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Exploring the Ecosystem Approach to Urban Environmental Management

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Abstract

Conceptualizing the city as a biological entity (or organism) has a long history, but the use of the perspective as providing a basis for urban management has only recently been advocated. What this new management approach has to offer urban planning, however, is not well understood. As a first step in exploring the value that the ecosystem approach offers planning, this paper will address the questions of: 1) What are the fundamental elements of the ecosystem approach? 2) How have these elements been applied to understanding how cities work? 3) What are the ecosystems related concepts applied in the management of cities? 4) What are the challenges as well as potentially advantageous aspects of the approach?

To understand the elements of the ecosystem approach implications to two different aspects of the perspective are explored: conceptual and procedural. After an exploration of the elements of the perspective, some examples of how they are applied are given in both cases. Finally, the paper identifies both challenges for the application of the perspective and the promises that it provides. Continued application of the ecosystems approach remains promising, but success is largely unproven in the urban realm.
Section 1: Introduction

Environmental burdens associated with urban development are of growing interest to decision makers around the world and at all levels of governance. Environmental burdens within cities, particularly within the developing world, are also growing and becoming more complex. Most global environmental problems can be traced back to patterns of growth and activity in developing and industrialized cities. As urbanization continues, the impacts on ecospheres at all levels are predicted to grow and intensify.

Environmental challenges associated with cities of the developing countries are more complex than experienced previously by now industrialized urban areas. The developing world faces similar challenges of that the developed world faced, but the context under which they are developing is different. For example, those countries within the rapidly developing world, such as those in East, Southeast and now South Asia, environmental challenges are appearing sooner in development process and emerging more simultaneously (i.e., previously sequential challenges are increasingly overlapping in time) (Marcotullio, 2004a). For example, the provision of water supply in the now developed world was met through private actions until the middle to late nineteenth centuries when Western Europe and the USA and other Western offshoots reached comparative GDP levels of G-K$2,643 and G-K$3,372, respectively. At that point proto-comprehensive water supplies began to appear (Melosi, 2001). These levels are significantly higher than the average GDP per capita for 26 East and Southeast Asian countries in 2001, G-K$ 1,482.¹ This creates new challenges, as lower incomes translate into less revenue to deal with them and the emergence of simultaneous issues translates into less time to address them (Marcotullio, 2004b). It is increasingly important, therefore to find the most appropriate technologies and management practices for the developing world context.

Activities within developed world cities, on the other hand, are impacting increasingly wider geographic scales. Cities in the USA, for example continue to grow outward, consuming land at greater rates than that of population growth. Urban encroachment has consumed peripheral agricultural land and eroded rural forest area. More importantly, sprawl, as some term the process, is contributing to a variety of problems including making these cities the largest emitters of carbon dioxide, a major course of global warming. In general, consumption and

¹ Values for GDP per capita are calculated by Angus Maddision (2001).
lifestyle choices are impacting ecosystems thousands of miles away, manifesting in such problems as regional acid rain, tropical deforestation and global warming. The growing ‘ecological footprint,’ or the area representing the resources consumed and waste generated by these cities is many times the size of land covered by administrative boundaries. London’s ecological footprint is 120 times the area of the city itself and Tokyo needs 1.2 times the land area of all of Japan to sustain its levels of consumption.3

Cities in developed countries, however, have successfully overcome several traditional environmental problems, particularly within their own borders. For instance, mandates to implement end of pipe technologies or prohibit certain additives to products have been successful in lowering the levels of ambient SO₂, Pb and water pollution in countries of the Organization of Economic Cooperation and Development (OECD). These environmental successes were based upon traditional scientific understandings which solved single-issue problems separately. Planners have realized, however, that in other situations environmental responses (such as mandates for higher smoke stacks) have simply shifted burdens and risks to other populations (Jackson, 1996; Melosi, 2001; Tarr, 1996). In other cases, finding appropriate regulations and incentives to reduce some types of pollution (i.e., non-point source water pollution, toxic waste remediation and some forms of local air pollution) have been largely unsuccessful. Policies to help alleviate these complex problems require new understandings of how they have emerged and how they might be mitigated.

In recent years, environmental policy and research circles have advocated various ecosystem approaches as a possible solution to resource management concerns. The fifth meeting of the Conference of the Parties (COP) 2000, to the Convention on Biological Diversity (CBD), for example, outlined operational guidelines for the application of the approach that arguably would address the objectives of the convention.4 This approach has also been applied to managing forests and agricultural lands. It has yet to be applied widely to help resolve urban

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2 The area of land needed to provide the necessary resources and absorb the wastes generated by a community to highlight the impact on the environment.
3 See for example, Giradet, 1999. More information on the ecological footprint can be found at ‘The Global Development research Centre’ website http://www.gdrc.org/uem/footprints/index.html and the website for “Redefining Progress” http://www.rprogress.org/
4 The fifth meeting of the COP in Nairobi also devised twelve principles of ecosystem approach and five major points as operational guidance for the implementation of the convention. Few of the major principles could be cited as follows (the details can be viewed at the web site http://www.biodiv.org/decisions/default.asp?lg=0&dec=V/6)
environmental challenges (exceptions include the on-going experiments in Baltimore and Phoenix, USA). This paper explores the ecosystem approach to urban environmental management attempting to answer the following questions: What are the fundamental elements of the ecosystem approach? How have these elements been applied to understanding how cities work? What are the challenges as well as potentially advantageous aspects of the approach?

In order to explore these questions, the paper is divided into four subsequent sections. The next and second section of this paper defines the ecosystem approach as an “integrated response” and outlines its different elements. The third section presents examples of the application of the ecosystem approach, including those that have been applied conceptually and those that were implemented. The fourth section presents the limitations and promises of the approach. The last section concludes and summaries the arguments.

**Section 2: Defining the urban ecosystems approach**

The ecosystem approach is an integrated response to current environmental challenges. Responses are human actions to address specific issues, needs, opportunities, or problems in governance and management. They embrace all policies, strategies, measures and interventions that are established to change ecosystem status and processes directly, and for modifying the direct or indirect drivers that shape those status and processes and include legal, economic, social, behavioral, technological and cognitive aspects (Millennium Ecosystems Assessment, 2004).

