Chapter 6

Summary and Conclusions

The changes in Delhi’s green spaces over the last few decades reflect a blend of various imprints left by socio-economic-demographic and institutional drivers. Urban population in Delhi has grown almost exponentially in the past few decades. Much of this growth is a result of migration from neighbouring states (Jain et al., 2011). This enormous growth of population is associated with increased opportunities and investments in the construction sector, which lead to unfettered expansion of the city. Unfortunately, urban nature in Delhi has become a victim of unprecedented, rapid and mostly unplanned urbanization leading to fragmentation, shrinking and disappearance of urban green spaces such as vegetation and waterbodies. This severely impacts ecosystem services and biodiversity. In spite of the ongoing degradation, Delhi has the largest green cover amongst three metropolitan cities of India, namely Delhi, Mumbai and Chennai (FSI 2013). This is primarily because of the ridge forests, the densely vegetated Delhi Cantonment area and large numbers of avenue trees in Lutyens’ Delhi. In the present research, drivers of change in green spaces has been critically reviewed and analysed at a global level; the impact of Delhi’s urban development on the extent and fragmentation of green spaces has been assessed; attitudes and perceptions of public visitors using parks in Delhi has been explored; and finally, management and communication networks that are associated with park governance have been investigated.

The world urban population is increasing at a staggering rate and cities of developing countries of Asia and Africa are expected to gain the largest share of world urban population in the coming years (United Nations 2014). Often, cities in developed countries differ from cities in developing countries in terms of density and spatial form of urban land cover distribution. The cities of developing countries are growing in a frenzied manner leading to urban densification, with higher population density and marginal open space compared with cities in developed countries (Huang et al., 2007; Schneider and Woodcock 2008).
Regardless of level of development status, many nations are facing the challenge of transition towards sustainable cities (Haq 2011). Urban sustainability requires enhancement of the quality of the urban environment and reduction of pollution, which can be to some extent brought about by improving the green cover of the city (Jim 2004). But in an urban system, the green spaces are in a continuous process of adaptation and change. A myriad set of factors driven by various human (social, economic and political) and natural (biophysical) forces, often operating as proximate causes, play a role in this changing green cover (Geist and Lambin 2002).

The review of 66 studies across the world conducted in this thesis, assessing drivers of change in urban vegetation, revealed that changes in urban green cover are a direct outcome of dimensions of rapid urbanization at the proximate level. In most cases, depletion of urban green cover is mainly driven by rapid urbanization that requires infrastructure expansion. This has resulted in infringement of urban green spaces and is supplemented by urbanization and economic policies that stimulate further urban growth, at an underlying level. But there are instances of cities where conservation efforts for the existing greenspaces are underway and efforts have been made to compensate for the losses. This leads to increase in green spaces, an outcome of urban greening policies. Thus policies and planning, like urban reconstruction policies and greening policy guides agencies such as forest department and other agencies in management and augmentation of urban green spaces. Greening policies also resulted in the transformation of industrial land to green areas and to an increase in public institutional ownership, that have successfully preserved green spaces in some cities. Several cities have however experienced a decline in green cover as a consequence of reconstruction policy. In such cities of developing countries, meeting the basic demands of development are given precedence over the efforts of green space preservation and enhancement, thus leading to the overshadowing of greenery and other environmental concerns by developmental needs and agendas (Jim 2004).

In general, there is a dearth of adequate attention of urban policy on urban greening, globally, as well as in South Asia (United Nations 2014). Further, there is a need to advance understanding of the causal association between the role of human drivers and urban forest fragmentation in Asia (Gong et al., 2013). Hence, understanding the impact of urban development in shaping differences in the extent and fragmentation of green spaces in the large megacity of Delhi and evaluating the role of public
institutions in protecting green spaces helps in advancing our understanding of the pattern-process relationship between urbanization and land cover change/fragmentation in Delhi.

