Delhi's Natural Heritage

USIEF

INTACH

FULBRIGHT

Delhi's
Natural Heritage

Symposium jointly organized by
Indian National Trust for Art and Cultural Heritage
(INTACH)
and
United States-India Educational Foundation (USIEF)

USIEF

INTACH

FULBRIGHT

Cover Photo: Wetland in Yamuna Biodiversity Park
(Photo : Faiyaz Khudsar)

First Edition 2009
Editor: Amita Sinha
Editorial Assistant: Swati Kittur
Published by: United States-India Educational Foundation (USIEF) and Indian National Trust for Art and Cultural Heritage (INTACH)

CONTENTS

FOREWORD

The US Government funded Fulbright Programme was established in 1946, soon after World War II, under legislation introduced by the former Senator J. William Fulbright, designed to increase mutual understanding between the people of the United States and the people of other countries. The programme has grown into one of the largest academic and cultural exchange programmes in the world. Currently, 155 countries participate in the Fulbright Programme which offers grants for US citizens and nationals of other countries for teaching, advanced research, graduate study, and professional development. Since its inception, the Fulbright programme has funded approximately 300,000 scholars around the world.

Formerly named the United States Educational Foundation in India (USEFI), our Foundation was established in 1950 to administer the Fulbright Programme in India. The signing of the new Fulbright agreement on July 4th 2008 has resulted in the two governments becoming full partners in the implementation of the Fulbright Programme. The Foundation is now called the United States – India Educational Foundation (USIEF) and we are now awarding Fulbright – Nehru grants and scholarships. Since 1950 USIEF has awarded approximately 8100 Fulbright fellowships to American and Indian citizens. In addition, USIEF in its continuing effort to foster exchange and promote mutual understanding supports opportunities for dialogue between Fulbright scholars and their communities. The Symposium on Delhi's Natural Heritage has been one such forum. The papers presented in the Symposium and published in this volume will contribute to the debate and discussion on conservation practices.

In the last 20 years of my acquaintance with Delhi, I have witnessed its expansion, modernization and most recently her

and translate them into action appear to have been drawn up. Although Delhi is well endowed with greenery, overall the green lungs are inadequate and unevenly distributed. Tree planting efforts in the last decade have succeeded in raising the tree cover to about 22% of the total land area, but the green areas are bounded and fragmented, and a continuous green network is lacking. A new ecological paradigm is certainly needed for the urban landscape of Delhi.

In this connection, it is necessary to mention that a complete and comprehensive mapping of the natural heritage of Delhi is lacking and this work should be undertaken on priority. INTACH has done listing and documentation of Delhi's built heritage. A similar effort has to be made in respect of natural heritage and INTACH would be happy to take up this assignment, if the NCT Government is willing to support the initiative. Another specific proposal relates to the designation of State Bird, State Animal and State Tree, as has been done by almost all the State Governments. Somehow, Delhi is missing from the list and it is necessary to rectify this situation.

A clean and healthy environment is part of the fundamental 'Right to Life', as held by the Supreme Court more than once. To that end, each and every component of the natural environment has a crucial role and no effort should be spared to protect and preserve this precious and irreplaceable heritage in the interest of the present as well as future generations. The papers presented in the symposium and included in the volume address these and related issues and outline concrete ideas, suggestions and solutions.

S.K. Misra
Chairman,
Indian National Trust for Art and Cultural Heritage
(INTACH)

[Note : INTACH's proposal towards designation of Delhi's State Bird, State Animal and State Tree is given in Annexure C]

PREFACE

Ever since its establishment 25 years ago, INTACH's mandate has included the conservation of India's natural heritage. Over the years, INTACH has earned a certain name and reputation for its work on man-made heritage, especially in regard to architectural and material heritage. Now, our ambition is to make a similar mark in respect of natural heritage. To that end, a strategy has been prepared and some initiatives taken. It is in line with this approach that the Symposium on Delhi's Natural Heritage was organized jointly by INTACH and the United States-India Educational Foundation (USIEF) on 13th May 2009.

INTACH has a long relationship with USIEF, especially in the context of the Fulbright Scholarship Programme. INTACH greatly values this partnership. The collaboration for the Symposium is on a topic of considerable importance. On behalf of INTACH, I profusely thank the USIEF and especially it's Director, Dr. Adam Grotsky, for supporting the initiative.

Delhi's natural environment is of enormous significance and a tremendous asset to a major metropolitan area of the world. The Yamuna river and its floodplain, the Ridge ecosystem, the historic gardens and orchards as well as the more recently developed urban park system, the numerous water bodies and the remarkable diversity of birds and trees constitute Delhi's rich natural heritage. This heritage has been at best ignored, at worst exploited in the rush for development. Unplanned development and rural migration from neighboring areas have put enormous pressure on the city's natural resources. Most alarming has been the depletion in the ground water level due to over extraction and the high levels of air and water pollution.

The Delhi Master Plan (2021) is emphatic in the need to integrate the Ridge and the Yamuna riverfront as natural heritage corridors in the planning of the metropolis for improving its physical environment and ecological health. Yet, no detailed landscape plans that would achieve the broadly stated goals of the Master Plan

commitment to respect her people, public spaces, buildings and most importantly her air. The conversion of fuel to CNG for auto rickshaws and busses has made a remarkable difference in the quality of life here and obviously the impact has been extremely positive on the overall environment. One thing that I've noticed and find really amazing in my walks and travels around the city is the ability of the people to use the relatively small public places available to them. For example, I am always impressed with how people utilize traffic roundabouts as a park, as a place for leisure, where they go to meet friends, to do yoga, to exercise and even manage to play a cricket match from time to time. But while Delhites have an incredible knack to make the most out of the spaces that they have, there is obviously substantial pressure on the landscape here, which is a result of rising population, migration to the city and increased development both in the commercial as well as housing sectors and I fear the toll that this will take on Delhi, on its parks, heritage sites and on its green areas in the years to come. I am very happy that USIEF could support this initiative to help improve the great city of Delhi, which has been the home of our Foundation for almost 60 years.

Adam Grotsky
Executive Director,
United States-India Educational Foundation
(USIEF)

INTRODUCTION

Samar Singh
Sr. Adviser, Natural Heritage, INTACH

Conservation of India's heritage is the mission and mandate of INTACH and the organization has earned a reputation for its remarkable work on built and material heritage. Not so well known is the fact that ever since its establishment in 1984, the conservation of natural heritage has been also a part of INTACH's mandate. In furtherance of this mandate, the Natural Heritage Division at the INTACH Head Office in Delhi has been undertaking various initiatives and activities over the years. In doing so, INTACH greatly values partnerships with other like-minded government and non-government agencies, organizations and persons.

It is in line with this approach that the Symposium on Delhi's Natural Heritage was organized jointly by INTACH and the United States – India Educational Foundation (USIEF) on 13th May 2009. The USIEF provided funding support for the symposium. Dr. Amita Sinha, Senior Fulbright Scholar deputed to INTACH by USIEF, played a significant role in organizing the event. The Symposium was essentially aimed at focussing attention on the natural environment of Delhi. The National Capital has a rich, though chequered, past and even now has "a unique and distinctive character", as stated in the Delhi Master Plan 2021. After all:

- Which other city in the country, and even elsewhere in the world, can claim the antiquity, history and close relationship to people's lives, as Delhi's most prominent natural features – the Yamuna and the Aravallis—do?
- Which other city can boast of an avian diversity of about 350 bird species?
- Which other city can compare with the greenery of New Delhi?

All this and more..... but the fact is that the natural environment has neither voice nor votes. Besides, the general attitude is to take Nature and all its bounties for granted. The consequences are in evidence everywhere, raising concerns that are too serious to ignore any longer. The concern for the natural environment covers not just birds, bees, butterflies, trees, forests or tigers, important as these surely are. Most importantly and ultimately, it involves issues of clean air, clean water and other life support systems without which human existence itself is not possible. These have to do with human health, human well-being and human survival. To overlook this crucial aspect is tantamount to utter self-delusion and courting disaster, which is what we are fast moving towards.

The ambition to make Delhi a "World Class City" is driving trends and developments that are exerting enormous and unprecedented pressures on the city's natural environs. Besides, even when the intention is good, the gap between intention and implementation, between ambition and actual realization, leads to unacceptable consequences. It is to take stock of all this, find solutions and to seek corrective action that the Symposium was organized.

The Symposium was inaugurated by Smt. Sheila Dikshit, Chief Minister of Delhi, on the forenoon of 13 May 2009 at the INTACH Head Office in New Delhi. Her inaugural address is being carried in this publication.

The Opening Session was followed by three substantive sessions:

Session I – 'Natural Environment of Delhi', chaired by Shri O.P. Jain, former Convenor, INTACH Delhi Chapter.

Session II – 'Policy, Planning, Documentation & Design Approaches', chaired by Shri K.T. Ravindran, Chairman, Delhi Urban Arts Commission.

Session III – 'Green Delhi Vision 2021', Shri J.K. Dadoo, Secretary (Environment), NCT Government of Delhi.

Each session was marked by very useful and insightful presentations by several experts and professionals on different facets of Delhi's natural heritage and related aspects. Many of these are included as papers in this publication. The open discussion following each session elicited active participation and provided opportunity for a free exchange of ideas and perspectives.

The participants included representatives of the Union Ministry of Environment & Forests, NCT Government of Delhi, Delhi Development Authority (DDA), Municipal Corporation of Delhi (MCD), New Delhi Municipal Committee (NDMC), Delhi Urban Arts Commission (DUAC), School of Planning & Architecture, Delhi University (DU), Jawaharlal Nehru University (JNU), Indian Institute of Technology in Delhi (IIT Delhi), several Delhi-based NGOs, and other experts and professionals.

Overall, the Symposium was successful in bringing together, perhaps for the first time, environmental experts and professionals with concerned officials and NGOs to deliberate and focus attention on the conservation of Delhi's natural heritage. The participation of the Chief Minister and the positive attitude displayed on behalf of the NCT Government of Delhi was another notable feature of the Symposium. As a result, a broad consensus emerged on the need to undertake a comprehensive listing and documentation as well as ensuring proper protection of the city's existing natural heritage. It was also felt that in the context of Delhi an integrated approach linking the cultural and natural heritage would be appropriate.

[*Note : Symposium Programme and List of Participants are given in Annexures A & B*]

INAUGURAL ADDRESS

Smt. Sheila Dikshit
Chief Minister of Delhi
(Chief Guest)

We, as the local Government, are ever conscious of the fact that we have to keep Delhi's green cover, ambient quality and the Yamuna as clean as we can. We have done some work in the last decade and, in spite of increased urbanization, Delhi has not lost but gained green cover. The ideal cover for Delhi would be twenty-five percent and we have reached over twenty-two percent. We have enforced the regulation that on felling one tree, you have to plant ten more. We have been helped enormously by the community in Delhi, particularly the school children who are becoming increasingly conscious of the fact that without a green cover the city will become a desert. There is a shortage of land in Delhi and sooner or later it will get totally urbanized. We have managed to create eighty-two forest areas; we have to create sixty more. We have started building a high wall around the Ridge area because it was being used as a garbage dump. There have also been many intrusions by people wanting to live there and some buildings have unfortunately come up due to the multiplicity of authorities in Delhi. But the Ridge has to be conserved under all circumstances. What is also worrying is that there are some species of trees being planted which are not suitable. I am thankful to Shri S.K.Misra for having said that we should carry out documentation of the bird and tree species. It would be a great help if INTACH could carry out a study on our behalf.

The bird life in Delhi had decreased considerably over the years but the increase in green cover and water bodies has helped bring them back. About one hundred water bodies have been preserved and conserved. In the past years, small water bodies were filled & taken over by builders, and ultimately settlements have come up. We have lost those but must preserve and conserve

the ones that remain. Then, we have an immense network of drains that flow into the Yamuna river which are not in the best of health and carry sewage and pollutants, which in turn pollute the Yamuna. We also have an industrial base within Delhi other than the twenty-eight industrial areas. These are small, hazardous industries often located in small households and bazaars. A study has been done by the Engineers India Limited to see if we can have interceptor canals, so that the water that goes into these huge canals is cleaner when it reaches the Yamuna. There have also been encroachments all over, in areas which could have really become parks on the river bank. There is a rather skewed system of providing housing for the middle and lower income groups in the face of tremendous population pressure. Under the urban renewal mission, we can build permanent housing for people from low income groups at a minimal rent. These permanent dwellings must have good drainage systems, proper roads and toilet facilities, otherwise they add to the bad quality of life, air and surroundings in Delhi.

Where the Aravallis are concerned, Bhatti mines fall in a part of Delhi. Over the past eight years, we have worked towards its greening and now it has become a green forest and a wildlife sanctuary. However, unless we involve the people and elicit their co-operation and understanding, the future of Delhi would be bleak. We do have a system where we interact with NGOs, citizens' groups, and above all with schools. We have about 2000 plus eco-clubs where children are taught conserving natural resources, water and power; and about reduction and management of vehicular traffic so as to make Delhi into a clean and green city. But the most important issue for me is the Yamuna. It comes all the way from the Himalayas and although it is also polluted by the other states that it passes through, we must think about what we can do to conserve and preserve the twenty-five kms stretch that passes through Delhi. This is something that needs to be prioritized. We have begun a campaign to make people aware of this and I feel that INTACH is one agency which can be used to change people's mindsets.

We may build beautiful buildings and gardens, but conserving those to look as beautiful as they ought to be is a big problem. If INTACH could help us, like they have with the conservation of built heritage, to conserve the green heritage, it would be wonderful. I am open to any idea like setting up a heritage council of eminent citizens, but we have to reach out to the people because unless the people become aware, our ideas will just remain ideas and we will not succeed the way we would like to.

We have made two biodiversity parks - one is near Vasant Vihar and the other is near Bhalaswa-Jehangirpuri in the north of Delhi. These were planned by experts from the University of Delhi. But these parks are islands, whereas we need to make the whole city look green. I will be happy to co-operate with INTACH to bring about awareness through advertisements or booklets, for those who are unaware and to give them a sense of pride and a sense that the future will be bleak unless we change things. To give a few examples, I recall that there was a week of chaos in Delhi when we shifted to CNG fuel. People were afraid of the change and even a few buses were burnt. Today, we are the largest users of CNG, which has made a very big difference in the air quality. Change in cultural habits and thinking takes time. I also recall that hardly anyone was ready to use CFL lamps because they were initially expensive, but today you see everybody using CFLs.

Our next task is the proper and equitable distribution of clean and safe drinking water. The problem in Delhi is that it is an ancient city and some of the old water lines run below houses. We have to figure out ways and technology to access these lines to repair and manage them. And, we cannot expect people to allow us to dig under their houses.

We have islands of wonderful places in Delhi. For example Tughlaqabad, but it has been desecrated. Over the years, villages have come up within its walls. We now have to decide if we can

relocate the people or conserve and preserve as much as possible in spite of the people living there. We may remove the slums but the people also need an alternative that is near to the places where they work, because a lot them are service providers to other people. So, the issue cannot be looked at only from the heritage or livelihood or greening point of view. We have to look at it collectively. We are making progress and moving forward; people are becoming conscious of the fact that unless we look after what we have today, we will have a Delhi that is very different from the Delhi we see today. The demands for widening streets, building flyovers and airports is huge and also necessary, but reduces land available for afforestation or other purposes and also brings with it other problems.

The metro has come up very well, but it has come up at the cost of some people who have had to be removed from their homes because they lay in the path of the metro. So that has caused a human problem because once you shift them outside the city you have to provide them with transportation to and from the city because they do provide services to people in the city. We are trying to incorporate them into small communities that would become self sufficient and are able to sustain themselves. We have got about eighty-two gender resource centers running where women are taught skills so that they can earn a livelihood. I am happy to share with you that we have got over 100,000 women involved in this, which means about 100,000 families, and they are earning from about Rs 500 to 5000 working from their homes. Marketing problems have also to be sorted out.

A holistic view is essential. Above all, the solutions should be in tune with the natural habitat of Delhi. I cannot import a tree from the Himalayas and say it will do well here. The ground water is heavily depleted and rain water harvesting will surely help. Even one house can make a difference. Five years ago, nobody ever thought about the environment or greenery, or that using plastic bags or blasting crackers on Diwali would be harmful.

The use of crackers has reduced because of a sustained campaign with the children. This year some children came to meet me with sweets and when I asked them if they had burst crackers, they said that they would be bursting just one cracker because it is auspicious. So that is the kind of mind change we need to bring about.

Living conditions need to be improved. We have to reach out to the commonest person, to avoid use of plastic bags and irresponsible disposal of garbage and reduce use of packaging. These changes do not happen overnight and we cannot compete with other countries of the world because other cities do not have the density of population that we do. We have to think of innovative ideas that suit the conditions of Delhi.

The government takes a long time to take a decision, so we need the push of the people. Fortunately, there is no shortage of funds, but there is a shortage of the will to do something and meet the challenges on the ground. But, the most important thing is that we need to educate the people and make them think about the world that they will be leaving behind for the future generations.

CONSERVING DELHI'S LANDSCAPE HERITAGE

Amita Sinha
Professor, Department of Landscape Architecture, University of Illinois at Urbana Champaign, USA.

Although Delhi's cultural heritage is a matter of great pride for its citizens and is well celebrated in countless books, exhibits, movies, and guidebooks (Dalrymple, 2003; Frykenburg, 2002; Gupta and Bobb, 2007; Singh, 2001; Spear, 2002), its natural heritage does not receive the same degree of affection and regard. The reasons are not hard to fathom—the Ridge and the River Yamuna, the two salient natural features of the region, are not valued because they are not part of everyday experience. [1] Not only is there little understanding of their contribution to Delhi's many cities and their cultural ethos, there is widespread lack of awareness of their heritage value and as natural assets to be conserved. Their dwindling presence in the public consciousness and the urban landscape raises questions about the current conservation approach towards natural heritage in Delhi.

The description of Natural Heritage worked out by INTACH during the National Workshop on Natural Heritage organized by INTACH, with the support of the Ministry of Environment and Forests, on 4-5 September 2008, draws inspiration from the World Heritage Convention of 1972 and emphasizes '*terrestrial or aquatic sites or features, including riverine, wetland, coastal or marine areas, along with their varied biota, processes and*

[1] A recent survey revealed a very low percentage of Delhi citizens regard Yamuna to be of heritage value. See
Knowledge, Attitude and Practice of Delhiities Towards the River Yamuna
—A Report by Peace Institute Charitable
Trust and CMS Environment, 2009 that concludes that poor access to the River from the city contributes towards this lack of knowledge. Likewise the protected forests of the Ridge seem to be an urban void, not evoking any cultural affinity.

occurrences, that are essentially nature's creation and / or have ecological, scientific, cultural, spiritual or aesthetic significance.' (see Annexure D for details) The explanation mentions 'unique ecosystem' or 'rich in species diversity', or 'critical to the provision of ecological services' or 'hosting interesting ecological occurrences'. Natural heritage sites could be 'pristine or near wilderness areas, regenerated areas (with or without human intervention) or areas managed for scientific or conservation objectives. Such descriptions apply to wilderness where human intervention is absent or minimal, and where bountiful nature needs to be preserved from human spoliation.

The limitations of this restricted view become apparent when considering metropolitan areas such as Delhi. The pockets of nature within the city in reserved and protected forests are a small fragment of the urban landscape and barely fulfill some of the criteria for natural heritage such as possessing extraordinary species diversity. Neither are these sites of pristine wilderness, in fact their greenery is a result of considerable reforestation over time. For natural heritage to be a meaningful concept for all citizens of Delhi and not just the environmentalists, it is necessary that its ambit be expanded to include landscapes produced by nature-human interactions. An environmental heritage narrative in which human intentions and actions are acknowledged has a far better chance of being a meaningful guide to sustainable development.