Integration is the act of combining or coordinating two or more elements. The purpose of integration is to produce increased or enhanced effects – or in current policy language increases chances for synergetic solutions. Within the context of responses to environmental challenges integration includes combining or coordinating actions related to natural and social systems informed by ecological, economic and social theories (Gunderson and Holling, 2002). As such the ecosystem approach results in the coordination of resource conservation, economic development and empowerment objectives, all of which are necessary components of sustainable development.
Ecosystem approaches have been applied at different governance levels. Examples include some multi-lateral environmental agreements (MEAs), environmental policy integration within national governments and multi-sectoral management strategies such as Integrated Coastal Zone Management (ICZM), Integrated Water Resource Management (IWRM) and Integrated River Basin Management.

With increasing attention to this approach has come, not unexpectedly, an increasing diversity of definitions and variations of applications. This section reviews some of these efforts in an attempt to outline the distinct elements that define it. A useful way to proceed is to explore how the approach has been applied conceptually (how are ecosystem approaches understood), and procedurally (how are ecosystem approaches are aided or constrained by formulation of legal frameworks, property rights and organization of government, civil society and the private sector in their implementation).

2.1 Conceptual elements of the ecosystem approach

The conceptual elements that define the ecosystems approach include a systems understanding of theory; a multi-disciplinary perspective and the inclusion of both temporal and spatial scales in analyses. These conceptual elements are discussed in terms of their application to cities and urban planning.

The city as a system has been a central metaphor for urban management in the second half of the 20th century. The systems approach is essentially a formalized method of determining the role of components within the overall operation of the unit of study (Exline, Peters, and Larkin, 1982). Each system has coherence or unity, which enables distinctions between it and other systems. With the subject, often defined in spatial terms, the system can be viewed a complex whole. Thus, a system is analogous to a set in mathematics, where what is common to a set is what unifies and distinguishes it from other sets. What makes a system, however, is not just its distinction from other systems, but that it can be defined by the interconnection of its parts, through stocks and flows. The structure of a system is determined by the predictable ways in which these parts interact.

General systems theory evolved mainly as a response to the increasing specialization and compartmentalization that occurred in both the natural and the social sciences. Systems were thought to exist in two forms: open and closed. An open system interacts with its
environment; a closed system is isolated from it. Cities are open systems because they have within them nested sets of partially closed systems, and as a unit each sub-set exchanges energy and materials with a larger scale system.

The systems approach to urban planning focuses on the articulation of various components of a city and the flows and processes between them. In this sense, urban planning involves exercising control over the workings of parts of the entire system. This notion was a radical departure from previous views of addressing urban environmental problems. Before the application of the urban systems approach, planning as largely an exercise in design (Friedmann, 1987; Taylor, 1998).

The new approach brought significant changes to planning cities. Planners and city managers were required to understand and appreciate the complex inter-relationships between various and diverse phenomena that gave rise to urban development. In ecosystem terms these flows are called drivers or pressures. They could be indirect drivers, such as globalization flows, or demographic changes, or more direct pressures, such as lack of provision of water supply. Drivers result in a given state of the environment, which is seen as having impacts on ecosystem structure and function. When not functioning appropriately, urban ecosystems are associated with negative impacts on human well-being.

Within the systems approach proposals for development (both in terms of private and public decisions) are evaluated in a significantly different ways than the when finding the right urban form was the central focus of planning. Within the ecosystem perspective, planning focuses on the flows that create urban areas whereby internal environments are healthy for humans and other creatures which also have reduced demands on resources outside their immediate borders. Ecosystem planning emphasizes activity, dynamism, and change rather than producing detailed ‘end-state’ master plans. These documents focused on trajectories, rather than end-state blueprints for a fixed future. Planners, rather than having a more limited role, were given greater importance in urban development. As planning was an ongoing process of monitoring, analyzing, and intervening in fluid situations, their input was needed on a daily basis. This includes a broader remit for planning than previously encountered.

Previously, systems scientists worked with large-scale quantitative models. The models they produced were attempts to optimize outcomes among different variables. Despite the many
merits of the systems approach and the value it adds, at least three weaknesses have been identified. First, alone it does not deal effectively with the biophysical components of the 'systems environment'. Second, and related to the first, optimization exercises were based on the idea that all components to planning exercises could be evaluated on the same footing. The idea that some environmental considerations were not quantifiable or that it was difficult to derive monetary values necessitated their removal from models. Finally, the modeling and applications that came from the first types of systems approach to planning were frequently described in highly abstract, technical, and mathematical terms. They were therefore unusable to decision makers and indeed to those not familiar with details of model interpretation. In order to correct for these deficiencies other conceptual components have been added to systems thinking. The first of which is the multi-disciplinary thinking.

During the late nineteenth and for most of the twentieth centuries academic disciplines became more specified, focused and isolated. In particular, the social and biophysical sciences did not interact and thus developed methodologies that prevented their working closely together. Increasingly, however, scholars and practitioners agree that expertise from one field alone cannot solve complex contemporary problems. The sciences must work together to solve the world’s current dilemmas, and nowhere is this truer than in the world’s cities. In doing so, new ways to combine social issues (e.g., economics: income, employment, poverty; health: nutrition, access to water, sanitation, disease, service care; demography: urbanization, fertility, household family planning, gender) with the physical science issues (e.g., ecology, physics, chemistry, meteorology, geology, physical geography) are under consideration. Many contemporary global environmental efforts attempt to do so (see for example, the International Human Dimensions Programme).\(^5\)

In order to find common ground among disciplines on which to share understanding, multi-disciplinary research projects focus on specific issues or problems. That is, different disciplines bring to bear their theories and tools on a set of agreed upon objectives. Moreover, the focus or problems that they address integrate human activities with the bio-physical world. One example of how this is performed is through concentration on an ecosystems ability to provide goods and services for human well-being (Millennium Ecosystem Assessment, 2003).

In terms of urban ecosystem approaches the inclusion of the biophysical in addressing issues of concern is somewhat problematic, as much of the “natural” world within cities has disappeared or for that matter, the services provided by natural ecosystems have been overdrawn. This dilemma is overcome, in part, by the third important element of the conceptual underpinnings of the ecosystem approach, the inclusion of geographical and temporal scale in analyses.

Ecosystem approaches differentiate between the geographic and temporal scales. Wealthier cities are typically associated with wider (global) life support system impacts that are delayed in time, while lower income cities are associated with more localized impacts associated with immediate health threats (McGranahan, et al, 2001). While these generalizations are true, the growth and development of urban ecosystems impacts a number of different scales simultaneously. Hence local problems are at once local and regional and global. Therefore, a multi-scaled understanding of how they operate is necessary. For example, globalization flows operate at one scale, but underground hydrologic flows operate at another. Both impact the way water systems develop.

