1. The sustainable city: introduction and overview

Hilda Blanco and Daniel A. Mazmanian

INTRODUCTION

The unprecedented urbanization of human populations around the world presents one of the most profound challenges of the twenty-first century. The causes and consequences are many, diverse and much debated. Yet the number of urban dwellers, along with the growth of, especially, medium, large and truly mega-cities continues unabated, with significant implications for the health and viability of their populations and their impact on nature's services.

We believe that in this context any meaningful path forward must weave together both intra- and intertemporal needs and challenges into a more comprehensive and thus sustainable cities approach. This approach must ultimately be spread globally, although not through the dictates of a central authority or even a binding global policy agreement, but through the cumulative action of path-breaking lead cities and their leaders around the world. Urban centers are the very places where societal challenges have throughout human history been confronted and overcome, through necessity, human ingenuity, experimentation and the diffusion of good ideas.

Cities today are already coming together in a shared concern with the challenges of today's urbanization, persuaded that the solutions can be found in charting a new course, that of becoming more sustainable: socially, economically and environmentally. The sustainable cities movement is beginning to emerge in a host of cities around the world, ranging from social and environmentally sensitive actions by groups of citizens, to implementing sustainable public policies, to embracing a comprehensive approach to sustainability that brings the major economic, social and environmental pieces together within a comprehensive 'systems' approach to the city, making it more resilient and livable.

We do not ignore the importance of global-level action when it comes to sustainability, but recognize that this is a long way off politically and will likely be based on what is learned through the efforts of cities in this transition period for human populations. In effect, cities' initiatives

on sustainability are a critical step in the global transformation to sustainability, serving as exemplars, as pragmatic local ways of addressing both local and global issues, as means of empowering those who appreciate the significance of the challenges of moving toward a more sustainable future and choose to be a part of the process.

The present volume provides a framework for understanding the city as a critical building block of a more sustainable future. The city is approached in terms of becoming a 'sustainable system' in itself, nested within a broader subnational, national, continental context, and ultimately, a global systems context. It is a place where sustainable strategies are being devised, and methods and tools for achieving them applied. The volume is organized primarily to capture the two aspects of the transformation: Part I focuses on examples of social, economic, political and environmental policy strategies that are being developed. Part II brings to the fore methods and tools for applying the various strategies and analyzing the extent to which they are leading to greater sustainability, likewise, along social, economic, political and environmental lines. The authors bring to the discussion their diverse analytical and disciplinary trainings and backgrounds and, together, provide a wide array of strategic thinking and methods of analysis. Each strategy, each method, is a type of 'intervention' in what is inherently a complex system, with a myriad of interconnections and moving parts. However, cities, as any complex system, do not evolve or change automatically or holistically, but through interventions that leverage inflection points that move or steer them in new directions. In the contemporary parlance of change, interventions – imposed from outside a system or cultivated from within – are points of inflection and turning points (sometimes referred to as tipping points). In this case, strategies are interventions that turn cities in the direction of increasing sustainability.

The final part (Part III) provides several thought-provoking perspectives looking beyond current strategies and interventions, to more holistic futuristic visions of the sustainable city. Perspectives on urban form, the economic system, governance and technologies of the sustainable city are elaborated.

The volume is intended for use by scholars, practitioners and students interested in the role of, and prospects for, cities in the movement toward sustainability. It is designed to be a comprehensive source of contemporary research and knowledge about the array of methods and strategies in use, providing insights and actionable information organized around the environmental, social and economic dimensions of a sustainable city.

THE URBANIZATION CHALLENGE

An increasing population in a world of finite resources encapsulates the challenge of sustainability. Sustainability is further strained by the increasing and uneven rate of resource consumption. While the world's population tripled during the twentieth century, reaching seven billion in 2011, the use of water resources grew six-fold. One-sixth of the world's population lacks access to safe drinking water and one-third lacks adequate sanitation. Over the past two centuries, resource depletion and loss of biodiversity have accelerated. Increasing greenhouse gas (GHG) emissions threaten global climate patterns.