Globally, urban land use/land cover and vegetation change has been successfully monitored by the use of Remote Sensing and Geographical Information System (GIS). Developing countries are extensively adopting low cost GIS, underlying Spatial Data Infrastructures (SDI) and spatial methods of analysis to find a solution to various emergent issues and problems arising out of urbanization, while developed countries are increasingly using high-resolution satellite imageries and aerial photographs for understanding the spatial distribution of vegetation. The present research has also successfully used satellite imageries from three dates since 1986, spanning 25 years, for monitoring of extent, distribution and fragmentation of Delhi’s greenspace. The impact of built environment and the spatial differentiation of urban vegetation can be understood in the light of sociological data and observations. Majority of the studies from developed countries address variation in urban vegetation in relation to socio-economic, demographic variables (education, minority status, household income and household density) and land tenure derived from secondary sources, telephonic interviews and mailed questionnaire surveys. Like most other studies from developing countries, my study also used field observations for the training, verification and interpretation of the classified images. The present study created vegetation cover change trajectories, where in, information from images of two time periods is fused to create a vegetation change trajectory for each pixel in the image. This relates the type of transformation occurring in that location (Nagendra et al., 2012), thereby imparting a greater understanding of the course of change in urban vegetation cover. Future research aims to build on this database, using high-resolution imagery to study the drivers of distribution and fragmentation of urban vegetation at a finer scale.

This research shows that the extent and pattern of distribution of Delhi’s green spaces is shaped by urban patterns of development. The city core contains more green spaces with less fragmentation compared to intermediate areas and the peri-urban periphery. Yet, the city core comprising of Old Delhi tehsils (Karol Bagh, Paharganj, Sadar Bazar, Daryaganj, Kotwali) and New Delhi tehsils (Parliament Street, Connaught Place and Chanakyapuri), has also experienced the greatest degree of vegetation clearing and fragmentation since 1986 due to infrastructural expansion, while the peri-
urban periphery has shown an increase in vegetation and a decrease in fragmentation due to compensatory plantation in these peripheral areas. Public institutions like forest areas, archaeological sites, and military and academic campuses have played a major role in protecting green cover and limiting fragmentation in the core and intermediate areas of the city. Apart from clearings for infrastructural development and encroachments, Delhi Ridge, the ‘green lung of Delhi’, is still intact. On a positive note, the Southern Ridge gained vegetation between the years 1999 and 2010, because of eco-restoration initiative by the Eco Task Force. The periphery showed a trend of increase in vegetation cover between 1999 and 2010, due to afforestation and development of number of small urban forests and parks as part of compensatory afforestation measures and plantation initiatives by Government organizations, civic groups and Resident Welfare Associations. According to the directives of the Central Government, compensatory afforestation is usually undertaken when there is de-reservation or diversion of vegetated land for non-vegetated uses. Such initiatives need to be significantly strengthened and supported by planners and administrators with an aim to protect critical urban ecosystems in the peri-urban city fringe.

With the urban expansion and densification, large numbers of urban parks in Delhi are successful in preserving and enhancing the green cover of the city. Urban parks and gardens provide an opportunity to the city dwellers to connect with nature. This research used primary data gathered through a survey conducted among visitors and keepers of four of the city’s large iconic parks in New Delhi, namely, Buddha Jayanti Smarak park, Lodhi garden, Safdarjung’s tomb and Bhuli Bhatiyari park. Both quantitative and qualitative analysis techniques have been used to analyse the data collected. Similar to the most studies on visitor perception studies worldwide, the questionnaire survey revealed visitors’ perceptions, expectations and accessibility of the urban nature in Delhi.

The study showed that people are in favour of more green spaces, with visitors deriving a wide range of benefits. Visitors valued green spaces primarily for environmental, psychological and health benefits. There is a variation in the responses of different age groups. Older respondents valued environmental, psychological and health benefits, while younger respondents were more aware of the other benefits of green spaces, like timber, food and opportunities for environmental education. But surprisingly they have limited awareness of biodiversity, with one out of 3 visitors
unable to identify tree species, and one out of 4 visitors unable to identify animal species frequenting the park. Hence, there is need for nature education efforts, so that there are more informed and environmentally aware urban residents.

In Delhi large number of parks is managed by various agencies, like DDA, CPWD, ASI etc. or in alliance with non-governmental organizations, resident’s welfare association. Apart from the parks/gardens maintained by the Archaeological Survey of India, entry is free in most of the parks. ‘The assessment of willingness to pay is indicative of the value attributed to parks/gardens by the individuals’ (James et al., 2009). Visitor opinions were divided over their willingness to pay for park use, with most asking for improved safety and infrastructure. Safety for women and families, especially, represented a constraint on the use of parks, particularly in the interior areas of these large parks. Thus, there is need for increased attention to security, which will help residents to access urban green spaces in larger numbers without compromising their personal safety.