The history of provision of ecosystem services to urban areas can be understood in terms of increasing scale of urban environmental impacts. The search for adequate water supplies and safe locations for dumping waste water for example, can be seen as the extraction of ecosystem services from larger geographical areas or those further away from urban areas as well as search for larger scales sinks into which wastes are dumped (Tarr, 1996). We can look at these same scale issues over time as well. The transfer of risks associated with environmental burdens has increasingly been displaced upon future generations. For example, CO₂ emissions, largely from cities, have generated unclear but significant burdens on global climate, which while not evident immediately, is believed to be one of humankind’s greatest impacts on the Earth.

2.2 Procedural elements of the ecosystem approach
The procedural aspects of the ecosystem approach include those issues related to its implementation. In this instance a number of components are influential including the creation and flows of “useable knowledge,” the inclusion of all potential stakeholders in the development of ecosystem based assessments and strategies and the emphasis on flexible (or adaptive) management procedures.
Based upon the notion that the ecosystem approach is problem-oriented, solutions include the creation of information that is useful to those responsible for problem resolution. Useable knowledge is timely, understandable, relevant to decision-making and defensible (Machlis, 1996). The creation of useful information can be performed through a number of different ways including assessments and scenario building, for example.

Assessments provide a critical, objective evaluation and analysis of the current state of things. Typically they focus on the condition and trends of phenomena along with their influences (or driving forces) and impacts. Things that could be assessed range from the state of knowledge to the state of the environment. In the case of ecosystem assessments, a question arises as to how to evaluate the condition of these entities. When are ecosystems in good condition and what parameters can be used to identify when they are being degraded or improved. Concepts such as “ecosystem health” or the focus on the ability to provide “ecosystem goods and services” have been ways in which to address this dilemma. Another way to provide knowledge about ecosystems is in terms of their resilience or vulnerability. Resilience is the capacity to absorb shocks while maintaining function. When change occurs, resilience of a system allows for its renewal and reorganization (Gunderson and Holling, 2002). Whether the assessment is focused on ecosystem health, provision of services or resilience, the association of ecosystems to human well being is a crucial element. For example, ecosystem health can be defined by anthropogenic changes brought about by human activity and their impacts on the flora and fauna within a particular ecosystem type. The delivery of goods and services from ecosystems is analyzed in terms of their human consumption. Resilience, is typically applied to integrated systems of people and nature and placed in terms of managing environments were the future is unpredictable and surprise is likely (Holling, 2001).

Assessments also generate defensible information. Defensible information both provides a rationale for particular decisions and is based upon the use of science for its generation. To turn this ecosystem studies from information into usable knowledge that is both understandable and relevant to decision-making, scenarios are sometimes employed.

Scenarios are plausible, challenging and relevant stories about how a limited number of different futures might unfold. These stories are told in both words and numbers. In telling the stories, the potential consequences of current actions are revealed and thus they support
informed rational decision-making. Typically scenarios are built around four different archetypal visions of the future including worlds that evolve gradually, shaped by dominant driving forces; worlds that are influence by a strong policy push for sustainable goals; worlds that succumbs to fragmentation, environmental collapse and institution failure; and worlds where new human values and forms of development emerge (Millennium Ecosystem Assessment, 2004 Scenarios Volume, Chapter 3).

Together assessments and scenarios make up an important application of the ecosystem approach. When they are preformed consistently a database of information is generated that provides for the timely delivery of information. Moreover, they have the potential to make condense complex information into useable knowledge.

The flow of this information, however, requires fundamental shifts in governance institutions in terms of skills, knowledge, capacity and organization. Conventional organization of governance institutions militates against successful design and implementation of ecosystem approaches as fragmentation exists. Therefore, an ecosystem approach to urban management would require the removal or displacement of these constraints. Notwithstanding re-structuring of government, this could be accomplished in a number of ways, two of which include the development of inter-linked policies and their applications across sectors and levels of governments and the implementation of new institutions (i.e., ecosystem offices) that cross administrative boundaries among and between government offices.

Another procedural component of the ecosystem approach addresses the increasing complexity of environmental problems in a world of increasing uncertainty. Despite the clarity that assessments and future scenarios might bring, uncertainties cannot be eliminated. A partial solution to this dilemma has been the development of a flexible management tool called adaptive management. Adaptive management, sometimes called *learning by doing* includes the application of policies as experiments. Adaptive management accommodates learning, uncertainties associated with limited knowledge, unexpected outcomes, surprise, vulnerability, and outside shocks.

In general, too often plans and strategies are created that are not flexible enough to deal with the variety of ‘surprises’ that are increasingly experienced within cities and the larger ecosystems within which they impact. Urban ecosystems change, including population,
economy, environments, species composition, relations to hinterlands, water and air quality, biodiversity, soils, and forests. Apart from their inherent dynamics of change, ecosystems are beset with a complex of uncertainties and potential ‘surprises’ in the human, biological, and environmental realms. The ecosystem approach must utilize adaptive management in order to anticipate and cater to such changes and events, and should be cautious in making any decision that may foreclose options, but consider mitigating actions to cope with long–term changes such as climate change.

The importance of understanding that ‘things change’ not only relates to “nature” but also to social systems. For example, adaptive management has implications for addressing decisions and actions at all scales of social action. At the lowest scale, changes in actions taken by individuals, in terms of the rethinking the level of commitment to personal plans and strategies, and at the household level, in terms of how families respond to rapid and unexpected changes can be accommodated.

Adaptive management is itself a learning, experimenting, and improving process and reduces uncertainty by incorporating the process itself into decision making process. Under this procedure actions can be revised and implemented under novel means. Moreover, adaptive management is based upon the understanding that solutions should be bio-regional in scope (limited as best as possible in spatial scale) (Kai, 1999).

Another basic component of the procedural aspects of the ecosystem approach is the inclusion of all appropriate stakeholders in addressing challenges. Decentralization is part of this process as governments transfer management responsibilities, including those related to environmental concerns to lower levels of government. Deliberative and inclusive processes are increasingly viewed as a means of integrating civil society and other actors into governance. Moreover, the ecosystem approach suggests that working with populations will enhance the legitimacy and equity of solutions and promote successful actions in general.

An important caveat flows from this analysis. The history of responses to environmental burdens is the history of displacement of risks, some current environmental challenges, despite being local in nature, cannot be identified, analyzed or controlled by local populations. Moreover, decisions are larger scales, such as those associated with global markets, have
large impacts on the consumption of ecosystems services at the local level. These cross-scale governance issues, suggest actors at a variety of scales be included in deliberative processes.

