSTRACT: There has been wide-ranging discussion about the importance of achieving inter- and intra-generational sustainability. The debate has covered many issues related to population, agriculture and biodiversity, industry, energy consumption, global warming and pollution, as well as equity in access to resources and urbanism. The arguments have largely moved on from the rather doom-laden scenarios of global catastrophe, towards a certain optimism that having understood the problems, solutions might be found. While the whole range of environmental issues is important and all are interrelated, it is the issue of urbanism that seems to provide the problems that are among the most intractable and difficult to solve. The significance of cities is not in doubt. Cities will need to become more aware of the impact that their consumption patterns have on other regions and ecosystems. A sustainable city also will need to acquire accountability and responsibility for increasing consumption patterns. Economy, ecology and social cohesion are the pillars of the sustainable city. These must be in balance and, therefore, require an integrated approach.

INTRODUCTION

Cities will need to become more aware of the impact that their consumption patterns have on other regions and ecosystems. A sustainable city also will need to acquire accountability and responsibility for increasing consumption patterns. Cities may work towards responsibility by adapting a policy to reduce, recycle and re-use consumed goods. Some cities may go as far as implementing user fees in order to control unsustainable consumption patterns. By examining the characteristics of a sustainable community, a better understanding can be reached about defining a sustainable community. Being very complex entities, cities can be characterised by a number of different properties. These properties may change across countries and geographical regions. This section gives an overview of the most important sustainability issues in cities - grouped by the geographical locations of the project partners [1].

Economy, ecology and social cohesion are the pillars of a sustainable city. These must be in balance and, therefore, require an integrated approach. Dialogue is the basic principle for achieving this for Local Agenda 21 [2]. Cities have become the focal points of these components as major consumers and distributors of goods and services. However, many cities tend to be large consumers of goods and services, while draining resources from external regions they depend on. As a result of increasing consumption of resources, and growing dependencies on trade, the ecological impact of cities extends beyond their geographic locations. It has been recognised that the concept of sustainable development is an evolving, debatable term.

Sustainable urban management should challenge the problems both caused and experienced by cities, recognising that cities themselves provide many potential solutions, instead of shifting problems to other spatial levels or shifting them to future generations. The organisational patterns and administrative systems of municipalities should adopt the holistic approach of ecosystems thinking. Integration, cooperation, homeostasis, subsidiarity and synergy are key concepts for management towards urban sustainability [3]. Existing tools developed in relation to environmental action need to be extended to address the economic and social dimensions of sustainability.

Sustainable management of natural resources requires an integrated approach to closing the cycles of natural resources, energy and waste within cities. The objectives of such an approach should include minimising consumption of natural resources, especially non-renewable and slowly renewable ones; minimising production of waste by reusing and recycling wherever possible; minimising pollution of air, soil and waters; and increasing the proportion of natural areas and biodiversity in cities. These objectives are often easier to achieve on a small scale, which is why local ecological cycles can be ideal for introducing more sustainable policies for urban systems. Local government, therefore, plays a crucial role.

Sustainability is strongly linked to socio-economic aspects of cities. There is a need for the European Union and Member States to create the conditions in which businesses can profit by operating in more environmentally sound ways. Regional and local authorities should explore ways of creating employment through environmental measures, encourage better environmental performance in existing businesses and encourage industry to adopt an ecosystems approach. Authorities should strengthen the well-being of the population and promote equality and social integration by ensuring that basic services and amenities, education and training, health care, housing and employment are available to all. Resisting recent trends of ignoring environmental and social risks while concentrating on accumulating material wealth requires changes to the underlying values in society, as well as to the basics of economic systems.

Spatial planning systems are essential for the implementation of city-wide policies for sustainable development. Existing spatial planning systems should be strengthened by encouraging ecologically-based approaches and a move away from a narrow land use focus.