The amount, quality and distance to urban recreation areas and green space affect as to how urban citizens use green spaces to meet daily recreational needs (Tyrväinen and Väänänen 1998; Van Herzele and Wiedemann 2003). This research ascertained that the majority of daily visitors were located within 0.5 km of these parks. However some visitors traveled over 10 km to visit major, iconic city parks, despite having smaller parks in their neighborhood. This study underlines the importance of large, well maintained, publicly accessible parks. Even though there are large numbers of neighborhood parks, the accessibility of parks is low in Delhi. Hence, the study makes evident the need for increased green spaces to maintain human health and wellbeing in a city of 16 million inhabitants. Delhi is also home to great ethnic and cultural diversity and to economically less privileged communities. In future, it will be interesting to look into the perception of visitors of diverse ethnic, cultural and economic backgrounds, whose needs and interests are different from the general population and are often ignored. This will assist planners and managers to make more informed and equitable decisions to fulfill the need of diverse users (Gobster 2002). Nevertheless this study of visitor perceptions adds to the small but growing literature on people’s perceptions of and needs from urban green spaces in cities in the global South. The integration of people’s expectations and preferences regarding urban green spaces by the planners and urban would render a more satisfying urban
nature experience and could help to increase the uses of green space by a diverse mix of gender and age groups. In the near future, urbanization induced societal changes will bring in changes in the perception of greenspaces and environmental knowledge, hopefully with improved awareness of conservation issues, as observed in China (Watson 2000; Jim and Chen 2006).

Delhi has a large number of parks and gardens. They are administered by different civic bodies alone or in alliance with non-governmental organizations, resident’s welfare association and private sector organizations (Raut and Raut 2013). But the challenge lies in identifying a model of governance that works best, which can effectively facilitate a rich urban nature experience for its users. The success of a park agency is dependent upon the quality of the visitors’ experiences (Hamilton et al., 1991). The study of park governance structure and its relation with park performance reveals the following. First, there is requirement of a strong and dynamic leader providing guidance and encouragement to the workers. Second, better communication and dissemination of information from the upper level to the lowest level of the park is an essential requisite. Lastly, strengthening and increasing the interactions of co-workers in the park is also important as it will lead to collaborative learning and sharing of job experiences. The ideal amalgamation of these three findings would help in achieving well-managed parks, capable of providing satisfying park experiences for visitors. Changes in park governance are internally driven in response to external demands i.e. the demands of the park users. But the alteration of the structure of governance is a challenging endeavor. Yet, this study has implication for planners, managers and civic agencies for effective upkeep of the parks. Even though only four parks were considered for analysis, a clear relationship emerged between the network indices and park performances. Building on this study, we can develop a more generalized understanding of the relationship between the network indices and park performance.

Social Network Analysis mapped the communication networks and the structure of management of the parks to relate them to the park performance. In recent years, growing number of studies have effectively used SNA in the study of natural resource management, with focus on adaptive co-management of natural resources. But Social Network Analysis of the parks put forward strategies for the public authorities for
effective management and governance of the parks capable of rendering the satisfying urban park experience.

By the year 2028, India will be the most populous country in the world over-taking China and in the coming decade Delhi is likely to have 20 million inhabitants (United Nations 2014). Thus the unrelenting growth of the urban population will put excessive pressure on existing resources, leading to contested access to water, green space and other natural resources. This is likely to eventually lead to loss of ecosystem services, connectivity and disappearance of biodiversity. The urban planner and manager have a crucial role to play in combating the detrimental fallouts of development and urbanization and improve the quality of urban life. The present thesis adds to our spatio-temporal knowledge for monitoring changes in vegetation cover and fragmentation in urban areas in the Indian context and its association with socioeconomic and institutional drivers. The study examines where the changes in vegetation cover have occurred, what are the drivers of such changes, what are people’s expectations from urban nature and how park management networks enable the needs of visitors to be fulfilled. Incorporation of the findings in the planning and designing of urban green spaces in Delhi will ensure healthier green infrastructure, rendering important ecosystem services and adding to health and wellbeing of urban communities. In summary, in order to overcome the growing challenges of urbanization and to render a truly environmentally and socially sustainable city, there is need to embrace a set of managerial strategies and practices suited for it. The findings of the present research can serve as useful reference for planning authorities and designers. This will ensure the protection and enhancement of biodiversity and support green spaces to improve human well-being, hence steering ecologically smart city growth.