



# Green-space preservation and allocation for sustainable greening of compact cities

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Including greenery in human settlements is a tradition deeply rooted in antiquity, with diverse expressions. Realization of the green city ideal has changed with prevailing social–economic–political regimes and landscape styles. Variations in land use and development mode have generated green spaces of different geometry, distribution and composition. The compact city incurs inherent physical and institutional obstacles, restricting the quantity and quality of amenity vegetation. Recent research findings in arboriculture, urban forestry, urban ecology, urban planning and urban geography suggest alternative strategies for both existing and new green sites. A multidisciplinary interpretation distils relevant principles and practices to facilitate greening in packed neighborhoods and overcome major constraints. Measures are proposed to guard green spaces from intrusion, intensification and infilling to preserve both sites and conditions for plants, wildlife and ecological functions. New developments and redevelopments, with suitable encouragement and incentives, can earmark enough new green areas with appropriate location and design. Natural enclaves, especially woodlands, with high biodiversity and complex biomass should be incorporated into the future built environment. Partnership among government, developers and citizens should nurture the community's determination and capability to augment greening. A coordinating body to mobilize initiatives and efforts could gel disparate stakeholders and bring concerted actions.

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## Introduction

The green city is an ideal of universal appeal that transcends temporal, spatial and cultural divides (Hestmark, 2000). Greening is realized to different extents in cities, often subject to fluctuating contemporaneous societal attitudes and political climate (Mumford, 1961; Attorre *et al.*, 2000). A city with high-quality and generous green spaces epitomizes good planning and management, a healthy environment for humans, vegetation and wildlife populations (Adams and Leedy, 1987; Johnston, 1990; Godefroid, 2001), and bestows pride on its citizenry and government. It is human nature to harbor psychological attachment to beautiful natural objects such as meritorious amenity vegetation

(Kaplan, 1984; Ulrich, 1986). Different socio-economic strata develop similar appreciations and preferences for urban nature (Kuo *et al.*, 1998). The multiple functions and benefits of urban vegetation are widely known (Mole and Young, 1992; Petit *et al.*, 1995) and expressed in tangible monetary terms (McPherson *et al.*, 1997; Nowak and Dwyer, 2000), yet they can be sidetracked, if not suppressed, by political expediency and bureaucracy (Foster, 1977; Duvernoy, 1995). Regardless of existing green endowments, many enlightened and informed politicians, administrators, planners and citizens aspire to create green cities (Hough, 1994; Bradley, 1995) that echo the garden-city ideal (Howard, 1902). Many cities earnestly provide greenery in new developments and preserve existing greenery in redevelopments and expansions (Gordon, 1990; Beatley, 2000). Urban sustainability increasingly requires the abatement of pollution, plus the addition of positive features, notably trees, to

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ameliorate the new scarcity of healthy environments (Finco and Nijkamp, 2003).

Compact urban areas are characterized by the close juxtaposition of buildings and roads with limited interstitial space to insert greenery; mixed land use; and a union of form and function (Jenks *et al.*, 1996). The compact city here encompasses the high-density built form (Burton, 2002) with a high proportion of the land surface covered by buildings and other artificial structures and surfaces. The ratio of impervious to pervious areas is very high (Arnold and Gibbons, 1996), and conditions for plant and animal life are usually trying. The advantages and disadvantages of compactness have been well expounded. Many cities contain areas with exceptionally high development density in the inner city or the old urban core, formed by organic accretions. Some cities develop new compact areas or infill existing areas to a higher density (Williams, 1999). Whether old, modified or new, such compactness needs more attention to green-space provision and environmental well-being, which could be overlooked or sacrificed (Jim, 1990). If green space is deprived, a compact city becomes the antithesis of a green city. The destruction of existing vegetation and inadequate plantable spaces (Jim, 2000) degrade the environmental quality, quality of life and human health (Jackson, 2003).

The case of cities in developing countries in particular is worrying because of the urge to take the myopic path of developing first and making amends later (Olembo and de Rham, 1987), and failing to benefit from other cities' experience. The exigencies of meeting basic needs and development aspirations may overshadow greenery and other environmental concerns (Marcotullio, 2001). Rapid urbanization and intensification, especially in some developing cities, could compromise environmental planning. Whereas individual cities have unique problems and limitations in implementing the greening imperative, most physical and physiological constraints that beset vegetation growth tend to be generic (Grey and Deneke, 1986; Bradshaw *et al.*, 1995; Jim and Liu, 2001a). The constraints, however, are manifested at an increasing magnitude and pervasiveness in areas with condensed development. An understanding of the tangible and intangible limitations (Grey, 1996; Miller, 1997) could provide hints to maximize opportunities for green space and greenery in the sustainable city quest.

Urban greening, a common if not universal environmental issue, deserves more attention and resource support, with strengthening of both policies and practices. Comparing to spacious developments, green spaces for compact city areas encounter more restrictions and stresses, and are more amenable to degradation and losses (Jim, 2002a). Their green-space planning and management require more dedicated and coordinated

efforts. This paper, adopting a problem-based approach, surveys the pertinent limitations to greening in packed city precincts, proposes precautions and preventive measures to forestall greenery degradation, and identifies practical alternatives, solutions and opportunities for greenery. With planning and foresight, compact areas could provide a reasonable quantity and quality of amenity vegetation to ameliorate the harsh milieu.

The first-hand experience on urban greening in compact cities, which epitomizes some of the extremely packed urban form, in conjunction with observations in other cities, provides information and insight for the ensuing analysis. By modifying existing approaches or adopting innovative ones, whether successful or otherwise, cities offer empirical examples from the standpoint of both researchers and practitioners. Urban greening is inherently a multivariate venture that demands the union of knowledge from disparate expertise and disciplines, and that the experience of a city could often be useful to others. Many fine cases, good practices and object lessons, however, remain obscure or fail to propagate and be applied outside their original realms. The gap between research and application and between science and practice, in the field of urban greening, needs to be closed by a more effective amalgamation of ideas and communication.

Recent research findings in a group of cognate disciplines, including arboriculture, urban forestry, urban ecology, urban planning and urban geography, have nurtured an interdisciplinary confluence that could be translated into policies and practices. A comprehensive review can serve to integrate the latest findings in the field from a planning perspective. With a longer life span, larger biomass and more notable environmental functions, trees are used as the surrogate of urban vegetation in the discussion. Relevant issues will be explored from the viewpoint of two fundamental entities in the urban greening equation, namely existing and new green sites. Existing sites have to be preserved against development pressure, and new ones adequately designated in new developments. The analysis is structured around five basic questions, namely what, where, when, how and who? The principles are expounded first, followed by their translation into practices to implement greening endeavors. Where appropriate, actual examples will be used to support or illustrate the exposition.

### Existing green sites

*What could be accomplished?* This category includes all existing green spaces principally situated at the ground or street level, provided by the government and private sector, with or without

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