Delhi's rich urban history chronicles the ways in which natural ecology has been the basis of past settlements and modes of livelihood, and woven into the very fabric of pre-industrial life. Landscape heritage speaks of this inheritance more eloquently than the notion of untouched wilderness that has so far been employed in conservation efforts. The justification for a wider definition lies in the idea of landscape itself that can represent both natural and cultural heritage as they have been articulated in the conservation discourse (Palang and Fry, 2003). The semantic separation implied

in this binary categorization of heritage types stems from the long standing opposition of nature and culture embedded in Western thinking. Landscape as scenery has played into this semantic divide by excluding sites that do not conform to the aesthetic norm.

In Delhi, as in other parts of India, cultural heritage conservation is largely equated with protecting and restoring heritage monuments in the city while wildlife conservation is the domain of efforts to protect natural heritage. Separate disciplines, institutions, and statutory laws are responsible for heritage management with the result that the city is divided into neat parcels of fenced off monuments and walled nature preserves. While the roots of this lie in colonial ideology, the post-independence period has not witnessed a determined effort to think otherwise and treat urban conservation in an integrated manner. Cultural landscapes are an opportunity to bridge the divide between natural and cultural heritage in the Indian city.

"Cultural landscapes often reflect specific techniques of sustainable land-use, considering the characteristics and limits of natural environment they are established in, and a specific spiritual relation to nature. Protection of cultural landscapes can contribute to modern techniques of sustainable land-use and can maintain or enhance natural values in the landscape. The continued existence of traditional forms of land-use supports biological diversity in many regions of the world".

Furthermore, as the above UNESCO-ICOMOS description of World Heritage Cultural Landscapes promises, cultural landscape preservation can promote sustainability, enhance bio-diversity and foster natural values.[2] Cultural landscapes of the past represent building technologies that would be termed 'green' in current terminology, intimate and first hand knowledge of the lie of the land and its flora and fauna, and sustainable agricultural

[2] http://www.international.icomos.org/centre_documentation

practices. They impart many lessons for a healthy and balanced relationship with the natural world and its integration into the face paced, technology driven lifestyles of a modern metropolis.

However, before conservation measures can be taken, historic landscapes worthy of protection have to be identified, a difficult task indeed given that their ever-changing, dynamic aspect has ensured that very few or more likely none would have survived from the past, except as remnants or in mutant forms. To list, protect, and conserve landscape heritage in the face of changing social and cultural contexts is a daunting task. As a beginning the papers presented at the Symposium on Delhi's Natural Heritage in May 2009 dealt with the cultural landscape that is the city's environmental legacy. Landscape heritage of Delhi in these papers covers a gamut from the remnant Ridge forests, historic gardens, monument precincts, to Yamuna floodplain and ecologically restored sites. Landscapes are envisaged as sites and networks, bounded entities and flows, impacted by human use. Going beyond the conventional binary categories of untouched wilderness and manicured parks, they include an array in between—sites of cultivation and natural regeneration.

Landscapes are not only beautiful gardens and parks, shaded avenues, sprawling greens surrounding the great monuments of the city, and the luxuriant vegetation in campuses, but also wetlands, streams and *nalas* (drains), urban farmland on Yamuna banks and thorny scrub of the Ridge. They are not just places where nature has been ordered and manicured to delight the eye and soothe the senses, but also abandoned quarries, green corridors of human and wildlife movement, stormwater channels reclaimed by nature, and sites of seasonal farming. The underlying premise in this broad take is the need to think beyond gardens and parks where nature is shaped in the colonial legacy of the picturesque ideal. Manicured greens demand tremendous resources to be maintained given the hot, dry climate, and are socially and environmentally unsustainable. Besides, not every citizen has equal

access to them; some are more privileged than others in enjoying access to the greenery and its benefits.

How does one assess the heritage value of such a variety of landscapes, some of whom may not have any remaining visible links with the past? While a definitive environmental narrative of the Delhi region remains to be published, Delhi Gazetteers are a source as are books published on trees and birds of Delhi (Krishen, 2006; Ganguly, 1975).[3] No gardens from the pre-Mughal period survive in any recognizable form. Mughal gardens themselves were overlaid with elements of the colonial picturesque park, making authentic restoration problematic. Public parks of the colonial era and open spaces of the civil lines and cantonments form the largest extant segment of the landscape heritage.

Material evidence of historic building structures and their fragments are clues to the landscapes of the past. Remnants of fortwalls, hydraulic structures, and urban settlements when mapped can begin to tell a story of the ways in which landscapes were managed in the medieval era. These fragmented assemblages of ruins, with appropriate urban interventions, can become sites of ecological restoration and once again function as vital public places, part of the contemporary urban fabric. When connected with greenways and waterways, these conservation zones within the city will enhance its bio-diversity, recharge its aquifers, and reduce its air pollution. Contiguous left over urban spaces that are unsuitable for building can be planned as ecological service areas, adding to the conservation efforts.

Historic Gardens

Historic gardens are the most visible type of heritage landscapes and not surprisingly have received the greatest attention from conservationists. Meenakshi Damle has traced the evolution

[3] Gazetteer of the Delhi District 1883-84 by Punjab Government; Gazetteer of Delhi, 1912; Delhi Gazetteer by Delhi Administration, 1976

of Delhi landscape from 'janglat sey bagh', i.e. wilderness to cultivated landscape of orchards and gardens that began with the Sultanate era and reached its apogee in the late Mughal period (Damle, unpublished). In the 17th-18th centuries, gardens flourished within and outside the walled Shahjahanabad, and those laid out by the royal princesses were well known for their pavilions, tanks and ornamental parterres. A large number were little more than orchards supplying exotic fruits to their wealthy owners, planted along the Grand Trunk Road and following the course of Hissar-Firoz Canal.

In the face of changing contexts and uses that the historic gardens of Delhi have been subject to as well as absence of adequate pictorial and textual records, conservation has proved to be a challenge. When their context is irrevocably changed, not only are the gardens affected in terms of their accessibility but also internally as in the views and water resources they could command for their effective functioning. Mughal gardens were sites of specific courtly and aesthetic traditions that legitimized royal privilege and social hierarchy at the same time celebratory of the concept of an otherworldly paradise. While most gardens became derelict with the waning of Mughal power, some were revived and altered in the colonial period, in the process acquiring new structures and uses. Humanyun's Tomb Garden, is a successful example of a recent garden restoration with repair of pathways, tanks and water channels, addition of interpretive signage and seating, and historic planting in the outer parterres (Journal of Landscape Architecture, 2007).

Priyaleen Singh traces the changes in context and use of three historic gardens In North Delhi—Shalimar Bagh, Roshanara Bagh, and Qudsia Bagh (paper on page 25). Gardens, usually regarded as 'appendages' to monuments, do not receive the attention they deserve from conservationists. She describes the challenges faced in garden restoration as urbanization destroyed their visual and ecological contexts, fragmented them with new

roads and encroached with new incompatible development. She points out that garden conservation is really management of change and suggests administrative and planning measures needed to address it. In the post-independence period, the pressure on historic gardens to perform as neighbourhood and city parks is great. The seventeenth century Shalimar Bagh for example is now known as the Zilla (District) Shish Mahal Park. The challenge in conserving the garden lies in not only restoring the historic pavilions, Shish Mahal, the water tank and the channel but also accommodating some of the present uses in a manner not injurious to the Mughal garden 'look' (Sinha, 2009).

With the British colonial rule in the nineteenth century, to the walled city of Shahjahanbad and its pleasure gardens were added cantonment and civil lines with their company baghs and malls, race courses and cemeteries. The sparsely populated, spacious green enclaves presented landscape imagery reminiscent of 'home' while admirably serving as an antidote to the perceived miasma and squalor of the Indian city. Many Mughal gardens were appropriated as leisure spaces for the colonial elite and modified according to new tastes. The colonial landscape of the bungalow and the landscape park was internalized as the desired habitat for living by the aspiring Indian upper and middle classes. Incorporated into the garden city ideal of New Delhi it has had a long lasting impact in the emerging landscape of the twentieth century.

Jyoti Sharma analyzes the colonial landscape heritage thematically as Mutiny Memorials, civic and leisure landscapes, and Durbar cities (paper on page 33). Nicholoson's cemetery garden, Mutiny Memorial on the Ridge, Chandani Chouk Square, Queen's Garden, Coronation Park, are among the many heritage sites of that era that are protected but their potential in attracting visitors remains unexploited. Mughal gardens such as Begum-ka-Bagh, Roshanara Bagh, Sirhindi Bagh, Qudsiya Bagh were remodeled in the colonial era with a different landscape vocabulary in keeping with new ideas of leisure, recreation, and aesthetics.

Today these sites survive as isolated urban fragments, remnants of an expansive continuous cultural landscape largely forgotten. Sharma points out that their improved accessibility via the Delhi Metro can be utilized in planning the colonial heritage tourism circuit.

Heritage Corridors

An integrated conservation approach entails more than separate protection of its forests and monuments and should achieve the inclusive goal of conserving the larger cultural landscape that forms their context thereby promoting accessibility and use. Contiguous heritage precincts and conservation zones can be linked with greenways resulting in a continuous open space system that will facilitate human and wildlife movement, add to urban greenery, and will promote accessibility to protected sites within. Restored historic water bodies will add to the heritage landscapes and natural waterways can be a significant linking element as green corridors collecting urban runoff.

In South Delhi, for example, from the remains of the four historic cities on the Ridge, can be surmised a medieval landscape fashioned out of the rocky spurs, defiles and ephemeral streams. Concentrated building activity over five hundred years on the Ridge heights was a reflection of the precarious times when strong fortifications enabled the communities to withstand almost continuous depredations. The massive walls and gateways of the forts and their citadels were built with grey quartzite of the Ridge making them invincible. The forests supplied timber for palaces and mansions within. Rain water was harvested in numerous lakes, ponds, *baolis* (step-wells), and tanks within or at the edge of settlements. Traces of this vast hydraulic infrastructure are found even today in the vicinity of ruins.

Although the contemporary landscape of South Ridge is heavily built up, it contains a larger area of protected forests than North or Central Ridge. These forests are close to heritage

monuments and together with their gardens and parks form large green pockets in the urbanized landscape. About 4700 hectares in Asola Wildlife Sanctuary are in proximity to Tughluqabad Fort; Sanjay Van is not too far away from Qutub Complex and Mehrauli; and both Siri and Jahanpanah walls nestle against forest named after the historic cities. DDA has built parks next to archaeological gardens in Mehrauli, Hauz Khas and is planning one in Tughluqabad (see plate 2).

A continuous open space system can be developed by linking Tugluqabad Archaeological Park with Jahanpanah City Forest and Asola Bhatti Wildlife Sanctuary through urban greenways, utilizing the public right of ways on existing streets (see plate 3). Similarly greenways linking Hauz Khas, Mehrauli and Sanjay Van would provide a seamless continuity between the Ridge protected forests and monumental heritage sites and an alternative green trail system that overlays the existing road network. They will connect with local trails and paths within the protected heritage zones and provide pedestrian (and light vehicle) access to visitors and residents living in the vicinity. They would facilitate local access to the monument parks and in some instances provide a vegetative buffer around a protected structure such as the remains of fort wall.Their most important function in providing access to monument parks and nature preserves would be to reverse the process of segregation that has resulted in green enclaves inaccessible to the public at large (Mandal and Sinha, 2008).

Historic waterways are another opportunity to link heritage sites including 'last-mile connectivity' to the new rapid transit systems (Metro or BRT—Bus Rapid Transit), as envisioned by Akash Hingorani (paper on page 42). The Ridge is a natural watershed to the Yamuna on its east and its many streams have been dammed and channelized to collect and convey rainwater for myriad purposes through the ages. The 12.5 km long Barapullah Nala is one such natural waterway along which monuments as far flung as Qutub and Humayun's Tomb can be found. Hingorani suggests that the *nala* could have served as a security moat to

earliest two cities of Delhi—Qila Rai Pithora and Siri. Although debris ridden and carrying waste water in metropolitan Delhi, there are segments where natural greens with urban wildlife can be found. Designing the Barapullah Nala as South Delhi Greenway with biking and walking trails, wetlands, and vest-pocket parks, is an opportunity to add a linear public space to the city that would serve as an example of eco-restoration of a historic landscape feature.

As Tapan Chakravarty outlines in his paper (page 47), heritage corridors connecting monument greens in north and central Delhi such as the one proposed between the two World Heritage Sites of Red Fort and Humayun's Tomb can be designed in such a way that they provide porous and accessible interface between the tourist enclave and the bustling streets. He argues that corridors can contribute to the public life of the city by making the heritage precincts inviting to Delhi residents and visitors. Instead of railings, fences, and walls insulating the monument-in-a-lawn from the city, traditional landscape typologies such as *chowks* (squares at street intersections) and *baaghs* (orchards) should be the transition spaces at the entries and around the monuments. The heritage corridors would be in keeping with the garden city concept of Lutyens' New Delhi with its handsome tree-lined boulevards. [4] More importantly they would provide the 'missing link' between heritage precincts.

Ecological Service Areas

A city's heritage is also encompassed in ways in which its natural resources were harnessed in the past. Historic settlement patterns adapted superbly to the terrain and climate were shaped by intuitive knowledge guiding decisions on appropriate sites to build and cultivate. Today with the urban population exceeding

[4] The exhibition *Imagining Delhi* organized by the Delhi Urban Arts Commission proposed networking green spaces all over Delhi including the Mehrauli-Hauz Khas-Tughluqabad Heritage Zones. See the special issue of the *Journal of Landscape Architecture*, Summer 2006, vol. 4, no: 2.

that of the medieval city by a factor of 100, tremendous demands on natural resources have caused alarming scarcities. From a situation of abundance to paucity has meant that resources largely taken for granted until now have become precious natural heritage whose extinction threatens urban survival. Water is one such resource whose supply can be augmented by landscape conservation.

The hydraulic infrastructure of the historic cities of Delhi was based upon rainwater catchment system and the River Yamuna. The harvesting of the river in the last two hundred years has meant that its reduced waters in the 22 km stretch along Delhi are highly polluted from the city wastes and have lost their self-cleansing capacity. Increasingly ground water is being tapped for drinking water with consequent reduction in the water table especially in South Delhi. Vikram Soni advocates the preservation of the Yamuna floodplain for natural storage of the monsoon waters that will recharge the aquifer (paper on page 52). The floodplain can store 2 million cubic meters in 100 sq.kms (with an average depth of 40 meters) and can meet the requirements of 6 million Delhi residents. Soni's mantra of 'preserve and use' has tremendous ramifications on the management of the riverine landscape. It means that development controls should be immediately placed on further building on the Yamuna bank and its landscape should be zoned for productive and recreational uses. The recently constructed Yamuna Biodiversity Park, where more than seven acres of wetlands were created (paper by Faiyaz Khudsar; on page 79), and other kinds of aquatic landscapes that retain water and recharge the aquifer would be appropriate for this conservation zone.

Yamuna shifted its course eastwards over the centuries leaving in its wake an alluvial plain with a high water table and an extensive water cover in lakes, ponds, and marshes. A survey by INTACH in 2001 revealed about 508 water bodies in the National Capital Territory of Delhi and there are estimated to be more (Bhatnagar, 2005). These water bodies never considered a precious resource and not under any kind of legal protection have been

slowly reclaimed with urbanization. Their water quality has deteriorated and the building of embankments on the river has cut off their source. This has resulted in a loss of aquatic and avian biodiversity, increased flooding, and depleted ground water reserves. In the last decade, INTACH has drawn up an ambitious blueprint for water augmentation in Delhi and made detailed proposals for conservation of historic lakes such as those in Hauz Khas and Purana Killa and natural water bodies such as Bhalaswa Lake, Sanjay Lake, Jehangirpuri Marshes, and Palam and Supplementary Drains. Ritu Singh in her paper (page 58) describes the process of restoration though bio-remediation, desiltation of the lake bed and increased water supply utilizing natural drainage. She enumerates the benefits of urban water body conservation pointing out that not only will the restored lakes, ponds and drainage system improve the environmental quality in their immediate vicinity but also play a part in reviving the moribund Yamuna.

A.K. Jain in his paper on (page 82) making Delhi a low carbon city emphasizes natural resource management and landscape conservation as significant factors in reducing air pollution. More public transportation and an accompanying reduction in the number of private automobiles of the roads of Delhi will undoubtedly impact pollution levels. However these measures need to be augmented with massive planting to increase forest and tree cover in the city. The pre-industrial cities of Delhi were small, compact settlements nestling against the Ridge forests and surrounded by alluvial fertile plains of cultivated countryside, orchards and woodlands. They were dependent for their supply of vegetables, fruits and cereals grown on the fertile silt deposits (*khaddar*) by the Yamuna. The cutting down of Ridge forests and retreat of the countryside as Delhi expanded has led to serious concerns about the appropriate balance between nature and built form and also occasioned new thinking about alternatives to the manicured urban parks as the only appropriate model of greenery.

Urban wilderness is only one among the diversity of landscapes that make up Delhi's environmental heritage. C.K. Varshney in his paper (page 66) draws attention to the fact that the present plant diversity of Delhi is richer than its original natural vegetation. In the four segments of the Ridge in the Reserve Forest can be found vegetation indigenous to the Aravalli Hills, although Vilyaiti Kikar *(Prosopis Juliflora)* planted early in the 20th century, has replaced native trees such as *Dhau* (Krishen, 2006). Many parks on the Ridge—Kamla Nehru Park on Northern Ridge, Buddha Jayanti Park and Mahavir Vanasthali on the Central Ridge, Sanjay Van, Hauz Khas District Park, Jahanpanah City Forest on the South Central Ridge have ornamental trees and native vegetation. Aravalli Biodiversity Park spread over 700 acres, as Faiyaz Khudsar describes, is an example of a successful ecological restoration of a mining sit. Forest communities of the Aravalli hilly range in four states—Gujarat, Rajasthan, Haryana and Delhi—have been planted including 32-40 Acacia species and 60 acres of native grassland. Managed landscapes such as those of Jawaharlal Nehru Campus have a rich collection of tree species native to Aravalli Hills as well as ornamental and fruit trees. Surya Prakash in his paper (page 74), narrates the history of the campus and institutional efforts to conserve the natural ecosystem and promote biodiversity.

Manu Bhatnagar advocates naturalizing Delhi through a grand scheme of planting in derelict urban spaces by designating them as 'local nature reserves' or 'ecological service areas'(paper on page 99). This would increase the density of green cover, reduce 'heat island effect', increase oxygen generation, and provide eco-corridors for wildlife movement. His typology of urban left over spaces includes marshes and wetlands on the floodplains and along drains, quarries, landfills, and flyash deposit sites, railroad tracks, and roadside verges. He points out in his paper that while cultivated greens of city and neighbourhood parks consume water, fertilizers, and manpower resources, natural greens as in woodlands, wetlands, and wildlife gardens enrich soils, retain monsoon runoff,

and increase bio-diversity by providing habitats for flora and fauna.[5] INTACH's specific proposals for ecological service areas include Defense Land in Mahipalpur in Southern Ridge connected with a green corridor to Aravalli Biodiversity Park, Jehangirpuri Marshes in North Delhi, Bhalaswa Lake in North Delhi, Sanjay Lake in East Delhi, flyash deposit area for Badarpur Thermal Plant on the Yamuna riverfront, and eco-corridors along Palam and Barpullah drains.

The Symposium covered several aspects of the cultural landscapes of Delhi, whose conservation will protect natural *and* cultural heritage. Wildlife Protection Act (1972) for natural heritage and Ancient Monuments and Archaeological Remains and Sites Act (1958) for historic sites can be extended to cover areas around and between the protected sites that function as buffer zones, movement corridors, and viewshed easements. A case for cultural landscape protection can thus be made by increasing the scope of existing legislation. To the listed protected forests and wild life sanctuaries can be added historic gardens and water bodies, and other cultural landscapes of significance—streetscapes (such as Chandani Chowk, Rajpath), memorial parks and gardens (such as Nicholson's cemetery, Rajghat), and districts (such as Lutyen's bungalow zone).