Urban regeneration should be used to meet goals of sustainable development through the recycling of previously developed land or existing buildings, the retention of greenfield sites and protection of countryside and wildlife. Detailed sustainability objectives, including the establishment of ecological links, improved accessibility, energy efficiency and community participation, also should be pursued. Decontamination of polluted soil, a major concern in many urban regeneration projects, should be seen as part of an integrative approach which provides the possibility for achieving cross-subsidy between sites. Tourism and leisure activities can have significant impacts on the quality of a city's cultural heritage. Planning for tourism, leisure and cultural heritage should be integrated in national guidelines and regional policies addressing economic, social, environmental and cultural aspects.

The sustainable city process is about creativity and change. It challenges traditional government responses and seeks new institutional and organising capacities and relationships.

ANALYSIS OF THE VULNERABLE COMPONENTS OF THE CITY

Experience shows that even in the present age of high technology and progress, the city is particularly vulnerable to natural disaster phenomena which, apart from the immediate damages they cause, often result in the dissolution of all development, creating irreversible situations, even leading to complete decay. An examination of the vulnerability of the city is part of a general risk management plan, a specialised planning approach to urban space. It is obvious that measures for the prevention of, and the protection from, natural phenomena must be included in the overall process of urban planning. Vulnerability analysis, therefore, relies on an evaluation of human and material losses, if possible on economic terms, with a view to making a quantitative assessment of damages and an appreciation of the risk. This approach to vulnerability, which is based on the dire consequences of the event, is complemented with a qualitative approach related to the causes of the disaster. According to this view, vulnerability corresponds to the tendency a given community has to suffer damages due to some natural phenomenon [5].

Vulnerability, then, depends on a host of parameters: urban planning, socio-economic, political, demographic, psychological, historical, technical, functional, etc. In comparison with other types of natural disaster, the consequences of an earthquake are usually completely unpredictable, dramatic and random. In addition, an earthquake can affect a much wider area and the urban components that receive the consequences will be great in number. It is, therefore, unrealistic to claim the vulnerability of every component can be analysed in detail. For this reason, a selection of vulnerable components is often resorted to: those which, if damaged or completely destroyed, will cause the most severe dysfunction for the city. In this sense, the vulnerable elements of space are:

a. The population in a broad sense; that is, permanent inhabitants, as well as temporary population (visitors on business, tourists, etc);
b. Certain buildings and infrastructures of the city receiving on a regular basis a large number of visitors, such as public buildings, services, etc;
c. Buildings of strategic significance, characterised by their usefulness at times of crisis, such as hospitals, communication centres, transportation networks, networks of general infrastructure, decision quarters (Ministries, City Hall, etc), production centres, etc;
d. Monuments, buildings that belong to the local cultural and historical heritage, buildings of architectural significance;
e. Components particularly susceptible to risk, such as particular plants, nuclear stations, toxic material storehouses, etc.

In anticipating the possibility of a natural disaster - a *crisis situation* - preceding it must be an identification of all vulnerable elements of the city above; of everything, in other words, that can impede its normal function. Apart from the analysis above of natural vulnerability, that is, the vulnerability that concerns the built space, an investigation of the vulnerability of the city must also include analysis concerning a series of additional vulnerability factors. In particular, it is essential a study of population distribution is conducted, of its socio-economic characteristics, of urban indices of the city, of its functions, of productive and economic activity, of its infrastructures, as well as the city's relation to the surrounding area [5][6].

CITY AND SUSTAINABILITY

Sustainable development is thus a much broader concept than is environmental protection. It implies a concern for future generations and for the long-term health and integrity of the environment. It embraces concerns for the quality of life (not just income growth), for equity between people in the present (including the prevention of poverty), for inter-generational equity (people in the future deserve an environment which is at least as good as the one currently enjoyed, if not better), and for the social and ethical dimensions of human welfare. It also implies further development should only take place as long as it is within the carrying capacity of natural systems. Clearly, addressing the sustainable development agenda provides new challenges for urban policy integration within holistic frameworks.