Section 3: Applications of the ecosystem approach to urban areas

This section discusses a limited number of theoretical and practical applications of the elements described above. They have been combined in a number of ways resulting in a rich number of ecosystem approach variants. The first subsection identifies some of the theories that include ecosystem approach concepts. The second section describes practices that include both conceptual and procedural aspects of the approach in policies. Neither section is inclusive of all ways in which the ecosystem approach has been applied, but rather is indicative of the variety of ways in which it has been used.

3.1 Conceptual applications of the ecosystem approach to cities

There is a rich and varied history of understanding the city as an ecosystem. Notwithstanding oversimplification, the paper divides the many currents into six streams. The first is the urban ecology approach. The second is the city as flows approach. The third is the biosocial approach from which developed the human ecosystem framework. Fourth, an approach that focuses on the provision of ecosystem services make up a category. Fifth, an approach that attempts to identify and therefore reduce vulnerability and increase resilience as applied to cities has generated important research results. Finally, aggregate approaches to the subject are emerging. All of these approaches will be described in terms of their direct application to understanding dynamics associated with urban areas.

3.1.1 Urban Ecology

The urban ecology approach was and remains largely within the realm of biology and urban design. In this understanding, ecologists have looked upon cities as unique types of natural ecosystems. Cities are therefore not unlike natural landscapes (coastal scrub, grassland, oak woodlands, marshes, and stream–sides), holding a wide range of species. Many of these types of studies have applications to urban planning (see for example, McHarg, 1966; Hough, 1990, Register, 2002). “Eco-cities approaches,” for example, attempt to combine natural aspects of the local environment with low scale (human) high density green buildings to effect more livable environments which are less resource intensive. A particularly important concern of eco-city writers is the use of public and non-fossil fuel transport (walking and bicycling).
Generally, however, urban ecology studies keep humans and human activities separate from the ecological world. Those working within this approach are largely interested in the concepts and processes of the stresses, disturbances, structures, and functions of urban ecological systems, and how urban ecosystems relate more generally to larger ecosystems (excluding people). These types of studies have also been called the ‘bio–ecological approach’ (Grove and William R Burch, 1997).

Despite the separation of human and natural processes, there are interesting results and new techniques that have emerged from these studies, which have the potential to provide understanding of the relationships between human density and various ecological activities. One is the examination of changes in natural processes and conditions that occur along the rural–urban gradient (see for example, Pickett and McDonnell). Another is how natural processes can be restored within areas disturbed by humans (Givoni, 1991). These studies provide details of how to reverse and deal with human–induced hazards and adverse health effects and how urban ecosystem processes can be use to mitigate problems.

While these and similar studies provide insight into the biology of systems within cities, they remain only marginally useful in providing a policy framework for dealing with the complexities of cities, as they do not focus on the role and influence of social structures and activities in ecosystems processes.

3.1.2 The Flows Approach
A technique that attempts to incorporate results of human activities into the understanding of urban dynamics through the analysis of movements of materials and energy is called the flows approach. Like all ecosystems, a city can be studied in terms of inputs and outputs of resources, materials, and energy. The study of ‘urban metabolism’, as the first studies in this field were called, began in the 1960s (Wolman, 1965). This line of thinking was then promoted by the UNESCO/MAB’s first international effort to consider cities as ecological systems. In the mid–1970s, Stephen Boyden piloted the UNESCO/MAB pilot project on Hong Kong as an ecological system (Boyden and Celecia, 1981). The approach viewed the city as an ecological system with quantifiable flows of energy materials and information. Since the human population was a dominant component, the approach required the study of intangible aspects of human experience such as feelings, perceptions, and values. The two–decade project produced over 100 studies. The studies were directed at increasing the
efficiency, self-sufficiency, and ‘humanness’ of cities, and minimizing their impact on near and distant hinterlands in an effort to make the city system more sustainable and livable and to conserve resources. Notable examples of such studies and the ‘points of entry’ of their conceptual and methodological frameworks include patterns of extra-somatic energy flow (Hong Kong, Gotland), use of plants as indicators of chemical changes in the urban environment (Vienna, Rome), urban food production (Buenos Aires, Lae), urban forestry (Madrid, Xalapa), managing urban space for children (Toronto), use of sensitivity models for urban and regional planning (Lower Main–Frankfurt), and vegetation and urban climate (Dayton, Valencia).

Important studies in cities such as Hong Kong, Rome, Barcelona, Lae, Bangkok, and Seoul encompassed a spectrum of natural and social disciplines as well as actors. Assessments of sources and flows of energy and materials (e.g., water, foodstuffs, polluting substances) were complemented by studies of urban nature (with particular concern for biological and genetic diversity in cities) and the role of culture and societal organisation making city living ‘urbane’. These included psychosocial studies in Hong Kong and Rome (Celecia, 1996).

From the urban metabolism school an increasingly popular concept emerged, which demonstrated the impact of urban activities as a single unit. The ecological footprint attempted to identify how much of the carrying capacity of the earth is used by cites. As forwarded by William Rees in early 1990s this tool has been instrumental in providing the first measure of the environmental impact of cities (Rees and Wackernagel, 1996). Ecological footprint analysis illustrates that high-density human settlements no longer have boundaries that coincide with land needed for their daily activities. Thus, cities in the developed world cannot achieve sustainability on their own. Indeed, they demonstrate that the human history displays the ‘Easter Island syndrome’ (Rees, 2002).

By looking at the city as a whole and by analyzing the pathways along which energy and materials move, these studies have demonstrated how cities are increasingly out of the web of natural flows. This calls for a reintegration of urban activities with natural processes, increasing the efficiency of resource use, the recycling of wastes as valuable materials, and the conservation of energy (Newcombe, Kalma, and Aston, 1978). Urban metabolism studies can be used as tools in pointing to environmental problems (and economic costs), related to growth of inputs (as resources), and management of outputs (primarily the wastes). At the
same time, this approach often calls for radical responses to these trends. This comes in the form of changes in behavior (see for example Rees, 2002). The urban metabolism and ecological footprint analyses, have provided interesting critiques of the impact of cities on the environment, and are effective awareness raising tools, but have been weak on providing solutions.

3.1.3 Biosocial Approaches
Sociologists also employed ecological metaphors for the city. In the 1920s and 1930s, the Chicago School of Sociology applied principles of ecology to social theory with the objective of studying the community as an evolutionary entity. According to Vasishth and Sloane (2002), the founding sociologists of Chicago School derived their urban theory from their conception of science and nature, particularly ecology and evolution. They used work from animal ecology and cell physiology to understand the role of competition and cooperation as mechanisms of change and progress. These sociologists were the founders of the study of society through efforts to empirically measure and map urban patterns and processes using principles of ecology. The management implications adopted from this theoretical point of view were based on laisse faire economics and free market attitudes toward urban development.