The world's population is not evenly distributed, but concentrated in human settlements. Further, in 2008 the world reached a momentous milestone: over half of the world's population now live in urban areas. This urbanizing trend will accelerate in the twenty-first century. As of 2010, over 82 percent of people in North America, over 73 percent in Europe, 83 percent in South America and 89 percent in Australia were already living in urban areas. Although Africa (39.3 percent urban population) and Asia (44.4 percent urban) are still mainly rural, by 2050, urban populations are projected to reach 57.7 percent in Africa and 64.4 percent in Asia (United Nations 2012).

Cities are the dominant human habitat. If we are concerned about the sustainability of the planet, then we need to focus on the sustainability of cities. Cities are the place where global challenges converge, ideas are tested, and solutions emerge. In order to discuss urban sustainability, we need first to clarify what we mean by sustainability and by urban settlements.

THE SUSTAINABILITY CHALLENGE

Sustainability has become a popular term, and there are likely hundreds of published definitions (Hempel 2009). The root of sustainability is the adjective 'sustainable', which the dictionary defines as the ability 'to be maintained at a certain rate or level: *sustainable fusion reactions. (Ecology)* (esp. of development, exploitation, or agriculture) conserving an ecological balance by avoiding depletion of natural resources . . .' (McKean 2005). According to the law of entropy, in the long run nothing is sustainable. Thus we should understand the term as a comparative, relative, not an absolute term, judging situations as more or less sustainable over a given time period, or cities as more or less sustainable compared to others.

Two major definitions of sustainability are important to understand: the Brundtland Commission's and 'balancing the three Es' definitions.

The canonical definition of sustainable development is that of the United Nations World Commission on Environment and Development Report published in 1987, commonly known as the Brundtland Report (after its Chairman, Harlen Brundtland):

> Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. (UN WCED 1987)

This definition builds on the common meaning of the term, the ability to maintain an activity 'at a certain rate or level', and emphasizes retaining opportunities of development for present generations, especially the poor, and for future generations. It also refers to the more recent ecological meaning of sustainability, the natural environment's ability to meet human needs and functions. This idea implies that earth systems have a carrying capacity, a finite ability to sustain or carry life, and that at this point human activity is unsustainable.[1]

Development that balances the three Es, environment, equity and the economy, is a popular definition of sustainability (Daly and Cobb 1989; Elkington 1994; Campbell 1996; Godschalk 2004). On this definition, these three systems, the natural environment, along with the economy, and the social/political/ethical system that would guarantee a certain measure of equity, are assumed to be co-equal. Figure 1.1 is a popular way of depicting this idea. This balancing of the three spheres concept has been popularized for the business sector through the concept of the triple bottom line (TBL) or the three pillars: people, planet and profit. TBL has developed accounting systems that expand the traditional financial performance measures to incorporate social and environmental dimensions (Elkington 1998).

The definition of sustainability as a balance of the three spheres/dimensions, however, gives a misleading impression of the relationship among the three systems, environmental, social and economic. The relation is not of equals but of nested dependency. Figure 1.2 shows a more realistic schematic of the three systems, indicating the nested relations among the three. All human societies depend on the natural environment for land, goods, food, water, air and energy (Ross 2009). All manufactured goods are based on these natural goods. We have no substitutes for many of these natural goods, and thus the natural environment is the primary system on which all human societies depend. Economies, which are social constructs, dependent on human social organizations, vary across the world and across time. This relationship of dependency establishes an order of system adaptation in our pursuit of sustainable development: societies must strive to conserve natural resources and reduce resource degradation; and economies within these societies will require changes to facilitate the