Cities affect the global system through, for example, energy and resource use, waste and polluting emissions. They affect regional systems though river catchments and flows, patterns of land use and stresses on surrounding rural areas which are subject to pollution, development and recreational pressures. Within the city itself, it is possible to speak of ecology in the literal sense: the habitats cities provide and the plants and animals that live in them. It is also possible to conceive of the human ecology of cities - the way cities provide for human needs and wants, the qualities and options of human life they make possible, and the relationships between planning, design and service provision and human behaviour and welfare. Finally, and of most relevance in this policy report, ecology may be used as a metaphor or model for the social and economic, as well as physical, processes of cities, viewing the city itself as a complex, interconnected and dynamic system. Cities are both a threat to the natural environment and an important resource in their own right. The challenge of urban sustainability is to solve both the problems experienced within the cities themselves (the focus of action in the past) and the problems caused by cities.

A framework for local action is provided in this paper and it identifies a set of principles to use in setting goals and in evaluating and monitoring progress towards sustainability in urban areas:

a. *The principle of urban management:* Management for sustainability is essentially a political process, which requires planning and has an impact on urban governance. The process of sustainable urban management requires a range of tools addressing environmental, social and economic concerns in order to provide the necessary basis for integration. By applying these tools, urban policymaking for sustainability can become broader, more powerful and more ambitious than has been generally recognised.
b. *The principle of policy integration:* Coordination and integration are to be achieved through the combination of the subsidiarity principle, with the wider concept of shared responsibility. Integration should be achieved both horizontally, to stimulate synergistic effects of social, environmental and economic dimensions of sustainability, and vertically, between all levels of the European Union, Member States, regional and local governments to achieve greater coherence of policy and action and to avoid contradicting policies at different levels.
c. *The principle of ecosystems thinking:* Ecosystems thinking emphasises the city as a complex system, which is characterised by flows as continuous processes of change and development. It regards aspects such as energy, natural resources and waste production as chains of activity that require maintenance, restoration, stimulation and closure in order to contribute to sustainable development. The regulation of traffic and transport is another element of ecosystems thinking. The dual network approach, which provides a framework for urban development at regional or local level, is based on the principles of ecosystems thinking. Ecosystems thinking also includes a social dimension, which considers each city as a social ecosystem.
d. *The principle of cooperation and partnership:* Sustainability is a shared responsibility. Cooperation and partnership between different levels, organisations and interests is therefore crucial. Sustainable management is a learning process, within which *learning by doing*, sharing experiences, professional education and training, cross-disciplinary working, partnerships and networks, community consultation and participation, innovative educational mechanisms and awareness-raising are key elements.

Urban activities have great impacts on global carrying capacity thresholds through:

- the use of fossil energy in urban buildings, economic activities and transport, and corresponding emissions of *greenhouse gases* and other pollutants;
- consumption of physical resources and production of wastes (which should be seen as two sides of the same coin);
- releases of globally damaging pollutants such as ozone depleters and heavy metals.

As at the global level, resource depletion is mirrored in waste generation. Environmental systems have been swamped by human waste arising from increasing levels of consumption concentrated in urban areas. For example:

- the volume of liquid wastes from cities has frequently overwhelmed the carrying capacity of rivers, causing loss of fish and other species, eutrophication and accumulation of toxic residues;
- urban air pollution has frequently formed a health hazard;
- disposal of urban solid wastes has consumed large areas of land and resulted in leachate and methane problems.

Cities also exert a powerful *gravitational pull* on surrounding areas. They always have had a tendency to draw resources in from far afield. As local carrying capacity thresholds are reached, as urban administrations become more aware of

them and fastidious about not breaking them, and as long distance transport becomes cheaper and easier, the ecological *shadow* of cities - the hinterland affected by urban demands - rapidly grows. For example:

- mines, quarries and power stations in rural areas increasingly service urban resource and energy demands;
- urban waste is exported further and further to rural dumps;
- farming is increasingly geared to urban demands for highly processed, permanently available, packaged food. Ease of transport, consistency and standardisation take precedence over nutrition, animal welfare, resource efficiency, diversity, regional differentiation and even taste;
- the volume of city dwellers seeking rural recreation imposes stresses on the countryside.