In the 1970s, William Burch, Jr., started with the sociological viewpoint, but added natural components to his analysis. As a result, he began to articulate a ‘bio–social approach’ to human ecosystems. He and his students examined the energy, materials, nutrients, population, genetic and non–genetic information, labor, capital, organizations, beliefs, and myths and the knowledge that affects the distribution of critical resources within a human ecosystem. This work developed into the human ecosystem framework (HEF). The human ecosystem is a coherent system of biophysical and social factors capable of adaptation and sustainability over time, and argues that human ecosystems could be a starting point for the management of urban and other ecosystems (Machlis, Force, and Burch, 1997; Pickett, Burch, Dalton, Foresman, Grove, and Rowntree, 1997).

The framework includes three kinds of critical resources including natural resources (e.g. energy, wood, water), socioeconomic resources (e.g. labor, capital), and cultural resources

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6 For more information see [http://www.ecostudies.org/bes/](http://www.ecostudies.org/bes/)
Rather than a ‘self–regulating’ system, the flows of these resources are regulated by an unpredictable social system. The social system is composed of three subsystems including social institutions, social cycles, and the social order. The social order further includes three key mechanisms for understanding the organization of behavior including personal identities (e.g. age, gender), norms (e.g. rules for behaving), and hierarchies (e.g. wealth, power). The power of this model is the inclusion of an array of social and biophysical factors that define the urban ecosystem.

Machlis, et al (1997) argued the HEF is not a theory, but a conceptual framework that provides a number of important insights in human ecosystems. First, it provides the basis for using a systems approach to integrate socio–cultural and biophysical systems by describing the internal behavior of these systems and their interactions with each other in terms of flows and cycles of critical resources and allocation mechanisms. Second, it relates socio–cultural and biophysical patterns and processes at different scales. Third, by articulating the relationships between and among socio–cultural and biophysical patterns and processes, different types of system change such as resilience, resistance, persistence, and variability are highlighted. Fourth, it facilitates the explicit spatial measurement, classification, and analysis of socio– cultural and biophysical patterns and processes. Finally, this framework fits within a broader understanding of ecological systems for social and biological scientists.

The HEF has been applied as a framework and landscape approach in Baltimore, Maryland and more recently in Phoenix, Arizona, and has been incorporated into the National Science Foundation’s long–term ecological research (LTER) network, established in 1980. The model is useful in providing pathways for solving everyday problems within cities in an integrated, holistic manner. It overcomes the problems associated with the systems approach by including biophysical influences and includes human influences making it more useful than approaches that exclude people.

While the HEF provides the necessary framework for focusing research efforts, it does not describe the functions or processes that are inherent within the urban ecosystem. Further work in this area is necessary and depends on the unique characteristics of each city.
3.1.4 Ecosystem services approach

The Millennium Ecosystem Assessment (MA) was originally designed for serving the assessment needs of three international conventions namely, the CBD, the Ramsar Convention on Wetlands, and the Convention to Combat Desertification as well as national governments and local agencies. The approach is based upon analyses of the capacity of various ecosystems to provide goods and services important for humans (see for example, Daily, 1997). It includes ecological, social, and economic analyses and considers the current state of ecosystems and their potential in providing ecosystem goods and services. Considering geographic boundaries of an ecosystem are arbitrary, the approach is unique in its attempt at providing assessments at different scales.

The framework underpinning the MA includes driving forces, pressures, a variety of ecosystem services, indicators of human well-being and responses. The interrelationship among these factors is assessed globally in several ways including: the condition and trends of ecosystem and their services, future scenarios, responses and through a selected set of sub-global assessments. The result of this assessment will be published in four volumes.

Within the MA, the urban ecosystem is seen as being both a system in itself as well as an important, if not essential element in understanding the transformation of all other ecosystems (as a driver). As such, the MA is attempting to define urban ecosystems at different scales. They have also encouraged the implementation of several local levels and urban ecosystem assessments under their framework.

3.1.5 Resilience approaches

Groups that employ the concept of resilience to the study of sustainable development and ecosystem approaches include the Resilience Alliance (RA) and the Sustainability Science Initiative. The RA is a consortium of institutions that seeks novel ways to integrate science and policy in order to discover foundations for sustainability. These institutions have capitalized on recent discoveries in the way ecosystems, institutions, and economies interact to support or degrade the resilience of systems that sustain the livelihoods of people.

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7 Recently the MA has been invited to contribute to the Convention on the Conservation of Migratory Species. For more information see http://www.millenniumassessment.org/en/. The ‘urban systems’ chapter is included as part of the ‘Trends and Conditions’ working group and there is at least one ‘Sub-Global’ urban assessment being conducted.

8 The Alliance grew out of the work that compared different ecosystem types around the world, and how they were managed. For more information see http://www.resalliance.org/.
Resilience in this sense includes the amount of disturbance a system can absorb and still remain within the same state or domain of attraction, the degree to which the system is capable of self-organization and the degree to which the system can build and increase the capacity for learning and adaptation (see for example, Folke, et al, 2002). This specific theory suggests that the path to sustainable development and management of global and regional resources lies in a combination of social, environmental, and economic analysis.

The Sustainability Science Initiative is a forum on science and technology for sustainability that works to facilitate information exchange and discussion among the growing and diverse group of individuals, institutions, and networks engaged in the field of science and technology for sustainability. It seeks to provide access to emerging ideas, relevant activities, key documents, and web sites. It also employs the concept of resilience through its opposite, vulnerability. Vulnerability refers to the propensity of social and ecological system to suffer harm from exposure to external stresses and shocks (Kasperson, et al, 1995).

An application of the Resilience approach to understanding urban dynamics is incorporated in the Navigating Urban Transitions for Sustainability (NUTS) concept (Lebel et al, 2004). This approach to ecosystem studies highlights the complexity of the urbanization process and the limitations of planning and controlling the dynamics of urbanization. It examines the relation between resilience, governance and knowledge in achieving sustainability and attempts to reveal how interactions between humans and the environment emerge from complex social-ecological adaptive systems. The overarching metaphor for the approach is “navigating” the process of urbanization rather than directing or controlling, with knowledge and governance becoming crucial elements for precise navigation. A dynamic model presents several layers of analyses. The approach provides a framework for identifying the roles of actors at different scales and describes their relative positions within the social-ecological adaptive complex. The author claims that the perspective provides the foundation for understanding how the different parts of systems respond dynamically to internal and external changes. It is only in the initial stages of development.