An integrated planning approach at the city scale that expands the ambit of conservation beyond the protected forests and archeological parks to management of urban private and public landscapes in heritage precincts, corridors, and ecological service areas carried out under the aegis of Delhi Master Plan is recommended. This would be best achieved by developing heritage

[5] In Meadowbrook Park on the southern edge of the University of Illinois campus in Urbana, Illinois, USA, where I live, a concerted effort has been made to restore the pre-agricultural landscape of prairie and savannah on an old farm field. The native prairie intertwines with many recreational and productive uses—hiking and bike paths, sculpture walk, memorial and organic gardens. The Park is maintained by naturalists who do much of the invasive species removal and prairie burning. What has made the Park a success is not the idea of protecting wilderness from people, but integrating the community with its natural heritage.

conservation methods that involve the citizens of Delhi not as despoilers of heritage, but as co-partners in conservation efforts. Residents Welfare Associations, eco-clubs, and heritage groups can collaborate with government institutions for community gardening, rainwater harvesting, and 'adopting' sites to keep them clean and free of encroachments so that they can be community assets (Sinha, 2005). At the same time public and private investment is required in improving the basic infrastructure of resident communities living in the vicinity. In the absence of such measures, conflicts between what Baviskar (2003) terms as 'bourgeois environmentalism' and the needs of the poor will be a major force derailing attempts to preserve heritage. The rationale for cultural landscape approach lies in not just preserving sites but also integrating them in urban landscapes of today thereby planning for an environmentally healthy, sustainable future.

References

Bhatnagar, Manu, "Proposed Action Plan for Conservation of Water Bodies in Delhi", *Context*, vol. II, nor; 1, Spring/Summer 2005, pp.47-52.

Baviskar, Amita, "Between Violence and Desire: Space, Power and Identity in the Making of Metropolitan Delhi", *International Social Science Journal*, 175, pp. 89-98, 2003.

Dalrymple, William. *City of Djinns: A Year in Delhi*. New Delhi: Penguin Books, 2003.

Damle, Minakshi. *Environmental History of Delhi: Anthology of Narratives*. Unpublished manuscript, INTACH.

Frykenburg, R.E. (ed.) *Delhi through the Ages: Essays in Urban History, Culture and Society*. Delhi: Oxford University Press, 1986.

Ganguly, Usha. *A Guide to the Birds of Delhi Area*. Indian Council of Agricultural Research, 1975.

Gupta, Narayani and Dilip Bobb. *Delhi, Then and Now*. New Delhi: Roli Books, 2007.

Krishen, Pradip. *Trees of Delhi: A Field Guide*. Dorling Kindersley, 2006.

Mandal, Sarmistha and Amita Sinha. "The Case of the Vanishing Ridge in Delhi, India: A Conservation Approach", *Architecture+Design: A Journal of Indian Architecture*, India, May 2008, vol. XXV, no.5, pp.124-130.

Palang, Hannes and Gary Fry (eds.) *Landscape Interfaces: Cultural Heritage in Changing Landscapes*. Kluwer Academic Publishers, 2003.

Singh, Khushwant (ed.) *City Improbable: An Anthology of Writings on Delhi*. New Delhi: Viking, 2001.

Sinha, Amita, "Reinventing People's Place", *Architecture+Design: A Journal of Indian Architecture*, vol. XXII, no. 9, September 2005, pp. 54-58.

Sinha, Amita. "The Mughal Garden Legacy—Changing Contexts and Regenerated Traditions", *Abacus*, India, Spring 2009, vol. 4, no: 1, pp. 44-50.

Spear, Perceival. *Delhi: A Historical Sketch* in *The Delhi Omnibus*. Delhi: Oxford University Press, 2002

Plate 1

Photo 1

Smt. Sheila Dikshit, Chief Minister of Delhi, receiving a Kadamb sapling from Chairman INTACH Shri. S. K. Misra.

Photo 2

Mr. Adam Grotsky, Executive Director, USIEF, addressing the gathering. On the dais, (left to right) : Prof. Amita Sinha, Smt. Sheila Dikshit, Shri S. K. Misra and Shri Samar Singh.

Plate 2

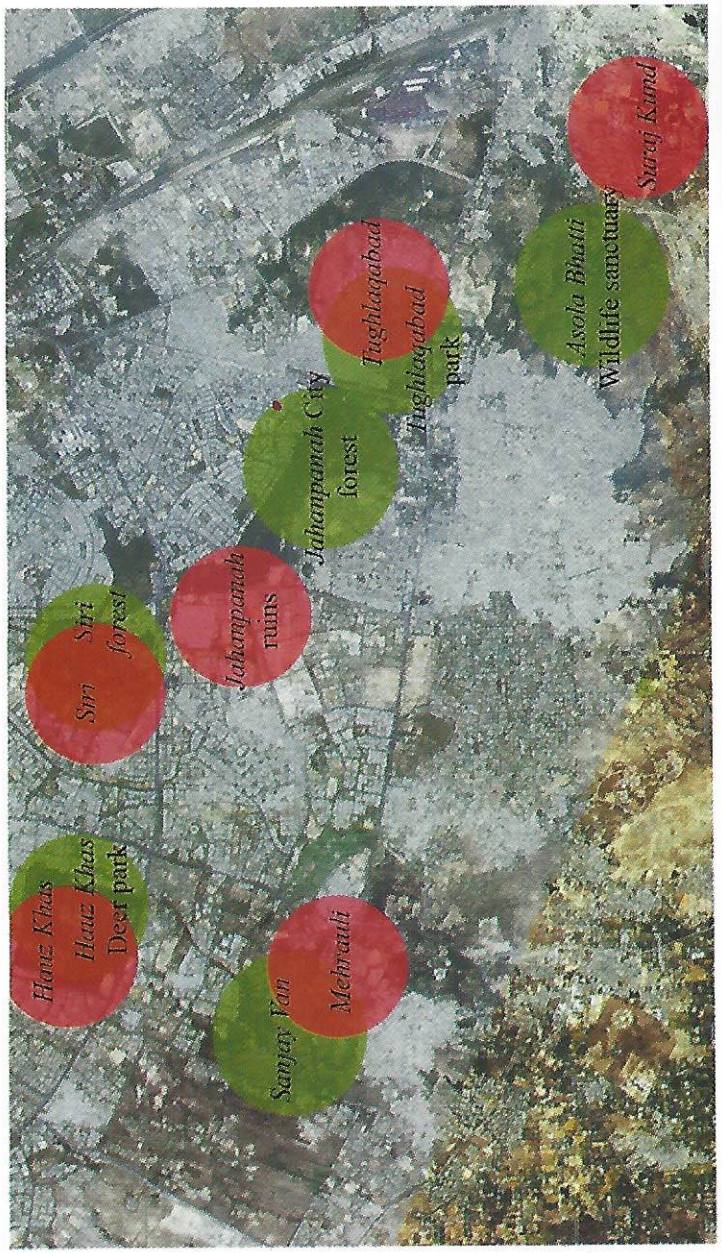

Photo 3

Natural and Cultural Heritage of South and South Central Ridge (illustration by Sarmistha Mandal); see paper by Amita Sinha.

Plate 3

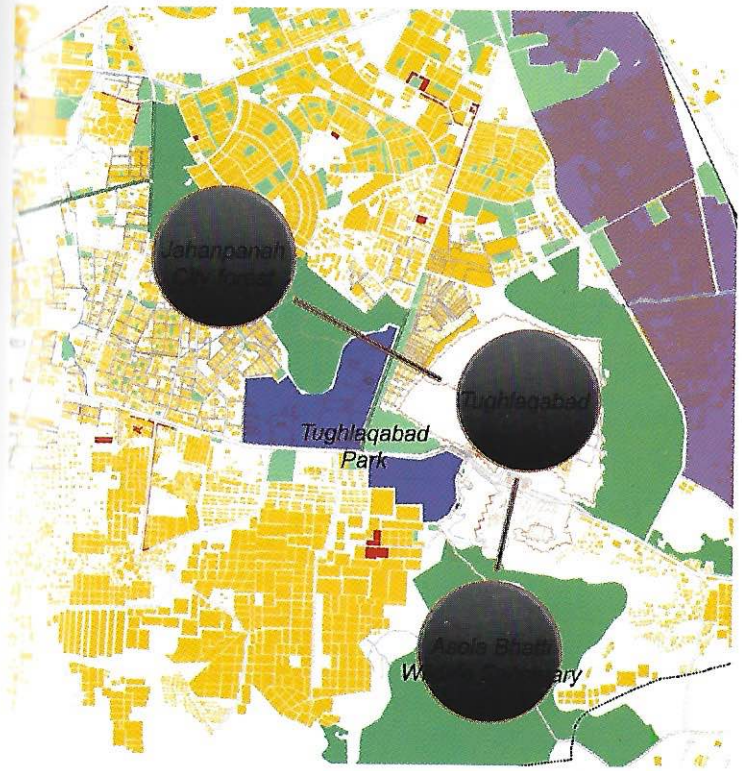

Photo 4

Greenways linking Natural and Cultural Heritage of South Ridge (illustration by Sarmistha Mandal); see paper by Amita Sinha.

Plate 4

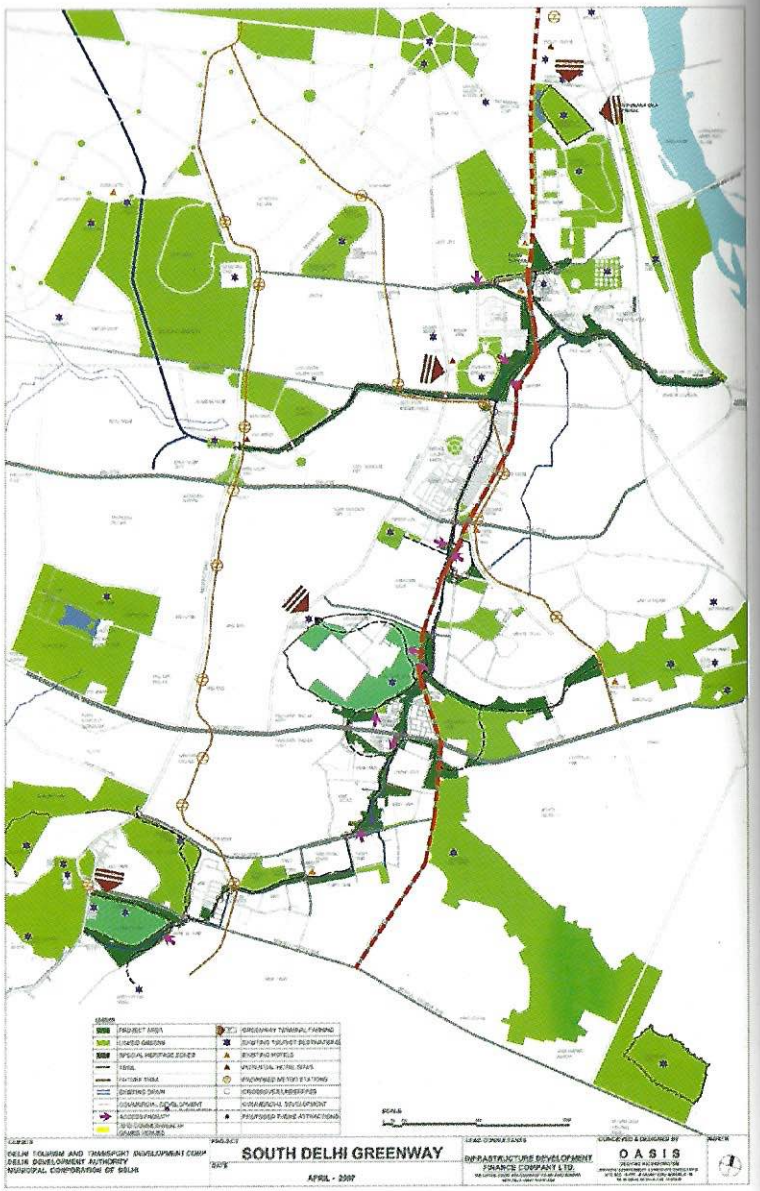

Photo 5

South Delhi Greenway Master Plan
(see paper by Akash Hingorani).

Plate 5

Photo 6

Barapullah Drain in Greater Kailash
(see paper by Akash Hingorani)

Photo 7

Barapullah Drain proposed as a Greenway in Greater Kailash
(see paper by Akash Hingorani)

Plate 6

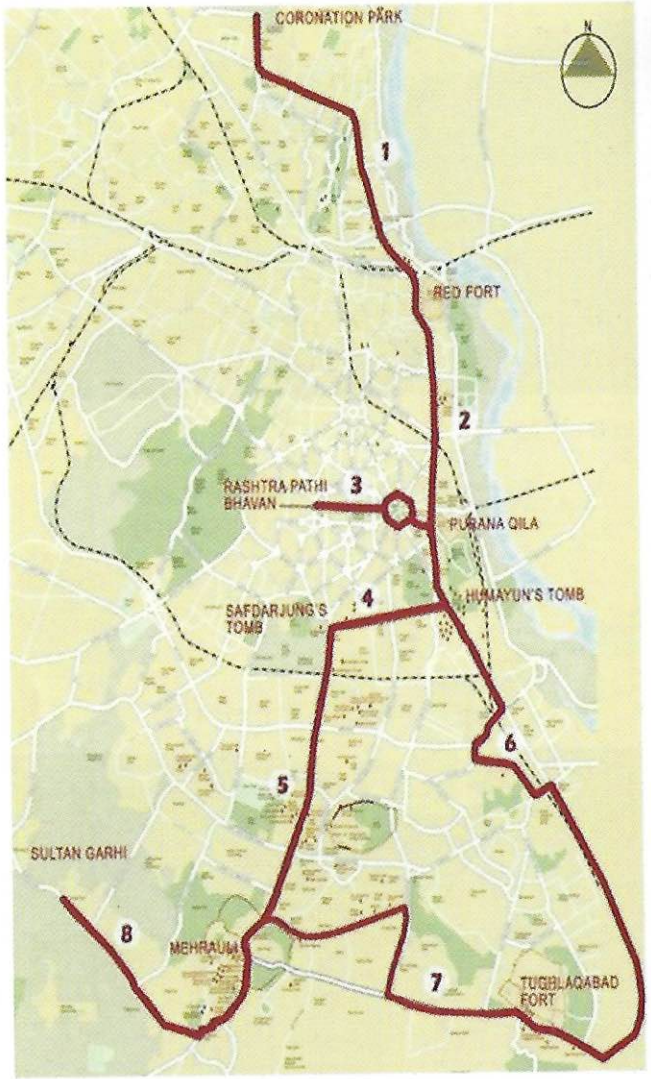

Photo 8

Heritage Corridors of Dilli (see paper by Tapan Chakravarty).

Plate7

Photo 9

A view of the restored Hauz Khas Lake
(see paper by Ritu Singh)

Plate 8

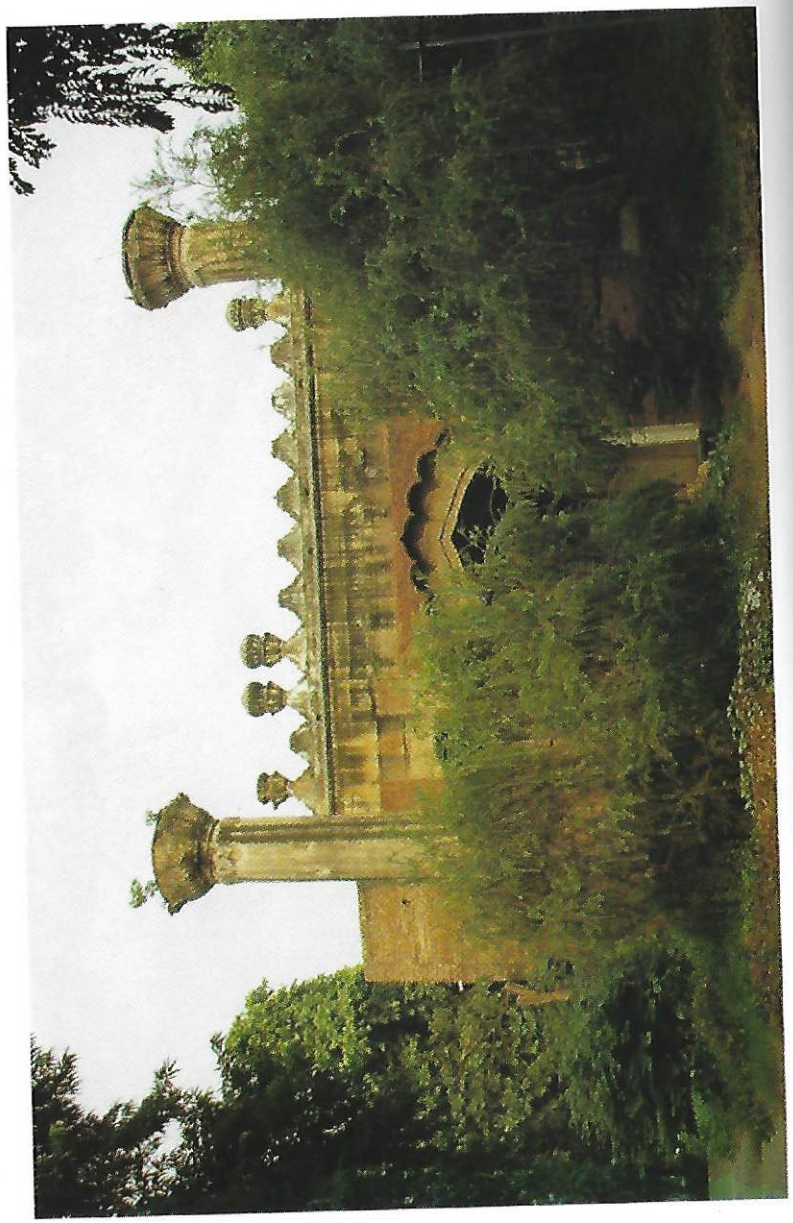

Photo 10

Qudsiya Bagh: 17th century gateway retained as part of the public park on account of its worth as a ruin
(see paper by Jyoti Sharma)

CONSERVING HISTORIC GARDENS OF DELHI

Priyaleen Singh
Professor of Architectural Conservation, School of Planning and Architecture, New Delhi.

Human relationship with nature has found expression in various civilizations, articulating the cultural aspects of the people, the place and the time. The garden was one such expression that wove its way into urban, suburban and rural landscapes imparting them with many secular and sacred meanings. The Indian landscape has a very rich garden design tradition against the background of which the social and cultural life of the people unfolded over various periods in history. From sacred groves to botanical gardens, from courtyard gardens of *havelis* to palace gardens, from fort gardens to suburban retreats, many of these historic gardens have survived to date.

These historic gardens and landscapes today form a very important part of our valuable heritage. However they are also perhaps the most vulnerable and the first to suffer destruction. While it takes effort, time and resources to demolish a heritage structure for new development, a historic garden seen by most merely as an open space offers itself for new development almost instantly. It is also true that while in the recent past there has been a lot of concern expressed towards the preservation and restoration of historic buildings, this has unfortunately not been echoed in the case of historic gardens. Gardens have been generally treated as appendages to and surroundings of historic sites and not as important entities in their own right. It is important to remember that historic gardens attain immense significance as they are a repository of not just historically significant design, but also communicate an account of a culture and a time, with many underlying meanings and symbolisms.

Gardens present special challenges for conservation. Neglect of historic gardens due to lack of finances or lack of understanding of its heritage significance has led to the loss of many a historic garden. Because of lack of proper planning and improper perspectives on development, that have led to land speculation and unplanned building activity these historic gardens continue to be destroyed. Subdivision of large garden estates resulting in fragmentation of the garden and multiple ownerships, as well as changes in land-uses within and around, are all factors responsible for this loss. Often is the case when after centuries of existence outside or on the fringes of city boundaries, historic gardens are today surrounded by a population of several thousands. While it is sometimes possible to retrieve and restore a landscape that has been neglected, unplanned urbanization on the other hand invariably tends to destroy not just the visual but the ecological and physical contexts as well. Compared to other heritage, historic gardens owing to their living character, wherein renewal is the essence of their existence, make themselves even more susceptible to change. These changes have in the past resulted in an evolution of styles over a period of time or in an imposition of a completely new set of ideas over an existing historic style. While natural change, essentially seasonal involving change in colour, form and textures is one of the attractions in a garden, managing this change needs formulating a sensitive and well thought out strategy. This is especially true of interventions, which often in the guise of efforts towards their conservation, result in the gardens losing their original meaning, content and form.