Cities are themselves ecological habitats. Urban development usually reduces biomass and biodiversity by building over land and displacing animal and plant populations. However, it also can create new habitats and niches. The character and structure of urban green spaces, the connections between them, their interactions with buildings, the ways they are managed, levels of noise disturbance and pollution, and patterns of human behaviour, such as recreation, will all influence the habitat qualities of cities.

SUSTAINABLE URBAN MANAGEMENT

A philosophical debate about the definition of *sustainable development* bringing together social, economic, moral and political considerations could develop at length. While these are important they also can distract us from our main purpose of exploring and disseminating ways of working towards sustainability in urban areas. However, the particular nature of sustainability as a policy goal calls for particular ways of working towards it. It is, therefore, necessary to understand certain features of the concept of sustainability before moving on to discuss how to achieve it.

First, it is important to recognise that the environment can impose thresholds for certain human activities, and that there are circumstances in which *trade-offs* should not be made of environmental resources or harm against any other potential advantages or benefits. The continuing ability of the environment to provide resources, absorb wastes, and provide basic *life support* services, such as temperature maintenance and protection against radiation, are of critical importance for human well-being and existence. If humankind does not have adequately clean air to breathe, enough water to drink, an atmosphere that shields against harmful radiation, and soils and climate which enable the growing of sufficient food, it is unlikely to regard any combination of other benefits as compensating for their loss. There is increasing evidence to suggest that humans are breaking or risk breaking, some important global carrying capacity thresholds.

Determining where environmental thresholds lie - the earth's *carrying capacity* - will not be easy. Even where (as in the case of greenhouse gases) there is evidence that an important threshold is being exceeded, scientific knowledge may not allow the precise threshold to be set. There may be many more thresholds which no-one is even aware of yet, because the consequences have not yet forced themselves into human awareness and scientists have not yet asked the questions revealing them. In cases of uncertainty, the avoidance of potentially critical risks to the physical ecosystem must be given substantial weight in decision-taking. Sustainable development requires the management of demands.

The precautionary principle means human activities must be carried out within limits imposed by the natural environment. This calls for policy processes designed to manage - that is, reduce or redirect - certain demands, rather than to meet them (which has been the traditional public service approach) or to find an optimum trade-off point between opposing demands (as in many systems of spatial planning). Sustainable development is concerned with reconciling this with the aspirations of human societies to develop, progress and improve wealth and living standards. At the level of municipal government, this overall aim is mirrored in the need to reconcile the pursuit of sustainability with day-to-day service delivery objectives and pressures, and the expectations of local people. Achieving this aim invokes two further principles - environmental efficiency and welfare efficiency. Reducing the use of natural resources, increasing durability and closing resource loops will contribute to sustainability.

The *principle of environmental efficiency* means the achievement of the maximum benefit for each unit of resources used and wastes produced. Environmental efficiency can be increased in several ways [7]:

- increasing durability, so that environmental costs are spread over a longer useful life;
- increasing the technical efficiency of resource conversion, for example through greater energy efficiency or recovery of waste heat;
- avoiding the consumption of renewable natural resources, water and energy, faster than the natural system can replenish them;
- closing resource loops, for example by increasing reuse, recycling and salvage (and avoiding pollution);
- simplifying and avoiding the need for resource use (non-renewable resources). There is a cultural tendency to multiply complexity - to pile elaborate solutions on to simple problems. In environmental terms it is often better to simplify productive processes and avoid the use of resources.

Strongly related to these principles are the aims of sustaining human life and well-being, as well as animal and plant life and to maintain and increase biodiversity and biomass. All of these, but especially the last, are related to what can be called the *principle of elegance* [8]. This is the principle of solving problems through simple, economical means. It is the principle according to which, for short distance personal transport, a bicycle is more elegant than a car because it provides essentially the same result with 20kg of material, converting the rider's motive power at 98% efficiency, rather than with 800kg of material and a fossil fuel engine operating at around 20% efficiency.