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9 For more information see http://sustsci.harvard.edu/index.html.
3.1.6 Aggregate approaches

A number of approaches are based upon an agglomeration of the above groups. These include, for example, the Social-Ecological-Natural Complex Ecosystem (SENCE) approach, and the United Nations Environment Programme’s Cities as Sustainable Ecosystems (CASE) perspective (Newman, 2004).

The SENCE framework reflects an Asian approach to understanding urban ecosystem dynamics. Chinese Scientists have used the five traditional Chinese elements of metal (minerals), wood (living organism), water (source and sink), fire (energy), soil (nutrients and land) as a basis for exploring, through modern scientific procedures, how these elements interact (Ma and Wang, 1984). The economic subsystem includes components responsible for production, circulation, consumption, regeneration and regulation. The social driving force includes culture, institution and technology. The deterioration of urban ecosystem services are related to three inter-related factors: the stagnancy and exhaustion of resource inputs into and out from cities, as part of their urban metabolism; the fragmentation of system structures which have negatively impacted their functions; and the short-sighted human responses in dealing with the relationship between parts & whole (Wang, 2004).

The CASE initiative advocates an urban ecosystem approach, which suggests that consumption and production systems should be modeled after the cyclical ecosystems of nature. It calls for an urban environmental policy framework that is based on natural ecosystems at national, regional, and local levels, as well as on human–environment interactions and a system of prioritization, which incorporates human life, health, depletion, and productivity of resource stocks, capacity of the environment, and systematic accounting measures. The integration of many interrelated economic, environmental, social, and cultural factors is presented in terms of urban resources, processes, and impacts. The model includes 12 principles which adhere to different aspects of model previously explained, such as the ecological footprint and metabolism approaches (Newman, 2004).

3.2 Examples of the implementation of the ecosystem approach

While the concepts and procedures discussed above have had influence within academic circles, they are only beginning to be implemented in practice. There are a number of

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integrated approaches currently being employed at various levels of governance. Most of these applications focus on natural resource management. Some directly attempt to manage urban environmental challenges. This sub-section reviews some of these applications. It is divided the scale of implementation of the approach.

3.2.1 Examples of global or national scale ecosystem responses
Those at the international scale include some Multi-lateral Environmental Agreements, (CBD, CCD, UNFCCC), Agenda 21 and Transboundary fisheries agreements. For example, the fifth meeting of the Conference of the Parties (COP) 2000, to the Convention on Biological Diversity (CBD) gave a description and operational guidance on the ecosystem approach to achieve the objectives of the convention. It calls upon an ecosystem–based strategy for the integrated management of land, water, and living resources that promotes conservation and their sustainable use in an equitable manner. The CBD’s ecosystem approach, unlike conventional scientific methods that often assume specialization in one area, calls for multidisciplinary thinking among a variety of actors to develop a collaborative vision of a desired future. The approach is goal and policy driven and is applied within a geographic framework defined primarily by ecological boundaries such as different land use conditions, watersheds, and groundwater system units. It also recognizes that humans, with their cultural diversity, are an integral component of many ecosystems.

Similarly, the International Development Research Centre in Canada\textsuperscript{11} has advocated an ecosystem approach to human health and supports research on the relationship between all components of an ecosystem to define and assess priority problems that affect the health of people and the sustainability of their ecosystem. In pursuing the aim of improving human health and well–being while simultaneously maintaining a healthy ecosystem, the emphasis is on the design of solutions based on holistic ecosystem management concepts rather than single sector interventions.

3.2.2 Examples of global applications of local ecosystems approach
There are a number of general programmes that employ aspects of the ecosystem approach to projects around the world. Two important ones include the UNESCO/Man and the Biosphere programme and the WHO Healthy Cities programme. At the same time, there also examples,

\textsuperscript{11} See http://www.idrc.ca/ecohealth.
still rare at this time, where ecosystem approaches have been applied to urban areas or those areas directly related to the provision of ecosystem services for cities. One such example is the New York City Integrated Watershed Management plan of the 1990s. Each of these types of applications will be briefly described in this sub-section.

**UNESCO/MAB Biosphere reserve programme**

The efforts of the United Nations Educational Scientific and Cultural Organization – Man and the Biosphere (UNESCO/MAB) (Biosphere Reserve Programme) are derived from the traditional protected terrestrial and coastal ecosystem approach, but the notion has evolved to include areas of promoting solutions to reconcile the conservation of biodiversity with its sustainable use, including areas around cities. Biosphere Reserves have been designed as tools for reconciling and integrating the conflicting interests and pressures that characterize land–use planning today.12

**WHO Healthy Cities Programme**

The WHO’s Healthy Cities programme attempts to promote healthy environments for a broad range of problem from infectious diseases and air pollution to unhealthy lifestyles, drug abuse, and violence within cities. The Healthy Cities programme does not provide a blueprint for a master plan, but rather defines a process that addresses the main health problems, their causes, and responses developed by all key actors within a city. Significant elements of the programme include commitments to participatory approaches in setting health strategies and a city or municipal health plan are often part of its development plan or city vision.13

### 3.2.3 Examples of a local application of ecosystem approaches (Pires, 2004)

New York City’s historic quest to secure a reliable and plentiful source of water and avoid the costs associated with filtration of surface water underscores the essential, longstanding and sometimes contentious dynamics of water supply and urban development. The city has had to alter the way in which it manages its water supply to satisfy legislative requirements and new emphasis on integrated, watershed-level ecosystem management. This brief overview of the integrated watershed management approach put into effect through

12 For more information see http://www.unesco.org/mab/.
13 For more information see http://www.who.int/hpr/archive/cities.what.html.
cooperation among the city, state and federal government includes the background and history of the system, the responses that created the integration and the lessons learned.

A complex network of reservoirs, aqueducts, tunnels and pipes supplies about 5 billion litres of water daily to over 9 million consumers in the City of New York and several suburban counties. Much of the infrastructure is aged (over 100 years in some instances) and in need of maintenance and repair. Although the yield of potable water is adequate, concerns have been raised over the last 10-15 years to the ability of the city to maintain water quality. New York’s water supply system is unique in that it is one of the few of its size in the United States to provide water from an unfiltered surface source. The City of New York has thus far been able to remain exempt from federal regulations which require most municipal suppliers to filter drinking water from surface sources – thereby avoiding the significant cost associated with filtration – in order to protect public health by convincing the United States Environmental Protection Agency (EPA) that it has put in place a watershed management programme that can safeguard the public from waterborne disease.