Gardens could be historically significant and culturally significant if they make an important contribution in understanding the history of a place or of a people and in their association with events and people. This paper in focusing on three gardens of Delhi, namely Shalimar, Qudsia and Roshanara draws attention to some of the critical issues confronting the conservation of these gardens. And before any strategy for conservation is outlined, it is important to understand the significance of each of these gardens from various perspectives.

Both Shalimar Bagh and Roshanara Bagh as examples of suburban Mughal gardens inform us of the planning principles of both the Mughal *chahar bagh* as well as of the life during the period of Emperor Shahjahan. Shalimar Bagh was one of many suburban gardens laid out by the Mughal royal family as part of the planning of Shahjahanabad. It was laid out under the guidance of A'zzu-unissa or Akbarabadi Begum and was ceremonially inaugurated by Emperor Shahjahan in 1653 A.D. Aurangzeb was enthroned as Emperor of Hindustan while camping here in 1658 A.D. Nadir Shah is also believed to have camped here after looting and plundering Delhi in 1739 A.D. These gardens are also culturally significant in their association with events and in their reflection of a way of life that once existed.

Roshanara bagh was laid out by Emperor Shahjahan's daughter Princess Roshanara, in 1650 A.D. as a *chahar bagh* following the principles of Mughal garden design. It was transformed from a pleasure garden to a tomb garden on her death in 1671 A.D. The garden further underwent major changes in the colonial period when large parts of the garden were restructured according to the then prevalent tastes of the British. Leasing out of the western part of the garden to the Roshanara cricket club in 1923 A.D. was one of the major interventions of that period, as also changing the large water tank of the Mughal period *chahar bagh* into an informal water body. These gardens are also ecologically significant as they exhibit an unusual richness of flora and fauna not seen elsewhere in Delhi. They also acquire functional significance in being vital green areas in densely inhabited areas, giving the residents an opportunity to enjoy a breath of fresh air. Gardens such as Shalimar Bagh also have economic significance in their production of fruit in the orchards and the subsequent auctioning of it by the DDA (Delhi Development Authority). The gardens sites could also become significant as educational sites as they have the potential to yield information that will contribute to an understanding of both the natural and cultural history of Delhi.

The issues confronting these gardens are many. The lack of a sense of heritage and history is evident in all the three sites.

Shalimar Bagh lay in neglect until 1803 A.D. when it was used as a summer residence by both Lord Ochterlony and Charles Metcalfe, who added structures within the orchard area of the gardens. Post independence the garden fell into disuse again and was encroached upon by various individuals and agencies and in the process lost out on a large part of the lower terrace of the historic Mughal garden. Parts of the garden have been re-laid in recent times on the model of the municipal parks. In Roshanara Bagh too extensive alterations were carried out in 1960's when a part of the garden was laid out as a Japanese garden by the MCD (Municipal Corporation of Delhi). The MCD in recent times also introduced many new pathways, a children's park, their own horticulture office, a nursery and other incompatible uses like a Traffic Training park within the garden. Similarly Qudsia Bagh, the garden laid out in 1748 A.D. by Udham Bai, known more popularly as Qudsia Begum, wife of Mohammad Shah Rangila, the Emperor in the late Mughal period, was part of a grand river front palace complex. Post independence the garden was completely encroached upon. The Masonic club that had been established within the premises in 1872 A.D. was further expanded. Palna, an NGO institution, which runs its offices from within the garden and the tennis courts of the club are the more recent additions that have further fragmented the already shrinking garden. Various features like a musical fountain and a statue of Maharana Pratap have also been introduced, further undermining the historic significance of the site. Today only a gateway and an inappropriately restored *baradari* stand as evidence of the once magnificent garden complex.

The changed context and the resulting pressure from the surrounding areas pose other threats. Shalimar Bagh was originally located in the suburbs of Delhi, sited amidst fruit orchards and was approached by the Grand Trunk road which was also the imperial highway connecting Delhi to Kashmir and to Lahore. However, because of the fast pace of urban development in more recent times, the garden is today in one of the most densely inhabited parts of Delhi. Roshanara Bagh from being a royal suburban retreat located north-west of Shahjahanabad, is today also an anonymous green open space surrounded by modern buildings. It is located in

the densely inhabited Subzi Mandi area of Delhi. Qudsia Bagh, which was a river front garden is today bounded by roads on all four sides. The ISBT (Inter State Bus Terminal) along with the newly constructed Metro station lies to the south and west of the garden, while the Ring road built over the banks of a receding river lies to its east.

The diminishing boundaries caused by encroachments are another issue confronting all three gardens. Shalimar Bagh was an enclosed garden with a series of boundary walls marking out a hierarchy of spaces within. The inner wall enclosed the *chahar bagh* while another outer wall contained the surrounding *baghs* or orchards. Both these boundaries of the garden have been lost to encroachments and wilful development under the successive Master Plans for Delhi prepared by DDA. With the loss of boundaries large parts of the orchards have been replaced by group housing and flats. As a result of this the garden has been reduced to almost one third its original size with the lower terrace of the *chahar bagh* completely lost to encroachments and roads. As a typical example of a Mughal garden in the plains, the Roshanara Bagh was also enclosed by walls on all sides. The scale of the surviving gateway suggests walls close to fifteen feet in height. All remains of this historic boundary wall have been lost and the eastern gateway is the only clue to where the wall once stood. In Qudsia Bagh too the garden has been completely fragmented and new boundaries and enclosures within the garden have emerged.

The loss of the original styles and altered planning principles has further reduced their legibility as historic gardens. Shalimar Bagh as a Mughal *chahar bagh* in the plains of Delhi was unique in adopting a terraced quartered plan. It drew inspiration from the other two gardens by the same name in Kashmir and Lahore. The Sheesh Mahal was the principal structure during the Mughal period and sited on the upper terrace it enjoyed the full view of the garden. Post independence all this was replaced with parks conforming to the DDA and MCD practices in landscape design. A children's park, complete with play equipment was also introduced and large stretches cleared as lawn spaces. Qudsia Bagh too was a garden

laid out in the late Mughal period and qualified as a *chahar bagh* in the late Mughal style. It was unique in its typology as a courtyard garden within the palace complex. Interventions after independence however display a complete undermining of the aesthetics the late Mughal garden would have had. These include interventions like the musical fountain in concrete constructed in the north-west part of the garden and concrete shelters that dot the lawn spaces. Today the garden exists as a most indistinctive green space. It is fragmented spatially by the introduction of an alien road network. With tennis courts being introduced and parts of the garden taken up by Palna, an NGO, the garden has totally lost its original spatial character. The new circulation system has completely obliterated the pathways that would have helped define the *chahar bagh* or quartered layout. The perception of the garden as a single entity is also lost because of all these changes.

Planting is the soul of a garden. Inauthentic plants species and planting systems can completely transform and undermine the authenticity of a garden. All the gardens have lost their original spirit because of alien planting vocabularies. In both Shalimar Bagh and Roshanara Bagh, gardens planned in the high Mughal period, the planting patterns helped determine the spatial experience within. As depicted in the paintings of the time, the axes in particular would have been defined by an avenue of large trees and the quadrants would have been filled with a mix of trees and shrubs. Today, not only are the plant species alien to the Mughal period, the patterns of planting also do not conform to those of the original *chahar bagh*. In Qudsia bagh too the plant species in their distribution and treatment are very alien to the late Mughal garden experience. Topiary work, that of shaping shrubs and trees into geometric shapes and animal forms abounds and lawns and avenues of new planting are laid out in large parts of the garden.

Water as the elixir of life was also the principal element sustaining the Mughal and late Mughal gardens. The water channels in the Shalimar and Roshanara Bagh, which were laid along the two axes, contributed significantly to the theme of a paradise garden. While symbolizing the four rivers of life, the four

channels in Roshanara Bagh culminated in a central tank with fountains within which the *baradari* was set. Of these four channels today only one channel survives, the others being replaced by roads and lawns. In Qudsia Bagh too there is no trace of any of the historic water channels.

The usage of all these gardens has changed over time. From being private imperial gardens for the exclusive use of the royalty, the gardens today are major green open spaces for the residents residing in the surrounding areas. In Qudsia Bagh the residents of close by areas such as Civil Lines and Kashmiri Gate are active users of the garden. It also houses the Masonic society, which as part of the Free Masons activities was a philanthropic organization when it was first established within the garden in 1878 A.D. However it started functioning as a club only from 1944 A.D. onwards and today the club has taken over almost the entire garden with its parking area also located within one of the quarters of the historic *chahar bagh*.

However, even with the relative increase in numbers of users over the years, the visitor amenities are completely absent in all these gardens. In Roshanara Bagh ill designed, badly maintained and insensitively located toilets are provided right at the entrance, next to the historic gateway. They are visually very obtrusive both in location and in design. And because of a complete lack of information on the historic significance and original layout of the garden most of the users are unaware of the significance of the site as a historic garden, viewing it only as a green open space. Similarly in Qudsia Bagh the uses within, such as the tennis courts give it the appearance of a private club rather than a historic garden.

Fragmented ownerships have further compounded the problems within these historic gardens. There are three principal agencies managing the Shalimar garden. The Archaeological Survey of India (ASI) looks after the remnants of the *chahar bagh* area which also houses the garden structures like Sheesh Mahal, the gateway and the pavilions of Jahaz Mahal. The Municipal Corporation of Delhi (MCD) looks after the park area while the

Delhi Development Authority (DDA) is responsible for the orchard area. At Roshanara Bagh too there are multiple agencies functioning within the site. While the garden is maintained by the MCD, the historic buildings which include the *baradari*, the entrance gateway and the one surviving water channel are under the care of ASI. The ASI has recently fenced off the area under their control, thus visually fragmenting the garden even further.

Clearly the conservation of these gardens is not easy. As a first step towards their conservation, it is important that the Master Plan of Delhi recognize the historic boundaries and protect them from any encroachments. The local people residing around these gardens also have to be actively involved in any management plan made as they are the principal stakeholders. A compatible usage profile within the gardens needs to be planned and removal of incompatible landuses initiated. Interpretation of the garden heritage has to be enhanced through signage. As a means to bringing greater awareness of their heritage value, connectivity with other tourist destinations in Delhi should be increased and adequate and appropriate visitor amenities provided. Garden archaeology needs to be undertaken to reveal the historic layering within these gardens. Subsequently the historic spatial character has to be restored through appropriate planting and design interventions. This is possible only after thorough and exhaustive research. The architectural heritage within also has to be restored following international norms of conservation. And it is here that professionals skilled in the field of historic landscape conservation need to be involved since conservation of gardens is both an art and a science very different from designing a new garden. All this needs to be done under a comprehensive conservation management plan which also identifies one coordinating agency/ one heritage cell that monitors the work of the multiple agencies working within the site. And it is here that INTACH can play a meaningful role as being that coordinating agency.

Note: This paper is based on a detailed report submitted to INTACH UK Trust on 'A Conservation strategy for historic gardens of Delhi'.

DELHI'S COLONIAL BUILT HERITAGE

Jyoti P. Sharma
Department of Architecture, Deenbandhu Chhotu Ram University of Science and Technology, Murthal, Haryana.

'The Delhi Institute in the Chandnee Chouk will well repay a visit. It is one of the largest buildings in the European style of architecture in India, and is a great ornament to the City. (....)'
H. G. Keene[1]

Keene was among the many writers of guidebooks on Delhi who urged visitors to not only visit the city's monuments but also see the British additions to the city including the Delhi Institute (Keene 1882). Most visitor trips to Delhi were deemed incomplete if sites like the Delhi Institute remained unvisited. Today, even as most of the British additions to Delhi, including the Delhi Institute, survive they hardly figure among places of interest. Indeed, the city's colonial built-heritage, with the exception of New Delhi's capitol, has been largely overlooked as a tourist attraction and as a subject of scholarship. This paper aims to create awareness about Delhi's colonial past by taking stock of its colonial heritage and drawing attention to the neglect, both physical and intellectual, that most sites suffer from. It concludes by making a case for going beyond conserving the sites to drawing them into the folds of the city's contemporary urban life.

Background

The British presence rose significantly in Delhi after the city came under the British East India Company in 1803 (Spear 1951; Gupta 1981). Company officials, military adventurers, merchants, missionaries and professionals, while only in a small minority, made Delhi their home. A general spirit of camaraderie initially marked the relations between the British and the indigenous

[1] *Handbook for Visitors to Delhi*, 1882

elite. While the general perception of Delhi was of an up-country town, the city had something to offer to both the seekers of worldly pleasures and for those looking to hone their intellect whether political or cultural. This perception was altered by the events of 1857 as Delhi became one of the major centres of the uprising (Kaye & Mallesons 1888; Roberts 1898). The British battled against the indigenous rebels to take control of walled Delhi with the siege lasting five months. Following their victory in September 1857, the British stripped Delhi of its imperial capital status as the city was annexed to Punjab. An urban reprisal programme was launched under the military authority that ultimately concluded with the building of New Delhi.

Colonial Architectural Interventions

Architectural interventions in Delhi responded to the prevailing political circumstances with two events in colonial Delhi's political calendar impacting the architectural responses. One was the uprising of 1857 and the second was the decision to shift the capital of British India to Delhi culminating in the building of New Delhi.[2] In the pre-1857 years, even as the British subscribed to the norms of colonisation, their architectural interventions in the city remained modest. They clustered around the 17th century Qila (now called Palace-fort) and readapted former elite havelis to meet their military and civilian needs. The grandest intervention was made by Resident Ochterlony who readapted Dara Shikoh's haveli precinct into the British Residency. In the northern hinterland the cantonment and civil lines were set up with former gardens and open tract ensuring physical distancing and bungalows coming up as the quintessential colonial residence. Perhaps the only architectural extravagance was in the form of the country estates of Delhi's

[2] For a detailed discussion on the architectural interventions made by the British in Delhi, see, Sharma, Jyoti P. 2005. Colonial Intervention and Urban Transformation: A Case Study of Shahjahanabad / Old Delhi. Doctoral Thesis (Unpublished), De Montfort University, Leicester, U.K.

'Nabobs' in the city's northern and southern hinterland.[3] This period of relative quietude was broken by the events of 1857.

Post-1857, the British in Delhi as in other cities that had been centres of the uprising set out to assert their authority (Gupta 1981; Oldenburg 1984). The government confiscated crown properties and laid out a military landscape sharpening its control over the city (Sharma 2005). An urban restructuring strategy based on demolition, seizure and rebuilding was launched that brought the cantonment into the heart of the city with the Fort turned into a garrison enveloped by a sanitised cordon. The railways were introduced to bolster communication and provide a fortified refuge against any future revolts. These interventions created a British enclave in walled Delhi whose civilian area included areas to the Fort's north, northwest and west while the Fort and area to its south formed the cantonment. Once the military handed over the city's administration to civilian authorities, new interventions were made to reinforce the legitimacy of British rule.

Mutiny Landscape

Delhi's Mutiny landscape was a landscape of victory that celebrated British heroism.[4] Designed to etch British victory in public memory, sites that had witnessed action during the siege were transformed. Places associated with the British were treated as hallowed ground, while those linked with the rebels were altered. The most venerated Mutiny site was the Ridge, where the British

[3] One of Delhi's most flamboyant 'Nabobs', Thomas Metcalfe laid out an extensive retreat in the vicinity of the Qutub complex in Mehrauli by readapting a 17th century Mughal era tomb. For details, see, Sharma, Jyoti P. 2008. A Delhi Nabob's Pursuit of Leisure: The Transformation of Built-heritage into a Pleasure Retreat. *Marg: A Magazine of the Arts* Vol. 59, Number 3: 54-63.

[4] The Mutiny was an extensively recorded event that made villains of the indigenous rebels and heroes of the British. Apart from physical interventions in the landscape, representations via literature, drawing, photography and cartography served as a medium of collective remembrance both for those engaged in battle and those far removed from the sites of action. For a complete discussion, see, Gupta, Narayani. 2004. Pictorializing the "Mutiny" of 1857. In Pelizzari, Maria Antonella. (ed.) *Traces of India: Photography, Architecture and the Politics of Representation, 1850-1900*. Ahmedabad, Mapin: 218-239. Also, see, Sharma, Jyoti P. 2008. Memorialising the Mutiny: Colonial interventions in the built-environment of post-1857 Delhi. *ABACUS: An Internationally Refereed Bi-annual Journal on Architecture, Conservation and Urban Studies* Volume 3, Number 2: 87-96.

had camped from June to September 1857, converting an assortment of structures into military posts. The structures, some of pre-colonial origin including Chauburji, Pir Ghaib / Observatory and a temple referred to as 'Sammy's House' and others built by the British namely Flagstaff Tower and Hindu Rao's House, were preserved as reminders of British heroic exploits. The Ridge was designated as a forest area. Sites near the city walls namely Qudsiya Bagh (photo on plate 8), Metcalfe House grounds and Ludlow Castle where batteries had been set up to attack the city were also designated as Mutiny sites with miniature batteries in place to educate the visitor of the action. Kashmiri Gate and Magazine Gateway deserved special treatment with obelisks and plaques commemorating the battles fought in their vicinity.

New interventions were also made to honour the memory of martyred British soldiers. The Mutiny memorial came up on the Ridge on an elevated site for greater visibility and was accessed from walled Delhi by a newly laid road, Mutiny Memorial Road. The highest honour was reserved for Brigadier-General John Nicholson, Delhi's Mutiny Hero.[5] Nicholson was laid to rest near Kashmiri Gate where he had spearheaded the final assault on the city. The site came to be known as Nicholson Cemetery. A memorial garden, Nicholson Garden, was laid out whose main attraction was an upright statue of the General. The road along which Nicholson led his troops and where he was mortally wounded (the site being marked by a plaque) was renamed Nicholson Road. Tourist guidebooks that proliferated in the post-1857 era urged Europeans to undertake the Mutiny pilgrimage devoting sections to describe the action at Delhi and outlining the Mutiny itinerary.

Civic Landscape

Victorian municipal 'improvements' were introduced in keeping with the prevalent Europeans notions of healthy living (Hosagrahar 2005; Sharma 2005). The newly constituted Delhi

[5] Nicholson epitomised the Victorian war hero and died a martyr while leading his men during an assault on the city. For a complete discussion on the veneration of Nicholson, see, Sharma, Jyoti P. 2008. Mutiny Myth Making: The construction of John Nicholson as the 'Hero of Delhi'. *CONTEXT: Built, Living and Natural* Volume V, Issue 2: 15-22.

Municipality set out to making Delhi a safe, clean and healthy city. A new civic space emerged in the area north of Chandni Chauk replacing the 17th century interventions made by Jahanara Begum who had laid out a garden, Begum-ka Bagh, and a Serai with built-form types evoking the Victorian civic landscape. The Railway Station and the multi-functional Delhi Institute (built on the footprints of the Serai) serving as a library, museum and club apart from being the Town Hall together with the Queens Garden (a remodelled and renamed version of Begum-ka Bagh) formed the new civic hub. Civic furnishings including a Clock Tower and a statue of Queen Victoria set amidst fountains embellished the urban space of the 17th century Chandni Chauk square. Architecturally speaking, the new landscape reflected the spirit of Victorian architectural eclecticism with the railway Station's open arcading and octagonal castellated turrets; Delhi Institute's classical façade and Queen's Garden laid out in the prevalent English fashion with winding walks, areas for games, bandstand and objects of antiquity (elephant statue from the Palace-fort) as park ornament. Guidebooks extolled these interventions asking readers to visit the Delhi Institute and Queen's Garden in particular (Cooper 1863; Harcourt 1886; Cole 1872; Keene 1882).

