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III.3 PLANNING FOR RESILIENT AND SUSTAINABLE CITIES

An original method for planning resilient and sustainable cities is presented here (Figure 3.1). The method builds on established planning methods and models (Ndubisi, 2002; Leitão and Ahern, 2002; Steiner, 1991; Ahern, 1995; Steinitz 1990). The method has f ve themes: (1) goal-oriented and ecosystem-services-based, (2) strategic, (3) scenario-driven, (4) transdisciplinary, and (5) adaptive. Each of these f ve themes is discussed in the following sections.

The planning process begins by determining, or reviewing, ecosystem service goals, define in the context of resilience factors—which are the trends and drivers of change. In planning to meet specifi ecosystem service goals, resilience planning strategies are considered in the context of the public will, the economic climate, and existing urban conditions. Spatial concepts are used to design scenarios to explore possible futures, including the means to their realization. With expert and stakeholder participation, the scenarios are evaluated and ultimately revised or modifie as an urban resilience sustainability plan. The plan is adaptively implemented, with monitoring of key indicators recommended to yield new knowledge and to continuously inform and (re)direct the planning process. While the method in Figure 3.1 is graphically represented as a linear process, in application it is cyclical, iterative, and may be entered or initiated at any point. For example, the planning process may start with an evaluation of a pre-existing plan, followed by goal re-determination, and development of new scenarios to explore new alternative strategies.

III.3.1 Ecosystem Service Goals and Assessments

The ecosystem services concept was developed as an integral part of the United Nation's Millennium Ecosystem Assessment (2005) to explicitly articulate the full complement of provisioning, regulatory, and cultural services provided by ecosystems by which humankind meets its needs. Ecosystem services, broadly define to include cultural services (Figures 3.1 and 3.2), are appropriate as goals for sustainability planning because they are explicit and can be scientificall measured and analyzed and discussed in a transdisciplinary process. Such discussion may lead to the definitio or appreciation of new ecosystem services, which can, in turn, also be discussed in the planning process.

Because ecosystem services represent the "process" side of the "pattern-process" dynamic; they can be explicitly "mapped" with geographic information system (GIS) models and algorithms. In other words, alternative spatial patterns can be modeled or tested for their effectiveness in providing specifi ecosystem services, such as providing coastal floodin protection, or corridors for wildlife movement through a

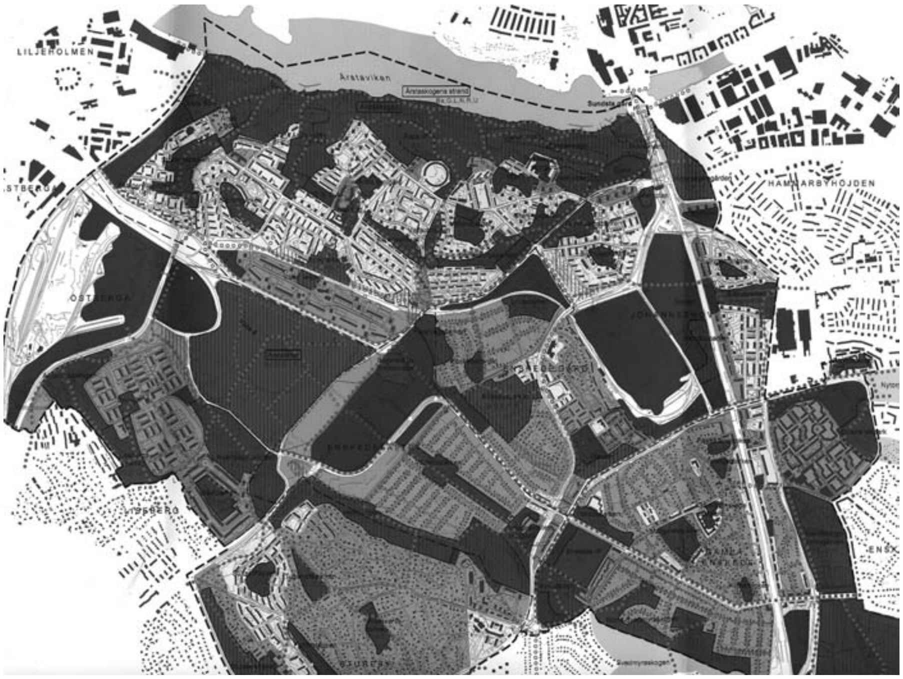

Figure 3.2 The City of Stockholm, Sweden, conducted an extensive survey exercise to identify the specifi outdoor activities people engage in, and the locations where these activities occur. The resulting "Sociotope Map" define spatially explicit patterns of use of all the public open spaces in the city. The map explicitly links patterns and process, for the important social functions of urban green spaces, informing and supporting green space planning and management decisions (Courtesy City of Stockholm).

city. When ecosystem service patterns are mapped with GIS, they can be combined with other ecosystem service "maps" to identify spatial patterns of compatibility or conflict and then be adjusted or modifie to resolve the spatial conflicts

Ecosystem services therefore can serve well as assessment metrics linking urban form (pattern) with urban process (ecosystem services), to support an informed discussion of goals and their associated spatial requirements and consequences. Once articulated, quantified and mapped, ecosystem services logically become the goals and benchmarks of progressive urban sustainability planning, for example, to improve water quality standards, or to provide a diversity of open spaces suited for particular outdoor activities (Figure 3.2).