THE ECOSYSTEMS APPROACH

The ecosystems approach enables cities to reach their potential in offering their citizens a sustainable quality of life. Scientists propose that a city can be considered an ecosystem, and that ecological concepts can be used for understanding the problems of urban sustainability and for choosing approaches to solving them. There are three interrelated strands to this idea. The ecosystems approach consists of three strands: physical, social and systems.

The *first strand* recognises that each city is, literally, a physical ecosystem in a similar way to a wetland or a forest. Techniques of empirical ecology can be applied to analyse cities in terms of flows of energy, nutrients and physical materials and to study effects on other physical ecosystems, such as the surrounding countryside. This is the sense in which ecological concepts have already been, in the first half of this section, used to describe the physical impacts of cities. Perhaps the most important insights, which this sense of ecology offers to urban environmental management, are those concerned with carrying capacities, thresholds, natural capital and the progressive closing of resource loops as a way for cities to continue developing after reaching resource limits.

The *second strand* of the ecosystems approach is to apply the concepts of physical ecology metaphorically to the social dimension of cities - as it were, to think of each city as a social ecosystem. Ecological concepts, such as niches (for different kinds of people, lifestyles, activities), diversity and different kinds of dependence (parasitism, symbiosis), can illuminate the *human ecology* (itself a revealing phrase) of cities.

The *third strand* of the ecosystems approach emphasises the *systems* rather than the *eco* aspect. This seeks to understand the *continuous processes* of change and development in cities by treating cities as complex systems to which concepts of systems theory can be applied.

Some of the key ecosystems concepts are:

- negative feedback, or *damping*, where the system reacts to change in such a way as to limit or contain it;
- positive feedback, or *snowballing*, where the system reacts to change in such a way as to reinforce it. An example might be the way that the choice by some well-off households to move out from an inner city area prompts others to follow, contributing to a cycle of decline;
- homeostasis, or change within stability, where negative feedback loops keep the overall system much the same while elements within it alter considerably. An example might be a city, which accommodates a complete change in its main industries without changing its overall character;
- state transition, or *step* change, where the way the components of a system mesh together alters fundamentally and irreversibly. An example might be the change, which in many European cities probably occurred between 1950 and 1970, from homeostasis in travel patterns to positive feedback encouraging car use;
- closure versus openness - the degree to which a system is insulated from, or vulnerable to, external changes. For example the Single Market and increasing requirements for tendering and restrictions on *anti-competitive* practices have in recent years opened both the private and public sectors to the vagaries of world markets, so that *the local economy* may mean little more than the enterprises which happen to be located in a particular area;
- emergence - the ability of a complex system to develop characteristics and behaviour *greater than the sum of its parts* and cannot necessarily be predicted or managed in terms of the behaviour of its constituent elements.

CONCLUSIONS

Cities and urban life hold the key to sustainable development. Europe's cities can and should be not only highly resource-efficient but also safe, healthy, pleasant, fulfilling and inspiring places to live. Too often they fail to be either physically or socially sustainable. This is, at least partly, because current management approaches often fail to recognise and respond to the complexity of the links between physical, economic and social processes within cities.

Ecological and systems approaches can help both to elucidate the complexity of urban management problems and to guide the choice and application of policy tools to tackle them, enabling European cities to live up to their full potential for environmental, social and economic sustainability. Ecological and systems insights offer a distinctive approach to urban policy making and require a distinctive set of policy tools. There is no such thing as one overall strict method to meet the aim of sustainable development. The ecosystems approach offers ways to tackle problems within their contexts; in relation to this, also exploring policy tools that can be applied in various combinations to manage change in practice.

At city level, local strategies for sustainability having the commitment and active participation of the local community can provide frameworks for effective action and experiment. If Europe's cities are to achieve their sustainability promise, governments must also allow cities maximum freedom to apply suitable tools at local level. Municipal and regional governments must be granted appropriate powers and resources, for example for taxation, subsidy, regulation and investment. Supranational and national governments have a major role in developing and using tools for sustainable development.

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