Leisure Circuit

The Victorian fetish for fresh air and exercise was transported to the Subcontinent along with the public park that could be laid out on either a new site or by appropriating existing Mughal gardens that had been confiscated by the British. The gardens were transferred to Delhi Municipality for management. Some gardens were remodeled into public parks to create a leisure trail that could be conveniently accessed from civil lines and cantonment. The circuit comprised Queen's Garden in the city and Roshanara Garden (developed as a public park by merging two former Mughal gardens, Roshanara Bagh and Sirhindi Bagh); Tees Hazari Bagh (a section of the Mughal garden was cleared of orchards to make room for a shooting range) and Qudsiya Garden (that was both a British Mutiny site and a public park) in the hinterland. Remodeling entailed making horticultural interventions in keeping with English landscape ideas, provision of areas for

sport, walking and driving, garden furniture, utilities and garden ornament in the form of historic ruins that accentuated the garden's 'picturesque' value. Tourist guidebooks and Delhi Gazetteers listed the gardens among 'Places of interest' (Punjab Government, 1988; Punjab Government. 1992).

Durbar and Cardboard Cities

Delhi was the venue of three Durbars (1877; 1903 and 1911-12) that showcased British authority. Their temporary nature notwithstanding, the durbars had spatial and functional pre-requisites entailing laying out the venue as a temporary city. Large unused tracts of land were appropriated and transformed into grand venues through mobilisation of men and resources transforming Delhi's northern hinterland plains into a vast tented city with an ambience of formality and grandeur equipped with necessary services. The venue's cardboard architecture reflected the prevalent political thinking. The durbars heralded the creation of a permanent setting for orchestrating a perpetual durbar via New Delhi. [6]

The building of New Delhi caused attention to be focussed on Delhi's immediate hinterland to the south that had since pre-colonial days largely been a necropolis. Indeed, the landscape was marked with graves and mausolea from the grandest to the humblest. Some sites like the Khairpur necropolis (tombs of Lodhi and Sayyid dynasty) and tomb complexes of Badshah Akbar and Nawab Safdarjung, were incorporated into New Delhi's layout to project it as a carrier of history. Transformed into archaeological parks by Archaeological Survey of India (ASI), these sites constituted the new leisure landscape for the British now settled in New Delhi. Gradually British interventions in the city's northern hinterland found new users. Indigenous recreational clubs came up in Queen's Garden that was also used by the nationalists for public gatherings.

[6]The idea of New Delhi being a permanent setting for a Durbar has been explored by Cohn and Hosagrahar among others. See Cohn, Bernard S. 1992. Representing Authority in Victorian India. In Hobsbawm, Eric J. & Ranger, Terence O. (ed.) *The Invention of Tradition*. Cambridge, Cambridge University Press: 165-209 See Hosagrahar, Jyoti. 1992. City as Durbar: Theatre and Power in Imperial Delhi. In Alsayyad, Nezar. (ed.) *Forms of Dominance: On the Architecture and Urbanism of the Colonial Enterprise*. London, Avebury: 83-105

The Ridge continued to be viewed as sacred territory with an extensive afforestation programme transforming it into a wooded area. Metcalfe House was turned into a Government Reception House. Mutiny pilgrimage sites continued to receive visitors as not undertaking the Mutiny pilgrimage invited the threat of being declared unpatriotic. Most sites were accorded Protection by ASI under Act VII of the Ancient Monuments Preservation Act of 1904. Interestingly, a list of 'Muhhamadan and Hindu Monuments in Delhi Zail' prepared by ASI in the early 20th century also listed British additions namely Flagstaff Tower; Hindu Rao's House; Metcalfe House and Mutiny Memorial as monuments (Archaeological Survey of India 1997).

With independence came newer perspectives that impacted Delhi's colonial landscape. Mutiny Memorial acquired a plaque that eulogized the sacrifice of the indigenous rebels. Hindu Rao's House turned into a hospital. Nicholson's Garden was amalgamated into a larger green named after the Indian nationalist Lokmanya Tilak. Queen's Garden fragmented with wholesale markets and parking coming up on sections of the grounds. Delhi Municipality continued to operate from the Town Hall, while a new judicial court complex came up on the site of Tees Hazari Bagh. Coronation Park (where the King-Emperor and his consort were felicitated during the1911-12 Delhi Durbar) became the recipient of statues of British personalities that were removed from their places of installation across the city and re-erected in the Park. Delhi's cemeteries witnessed graves being vandalized and the area taken over by the homeless. The transformations caused an undermining of this landscape's historical worthiness. The sites remained detached from Delhi's tourist circuit receiving very few visitors. The physical neglect of the sites by their respective custodians also added to their worth as heritage being compromised. In other cases inappropriate interventions relegated their past into obscurity.

Conclusion

Colonial Delhi has attracted limited attention as a cultural asset. Conservation initiatives were initiated by British Association for Cemeteries in South Asia (BACSA) as it took stock of colonial cemeteries across South Asia including those at Delhi. Sites like Flagstaff Tower and Magazine Gateway were declared protected and were taken over by Delhi Government's State Department of Archaeology. In 1999, the Delhi Chapter of Indian National Trust for Art and Cultural Heritage (INTACH) published an exhaustive inventory of Delhi's built-heritage that also identified and listed Delhi's colonial heritage (INTACH 1999). The listing recorded 'deterioration' in several colonial sites with the absence of legal protection making them vulnerable to abuse. Sites like Coronation Memorial and Park, St. James Church precinct and former Delhi Residency remain unprotected. Statutory protection notwithstanding, sites such as Mutiny Memorial, Rajpura Cemetery, Kashmiri Gate and Magazine Gateways have been victims of neglect and vandalism. Bungalows in civil lines are being replaced with builder flats. Of late, during the course of celebrating the 150th year of the First War of Independence, Archaeological Survey of India indentified fourteen sites associated with the events of 1857 in Delhi for conservation. Allocation of grants by the British High Commission in India recently enabled the upkeep of Nicholson's Cemetery. These endeavours, while commendable are somewhat limited in their scope as Delhi's colonial heritage continues to largely remain outside the public domain even as a few tourist guidebooks recommend a heritage walk of colonial Delhi (Barton & Malone 1997; Peck 2005). Conservation measures may have saved these sites for posterity, but they are removed from the city's contemporary life, largely unknown and unvisited by the common public and only occasionally receiving the heritage enthusiast and the scholar. Today most sites can be conveniently accessed via the Delhi Metro hence bringing them closer to the public at large. What is needed is an action plan that not only takes cognizance of this colonial heritage's worth but also manages it effectively as a public wellspring of physical, cultural and intellectual nourishment.

References

Archaeological Survey of India (1997) *List of Muhammadan and Hindu Monuments in Delhi Zail*, 4 Vols. Reprint . Delhi: Aryan Books International.

Barton, Gaynor. & Malone, Lorraine (1997) *Old Delhi: Ten Easy Walks*. 3rd edn. Delhi: Rupa & Co.

Cole, H.H. (1872) *Architecture of Ancient Delhi*. London: Arundel Society.

Cooper, F. (1863) *Handbook for Delhi*, Delhi: R. Williams.

Gupta, Narayani (1981) *Delhi Between Two Empires, 1803-1931, Society, Govt. & Urban Growth*. Delhi: Oxford University Press.

Harcourt, A. (1866) *The New Guide to Delhi*. Allahabad: G.A. Savielle.

Hosagrahar, Jyoti (2005) *Indigenous Modernities: Negotiating Architecture and Urbanism*. New York: Routledge.

Keene, H.G. (1882) *Handbook for visitors to Delhi*. Calcutta: Thacker and Spink.

Oldenburg, Veena Talwar (1984) *The Making of Colonial Lucknow, 1856-1877*. Princeton, New Jersey: Princeton University Press.

Peck, Lucy (2005) *Delhi: A Thousand Years of Building*. Delhi: Roli Books.

Punjab Government (1988) *A Gazetteer of Delhi (1883-4)*. 2nd edn. Gurgaon: Vintage Books.

Punjab Government (1992) *A Gazetteer of Delhi (1912)*. 2nd edn. Gurgaon: Vintage Books.

Roberts, Field Marshall Lord (1898) *Forty One Years in India*. 2 Vols. New York: Macmillan Co.

Sharma, Jyoti P. (2005) Colonial Intervention and Urban Transformation: A Case Study of Shahjahanabad / Old Delhi. Doctoral Thesis [Unpublished], De Montfort University, Leicester, U.K.

Spear, Percival (1951) *The Twilight of the Mughals: Studies in Late Mughal Delhi*. Cambridge: Cambridge University Press.

SOUTH DELHI GREENWAY

Akash Hingorani
Principal Architect, Oasis Designs Inc., in New Delhi.

Delhi possesses multiple layers of history defining the special character and the visual aesthetics of the city. Present day Delhi incorporates many ancient cities which make up its rich built heritage. Topographically, the Ridge and the River Yamuna comprise the two natural features of the city. The entire stormwater of the city drains out from the West to the river which runs along the eastern periphery of the city. The 'nalas' or the natural stormwater drains are a part of the city's natural topography. Most of Delhi's historic monuments lie in the zone between the Ridge and the river. The locations of these historic monuments also demonstrate the historic significance of natural water channels. The Barapullah Nala skirts around parts of the Qila Rai Pithora and the Siri Fort suggesting direct physical linkages between the city's natural and built heritage. The proximity and the shape of these medieval fort-walls in relation to the drain suggest that the drain apart from being a source of water for the city, could have also have served as a security moat.

Urban Scenario Today

As the city grew in modern times and the space in between the medieval cities witnessed a massive infill development, urban design and planning failed to actively integrate the presence of these natural drains into meaningful and purposeful spaces as part of the urban fabric of the city. This abject apathy towards the drains resulted in their being viewed as leftover, useless spaces in the city which soon became debris-ridden, foul-smelling eyesores in the city. With the sad state of neglect and disrepair, the city turned its back on these water channels and they soon deteriorated from bad to worse. This helped the neglected nalas to become natural overgrown green spaces, even though waste water and other debris found their way into the streams. They became the

city's undisturbed natural greens – a sanctuary for birds and butterflies. The entire stretch of the Barapullah Drain is full of wetlands and water marshes which support a whole range of birds and other animals. These spaces have also luckily escaped the heavy urbanization of the city and have managed to retain their natural character and calm.

Today, these naturally green corridors along the stormwater drains present the city with a unique opportunity to develop them into lovely landscaped eco-trails with minimum interventions. The South Delhi Greenway revitalizes the 12.5km long Barapullah Drain, transforming it into a pedestrian and cycling trail network, and also showcases the city's rich built heritage within the precincts of its natural heritage. The South Delhi Greenway offers a unique experience of the city's built and natural heritage together, helping the visitors understand our deep-rooted water traditions and our rich and diverse cultural heritage. As the city's new heritage trail, the South Delhi Greenway connects five of the many medieval cities of Delhi, in addition to connecting other important historic monuments such as the Qutab Minar, Khirkee Mosque, Chirag Delhi Dargah, Nizamuddin Dargah, and Humayun's Tomb. The project adds value to Delhi's bid to be included in the UNESCO's list of World Heritage Cities.

The water harvesting structure 'Satpula' built by the Tughlaqs in 1323 CE, is a wonderful example of the importance of rainwater harvesting in medieval times. Designed essentially as a sluice gate built on the Barapulla Drain, it would have stopped the rain-water from flowing away downstream to the river. This would have created a lake upstream, now completely built up with modern roads and buildings. Satpula literally means a bridge of seven spans built on the natural stormwater drain. As the drain approaches the river, further downstream is located the Barapullah Bridge with its 12 arch spans – from which the drain derives its name – Barapullah – or 12 spans. Within the Mehrauli Archeological Park are located some lovely ancient 'step-wells' or 'baolis' that along with the Rainwater harvesting structures such as the Satpula would have formed a part of a comprehensive water management system.

The South Delhi Greenway project has designed a nature park at Satpula with boardwalk facilities and observation decks for people to appreciate the ecology of the area. The site is also frequented by birds and is a candidate for eco-restoration as the area of the waterbody is more than 6 acres.

An Ecologically Sustainable Open Space Network

All modern urban settlements have to deal with stormwater runoff – and as we increase the paved areas in the city the runoff keeps increasing. Most of the conventional drainage engineering of the city aims to drain out the rainwater from the roads and other areas as quickly as possible into stormwater pipes, which in turn empty into the natural open drains of the city. The entire system aims at draining our city and carrying off the rainwater collected from different area quickly back into the river. The rainwater that the city receives hardly gets any place to recharge the ground water aquifer and soak into the ground – the lakes and wetlands in the city need to be filled up and revitalized to help store water, improve water quality and protect our waterways. The South Delhi Greenway incorporates policies for water conservation, stormwater management, wastewater treatment and groundwater recharge.

The South Delhi Greenway project would not be possible without treating the foul-smelling sewage water that flows through the drain and for this comprehensive decentralized biological wastewater treatment is necessary. We propose a biological treatment facility that uses natural biological processes to treat the wastewater. The treatment facility would become a demonstration of use of alternate technologies such as reed beds, duckweed ponds, and wetlands. Wetland- and bio-diversity parks can be a part of the project, further demonstrating how ecological sustainability can be achieved.

Urban Delhi is notoriously responsible for 80% of the pollution of the River Yamuna. This project with a decentralized approach to wastewater treatment will ensure that the pollution load on the river and the STPs being planned along with the

interceptor drain is reduced. For example near INA Market, the stormwater drain represents the worst off of environmental degradation with the stream being littered with debris and other waste. Our design redefines the cross-section of the drain and claims it for trails, also incorporating decentralized biological wastewater treatment facility.

The Google Earth capture of New-Delhi shows the proposed Metro Line (yellow) and the Bus-Rapid-Transport (BRT) corridor (red) superimposed on the South Delhi Greenway planned along the Barapullah Drain (map on plate 4; photos on plate 5). The South Delhi Greenway integrates around 700 acres of public parks by connecting them to the existing parks (in light green). The project would effectively create a much larger connected recreational open space plan for the city. This whole network will allow for safe routes for children to walk or cycle to schools and for others to connect to the Metro-stations or bus-stops. For example the stretch of the nala, presently foul smelling and overgrown, behind Greater Kailash-I, can be transformed with minimal landscape interventions into biking and pedestrian trails that connect with the new stops of the Bus Rapid Transit Corridor (BRT).

The Osho Park in Pune is a inspiration for this project, where a similar natural stormwater drain has been transformed into a beautiful zen-garden. The drain was in a very bad, polluted state as evident even now when one travels upstream to the location of the wastewater treatment facility where the dirty water is treated and then allowed to flow through the park as a naturalized stream. The water as it travels through the rock and plants actually becomes clean with the help of aeration and other natural processes. Small fish also inhabit the naturalized stream.

Challenges Ahead

Delhi is undergoing a huge infrastructural make-over in hosting the 2010 Commonwealth Games with new mass transport projects like the Metro and the BRT corridor. The South Delhi Greenway offers a fantastic opportunity to connect to these new

public transportation hubs. The project offers the 'last-mile connectivity' to and from various destinations in the city these new public transport systems. A few stretches of the drain are being or planned to be covered for making parking and roads in the city in direct conflict with the South Delhi Greenway project. These new roads over some of the covered stretches would directly impact the pedestrian and cycling trail continuity that in turn would be detrimental to the Greenway Project. For this naturally occurring eco-corridor to be transformed into the South Delhi Greenway, it is imperative that the drain corridor even if covered at places should allow for the greenway trail system to go through – and not become a vehicular road. This natural corridor along the Barapullah Drain is an opportunity that the city can capitalize on and achieve a continuous bike and hike trail system that can stitch the city together.

MONUMENT GREENS AND HERITAGE CORRIDORS IN DILLI

Tapan K. Chakravarty
Architect, Urban Designer and Visiting Faculty, School of Planning and Architecture, New Delhi.

Delhi/ Dilli, the capital of India, is a metro-city that can boast of a history going back to antiquity whose dates often lead to endless debates. Dotted with monuments, both known and unknown, Dilli can be seen as a treasure trove of heritage related sites that can be of immense interest to citizens and visitors alike. From ubiquitous tiny tombs, portions of mute walls and quaint forgotten gardens to overwhelmingly enormous forts, towering turrets, stretches of rugged terrain or forests, and lively bazaar lanes, Dilli has a rich and diverse legacy. This array of heritage sites, strewn all over the large expanse of the city, may well be threaded into tangible itineraries to assist in planning and programming for the monuments of significance. The pattern/s thus generated by such routes may also be used as a design layer to evolve a physical structuring of the city for its immediate future.

Monument Greens

Delhi is reasonably 'green' and a rare metro city with much of trees and plants and open spaces that are rendered 'soft'. Yet only a few such spaces are fully used by the people of various age/gender/economic groups. Most of the 'garden' like spaces, other than those in residential areas is used by a handful of male office workers for sleeping, playing cards and eating their tiffin.

Heritage monuments in Delhi are often surrounded or fronted by reasonable tracts of open space/s, not necessarily integral to the site/s, that are usually treated as soft landscaped areas with a horticultural flair. The landscape schemes, for such open spaces, are either over simplified and neutral, almost indifferent in their

rendering or they are unwittingly imposed as manicured gardens that often have little to do with any definitive concept of public use. Manicured gardens provide for very limited activities that which are conventionally suitable for their upkeep, purpose and image. These result in the formation of passive open spaces that remain primarily inactive, act as buffer zone/s and distance the monuments from the city's otherwise bustling activities. As passive areas usually prone to encroachment and vandalism, most of these open spaces tend to develop authoritarian compound walls and railings around them as 'protective barriers' for security and controlled access. These protective barriers further help insulate the open spaces, and eventually isolate the monument itself, from the people of the city.

Barriers also prevent/control access to informal activities and many such facilities/amenities that are important to attract and retain visitors and tourists interested in the monuments and their precincts. These acts alienate the monument/s from the people and eventually *contradict* the very reasons of conservation of the city's heritage. It is, therefore, important to create conditions that can help bring down these physical barriers and consciously integrate the spaces to make the heritage areas accessible to everyone living in or visiting to the city.

Historically cities in India had public spaces such as 'chowks' and 'maidans', besides the multi-usage streets, that were freely accessible to all age and gender groups for leisure, recreation and social activities. Informal commercial activities too found a spontaneous place in such urban areas. Mixed land-use patterns accommodated street vendors and performers that triggered a street culture characteristically unique to the city.

Modern urban planning, with its land-use based (or biased?) development, has redefined the streets as specialized movement spaces and the open areas as visually attractive garden environs. Both, being high maintenance areas, have designated and controlled usage and categorically discourage informal activities—commercial, recreational or social. Today, due to the

planning, design and maintenance practices, Dilli lacks public open spaces that can provide the simple urban pleasures within a hectic modern life style as well as sustain an informal economic activity well within the urban demands and constraints.

Heritage Corridors

The proposal to identify Heritage Routes in Dilli and articulate them within the cityscape is a significant urban design opportunity. The pilot scheme, for one of the routes, is an important step to make the difference that Dilli undoubtedly deserves. The linear winding route in the heart of the city, from Humayun's Tomb to Laal Qila, is a fascinating journey (of 540 years) along some of Dilli's well known monuments and activities. The pilot route forms part of a busy movement artery of the city that connects the historical with the modern development of post-independent Dilli and makes this project an important effort to establish a design vocabulary for future urban design schemes in addition to heritage and tourist related developments (map on plate 6).