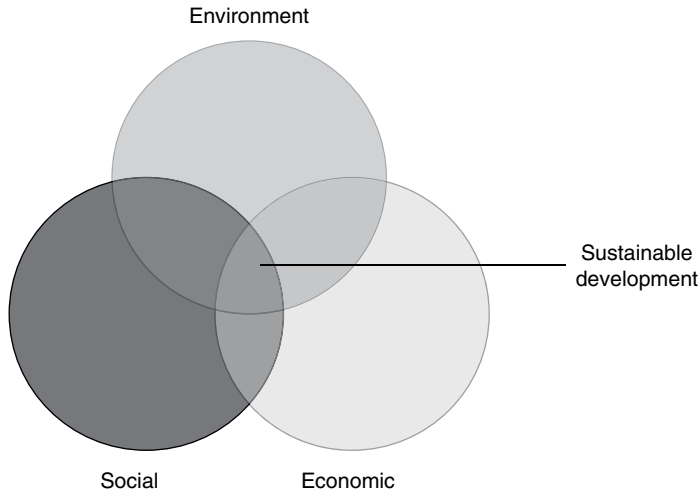

Figure 1.1 *Sustainable development as a balance or interface among three spheres*

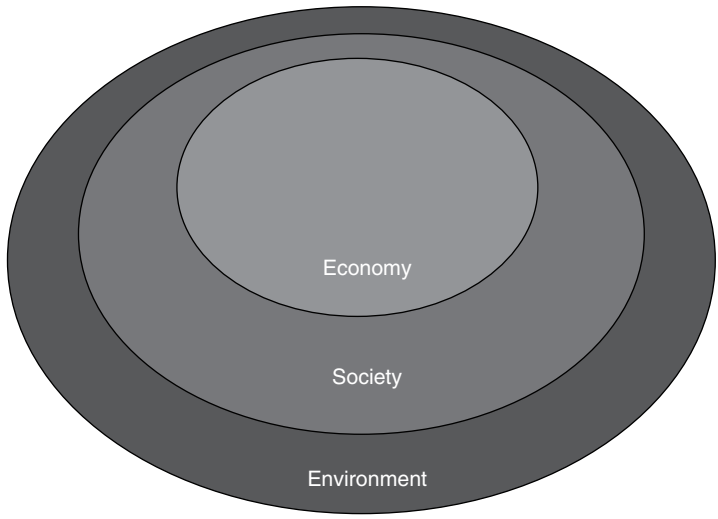

Figure 1.2 *The nested relationship among the three dimensions of sustainability*

conservation and quality of natural goods and services. How sustainability is to be achieved is all the more challenging in an age of growing economic globalization operating in a world of global supply chains where the traditional economic relations between urban areas and their rural regions are increasingly replaced by teleconnections or distal, often global, relations that are complex and only partly understood (Seto et al. 2012).

ON DEFINING THE URBAN

Defining the 'urban' in the urban milestone achieved in 2008 is almost as difficult as defining sustainability. There is no recognized, global definition of urban areas or cities. The United Nations, when it reports on urbanization or cities, uses countries' self-reports, with varying definitions. Urbanized land is typically defined as land in state-recognized cities (municipalities or local authorities), as land in agglomerations with threshold populations of from 1000 to 5000 persons, and in some countries in terms of density per unit area, ranging from 386 persons per square kilometers (USA), 1500 persons per square kilometer (People's Republic of China) to 4000 per square kilometer (Japan) (UN Population Division 2008).

Metropolitan areas are defined as integrated labor markets and commuting patterns rather than by density alone. They typically include at least one central city, other cities and towns, suburban areas, as well as the rural land in between. In this volume, we shall typically use the term cities and urban areas interchangeably to refer to areas with urban densities, and metropolitan areas to refer to areas that incorporate suburban areas and fringe rural lands.

