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Ecological disturbances due to high cutback in the green infrastructure of Karachi: Analyses of public perception about associated health problems

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ABSTRACT

This paper evaluates the changes to the green infrastructure of the megacity of Karachi, Pakistan, occurring during a period of rapid development, involving extensive loss of trees and green spaces since 2000, occurring as a consequence of road widening and improvements to the city's transport infrastructure, aggravated by a series of cyclones, involving further tree loss and which has led to numerous ecological problems in the city, assessing how the effect of the reduction of Karachi's green infrastructure has impacted both the reality and the perception of human health conditions. It uses medium-resolution satellite images classified for land use and land cover (LULC) data extraction and detailed field surveys to map the extent of change; structured questionnaires are used to identify the perception of selected, targeted groups regarding the state of Karachi's urban green infrastructure and perceived human health conditions. Findings indicate that the public perception of green space functionality or presence does not equate with the remote sensing and field mapping results, which show a dramatic loss. The need to develop a comprehensive urban greening strategy, which considers the needs and priorities of the population, is identified. The impact of such a strategy in terms of increased frequency of visits to green sites and associated increase in the physical activity of the people to improve overall physical health is discussed in relation to the general development of Karachi.

Introduction

Megacities such as Karachi, Pakistan, are unique urban systems with complex and dynamic ecological settings that present particular challenges to scientists studying urban landscapes and where the history of urban development is also the history of emerging novel ecosystem types (Sukopp, 2003). However, questions arise regarding the sustainability of such megacities (Annan, 2002; Wu, 2006, 2007; Ahern and Kato, 2007; Grimm et al., 2008; United Nations, 2008) and the ways in which they support individuals, especially regarding the relationship between individuals and the green urban environment. This is particularly important in a country like Pakistan where the rural population has essentially stopped growing and all future growth is expected to occur in urban areas (Grimm et al., 2008; Wu, 2008), with major decisions required regarding the development and management of the urban green infrastructure, which forms an integral part of the urban ecosystem.

Ahern and Kato (2007, p. 287) present a definition of green infrastructure as "Integrated networks/systems of built and protected/managed urban ecosystems that provide multiple, complementary functions in support of urban sustainability". This definition advances the previous idea of Sandström (2002), who suggests that the concept of green infrastructure has been introduced to upgrade urban green space systems as a coherent planning entity. Green infrastructure, as a term, has gained significant importance during recent years (e.g. Konijnendijk et al., 2000; Weber and Wolf, 2000; Benedict and McMahon, 2002; Williamson, 2003; Girling and Kellet, 2005; Low et al., 2005; CUDEM, 2006; Weber et al., 2006; Ahern, 2007; Gill et al., 2007).

However, the loss of green infrastructure as a result of urbanization is a serious threat to the overall biodiversity of urban areas and calls for a much more critical consideration of its role, provision and management (Yli-Pelkonen and Kohl, 2005; Yli-Pelkonen and Niemelä, 2005; Qureshi and Breuste, 2009). This requires that ecological knowledge should be improved, better integrated into social science research and ultimately into urban planning (Niemelä, 1999; Breuste, 2004, 2008; Breuste et al., 2008; Qureshi and Breuste, 2009).

The ways in which contact with nature contributes to improving the quality of life are wide ranging (Priego et al., 2008). In particular, the provision of appropriate green

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infrastructure has strong correlation with human health. For example, Kaplan and Kaplan (1989) stress the importance of nature in urban settings and sufficient evidence prevails to draw the conclusion that a robust and healthy green infrastructure is a vital public health factor for city dwellers. Both green infrastructure and human health are key indicators of sustainable urban planning (St. Leger, 2003; Stokols et al., 2003; Tzoulas et al., 2007), while 'green' (urban nature) is considered as the most important community feature contributing to resident's appreciation of their neighborhood (Crow et al., 2006; Priego et al., 2008). The availability of nearby trees, opportunities for gardening and places for taking walks are highly valued components of urban nature contributing to increased levels of satisfaction and a higher perception of well-being by urban residents (Tzoulas et al., 2007; Priego et al., 2008). The World Health Organization (WHO, 1948) also adopted the concept of well-being, which defines human health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Thus the relationship between urban green infrastructure (as urban nature) and human health is the subject of much examination (Ulrich, 1984; Pretty et al., 2003; St. Leger, 2003; Mayer and McPherson-Frantz, 2004; Mell, 2007; Tzoulas et al., 2007).