The project is an *opportunity* to involve the heritage sites and precincts with the city's urban and socio-economic structure. Thus, a three-pronged approach for the proposed design strategy is proposed:

- Heritage Centric Approach
  - Ø To enhance visual interest in heritage precincts and encourage accessibility by opening out frontal spaces for visual impact, enhancing axial access to entryways, connecting with neighbouring activities, and sprucing up its surroundings.
- Tourist Centric Approach
  - Ø To enhance physical interest in heritage precincts and encourage engagement by identifiable markers (signage, lighting, landscape, street-furniture), providing Interpretation Centers, memorabilia and gift shops, improving public facilities, cafes, food plazas, entertainment activities, and connecting them with optional activities for variety and expanded scope.

- Citizen Centric Approach
  - Ø To enhance functional interest in heritage precincts and encourage participation by creating public places with related amenities, making spaces/buildings physically reachable (for example by removing railings), informal activities within secure and clean surroundings, and linking with neighbouring activities towards extended public precincts.

The Delhi Heritage Route project will add a new typology of public place to the existing types that are already present as popular citizen's haunts and are adjunct to either Commercial or Ceremonial or Green/Garden areas of the city (e.g. Rajiv Chowk, Raj Path, Nehru Park).The idea of *Heritage based Public Places*, as distinct urban spaces, is a major contribution of this Project to the vision of the city of Dilli. The introduction of urban spaces or 'Chowks' (as pedestrian friendly plaza like spaces) and urban open spaces or 'Baaghs' (as user friendly garden like spaces) is a deliberate design intervention to create public places that accommodate street activities towards economic and cultural regeneration. The *Chowks* establish the urban interface and connect the various spaces/activities/elements within a close ambit of the precincts. They also provide the immediate level of change from the noisy traffic corridors. The *Baaghs* establish the heritage interface and delineate the time-space differences within the larger expanse of the precincts. They also provide the immediate level of change from the quiet archeological edifices.

Desirable Futures

The Dilli, we proudly inherited, today needs:

- Heritage precincts to be woven back into the city's fabric.
  The spatial design of the city's spaces/events/elements need to be 'radially spanning' rather than 'concentrically layered' with the Heritage Sites.

- Continuous and contiguous spaces as barrier free movements and links, both in the physical and the social sense.
- Visual synthesis through complementing; rather than supplementing; as the key for design choices that dictate material, technique and style.
- Integrated urban level design schemes instead of the usual isolated site and streetscape designs.

Dilli, as we see it today, was planned, engineered, and managed. Dilli, of tomorrow, needs to be comprehensibly planned and designed as well.

PRESERVE AND USE: DELHI AND ITS WATER RESOURCES

Vikram Soni
UGC Professor, National Physical Laboratory, New Delhi.

Mega-cities and their Local Living Water Resource

In the developing world pressures are such that cities have swollen beyond their carrying capacity. As uncontrolled urbanization is running roughshod over their local natural resource, cities like Beijing, Shanghai, Delhi or Chennai in densely populated China or India are now in permanent water crisis. Priceless local water resource is not being conserved in these cities. For these megacities in the developing world it is no longer a question of importing an essential resource like water which is just not there. In the more stable developed world, wilderness may be used to water cities. New York, for example gets its water from the Catskills forest, which is 150 kilometres away. Delhi or Beijing do not have such an option.

According to Newsweek (September 2007), China, with its explosive growth is running on the fast lane for everything. Huge urbanization, new coal fired power plants at the rate of one a week, big dams have all contributed in knocking down the environment – forests, water catchments, aquifers. Instead of preserving their natural resource values, they have opted for more technology. They have put down an astronomical sum of $25 billion a year to recycle water. The populous Shanghai area is spending over $5 billion in recycling water for its 25 million people. This is a quick fix. Obviously, this is a windfall for the big multinational companies like Veolia Environment, Thames Water and Suez. These companies have just announced a public issue in the Hong Kong stock exchange and as water reserves continue to deplete the stock of the water companies soar. This is indeed tragic. To continue to kill permanent natural resource in and around cities

and use invasive, expensive and heavy duty technology is to go from the frying pan into the fire. However, there may be a silver lining. The elders of Shanghai, seeing the degraded water quality in the city have declared a 10 sq. km. area outside the city a water reserve to be kept fresh by planting natural water cleansing vegetation.

As a citizen's group working on preserving the city of Delhi's environment we stumbled on a goldmine. Habitation was kept off the floodplains of the rivers in India as they always run their banks during the monsoon. Now, so much water is diverted out of the river into canals and with the loss of recharge from deforestation, there are only decadal floods. Though, the floodplains are a protected zone for water recharge, the powerful real estate lobby is swooping down on this prime 'real estate'. When our group began a protest against this, little did we realize that the floodplains are a huge sandy aquifer that could be the answer to city's perennial water problems. This is how the story unfolds.

The Yamuna Floodplain

The river Yamuna, a major tributary of the Ganges, comes down to Delhi from the Himalayas. It has been coming down for millions years, running its banks during the monsoon, swollen with water and depositing sands on its floodplain. This sandy layer on top is now about 40 meters deep – that's a lot. Take an equal amount of river sand and water in two identical glasses and start pouring the water into the sandglass, watchfully. Voila, half the water glass can empty into the sand. No surprise – sand and gravel are great for water storage – they are aquifer material. The Yamuna river floodplain in Delhi is about a 100 sq km in area and on average 40 meters deep. It can hold a lot of water - about 2 billion cubic meters.

Can we use this? Hydrology tells us that we may pull out over a third of this, near 700 – 800 million cubic meters. But, how do we recharge the floodplains? Earlier there were annual floods during the monsoon, which recharged the floodplain. Now there are only decadal floods. Even so, Nature has the answer. The monsoon still brings down about 4 billion cubic meters of water

into the river – from July to September. So, we have the natural storage in this floodplain and plenty of water to fill it every year. We just need a scheme to pull the water out of this giant aquifer and recharge it with monsoon water. Put a barrage upstream and close a barrage downstream and embank the rest of the floodplain and inundate it till the sand below saturates and we are ready to go. This is huge - it can take care of the water need of over 6 million people in the city. It is non-invasive. Preserve and use every year – nature's gift.

It is straightforward to set economic value for this water. At the lower end, the market value of tanker water in Delhi is $25 for 10,000 litres or 10 cubic meters. The recharge value of the flood plain the works out to be over $2 billion a year.[1] Recycling the same volume of water works out to be even a little more. Is it not crazy to lose quality in recycling water with more technology and dispense more waste in the environment, with costs over $2 billion a year, rather than have a natural and perennial source of water that does the same practically for free? Such a creative scheme can be of immense value in hundreds of cities that have a river flowing through.

Any tampering with the floodplains would be an unmitigated disaster. It means the loss of an incredible local water resource. But this is what is happening in Delhi, where huge development is imminent in the floodplains of the Yamuna and with Commonwealth Games Village and metro depots slated to come up in the floodplains, this is like cutting the branch you are living on. [2] This article puts a non - invasive annual economic value on natural resource to show that it far exceeds what it is being destroyed for.

The Ridge

Delhi is defined by two natural features, the River Yamuna and the Ridge- a part of the Aravalli Range of hills. Both of these carry

[1] Vikram Soni, A K Gosain, P S Datta , and Diwan Singh, 'A New Scheme for Large Scale Natural Water Storage in the Floodplains: The Delhi Yamuna Floodplains as a Case Study', *Current Science*, May 25, 2009

[2] Vikram Soni,"Three Waters", *Current Science*, 2007

essential water resource – 'that is why all the ancient and medieval cities were located either on the Ridge or on the banks of Yamuna. The enduring value of such natural resources is being lost for short term gain'[3]. The Ridge forest, Delhi's oldest natural heritage, is sculpted on quartzite deposits, which have cracks from 2 billion years of natural history. This recharges 60% of the rain falling on it. All rain fed aquifers surrounding the ridge are an incredible resource for pure water and must be preserved by protecting their recharge zones. The protection of the entire Ridge is crucial as studies indicate that the only aquifers in Delhi that have good water are those recharged by the Ridge

Only a part of the Ridge area in Delhi is notified as reserve forest. We take a conservative 80 sq km of Ridge forest area with a yet more conservative recharge potential of 50% of rainfall. Delhi's average annual rainfall is 60 cm which gives us an annual recharge potential for the Ridge of over 20 Million Cubic Meters (MCM). The importance of the Ridge lies in the fact that it provides us with pure quality water. It could provide natural mineral water for the whole city, when only the rich and famous drink processed water today. At one fifth the commercial rates for 1 litre mineral water bottles, $0.05 per litre, this works out to $1.2 billion a year from non invasive use of a permanent resource. At commercial rates for processed water, $ 0.25 per litre, it works out to somewhat more, $6 billion. At commercial rates for Evian mineral water it is worth $24 billion a year.

Yet, another and longer struggle carried out by citizen's groups has failed to save the Ridge - much of it is being taken out by thoughtless building. Here is a letter written to the President and Prime Minister of India by, A. J. Leggett, a Nobel laureate in Physics (2003), who has walked the Ridge area in Delhi and expressed concern about it being taken out.

'Having lived in various large cities on four continents, I know first-hand how much difference a resource like the Ridge makes to the quality of life of the citizens. There are very few cities

[3] ibid

anywhere in the world of the size of Delhi which are fortunate enough to have a similar "wilderness area" so close to the heart of the city. In this case, not only is it (as I was able to observe for myself) a major bird sanctuary, but I am told it is one of the oldest natural heritage sites in the world and an invaluable source of fresh water for the surrounding areas. It seems to me that it would be a major tragedy for the citizens of Delhi were this precious resource in their midst to vanish or be encroached on. I gather that although the area is protected in all the master plans of Delhi and building on it is forbidden, construction of commercial and residential complexes has recently begun; and that the Supreme Court of India and the Ministry of the Environment have taken the view that because the initial stages of the operation have already proceeded and some money has been invested, the construction should be allowed to proceed. I would like to appeal for your intervention in preserving this invaluable heritage in its pristine form.'

Just a few isolated examples on the value of water from living natural resource have added up to so many billions of dollars a year of perennial value. If we go around a 'Preserve and Use' tour of the planet it would certainly run up to trillions of dollars of non invasive potential value. Such resource is irreplaceable - none of these can be created by human engineering. This is the insight that goes into understanding evolutionary resource.

Postscript: Climate Change and Natural Resource Loss

There is a common perception that the biggest blight upon us is climate change. Climate change is associated with an alarming rise in greenhouse gases, particularly, carbon dioxide and methane, which cause global warming. Glaciers, for example, are receding due to climate change. The vast Amazon tropical forest is one of the largest sinks of carbon – it takes out huge amounts of carbon dioxide from the atmosphere and converts it to plant biomass. But the sacking of the tropical forest is not due to climate change – it is climate change which is due to the savage destruction of these huge natural reserves by greedy human consumption. Similarly,

rivers are not silting and dwindling due to climate change – glacier melt would increase the flow in rivers – but due to the razing of forests around their catchments, which steadily release water into the rivers. And, underground aquifers are not drying out due to climate change but human overexploitation and absence of wisdom. So, if we are not to confuse cause and effect – climate change is not equivalent to natural resource loss. The loss of natural resource, created over eons of evolution is immediate and irreversible and much of climate change is due to this loss. Natural resource loss has yet to come to the fore in the climate debate and to be clearly seen for what it is on the early warning radar.

There is a fault line here between the developed world which has stable populations and stable landscapes and the developing world which does not. For the former, its living natural resource is intact but the mobility of the air means that it cannot avoid being tickled by emissions. Many of the protocols are about this. On the other hand, with swelling populations and development, the other world is dangerously poised for a larger catastrophe - to lose its living natural resource.

With exactly such thinking and to make a difference on the ground we have created a comprehensive natural resource site (www.naturalheritagefirst.org and www.users.ictp.it/~vsoni/) on the urban natural resources for the city of Delhi. It details and maps areas of great natural resource value and equips the citizen to understand and evaluate them. It gives new, creative, perennial and non invasive solutions to secure the water, air, forest of cities, worth billion of dollars. All these resources are forever, but once lost are lost forever. It would be of great value to use it as a template for other cities and districts on the planet. It is the one way to move our scheme of living into a new gear – preserve and use this resource- to secure a sustainable future for the cities and their citizens.

URBAN LAKES AND WETLANDS

Ritu Singh

Consultant, Natural Heritage Division, INTACH, New Delhi.

Urban lakes, wetlands and streams are of vital importance to the city as a whole. Wetlands are valuable as sources, sinks and transformers of multitude of chemical, biological and genetic material. Although the value of wetlands for fish and wildlife protection has been known for several decades, some of the other benefits have been identified more recently. Wetlands are sometimes described as "the kidneys of the landscape" because of the functions that they perform in hydrologic and chemical cycles and because they function as downstream receivers of waste from both natural and human sources. Wetlands have also been called "biological supermarkets" for the extensive food chain and the rich biodiversity they support. They play major roles in the landscape by providing unique habitats for a wide variety of flora and fauna.

Lakes, wetlands and other urban ecosystems are coming under stress due to increasing urbanization. Essentially the hydrology of the region is changed by urbanization. These hydrological changes have direct and indirect effect on wetlands' structure and functions. The biodiversity of lake and pond ecosystems is currently threatened by a number of human disturbances, of which the most important include increased nutrient load, contamination, acidification, and invasion of exotic species (Bronmark & Hansson, 2002).

Natural water bodies tend to get absorbed in urban expansion and their catchment is disturbed as a result of development. Increased urbanization also leads to decreased surface storage of storm water thus increasing surface runoff. This reduces groundwater recharge and affects dry season stream flow with increase in flood frequency and magnitude. In Delhi in the Yamuna floodplain, the once river fed water bodies are disconnected from the river because of embankments. Urbanization

affects wetland vegetation—weedy, invasive species take over; small remnant patches are not connected to other natural vegetation and only animals and birds with a small home range can thrive. Sewage and garbage disposal in the catchment area affects the quality of the surface inflow and urban runoff. Large scale siltation of water bodies takes place through settlement of sludge leading to eutrophication. Village ponds are engulfed in urban expansion and become cesspools of wastewater.

Hydrologic change is the most visible impact of urbanization. Hydrology concerns the quality, duration, rates, frequency and other properties of water flow. Urbanization typically increases runoff peak flows and total flow volumes and damages water quality and aesthetics. Urbanized watersheds generate large amounts of pollutants, including eroded soil from construction sites, toxic metals and petroleum from roadways, industrial and commercial areas, and nutrients and bacteria from residential areas. At the same time that urbanization produces large quantities of pollutants, it reduces water infiltration capacity, yielding more surface runoff. Increased surface runoff combined with disturbed soils can accelerate the sourcing of sediments and the transport and deposition of sediments in wetlands. Thus there is an intimate connection between runoff pollution and hydrology (Azous & Honer, 1997).

Lakes and Wetlands of Delhi

Delhi's water-bodies include lakes, village ponds, wetlands and marshes, quarry reservoirs, and natural and manmade drains. INTACH's blueprint for water augmentation identified 44 lakes and 355 village ponds as major sites for water storage and recharge locations. A few such as Sanjay lake are isolated waterbodies while others like Najafgarh Jheel are connected with landscape through the Najafgarh drain. Restoration and connectedness of these urban wetlands and urban forest is imperative for provisioning of ecosystem services in the city.

A few of these are water bodies constructed by Delhi rulers in the past that have become defunct with time. When revived

they can be used for storage of rainwater and groundwater that will aid in recharging the groundwater in the associated aquifers. Huge tanks excavated during the Sultanate period caught and retained water draining from the slopes of the Ridge. Sultan Itutmish built a large rectangular tank Hauz-i-Shamsi (200mx125m) about 3 kms south of Qutub while 4 kms north of it another square tank Hauz-i-Khas (600mx600m) was excavated by Sultan Alauddin Khilji. Hauz-i-shamsi was part of a natural depression that was further excavated and maintained through regular desilting. Hauz Khas was probably a natural depression surrounded by hillocks on its south, east and west sides. Three storm water channels from the Southern Ridge supplied water that was trapped by embankments and diverted into the Hauz. Thus seasonal rainwater stored in the Hauz was used as a perennial supply for Siri Fort. It also supplied water to the settlement at Jahanpanah. The rocky defiles of the Ridge allowed for dams to be built for retaining large bodies of water as in the lakes in Tugluqabad and Jahanpanah; the embankment of the latter built with seven arches, 'Satpula' survives to this day.

Less than a decade ago, Hauz Khas Lake suffered from a fallen water table; its bed was dry and partly concretized. Surface water was not available for restoration. Stormwater from 125 ha. catchment area and treated effluent from Vasant Kunj Sanitary Treatment Plant was directed to Hauz Khas through a series of five check dams in Sanjay Van as per the INTACH proposal. From the large check dam, a 3 km pipeline was laid in SW nala to Hauz Khas ensuring gravity flow. The restored Lake is now a popular destination for tourists and Delhi citizens (photo on plate 7).

Purana Qila Lake has been fashioned out the moat of the old Fort constructed along its west side, in which the flood waters of the river Yamuna (on the east of the Fort) were retained. In the last 150 years the Yamuna has migrated eastwards, a kilometer away from the Fort. The moat remnants thus became a pool of rainwater during the monsoons and a dry ditch rest of the year. In recent years, a part of the moat has been maintained as a small lake by Delhi Tourism with facilities for boating. It is a popular

recreational spot as part of the Fort and Zoological Park precinct. In the absence of any natural water flows (except runoffs generated in the monsoons from a limited catchment area), the lake tends to run dry in the summer and is maintained by tubewells in the vicinity. INTACH proposed eco-restoration and water augmentation of the historic waterbody. The B12 Drain, about 500 m from the northern end of the Lake can supply water to the Lake as it carries a high volume of discharge with a low pollution load that can be treated in an aquatic plant lagoon. Contour 'bundhs' on E-W bank slopes can restrain the flow of eroded soils into the Lake which nourish weeds.

Bhalaswa Lake, the third largest in Delhi, is part of the riverine wetland system and a major site for water harvesting. Bhalaswa is an oxbow lake whose northern arm has vanished under relentless pressure for urbanization and is no longer connected or serviced by Yamuna's monsoon flow as a result of the construction of right marginal embankment. The rest of the lake has managed to survive in the guise of a recreational area and is managed by Delhi Tourism. The Lake lies in the Alipur sub-basin of Delhi and was originally the part of the khaddar soil tract nourished by the Yamuna. Wastewater and sewage from the Bhalaswa Dairy Colony on the western side of the lake are a source of pollution. Waters flowing in the Yamuna in the months of July to October when stored in the restored Bhalaswa Lake would increase the water supply by 2 million gallons per day. INTACH's proposal includes construction of new and raising of existing embankment, diversion of non-point inflows, bio-remediation, increased circulation of water from north to south end, vertical aerators, and pre-treatment of sewage in Supplementary Drain. The project could be combined with the somewhat similar and larger scheme for Jehangirpuri Marshes in the vicinity.

Jehangirpuri Marshes, the largest depression in Delhi, are a water logged area of about 180 hectares, surrounded by creeping urbanization and bounded on the north by outer Ring Road. The marshes lie on the NE of Delhi in the Alipur sub-basin and their land ownership rests with the Delhi Government. A substantial

volume of flood waters that flow away can be stored in them. INTACH advocates their development as a wetland park. Presently covered with water hyacinth, their water quality is eutrophic and requires bio-remediation. Sewage seeps in from unauthorized colonies and needs to diverted into the Sewage Treatment Plant. Jehangirpuri Marshes can be linked with Coronation Memorial Park, a cultural heritage landscape in the vicinity that also has wetlands.

Sanjay Lake is an old depression in low lying area of the old floodplain in East Delhi. It is the receptacle of rainwater discharge from a localized catchment. The lake is set in a green area of 70 hectares maintained by DDA, 17 hectares of which is covered with the lake waters. On the edge of the greens are many DDA residential and resettlement colonies whose sewage was discharged untreated through 11 drains in the past. Now only two continue to discharge sullage waters into the lake. This has resulted in severe contamination of the lake waters and disappearance of bird habitats. INTACH's proposal aims to balance Sanjay Lake's ecosystem, restore it as a biodiversity habitat, increase its water storage capacity, improve the water quality in the underlying contaminated aquifer and enable sustainable extraction of non-potable water for nearby areas. This would involve constructing wetland channels lined to prevent percolation. Sequential exposure in parts of lake bed is proposed to remove the contaminated sediments manually which will deepen the lake bed by 0.5 m thus increasing the water holding capacity by nearly 0.1 million cubic ms. Harvesting water hyacinth plants on a weekly basis would reduce nitrate concentration, phosphates and BOD value as would duckweed introduced with feeder fishes such as carp, catla, and rohu.