SUSTAINABLE CITIES

What then is a sustainable city? We can respond in simple ways, such as to say that a sustainable city is an ecologically sustainable, socially just and economically viable city. But going beyond easy answers, this is a difficult question because sustainability is an integrative concept. It involves many dimensions, related in complex ways. As we discuss above, there are three major dimensions of sustainability widely recognized: environmental, social and economic. Two other aspects of sustainability central to the concept, but not as widely noted, are the 'interdisciplinary or integrative', and the 'systems-oriented' aspects of the concept. The interdisciplinarity, or better, the intent to integrate various dimensions in a situation, is the hallmark of a sustainability approach, which is implicit in the definition

of sustainability as balancing the three Es. Thus, when applied to urban issues or urban sustainability, a sustainable approach requires 'substantive interdisciplinarity', beyond issues of environmental conservation, social justice or economic efficiency. That is, since urban issues are interdisciplinary, for example those of housing, land use, transportation and nature's services, whether development or urban life can be sustained over time requires knowing and taking into account the fundamental connections, for example, that housing has to transportation or to public health or other systems on which it is dependent or interdependent.

Figuring out how to make urban settlements more sustainable requires knowledge of how a local economy works, of how transportation systems are connected to land use and urban density, to economic activities, to the housing supply, to other public infrastructure and services, as well as to the distribution or accessibility of these services or goods for different groups within a city. The way urban systems work or fail to work together is a large part of the sustainability of an urban settlement. The complexity of varied, interrelated parts in these systems defies an explanation from a single discipline. Thus a sustainable approach fundamentally relies on interdisciplinary knowledge. Regarding the sustainability of cities, the three Es could be conceived as meta-criteria that rely on an integrative, systems-oriented, interdisciplinary knowledge base. That is, they are larger questions that can be posed of existing or proposed systems or projects once a rich understanding of a situation has been established: how can changes in such a situation conserve ecological systems; how can changes make systems more efficient; how can they improve social equity? Thus urban sustainability research could be conceived as essentially interdisciplinary research, with an overlay of environmental, social and economic criteria. Equally important, the sustainable city is where challenges and problems are addressed to meet the needs of the present without undermining or precluding the opportunities of future generations. A sustainable city, in this sense, is an active, evolving, organic community addressing problems of the present and foreseeable future while confronting ongoing challenges of economic development, equity and justice, and environmental protection.

CITIES AS COMPLEX SYSTEMS

The systems-oriented nature of the concept of sustainable cities, involving the complex interplay among urban systems of infrastructures, built environment, nature's services, organization and information systems that combine to facilitate urban life, is often also neglected.

Like all complex systems, cities involve hierarchies (ordered levels of subsystems). In particular, cities have been analyzed as open systems, that is, systems that have the ability to self-organize and sustain themselves by metabolizing inputs of energy, information and raw materials, and discharging into their environments wastes and disorder (entropy). The urban metabolism concept, a key method that is the subject of Chapter 13, is one example of how cities can be studied as complex systems. In a pioneering article on urban metabolism, Wolman (1965) analyzed a hypothetical city of one million as a complex open system, with energy, materials and water inputs and outputs. He estimated that, for one million inhabitants, 2000 tons of food, 4000 tons of fuel and 630 000 tons of water are needed daily as inputs. These are converted daily into 2000 tons of garbage, 500 000 tons of wastewater with 120 tons of solid particles, and 950 tons of atmospheric pollutants. This illustrates the tremendous flow of water moving through a city, as well as of materials and fuel.

Results from applying the method of urban metabolism analysis are in terms of flows, the main flows of water, energy and materials coursing through cities. The conduits for these flows are also complex urban systems, including transportation, water supply, wastewater treatment, solid waste disposal, energy and power systems, and information and communication systems.

Key to understanding urban complexity is the relation between urban systems and natural systems. For example, the built environment of cities composed of structures, combined with the sealed surfaces of streets, prevents precipitation from percolating into the ground and requires stormwater systems to prevent urban flooding. Another important impact of the sealed surfaces of cities is the heating of the local climate, also known as 'the heat island effect'. The removal of vegetation in cities and the concentration of asphalt and concrete, which absorb rather than reflect the sun's rays, increase the temperature of these surfaces as well as the ambient temperature surrounding them.