III.3.2 Resilience Strategies

Urban planning is inherently a strategic process in that it attempts to understand and proactively manage the elements and forces that are the causes of change, rather than employing tactics to respond to the changes themselves (Ahern, 1995; Sijmons, 1990). Planning is, by definition proactive—but not all planning is strategic. For urban planning to be strategic, it requires integration of interdisciplinary knowledge to defin strategic goals consistent with political expectations, economic factors, and the reality of the existing landscape condition. Strategic urban planning requires a particular blending and integration of knowledge, vision, creativity, and political skills.

A proposed suite of f ve urban planning and design strategies for building urban resilience includes: multifunctionality, (bio)diversity, multiscale networks, redundancy and modularization, and adaptive capacity. These strategies represent new ways of thinking and acting that address the inherent uncertainty of cities. They also represent a somewhat radical rethinking about sustainability and change. The paradox of sustainability relates to the intrinsic need for stability and security while simultaneously accepting the existence of and the need for change in all systems. To resolve or confront the paradox of sustainability requires strategic thinking, which understands the forces and drivers of change, and seeks opportunities to influenc these forces proactively, rather than reactively responding to the inevitable unexpected "surprises" characteristic of any urban environment over time.

Resilience is define as the ability of a system to experience disturbance and still retain its basic function and structure (Walker and Salt, 2006). Understanding resilience is central to understanding sustainability, since sustainability addresses the need for a long-term, multigenerational view, and under a non-equilibrium view all systems will change in unpredictable ways, especially over the long term. Resilience theory is at the frontier of contemporary urban planning and design, serving as a robust platform for shaping and articulating the regenerative work of landscape architects, planners, and architects in volatile times (Vale et al., 2005).

Resilience can be better understood in the context of the paradox of efficien y and optimization—two pillars of the modern, equilibrium paradigm (Walker and Salt, 2006). Optimization assumes that change will be incremental and linear; it also tends to ignore changes that occur at higher or lower scales of organization. Optimization doesn't always work because the world is often configure and reconfigure by extreme events, rather than by average, day-to-day events and incremental change. Efficien y leads to the elimination of redundancies, and keeping only those elements that are immediately beneficial The concepts of optimization and efficien y diminish the importance of unquantifiabl or unmarketed values (e.g., ecosystem services) and reduce time horizons below those at which important changes occur (e.g., climate change). Optimization is a large part of the sustainability problem, not the solution—because in a non-equilibrium view, there is no optimal state for a dynamic system. Therefore, embracing change is the essence of resilience. The resilience of any system depends on its current state, cross-scale connections, and its context (Walker and Salt, 2006).

Resilience is a new way of thinking about sustainability, rather than a specifi set of guidelines, instructions, or checklists. Resilience is more strategic than normative, because, to be effective, resilience must be explicitly based on, and informed by, the environmental, ecological, social, and economic drivers and dynamics of any particular place, and it must be integrated across a range of linked scales (Pickett

Table 3.3 Strategies for building urban resilience capacity

Strategies	Attributes/Characteristics	Examples
A) Practice Multifunctionality	Spatially efficien Economically efficien Builds a constituency of social/political support	Green Streets, Portland Oregon Stormwater wetlands
B) Practice redundancy and modularization	Risk-spreading Backup functionality Metasystems Decentralized, adaptable Can “contain” disturbance Flexibility, adaptability Spatial segregation	Created wetlands in Green Wedges, Green Infrastructure Watersheds and “neighbor-sheds” Gray water recycling systems
C) Promote (bio)diversity and heterogeneity	Differential response to disturbance, stress, and opportunity Bio-library of memory/knowledge Complementarity of resource requirements	Urban bioreserves Conventional, ecosystem-based, and hybrid functional types
D) Build and restore networks and connectivity	Metasystems Circuitry and redundancy, risk-spreading Design for functions and fl ws	Bluebelt, Staten Island, New York City Ecological Networks
E) Build adaptive capacity	Actions as opportunities for experimentation and innovation “Learn-by-doing,” “Safe-to-fail” design experiments	SEA Street, Seattle

et al., 2004). In addition, by definition resilience depends on being able to adapt to unprecedented and unexpected changes. Many such changes will affect, and will be affected by, the work of urban planners and designers, including: the effect of sea level change on coastal cities; the changing intensity of precipitation and runoff; and the changing composition and dynamics of urban forests, with implications for biomass production, carbon storage, and biodiversity. Urban planners and designers also affect the changing demographics of cities that defin cultural identity and social resilience. By focusing explicitly on ecosystem services, the design field are poised for leadership in building resilience capacity in cities at multiple scales and in multiple contexts. Table 3.3 summarizes f ve key strategies for building urban resilience capacity. These strategies will be discussed further.

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