Najafgarh Jheel on the Delhi Haryana border is the largest depression in the region and until the nineteenth century covered hundreds of acres in water until it was drained and cultivated. The Najafgarh Drain was cut from the Jheel in 1838 and carried off surplus water into the Yamuna. It is nearly 50 kms long and falls into the river just below the Wazirabad Pumping Station. If Najafgarh Jheel is revived in collaboration with the Haryana

Government, it can form a water spread of 7 sq. kms and can yield 30 million gallons of water per day to be shared between the two states.

The above proposals have the following measures in common for conserving urban water bodies—de-siltation, water augmentation by linking to canals, stormwater drains, or recycled water supply from Delhi Jal Board Sewage Treatment Plants, and up-gradation of water through bio-remediation. Given Delhi's large number of waterbodies, it has potential to house natural restored wetlands. The lakes of Delhi like the Sanjay Lake, Bhalaswa Lake and Jehangirpuri Marshes are but few examples of the wetland wealth of the city. These if restored, would add to biodiversity, green spaces, carbon sinks and aquatic habitat of the city.

It has been well documented that wetland fauna particularly birds use a wide range of habitats. They utilize several waterbodies for foraging, roosting, nesting, etc. Their movement helps in dispersal of floral species enhancing biodiversity of the landscape. Isolated forests and wetlands usually display low species diversity. However, if the habitats are connected, wetlands having buffers are connected with uplands and with other wetlands and lakes, and/ or, wetlands connected to one another through hydrology of the landscape, the diversity of aquatic species is greatly enhanced. This keeps the ecosystem healthy and functioning. Functional ecosystems are important for sustainability of the city.

Jehangirpuri Marsh, Bhalaswa Lake, Coronation Memorial and areas surrounding these can be connected to River Yamuna through proper ecological development of the Supplementary Drain. Although it may not be possible to restore natural hydrological patterns in the urbanized environment, one could utilize available stormwater runoff, and other waters and use after proper treatment. In the urban context it then becomes more important to address issues of water balance and water quality. Maintenance of water balance and water quality would require continued management.

Urban wetland management

Restoration of wetland hydrology is the single most important need for urban wetlands, but also the most challenging. Most of the wetlands are now located in places where adjacent land use cannot be changed. This then calls for innovative restoration techniques. Secondly, adjoining land use is an important factor in protecting biotic integrity of urban wetlands, densely vegetated forest edges helps protect these sites from exotic invasion.

Even in the face of encroaching development, urban wetlands can retain an impressive amount of integrity. Despite their need for restoration and management, urban wetlands remain functional and diverse ecosystems. It is important that urban wetlands be accessible to people, though it may be argued by ecologists (purist) as source of disturbance, therefore, a threat to ecosystem. However, use of wetlands by people who frequent formal or informal trail networks, may not be the important source of disturbance many assume. Indeed. The public support for wetland conservation that results from ability of citizens to use wetlands for educational and recreational purposes may be more important in protecting the wetlands' integrity than efforts to prevent any disturbances that come with trails.

An effort towards restoration of urban lakes through innovative measures has been demonstrated by INTACH through its project on Haus Khas. Other similar innovative endeavors are required. Further, instead of a project based approach we need to formulate a master plan for restoration of wetlands and lakes that includes present status and priority sites. There should be action plans for various blocks of the city; agencies should be identified that own the site and are responsible for maintenance.

Urban environment research in India is limited to pollution abatement in the conventional way. The need now is to identify and accept that there are 'natural' areas within urban area. These functional ecosystems including wetlands/ lakes are in need of

conservation. Their role in provision of ecosystem services, as wildlife habitats, as carbon sinks, as climate ameliorators, and as controllers of pollution merits their protection and incorporation into planning efforts.

References

Azous, A. and Horner, R. (eds.) Wetlands and Urbanization: Implications for the Future. Boca Raton: Lewis Publishers, 2001.

Bronmark, C., & Hansson,L. "Environmental Issues in Lakes and Ponds: Current State and Perspectives", Environmental Conservation, 29:290-306, 2002.

URBAN BIODIVERSITY

C.K. Varshney
Former Dean and Professor of School of Environmental Sciences,
Jawaharlal Nehru University, New Delhi.

Biological diversity or "biodiversity" refers to the variability among living organisms present in a designated area at a given time. It represents the totality of all living organisms including plants, animals and microorganism. The structural, functional, and spatial aspects of biodiversity can vary over time; therefore there is a temporal component to the analysis of biodiversity. For example, there can be daily, seasonal, and successional changes. Biodiversity can be expressed in different ways. One useful way is to break it down into different levels of biological organization: a) genetic diversity; b) species diversity; c) ecosystem diversity.

Urban Biodiversity

Urban biodiversity is not quite a misnomer as one might think. Urban biodiversity is the biological diversity of urban areas. A closer look reveals that Delhi — the burgeoning capital of India — actually has a wide range of diverse ecosystems including forests, rivers, canals, drains, ponds, lakes and other water bodies, parks, gardens and avenue plantations. Such diversity of ecosystems attracts a host of species of plants and animals by providing appropriate habitat, food, water and shelter round the year. Even garbage dumps, which have now become an integral part of urban complex, provide preferred habitat for many different kinds of scavengers, vultures and detritivores, in addition to a large array of decomposing and pathogenic microorganisms.

Urban biodiversity is a unique assemblage of communities of living organisms interspaced by residential, commercial, industrial, institutional, cultural–educational land uses. Patches of remnants of natural vegetation, secondary green areas, such as agricultural fields, gardens, parks, river, drains, and other water bodies, garbage

dumps, and other land uses, all of them are more or less suited as habitat for different species in urban centers. Biodiversity is found in natural, semi-natural, human-modified, human made and specialized collection systems and exhibits strong seasonality and changes over time. Urban biodiversity is spread over both publicly and privately owned spaces and contributes to the well being of urbanites in many different ways.

Delhi's Biodiversity

Delhi is an ancient city of preeminent historical importance. It has been a seat of power and a major commercial center. Delhi's indigenous biodiversity has been subjected to a strong human influence, and management decisions that have profoundly impacted its native biodiversity — vegetation, wildlife and ecosystems. In spite of prolonged human intervention coupled with ever-expanding urbanization and accelerating growth of urban population, considerable biodiversity exists in Delhi. The present day distribution and composition of Delhi's biodiversity has been shaped and evolved in tandem with changing land use, degree of patronage accorded by erstwhile rulers of Delhi and anthropogenic interventions. Deliberate and/or accidental introductions of alien plants and animals, specialized plant and animal collections and crazy pet lovers represent additional factors responsible in determining present urban biodiversity of Delhi. An important feature of Delhi's biodiversity is that it transcends different land uses and spreads over private and public owned spaces.

Delhi has a complex network of habitats including on the Ridge, agricultural fields, parks, gardens, avenue trees, road verges, open spaces, trees, the river Yamuna, canals, drains, ponds, tanks, wetlands, zoo, and derelict buildings, supporting urban biodiversity. An enumeration of flora of Delhi carried out by J.K Maheshwari (1963) recorded 531 species of plants belonging to 326 genera representing 168 families of flowering plants.

Delhi Ridge is the flagship ecosystem harboring rich biodiversity. With a mix of native and exotic plants, but it still retains

its semi-arid vegetation character. Certain valleys and undisturbed areas support impressive growth of native trees. The Ridge has however, shrunk over the years, and fallen prey to construction activities, conversion of forests to parklands, encroachments and garbage dumping. Continued exploitation of the Ridge and degradation of its native biodiversity led to public outcry resulting in its declaration as a protected forest. Later a relatively less disturbed portion of the Ridge was declared as Asola Wildlife Sanctuary. In spite of these initiatives, protection of North and South Delhi Ridge is far from satisfactory. It continues to suffer from degradation and threats of increasing magnitude.

In addition to the Ridge ecosystem, Delhi has an impressive number of gardens and parks of different sizes and descriptions dotted all over the city. The Delhi District Gazetteer of British India states that Delhi had several well laid out gardens, within and just beyond the city limits — Roshanara Bagh, Qudsia Bagh, Shalimar Bagh and the Queen's Bagh laid out by Jahanara Begum. Gardens of Delhi have a long history and have received patronage from erstwhile Mughal and British rulers. Some of these gardens are even present today bearing the names of legendry personalities of bygone era. After independence many public and private gardens and parks have come up in various parts of Delhi. A comprehensive list of Delhi's garden and parks and their holdings has not been attempted but such a list is likely to be pretty long because there are innumerable private gardens, orchids, farm houses, bungalows, and parks in residential societies managed by Resident Welfare Associations (RWAs). Prominent gardens of Delhi belonging to pre and post independence era are enumerated below to give an idea of diverse areas supporting rich urban plant diversity in Delhi.

Gardens of the pre independence era include the Lodhi Garden spread over more than 30 ha is and home to over 150 species of trees including a large variety of palms. Other historic gardens such as Shalimar, Roshanara, and Talkatora Gardens have many old and rare tree species. Gardens developed after independence includes the Delhi National Zoological Park spread over 214 acres and established in the year 1959. It houses more

than 2000 species of animals and birds and is acclaimed to be one of the best zoos in the entire Asian continent with a natural habitat for animals. In the Garden of the Five Senses more than three hundred varieties of rare plants, trees and shrubs are planted including medicinal plants such as Rudraksh, Chandan, Aloe Vera Arjun, Aamal, Kadamba, Kachnaar, Kewra, Camphor (Kupur), Kalpa-Vriksh, Kamandal, and Ritha.

In addition to the above gardens and parks, Jawaharlal Nehru University, Indira Gandhi National Open University, Delhi University, Hamdard University, Indian Institute of Technology, farm houses, nurseries, private bungalows, avenue plantations, institutional gardens, botanic gardens and newly created Yamuna Biodiversity Park represent extremely rich and highly diversified terrestrial biodiversity assets of Delhi.

Plant Collections

Degradation of indigenous biodiversity of Delhi is obvious. However in view of the many plant species discovered during a recent survey, rich agro-biodiversity as well as cultivation of many exotic species in many private gardens and specialized collections by dedicated individuals indicate that the plant diversity in Delhi is far richer as compared to its hinterland. Many individuals and institutions in Delhi have painstakingly made exhaustive collections of plants. Dr B.P. Saxena has single handedly developed an exhaustive collection of cacti and succulents using his own resources. His collection comprise of 1,500 varieties of cactus — which make around 8,000 plants in all, including many rare and endangered species, believed to be the country's largest stock of cacti. A sizable number of households in Delhi maintain some area for growing plants. Collectively the diversity of plants, present in gardens and homes of Dehiites, embraces an incredible variety of horticultural and floral biodiversity including many rare species.

Apart from conventional assemblages of plant and animal communities occurring in different ecosystems, Delhi has the distinction of housing a highly specialized collection of seeds and

propagules of crop plants and their wild relatives at Indian National Gene Bank, established by the National Bureau of Plant Genetic Resources to conserve national heritage of germplasm in form of seeds, vegetative propagules, tissue/cell cultures, embryos, gametes, etc. Currently holding of the gene bank has a total of 1,63,155 accessions of different agri-horticultural crops and it ranks fourth in the world.

Animal Diversity

Delhi is known to have an impressive wealth of wildlife including tiger and some other wild cats. Blackbuck, Nilgai and Chinkara roamed the scrub jungles of Delhi until the early part of the last century. Rapid urbanization and habitat degradation and destruction have taken their toll and over the years the Ridge has lost most of its big mammal population, with only the occasional Nilgai, hare or jackal still left. Urban areas also attract animals that are capable of surviving on what humans discard or produce. They nest on buildings, feed on food grains, food spoils, leftovers and wastes.

The bird diversity in Delhi is quite impressive including migratory visitors. Out of the 1200 species of birds found in India, Delhi is the proud home to around 500. The most significant bird area is Okhla Barrage, adjudged "Important Bird Area" by Birdlife International, as it holds over 20,000 water birds in winter and has a bird list exceeding 330 species. Other important bird rich areas include Asola Wildlife Sanctuary, Delhi Zoo, Kalindi Kunj, Deer Park, Jawarhal Nehru Nehru University, and Indira Gandhi National Open University. The recognition and understanding of urban bird biodiversity of Delhi is not new. Major General H.P.W. Hutson's The Birds about Delhi was published in 1954, followed by another book on birds by Usha Ganguly in 1975. The Zoological Survey of India has recently published a thick professional compilation on the entire faunal wealth of Delhi.

Delhi also has an impressive diversity of butterflies. Dr Surya Prakash has recorded more than 50 species of butterflies in

the Jawaharlal Nehru University Campus. Some of the butterfly species belong to endangered category and listed in Schedule-I of the Wildlife Protection Act, 1972. Fishes in general included groups of carps, catfishes, murrels and ornamental fishes. Hydrology is the key factor in governing fish fauna in the Delhi stretch of River Yamuna along with the floodplain wetlands that play a significant role as breeding and spawning grounds of the riverine fish species and their restocking into the river system. Ever growing pollution of Yamuna and conversion of floodplain areas for developments such as, construction of NOIDA Toll Bridge and Akshardham Temple have taken heavy toll of fisheries and other aquatic organisms of the river. Drainage and reclamation of low-lying areas and excessive pollution of water bodies have seriously decimated the populations of amphibians.

Urban Biodiversity – A Life Support System

Biodiversity and ecosystems provide the basis for urban life. The urban biodiversity of Delhi is unique. No matter how unnatural these assemblages are, they are the ones that the present populace of Delhi is familiar with, and will be experienced by the future citizenry of Delhi. Urban biodiversity provides one of the few avenues for urbanites of direct contact with plants and animals. It is a green infrastructure that is vitally important for sustainable growth of Delhi. It provides a range of valuable goods and services to the residents of Delhi. These include food, fruits and fodder production, thermal regulation, climate modulation, water quality improvement, aquifer recharge, runoff regulation, air purification, carbon sequestration, soil formation, erosion control, nutrient cycling, waste treatment and assimilation, biological control, resources for education, research and monitoring; and opportunities for income generation. Delhi's ecosystems also cater to social, recreational and aesthetic needs of Delhiites. Conservation of urban biodiversity thus assumes strategic importance.

References

Bolund, P., and S. Hunhammar. 1999. Ecosystem services in urban areas. Ecological Economics 29:293–301.

Draft Master Plan for Delhi –2021. Delhi Development Authority, New Delhi.

Folke, C., C. S. Holling, and C. Perrings. 1996. Biological diversity, ecosystems, and the human scale. Ecological Applications 6:1018–1024.

Ganguly, Usha. 1975. A Guide to the Birds of the Delhi Area. Indian Council of Agricultural Research.

Grimm, N. B., and C. L. Redman. 2004. Approaches to the study of urban ecosystems: the case of Central Arizona—Phoenix. Urban Ecosystems 7:199–213.

Hostetler, M., and C. S. Holling. 2001. Detecting the scales at which birds respond to structures in urban landscapes. Urban Ecosystems 4:25–54.

Hutson, H.P.W. 1954. The Birds about Delhi: Together with a Complete List of Birds Observed in Delhi and the Surrounding Country. Delhi Bird Watching Society.

Jansson, Å., and P. Nohrstedt. 2001. Carbon sinks and human freshwater dependence in Stockholm County. Ecological Economics 39:361–370.

Maheshwari, J.K. 1963 The Flora of Delhi/ CSIR, New Delhi.

Master Plan for Delhi- 2001. Delhi Development Authority, New Delhi.

Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being. Island Press, Washington, D.C., USA.

Pickett, S. T. A., M. L. Cadenasso, J. M. Grove, C. H. Nilon, R. V. Pouyat, W. C. Zipperer, and R. Costanza. 2001. Urban ecological systems: linking terrestrial ecological, physical, and socioeconomic components of metropolitan areas. Annual Review of Ecology and Systematics 32:127–157.

Rees, W. E. 1997. Urban ecosystems: the human dimension. Urban Ecosystems 1:63–75.

Rees, W. E. 2003. Understanding urban ecosystems: an ecological economics perspective. Pages 115–136 in A. R. Berkowitz, C. H. Nilon, and K. S. Hollweg, editors. Understanding urban ecosystems. A new frontier for science and education. Springer-Verlag, New York, New York, USA.

Varshney C.K. and Indrani Mitra. 1993. Importance of hedges in improving air quality. Landscape and Urban Planning. 25:73-85.

JNU CAMPUS – A CLASSIC EXAMPLE OF A RIDGE ECOSYSTEM

Surya Prakash
Research Scientist, School of Life Sciences, Jawaharlal Nehru University, New Delhi.

'The story of human presence on the campus begins with the crude stone tools of the Early Stone Age. More refined late Stone Age tools and microliths used in making sickles for cutting grass have also been found on the campus. ASI has collected these tools. Thus the story of the campus goes back in time to Early Stone Age, and so it continues till date.' Javed Ashraf[1].

Recently I have collected pictographic evidence and submitted to Archaeological Survey of India (ASI). According to their preliminary report Ashokan script going back to 500 BCE is found in the JNU campus, one among the five places in India where such scripts have been found. A confirmed report is awaited from ASI. Historical records show that JNU campus, Sanjay Van Ridge and Aravalli Biodiversity Park were merged with each other once upon a time and it was a hunting range of Firoz shah Tughlaq. Today each forest has its own identity.

Evolution of JNU Ridge Ecosystem and Its Sustainable Development

After the land acquisition in 1970, the first Vice Chancellor of JNU (Jawaharlal Nehru University) G. Parthasarthy constituted 'Campus Development Committee' under his chairmanship to scientifically study the geography, topography, soil quality, landscapes, natural sources of water and biodiversity of the land before finally floating the tender for the construction of the campus. This committee looked into various aspects related to development

[1] JNU NEWS 2008

and architecture of the campus and how to transform barren land into a green forest. The committee decided on the following:

A. Conscious and maximum utilization of natural resources of the campus land.
B. Architectural design style of the campus i.e. 'Exposed Brick Work' today which has proved to be the blessings in disguise as parakeets, mynas, owls and house sparrows, which are getting marginalized due to many reasons, have taken shelter within the campus buildings.
C. Rain Water Harvesting Programmes.
D. Garbage & Waste disposal methods, another important issue for a healthy ecosystem to monitor urban bird proliferation and to utilize biodegradable and control non-biodegradable waste especially polythene bags.
E. 'Environmental Task Force' constitution to regularly monitor the health of flora and fauna of the campus ecosystem. CDC proposed to have a 'Bird Sanctuary' and a 'Deer Park' within the campus.
F. Biodiversity Conservation and awareness programmes through publication of annual calendars, greeting cards, symposia and publishing booklets with the featuring flora and fauna.
G. 'Nature Walks' in the campus to inculcate awareness among children from the early age about conservation of Mother Nature.

JNU used its dry natural lake and old wells situated in the eastern side of the campus for rainwater harvesting in the beginning and used the water in its nursery in early 1970s. Later on, three check dams were constructed where rainwater stored during monsoons in late 1980. Side by side innovative & intellectual ideas scientists, engineers, conservationists and other dedicated experts were used for the development of the campus through the CDC and environmental task force. Many such brain storming sessions of CDC for several years and the practical execution of their decisions eventually transformed barren land into a lush green ridge ecosystem which is serving as Green Lung of Delhi today.