ORGANIZATION AND CONTENT

This volume does not attempt to focus on urban systems in themselves, but rather on strategies for improvement and methods and tools for achieving urban sustainability within a systems framework. Why this is imperative is underscored repeatedly throughout. Moreover, both strategies and methods aimed at urban sustainability need to be sensitive to the real-world subsystem addressed, as well as to the interconnections among systems to which a subsystem connects as part of the whole. We highlight

all of the three Es, environment, equity and economy, but note that both strategies and methods overlap these dimensions; for example, there are environmental/spatial aspects to health and a sense of community.

Understanding cities as complex systems is essential in charting a path to sustainability. However, just as important is the need to understand more clearly the strategic points of entry into the city system in bringing about change, in guiding and steering the city – the system – toward sustainability. This entails human volition, vision, leadership, capacity, timing and 'luck'. This is why, in each of the sections of the volume, case studies and examples are provided. While there is no formulaic approach that can be universally applied, there are a number of promising emerging models and helpful examples.

STRATEGIES

The section on strategies highlights several critical dimensions of a sustainable city. It begins with a discussion of the major contemporary effort by planners to address sustainability through compact and smart growth strategies, by Peter Newman (Chapter 2). Strategies for making our cities more sustainable along several key dimensions follow in the subsequent chapters, beginning with the management of water, by Blanca Jiménez Cisneros (Chapter 3), food systems, by Nevin Cohen (Chapter 4), and consumer products, by Gregory A. Keoleian, Joshua P. Newell, Ming Xu and Erin Dreps (Chapter 5). Other strategies that focus on economic dimensions of sustainable cities include attracting green industry, by Karen Chapple (Chapter 6) investing in sustainable infrastructure, by Rae Zimmerman (Chapter 7) and confronting the inevitable reality that no city can be sustainable absent fiscal sustainability (Chapter 8), by Richard F. Callahan and Mark Pisano. Critically important social strategies for sustainability focus on human health, as in the chapter by Alek Miller and Richard J. Jackson (Chapter 9), education, by Michaela Zint and Kimberly S. Wolske (Chapter 10) and strategies for effective public participation, by Connie P. Ozawa (Chapter 11). The section concludes with a focus on justice as a central component of the sustainable city, by Manuel Pastor (Chapter 12).

METHODS

Moving from strategies to methods and tools, a first-order requirement is how to analyze a city's overall metabolism, dealt with by Christopher

Kennedy, Larry Baker and Helge Brattebø (Chapter 13), followed by developing a set of metrics that measure and track progress toward sustainability, by Kent E. Portney (Chapter 14). One of the most salient issues facing cities today is climate change, and as an important dimension of sustainability cities need an operational mitigation plan, which is addressed by Michael R. Boswell, Adrienne I. Greve and Tammy L. Seale (Chapter 15) and a climate adaptation plan, by Adrienne I. Greve and Michael R. Boswell (Chapter 16). In Chapter 17, Adam Rose provides a valuable approach to thinking about the economics of sustainability by framing the issue as one of economic resilience, which enables economists to think ecologically. Finally, it is important to be able to assess the economic value of ecosystem services to a city, and a very concrete transformative way for a city to accomplish this is through its own purchasing practices, as presented by Laurie Kaye Nijaki (Chapter 18).

LOOKING TO THE FUTURE

The above sections of the volume focus on current implementation strategies and methods and tools aimed at providing cities ways to become more sustainable. As such, they are bound by current knowledge and understanding. Yet we recognize, for a volume focused on a sustainable future-in-the-making, that the future is capable of surprising us. With this in mind, we invited scholars who are looking ahead not to what is, but to what ought to be, and what they surmise will be, to develop contributions that are more speculative about aspects of sustainability that are crucial to achieving a more sustainable future for our urban species. This includes a select number of assessments of what a more sustainable city will look and feel like. Tridib Banerjee places the sustainable city in the broad sweep of movements and orthodoxies in planning, looking back and looking ahead (Chapter 19). This is followed by, broadly speaking, a systems assessment of what meaningful sustainable development will need to entail, by Edward J. Blakely (Chapter 20). In Chapter 21, Daniel J. Fiorino unpacks the concept of sustainable governance, and discusses the future of governance for achieving sustainable cities. The role that technology will play in the future, enabling cities to quantify their activities, to become smarter in their resource use, to enable more localized city functions, and to share information widely, is next addressed by Bill Tomlinson (Chapter 22).