Most of the studies presented in the literature exemplify a comprehensive understanding of this relationship but few explore the perception of people about its importance to their health. In particular, nothing has been studied regarding the specific circumstances of the inhabitants of megacities that are passing through major phases of urban renewal. Urban renewal itself is a challenge for cities' socio-cultural and physical environment where green spaces are frequently at risk. The correlation of health to green space provision thus suggests that the health of residents will be affected as green space is lost to alternative non-green uses (Ulrich et al., 1991; Ashton, 2002; Tzoulas et al., 2007). Hence, there is a need for in-depth studies investigating the relationship of the green spaces and human health, which are under pressure of mega-urbanization and the extent to which urban renewal is aggravating the situation.

Study area and problem

In this paper, our study area is the megacity of Karachi (Fig. 1), which is the business capital of Pakistan. The metropolitan area along with its suburbs spreads over 3530 km^2, having an estimated population of 18 million (CDGK, 2007). Butler (2005) ranked Karachi as the second largest city of the world. Enormous population growth and lack of effective planning have made it a hub of environmental problems. In particular, new development in Karachi has emerged following the implementation of a new devolution plan (NRB-GOP, 2001). As a result, the last 7 years have seen significant changes in terms of both environment and landscape (Qureshi et al., 2007; Qureshi and Breuste, 2009). Numerous development projects since 2001, undertaken by the City District Government Karachi (CDGK), concern the development of roads, overhead bridges (flyovers) and underpass construction. The Green Infrastructure of the city has had to absorb the pressure of these development activities where thousands of trees have been cut down with the additional removal of wide roadside greenbelts on the pretext of improving road safety, securing and upgrading the utility network. Additional tree loss occurred after recent torrential rains (as an aftermath of a series of cyclones) with associated damage to

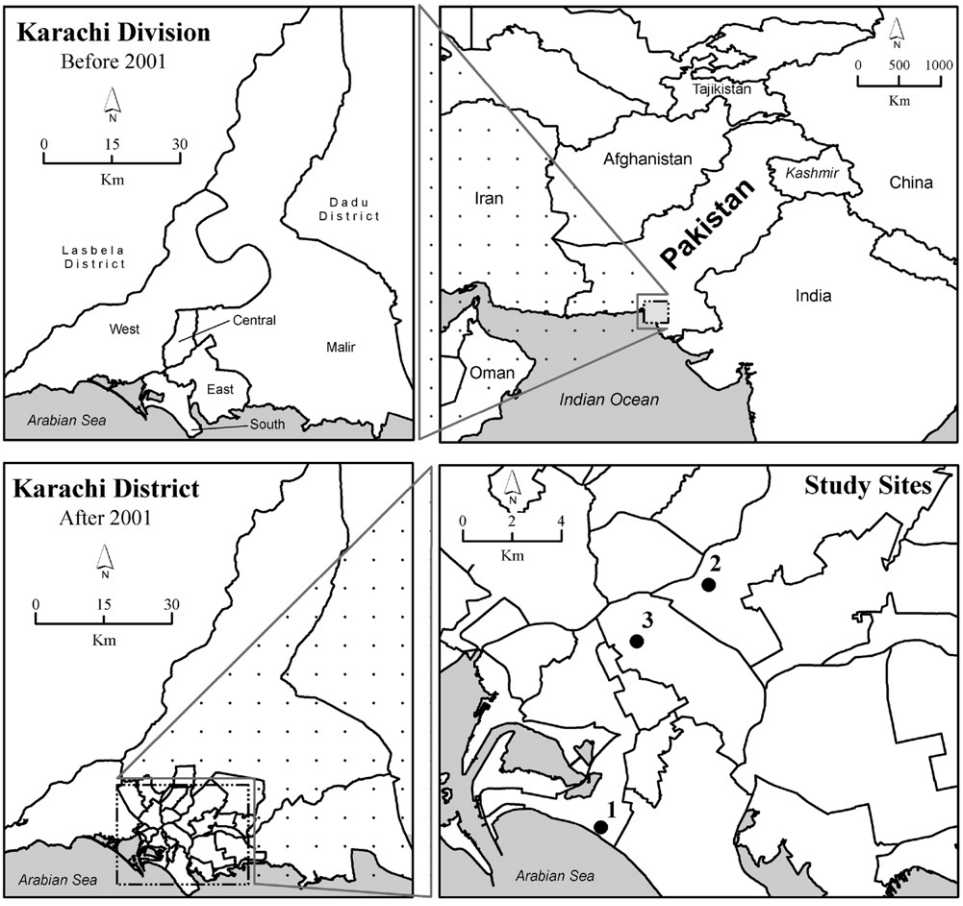

Fig. 1. Karachi with its administrative settings and selected research sites.