New York City has historically expanded its water supply system by acquiring the political and financial backing required to tap the natural resources of its rural hinterland. When the city expanded its territory and population by incorporating all five present-day boroughs into one political entity at the close of the 19th century, it was presented with an even bigger challenge which was met in part by legislature that granted the newly established New York City Board of Water Supply powers to secure private land outside the city limits and expand the water supply infrastructure upstate in the Catskill Mountains and Delaware River watersheds. Access to and control over these relatively unspoiled watersheds enabled the city to postpone dealing with emerging concerns about water quality degradation in the older systems and instead concentrate on the technical and engineering tasks of expanding its hydrological footprint to exploit more distant but cleaner sources of water. However, with the promulgation of new legislation in the 1970s, together with a new emphasis on integrated, watershed-level ecosystem management the circumstances under which the city manages its water supply have been altered and it can no longer rely on system expansion or technical engineering solution alone to provide potable water that meets legally mandated quality standards.
The city now has to negotiate in a far more complex institutional arena with a much larger number of stakeholders representing quite diverse interests. Indeed, both the city and various stakeholders in upstate rural and urban regions together in mutually dependent, although not always mutually beneficial, relationships. The dilemma facing the city is whether filtration can continue to be avoided without undermining regional development for some of the poorest communities in upstate New York.

The memorandum of agreement that governs the filtration avoidance outlines a three-pronged approach to protect the water quality of the Catskill/Delaware watersheds that includes: a land acquisition programme; new water supply rules and regulations, and a suite of watershed protection and partnerships programmes. The watershed management plan consists of two major strategies, structural and non-structural, for water quality protection. Structural strategies, such as wastewater treatment facilities or pollution control best management practices (BMPs), are geared towards mitigating pollution from existing sources in a watershed while non-structural strategies are designed to prevent or reduce potential pollution discharges from future sources. Examples of non-structural approaches include land acquisition, buffer zone designations, conservation easements, and zoning ordinances. Whereas, structural strategies involve mostly physical or technical approaches to watershed management, non-structural approaches concern institutional and policy arrangements that are closely related to and use and economic development planning.

The MOA emphasizes implementation of non-structural approaches to water quality protection that have a direct bearing on land use policy in the New York City watersheds. The city is aggressively pursuing the proactive watershed management approach in which land use policy plays a central role in providing the public with a safe and reliable source of water supply. In the process, strategies and practices are being developed to attempt to balance watershed protection with community development and preservation, and state powers with the rights of private landowners. A major challenge in this effort is convincing a wide variety of stakeholders that the dual goals of economic development and sustainable water quality are ultimately intertwined.

The MOA is an experiment in taking shared responsibility for watershed protection and its recent renewal by the USEPA demonstrates that the city takes watershed protection seriously. This is both a testament to the innovative cooperative efforts of wide variety of watershed
stakeholders, and a reminder of what is possible when committed individuals and agencies strive to achieve effective, forward-looking environmental stewardship.

3.3 Summary
As demonstrated there are a number of different perspectives that use the ecosystem perspective to understand the dynamics association with behaviour within urban areas and their impacts on the environment. No one approach can claim to be the ecosystem approach, nor even claim to be more valid than the others. In order to fully understand the impacts of urban activities upon the environment necessitates the employment of a number of these approaches simultaneously.

There are also a number of examples of the implementation of integrated ecosystem approaches, but most are sector based (WHO Healthy Cities, Coastal Zone Management), focus on a single ecosystem service (Integrated Watershed Management) or haven’t been in place long enough to fully evaluate (Baltimore LTER project). As a result, under these policies, it is not clear whether improvements in ecosystem services targeted, or in other ecosystem functions, happen largely by accident as a result of the inherent linkages between the different ecosystem services or through explicit design.

Section 4: The challenges of applying the ecosystem approach to cities
There are a number of challenges facing both the conceptual development and practical application of the ecosystem approach for urban environmental management. There are also several promising characteristics of the approach that add value to existing planning practices. This section will first review the challenges to the approach and then analyze what it promises to offer planners.

4.1 Challenges to the ecosystem approach
Notwithstanding the apparent lack of success in implementation, there are a number of both conceptual and procedural issues inherent in the approaches that suggest limitations to its use (Table 1). Conceptual challenges include quantifying measures for ecosystem degradation and therefore the identification of trade-offs that exist between ecosystems functions and structure and human well-being, integrating social and biophysical perspectives, and
identifying the scales at which these interactions and their appropriate responses could best be understood.

Table 1 Elements of the ecosystem approach

<table>
<thead>
<tr>
<th>Conceptual elements</th>
<th>Addresses</th>
<th>Focus</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems framework</td>
<td>Stocks and flows, dependencies of components within the system</td>
<td>System carrying capacity; ecosystem health; provision of ecosystem goods and services; resilience and vulnerability</td>
<td>Difficult to quantify</td>
</tr>
<tr>
<td>Multi-disciplinary</td>
<td>Different scientific understandings of similar problems and different knowledge systems</td>
<td>Inter-linkages between social and biophysical challenges; Solving same problem (asking questions that address the same problem)</td>
<td>Difficult to integrate</td>
</tr>
<tr>
<td>Scale</td>
<td>Influences and impacts of activities within a specified areas over space and time</td>
<td>Linkages of urban ecosystem to areas outside borders and over the long term</td>
<td>Difficult to identify</td>
</tr>
</tbody>
</table>

Procedural elements

<table>
<thead>
<tr>
<th>Focus on creation of useable knowledge</th>
<th>Information for decision making</th>
<th>Timely, understandable, relevant to decision-making and defensible provision of information</th>
<th>Based upon data intensive assessments and scenarios; May not be practical in developing context; costly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusiveness stakeholder practices</td>
<td>Public participation in development and implementation of agendas, rules, guidelines, laws, policies and strategies</td>
<td>User driven processes, deliberative agenda setting</td>
<td>Time consuming</td>
</tr>
<tr>
<td>Flexible/Adaptive Management Techniques</td>
<td>Management; strategies application to identify changes, make adjustments and provide visions for urban ecosystems</td>
<td>&quot;Learning by doing&quot; policy experiments; free flows of information</td>
<td>Significant institutional barriers to implementation</td>
</tr>
</tbody>
</table>