The volume closes with a summary and concluding chapter (Chapter 23) by the editors. It provides an overview of the chapters, reflects on the dimensions of sustainable cities addressed by the chapter authors, and raises issues for future research.

NOTE

1. For neo-classical economists, sustainability is interpreted as a 'problem of managing a nation's portfolio of capital (manufactured and natural) to maintain a constant level' (Ayres et al. 2001). Economists further distinguish between weak and strong notions of sustainability. Weak sustainability characterizes the view of neo-classical economists who believe that manufactured capital can be substituted for natural capital. Strong sustainability is the view that the existing stock of natural capital, such as the ozone layer, cannot be substituted by manufactured capital, and therefore must be maintained. This view holds that a minimum amount of different types of capital (economic, ecological and social) should be independently maintained to achieve sustainability (Brekke 1997).

REFERENCES

Ayres, R.U., J.C. van den Bergh and J.M. Gowdy (2001), 'Strong versus weak sustainability: economics, natural sciences, and "consilience"', *Environmental Ethics*, **23** (2), 155–68.

Brekke, Kjell A. (1997), *Economic Growth and the Environment: On the Measurement of Income and Welfare*, Cheltenham, UK and Lyme, USA: Edward Elgar Publishing.

Campbell, S. (1996), 'Green cities, growing cities, just cities? Urban planning and the contradictions of sustainable development', *Journal of the American Planning Association*, **62** (3), 296–312.

Daly, Herman E. and John B. Cobb, Jr (1989), *For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future*, Boston, MA: Beacon Press.

Elkington, J. (1994), 'Towards the sustainable corporation: win–win–win business strategies for sustainable development', *California Management Review*, **36** (2), 90–100, available at http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=9410213932&site=ehost-live (accessed 19 July 2009).

Elkington, John (1998), *Cannibals With Forks: The Triple Bottom Line of 21st Century Business*, Stony Creek, CT: New Society Publishers.

Godschalk, D.R. (2004), 'Land use planning challenges', *Journal of the American Planning Association*, **70** (1), 5–13.

Hempel, Lamont (2009), 'Conceptual and analytical challenges in building sustainable communities', in Daniel A. Mazmanian and Michael E. Kraft (eds), *Toward Sustainable Communities: Transition and Transformations in Environmental Policy*, Boston, MA: MIT Press, ch. 2.

McKean, E. (ed.) (2005), 'sustainable *adj.*', *The New Oxford American Dictionary*, *Second Edition*, Oxford: Oxford University Press, accessed 4 September 2010.

Ross, A. (2009), 'Modern interpretations of sustainable development', *Journal of Law and Society*, **36** (1), 32–54.

Seto, K.C., A. Reenberg, C.G. Boone, M. Fragkias, D. Haase, T. Langanke, P. Marcotullio, D.K. Munroe, B. Olah and D. Simon (2012), 'Urban land teleconnections and sustainability', *Proceedings of the National Academy of Sciences*, **109** (20), 7687–92.

United Nations (2012), *World Urbanization Prospects, the 2011 Revision*, Department of Economic and Social Affairs, Population Division, New York: United Nations, available at http://esa.un.org/unpd/wup/CD-ROM/Urban-Rural-Population.htm.

United Nations Population Division (2008), *World Urbanization Prospects: The 2007 Revision*, New York: United Nations, available at http://www.un.org/esa/population/publications/wup2007/2007WUP_Highlights_web.pdf (accessed 25 June 2009).

United Nations World Commission on Environment and Development (UN WCED) (1987), *Our Common Future*, Oxford: Oxford University Press, available at http://www.un-documents.net/wc.

Wolman, A. (1965), 'The metabolism of cities', *Scientific American*, **213** (3), 179–90.