Ecosystem health is difficult to identify. Attempts to use carrying capacity of the ecosystem have failed to provide for adequate levels of confidence in predicting change in these systems. For example, carrying capacity has been defined by the ability of an area to provide food for the population within that space (be in national or local) (WHO). Trade and advanced agricultural technologies and management practices, however, have allowed these entities to accommodate populations much larger than previously expected. Recent research suggests that surprise in “natural” ecosystem functioning may be more common than expected. Hence the notion that natural ecosystems are stable has come under debate in ecological circles. Not being able to track ecosystem health has lead to both attempt to define ecosystems vulnerability, ecosystem resilience and promoted the use of ecosystem services as measures
of degradation. These concepts, however, are difficult to measure. Ecosystem services have been identified as those things provided by ecosystem of use to humankind. Agricultural goods, such as grains, have been defined as ecosystem services. Other human managed ecosystems, such as cities, provide a number of other goods, however, that are not included as ecosystem services. Because picking a threshold for human interference with ecosystems in the definition of ecosystem services has been difficult, the concept remains vague. For example, if corn of grains produced by a farmer is an ecosystem service, why is not a shirt made of cotton? The other terms mentioned, vulnerability and resilience, while providing for interesting notions, have yet to be measured adequately for a wide range of human-ecosystem interactions.

Given that the general carrying capacity of the system is difficult to measure, the related task of identifying trade-offs between ecosystem services is problematic. The ecosystem approach attempts to bring a systemic, holistic approach to an extremely complex set of inter–relationships. Since the goal of the approach is to provide greater clarity and an expanded set of factors in terms of what might be lost or gained in making decisions, trade–offs and wider gains must be articulated as clearly as possible. A major challenge is the lack of tools that enable the identification of trades-offs between healthy ecosystems and other concerns (i.e., economic growth) and between ecosystem services themselves. If we cannot measure the health of the system, then identifying the trade-offs with other activities is also difficult.

All of the frameworks for ecosystem studies attempt to integrate social and biophysical factors. While useful, however, a system by which these very different types of studies can be fully integrated has yet to be identified. The biggest challenge in this regard is to identify a common currency from which comparisons can be made. Current attempts include the valuation of ecosystem services.

Challenges for the implementation of the ecosystem approach to urban areas includes the data intensive aspects of the approach, that are particularly difficult to fulfill in developing countries, the time consuming aspect of deliberative processes associated with public participation in agenda setting and the significant institutional barriers to implement adaptive management techniques.
As mentioned, data requirements for the frameworks provided under ecosystem approach perspectives pose serious challenges to municipalities with little revenue and without national censuses. The approach, not surprisingly, has been applied most often in developed countries and cities. Given the current state of statistics collection by municipalities this will remain a restraint in the medium term.

Applying the ecosystem approach requires public participation, which is time consuming. Bringing stakeholders together and employing participatory methodologies in decision making result in long delays in decisions. It also necessitates the incorporation of conflict resolution mechanisms adding to both the skills necessary in implementation. Policies incorporating adaptive management techniques for example, often get side-tracked (Kai, 1999). Moreover, finding consensus among a variety of stakeholders and between interest groups of varying economic and political power, through democratic and participatory institutions has not been experienced on a large scale by any society. Given that trade-offs between societal goals must be made, and that there will be groups and issues that will be asked to sacrifice their objectives, finding policies that are amenable to all will not be possible. Public participation in ecosystem approaches may increasingly be a time and energy consuming process.

Some of the practical challenges that the approach must address are the hard realities of current governmental structures and limited local capacities (particularly in developing countries) and the high costs of implementation. In terms of overcoming urban governance fragmentation, it is increasingly perceived that actions and consequences at the local level affect and are impacted by actors and influences at multiple scales. At the same time, cross these scales is a major inhibitor of applying successful solutions. While some inter-linkages between governmental entities have been bridged, horizontal and vertical integration remain out of reach.

The wave of decentralization that has taken place around the world holds promise for the application of the approach. At the same time, the type of decentralization actually implemented (i.e., authority without financial support) implies its limited use. Without financial responsibility for actions (i.e., control over revenue and spending), local authorizes do not have control over outcomes. The concept of subsidiarity, often promoted in Western Europe, suggests that control over management of environmental issues, for example, be
reduced to the lowest governance level appropriate for its resolution. Implicit in this principle is the match of management capacity (institutional and human resource) and authority (e.g. taxing) of different levels of government. While there are merits to subsidiarity, there are many challenging implications in involved in its implementation. The temporal and geographic scales within which urban ecosystems operate demand integrated multi–scaled governance (at best) and coordination among scales of governance for problem solving (at least). The numbers of those implicated in urban activities and their impacts on the environment is increasing and becoming more diverse. The set of actors includes those from government, non–governmental organizations, and the private sector. Urban governments are playing new roles as facilitators of private investment in new sectors such as water and waste management as well as dealing with an increased role for non–governmental organizations.

4.2 Promises of the ecosystem approach

There are a number of characteristics of the approach that add value to current planning practices. These include the integration of biophysical aspects of the environment to planning for human activities, the application of new and flexible tools in policy making, and promise that ecosystem policies, because they are implemented through deliberative processes will more likely reach their goals than those developed under non-integrated policies.

Integrated policies can provide synergistic solutions to current challenges. Indeed, the term integration suggests synergy. Given that environmental conditions and enhancing ecosystem service delivery increasingly require simultaneous responses, the ecosystem approach promises to be useful.

Techniques such as adaptive management provide new methods and flexible (experimental) features for policy development needed to meet the increasingly complex challenges of contemporary environmental conditions and trends. Surprises must no longer be outside the planning’s preview, but included adaptive strategies. Uncertainties will continue to plague decision makers, perhaps more so in the future, and therefore ways to move forward in the face of lack of experience must be considered.
Section 5: Conclusions

While the ecosystem approach is being promoted at all scales of governance, what it implies, when and where it is most needed, how it can be accomplished and what added benefits of pursuing integration as opposed to non-integrated approaches is still only rudimentarily understood. Like all policies, examples demonstrating the application of the ecosystem approach show that it meets some of its objectives, but not all.

Importantly, ecosystem approaches are long-term undertakings and therefore cannot be treated as time-bound. It might be most acceptable as an overarching framework within which a number of other policies are implemented. The idea of protecting ecosystems is commensurate with that of sustainable development and therefore may be as effectively accepted politically. At the same time, the ecosystem approach provides for more specific ways in which to integrate economic, social and natural concerns than previous attempts.

Implementing ecosystem management approaches for urban areas has many challenges including resource intensity. At the same time, however, the potential benefits can exceed the costs. In a world of rapidly decreasing resources and rapidly increasing consumption, it may provide directions for future ways to organize societal demands on natural systems. Certainly, it is worth continuing to explore.
References


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