The results were very encouraging as the campus ecosystem eventually transformed into a lush green valley with habitats such as grassland, wetland, and other aquatic ecosystems. .Over a period of time our nursery also developed and the natural manure produce from kitchen waste was used there. This worked out extremely well in providing microhabitat to microbes, which in turn helped insects to lay eggs. While the bio-kitchen waste was getting decomposed into manure it simultaneously helped soil transformation through earthworms. These producers were later consumed by reptiles and birds, after contributing their services to transformation of bio-waste into the natural organic manure for horticulture in our nursery. Insects and their larvae constitute major protein supplement for birds' diet, especially for their chicks to grow into a healthy adult. This process increased the population of small and other bush birds, which attracted many raptors who fed on the adults and chicks of small birds.

Other fruit trees started blooming from the 1980's onwards as a result of which birds like grey Indian hornbills, parakeets, barbets etc. started getting attracted to the Campus Ridge and gardens. This was the time when campus residents were also developing their own kitchen gardens and planting flowers, fruits and other ornamental trees. Check dams attracted many waders and other aquatic birds many of which were migratory in nature.

Today we have a large number of ornamental, fruit and some rare species of trees many of which are native to Aravalli Hills. Many species of insects include nearly 80 species of butterflies. A number of them are migratory, endemic and endangered ones. Roughly 160 species of birds, including many migratory and passage migrants, over a dozen snakes and other reptiles like Indian rock python around half a dozen species of lizards, more than a dozen small and big mammals some of which are protected under Wild Life Protection Act 1972 are found on the Campus.

Challenges Ahead

Having perfect habitat and ecosystem is not enough for the good health of any ecosystem so we do have our share of

problems associated with it like, there are many weeds within the campus but Prossopis juliflora is of great concern as it doesn't allow any other plants to grow in nearby area also, being Xerophytic in nature its roots penetrate very deep into soil thus encouraging ground water depletion. The continuous high frequency sound generated by air traffic is a serious concern for all of us as it has hazardous affects on the auditory system and psycho-biology of animals and humans.

High speed surface transportation is another threat to biodiversity outside and inside of the campus. Many wild animals cross Aruna Asif Ali road from Sanjay Van at night in order to enter JNU and are often killed by vehicular traffic. This is seen within the campus too. In the Ridge ecosystem of Delhi feral dogs occupy the topmost position in the food chain. They have become hunters and are killing jackals, Neelgai and their fawns, hare and common palm civets. Not only that, they are a serious threat to terrestrial birds including country's national bird, the peacock. The eggs and chicks of terrestrial birds including adults are often eaten up by dogs not only in Delhi but in other parts of the country also. If appropriate actions are not taken in time the day is not very far off when the ridge forests of Delhi will be devoid of any wild life.

DELHI'S BIODIVERSITY PARKS

Faiyaz Khusdar
Research Scientist, Center for Environmental Management of Degraded Ecosystems, Delhi University.

No city or town can sustain itself for long without maintaining its biological resources that constitute the life support systems. Delhi's two life support systems – River Yamuna and Aravalli Mountains or the Delhi Ridge, are both severely degraded and face high biotic pressure due to over exploitation, fragmentation and conversion of habitat, pollution, biological invasions and rapid population growth. These developments have led to rapid degradation of the ecology and environment of Delhi and the ecosystems have lost their resilience and natural self-sustaining ameliorative capabilities. Recognizing this, the Center for Environmental Management of Degraded Ecosystems, University of Delhi and the Delhi Development Authority initiated the collaborated project on establishing a network of biodiversity parks in the form of Yamuna and Aravalli Biodiversity Parks. Natural ecosystems characteristic of the Yamuna River Basin and Aravalli Mountain System are being developed in these parks respectively.

These parks are unique landscapes, the first of their kind in India and perhaps in the world, which, like nature reserves, harbour hundreds of vanishing species living together in the form of diverse communities and provide ecological, cultural and educational benefits to the urban society. They seek to conserve keystone species and other threatened plant and animal species, preserve the biodiversity of any habitat that is likely to be converted into urban infrastructure, establish field gene banks for threatened land races and wild genetic resources, establish native communities of the Aravalli hills and the River Yamuna basin particularly of the Delhi region, develop mosaic of wetlands that sustain the rich aquatic flora and fauna of the Yamuna and monitor short term and long term changes in the ecology of the Delhi region. Thus, Biodiversity Parks act as heritage sites and repositories of the approximately

50 threatened communities of the Yamuna river basin and Aravalli hills, provide ideal alternative habitats for migratory and resident bird species, enhance ground water recharge and augment fresh water availability, act as sinks for CO_2 and other pollutants, ameliorate local weather conditions and buffer ambient temperatures, promote eco-tourism and social connectivity across the urban community, serve as gene pools, and represent unique ecological models possessing not only wildlife and natural values but also aesthetic, environmental and educational values. The parks have already secured about 2000 species of plants & animals.

Yamuna Biodiversity Park

The Park seeks to conserve threatened and endangered plant communities found along the river Yamuna basin. The park is divided into visitors and nature reserve zone. When Yamuna Biodiversity Park was allocated a piece of barren land to carry out experimentation, it was difficult to grow and establish any plant because of high level of salinity. It was decided that raising land in the form of mounds may help in lowering the salinity, but the creation of mounds required huge amounts of soil. Two wetlands were created – One, shallow and narrow, 1.8 kms long and the other deep, about seven acres were created. Soil from the digging of these wetlands was utilized to create ten different mounds in visitor area. The wetlands of Yamuna Biodiversity Park have receive flocks of migratory birds (around 5000) from Siberia and other Palearctic regions every year since its creation. Some of the notable species include the Red-crested Pochard, Ferruginous Pochard, Eurasian Wigeon, Tufted Ducks, and Pintails (photo on front cover).

Visitors' Area consists of different modules such as Bambusetum, the Nature interpretation Centre, the Conservatory of fruit yielding species, the Migratory duck's wetland, medicinal plants conservatory, butterfly conservatory, and sacred grove. Ten Mounds in the Visitors' Area illustrate the different forest ecosystems in its miniature form found all along the Yamuna River Basin. The composition of forests, as in nature, consists of three to four layers: a tree canopy that supports climbers and provides shade for the middle storey tree layer and shrub layer which in turn protect the

ground-cover of herbs and grasses. Plantation on these mounds is designed on the basis of the structure and composition of the forest ecosystem found in its natural environment.

Herbal garden, in essence, is a reference collection of plant species of medicinal value. There are about more than 400 species of medicinal plants in the conservatory. Butterflies are important as they indicate the health of ecosystems and are often used to predict species richness of plants, lichens and birds. Keeping all these in view, apart from its education value, Yamuna Biodiversity Park has a butterfly conservatory which includes both nectar producing plants for adult butterflies and host plants for their larvae. Today it harbors about 37 species of butterflies. The conservatory of fruit yielding species offers a variety of fruits, year round, for frugivorous birds and other animals. There are about 350 specimens belonging to about 20-25 species of fruit yielding trees.

A quiet area, where fewer visitors are allowed to avoid human disturbance, has been emerging as a Nature Reserve with different forest communities interspersed with sprawling grasslands, where animals can live freely and increase in numbers. These include *Hardwickia* dominant, Teak dominated, *Adina* community, *Terminalia- Mitragyna* community, *Acacia* woodland, Sal-associates dominated, Emblica - Jamun community to name a few. The communities are developed by massive plantation programmes, some have already developed canopies and have attracted animals such as the monitor lizard, civet, jungle cat and Nilgai.

Regular monitoring of species groups is essential to record changes in its diversity as well as density. Such monitoring is necessary for manipulating species composition and creating niches for a specific faunal species. Changes in species diversity from 2002 to 2009 at Yamuna Biodiversity Park are presented below.

Species Groups	Year							
	2002	2003	2004	2005	2006	2007	2008	2009
Terrestrial Plants	90	145	340	480	652	656	737	808
Aquatic Plants	0	15	26	43	59	76	97	98
Avifauna	37	80	155	160	168	180	184	184
Invertebrates	39	78	102	114	119	122	129	132
Herpetofauna	3	7	11	13	14	16	17	17
Mammals	4	7	8	11	15	17	17	17
Fishes	0	3	7	8	10	12	16	16

Aravalli Biodiversity Park

The Park aims to create threatened plant communities of Aravalli hill ranges, is divided into Visitors Zone and Nature Preserve Zone. Visitors Zone has a Butterfly Conservatory, a Herbal Garden, an Orchidarium and a Fernery, besides steep slope communities. About, 72 butterfly species out of 74 species reported from Delhi have been spotted in the Park. The Medicinal plant conservatory has more than 350 species native to Aravallis. These species have curative properties of wide range of ailments such as blood pressure, rheumatism; Epilepsy, Hypertension and Liver disorder. A small pit covering an area of 0.5 acre was developed into an Orchidarium where12 species of orchids have flowered for the first time in Delhi. The conservatory has also a natural cave which harbors an insectivorous bat, and many shade-loving birds, snakes and butterflies. The Nature Preserve Zone has about 35 native Aravalli biotic communities with characteristics of the Gujarat Aravalli ecozone, the Rajasthan Aravalli ecozone and the Haryana - Delhi ecozone. The mixed dry deciduous forest communities include *Bucchnania*, *Dicrostachys*-, *Albizia*, and *Wrightia*.

As regards faunal diversity, about 164 bird species have been recorded in Aravalli Biodiversity Park in June 2009. Out of those, 132 bird species are resident and 34 are migratory including Red breasted flycatcher, Blue throat, Common teal, and Green sandpiper. Nineteen species of reptiles such as Fan-throated lizard, Lacertid lizard, Shaw's Wolf snake were recorded during 2008-09. About 14 species of mammals that include Blue bull, Jackal, Rusty spotted cat, Indian porcupine, and others have been encountered in the Aravalli Biodiversity Park.

Nature education, a major responsibility of Biodiversity Parks to is promoted by organizing educational trips to parks, encouraging plantation drives, workshops and seminars. The mission of the Biodiversity Parks is to serve as a repository of natural heritage of Yamuna river basin and Aravalli mountains with ecological, cultural and educational benefits to the urban society and promotion of conservation values.

MAKING DELHI A LOW CARBON CITY

A.K. Jain
Advisor, UN Habitat Global Research Network.

Delhi today is emerging as one of the largest cities of the world. From a settlement of seven lakh in 1947, its population increased to 138 lakh in 2001 at a growth rate of around 4.6% (1991-2001). Out of a total area of 1483 sq.km about 50% has already been urbanized and the rest is under heavy pressure of urbanization. In spite of the plans for decentralization and to restrict the growth of the city by development of the National Capital Region (NCR), the runaway growth of Delhi continues. It is projected that Delhi in the year 2021 will have a population of about 230 lakh, putting severe strains on its ecology with high carbon emission and demands on land, physical infrastructure, transport and housing. Models predict an average increase in temperature of 2.3° to 4.8° C for the benchmark doubling of carbon dioxide scenario. This warns us to change planning and development approach, based upon low carbon and Zero fossil fuel, which responds to local climate, culture and the urban context. The cornerstone for making Delhi a low carbon city is integrated approach towards ecology and environment. The central theme should be to make Delhi a modern eco- city, a sustainable and humane city.

A low carbon development envisages an urban form and development that reduce the demand for natural resources, fossil fuels, heat and power so that the development and living become zero polluting, energy conserving and self sustaining with the least possible footprint. This involves a holistic approach combining the issues and actions at various levels of planning, design and development. The low carbon development is a synthesis of several ideas, strategies and actions leading to a sustainable and energy efficient regime (see box 1).

SPATIAL SCALE	CITY/REGION (POLICY LEVEL)	COMMUNITY (LOCAL LEVEL)	HOUSEHOLD (BUILDING LEVEL)
KEY CHARACTERISTICS AND ISSUES	-Acid Rain, GlobalWarming, Heat Islands, Ozone Layer -Sprawl & Urban Footprints -Air Pollution -Water Sources -Power Plants & Energy -Natural Resources Management -Health -Poverty -Industry -Highways, Roads & Transport -Waste Treatment -Landfills/Toxic Dumps -Planning Process -Governance, Lack of Participation	-Water -Sewerage -Garbage -Drainage -Streets / Roads / Transport -Water -Waste Dumping -Flooding -Noise / Stress -Natural Disasters -Micro-Climate -Energy -Safety / security security	-Shelter -Water Pollution -Air Pollution/ Indoor Pollution -Drainage -Sewage/ Sanitation -Garbage -Ventilation -Disease Vectors -Energy / fuels -Safety /
KEY ACTION AREAS	-Urban Metabolism -Zero Carbon City -Zero Fossil Energy Dev. -Smart Growth & Mixed Use -Public Transport -Minimum Urban Footprints -Energy Efficiency /Alternative Sources Of Energy -Regulatory System -Legal Framework -Decentralised Process -Participatory Planning -Pollution Control -Intelligent City -Recovery Of Rivers/ Water Harvesting & Recycling	-The Organisation Of Space -Urban Transport & Fuels -Decentralised Services -Recycle/Reuse -Energy Efficiency/ Audit -Water Conservation/ Harvesting -Conservation Of Greens & Forests -Mixed Use -Zero-Run Off Drainage -Plg. Standards & Controls -Solid Waste Management	-Design With Nature -Passive Design -Water Conservation & Harvesting -Micro Climate & Bldg. Materials -Energy Efficiency -Shelter For The Poor -Jobs Generation -Bldg. Bye Laws & Standards -Intelligent Services & Maintenance

Box 1

Unprecedented scale and speed of urbanization in Delhi has resulted in enormous pressures on the physical environment with a severe adverse impact in terms of pollution, and today Delhi is considered to be among the most polluted cities in the world. The city's environment essentially cuts across the aspects of urban management- the environment *per se* or the habitat and services management. The former pertains to the natural features and resources including: the elements of air and noise, water (water bodies-river, lakes, drains and ponds- and ground water) and land with reference to open spaces, green areas and other surface and sub-surface conditions. The latter is related to the built environment and includes the environmental infrastructure - water supply, sewerage, solid waste disposal, and the transportation network.

Accordingly the following approach needs to be adopted:

i) Planning and redevelopment of a sustainable urban structure based on transit oriented development

ii) Conservation and Management of Natural Resources and related infrastructure and services in a manner that would lead to optimization of use of natural resources, reduction/abatement of pollution; technology upgradation and provide protection from natural hazards

iii) Conservation of ecology, greenery, landscape and heritage areas

iv) Adopting Clean Development Mechanism (CDM) protocol and practices

Sustainable Urban Structure and Transit Oriented Development

The sustainable development articulates with the urban form and its structure, zoning controls, land use and density pattern, together with, building and management options which have to be tackled in a holistic manner. Sustainable urban structure begins with the urban region; the city and its hinterland. The sustainability of each is interdependent. The town or city depends on its

hinterland for food and water, clean air and open space and, looking to the future, biomass for fuel. The hinterland depends on the town or city as a market for its produce and for employment and services. Sustainable planning demands a more holistic and integrated approach to the urban region, which recognizes the interdependence and potential of both town and country.

Several research findings have highlighted the negative economic, social, and environmental impacts of the urban sprawl. The Kenworthy and Newman Curve has shown that cities with a low density have much higher energy costs. This cannot be ignored in the context of the energy uncertainty as the availability of fossil fuels in the long term, a large increase in its demand in India and dependence on external markets for providing the same are to be considered. The dimension of energy efficiency is important in the process of deciding density and urban controls.

The studies indicate that dense and high rise cities consume less energy than those that are spread out. There is less loss in the transmission of power and water and there are energy savings in high rise-high density city in terms of transport, water, power and street lights. Dense and high rise cities provide far more open space. While the denser cities of the world like London, Paris, Berlin, Vienna, Singapore, Tokyo and Hong Kong etc. consume below 20,000 million joules per capita, more sparse cities like Houston and Phoenix consume nearly 80,000 million joules per capita. Higher Floor Area Ratio (FAR) and densities give a range of environmental benefits and reduce the pressure on land, public transport and services. The pressures of increased land values, urban accessibility, expanding population, globalization of commerce and the location preferences make higher FAR and densities inevitable. What should be of concern is the way local areas are redesigned with planning principles and controls on their location, linkages, services, urban design and built-form. Spatial models can be evolved to achieve sustainability, i.e. lesser need to travel, saving time and energy.

There is close relationship between compact urban form and the sustainability by reduction of dependence on automobile and efficiency of social infrastructure and public services. Compact cities can have significant implication in saving fossil fuel consumption, climate change and environment. Critical instruments for this policy option include coordination with public transport, infrastructure development, mixed land use, urban boundary and coordination of different level of government. "Smart growth" practices create more accessible city and reduce the need to travel. The Smart Growth aims to control urban sprawl, support public transit and make walking and cycling attractive.

A walk-able community should provide a fundamental building-block in creating a sustainable urban form. The concept of a polycentric urban structure with a network of distinct, overlapping communities, within which people can access on foot most of the facilities and services should be the basis of planning. Each of these communities is defined by the walking catchment or "ped-shed" around the center, which can be taken as maximum 800m, equating to a 10-minute walk. In Delhi, a polycentric structure with new centers should be created along the metro and public transport corridors, what could be described as "a centers and routes" model. In this way linear communities should be developed along the main movement routes between centers and especially along the principal routes, reflecting differences of geography and landform. As such the following planning principles can be drawn out:

§ Work centers, major institutions and services to be focused along public transit route at the convergence of movement routes and around key facilities such as metro stations, railways or bus terminal.

§ Creating a walk-able neighbourhood all (local hubs) should be within easy walking and cycling distance:

Transit Oriented Urban Hierarchy

4-10km radial	Sub-City/Zone (5 to 10 lakh population)	City Centre, Cultural Complex, Hospital, Shopping Mall, Professional College, City Hall, Stadium, sports complex Theatre/Multiplex, etc.
2-6 km	Sub-zone/ community (1 lakh population)	Sports Centre, College, District Centre, Police station Disaster Management Centre, Fire Station, Library, Health Centre/ local, hospital, etc.
400-600m	Neighbourhood (10000 pop.)	Local Offices, Sr. Sec. School, Community Hall, Local Shopping, PolicePost, playfield, temple, etc.
150-250m	Local hubs (5000 pop.)	Primary school, Clinic, park, dispensary, community hall, convenient shops, etc.

Integrated planning of intra-urban and inter-urban transport can bring about a new pattern of urban population distribution, settlement structure, industrial and tertiary growth that would lead to environmental conservation. This will require re-examining the concept of single land use zoning and city structure, which should be based on conservation of transport. This will also require the reorganization of land use including the circulation pattern and rationalization of land use and density with due consideration of parking requirements, pedestrians and efficient use of road right of way. This needs the integration of buses, trams route with MRTS, Metro rail, rail corridors, LRT, etc. with integrated Bus and Metro/ Rail Stations/terminals, with dispersal facilities and services such as parking, taxi stands.

Natural Resources

Natural resource conservation includes management of water (surface and ground), air and noise.

Surface and Ground Water

a) The surface water resources in Delhi are basically comprised of the river Yamuna, drains and the lakes/ponds. The ground water in Delhi occurs in confined and semi-confined conditions, with depths varying from 1 m to 10 m below the ground level, and, in the alluvial terrain, several sandy aquifers occur at different levels upto a depth of 70 m

Based on studies and statistics, some of the striking features that are revealed about the surface water resources in Delhi are:

i. The Yamuna river and the drains are highly polluted;
ii. The supply of water for human use is more than sufficient in absolute terms, but is characterized by iniquitous distribution in per capita terms in different areas, with significant wastage;
iii. Assuming that 80 percent of the water is converted into waste water, the capacity to treat waste water is grossly deficient;
iv. The actual quantity of waste water treated is much below the installed capacity on account of missing links in sewer connectivity between the generation points and treatment plants and choking/sitting of sewer lines, etc.;
v. The planned re-use of treated waste water is minuscule;
vi. The treated waste water is being largely put back into the drains and gets polluted again before flowing into the river Yamuna, which receives 70 percent of its waste from the 22 kms. of its flow through urban Delhi that, in turn, constitutes only 2 percent of the total length of the river basin stretching from its point of origin till its merger into the Ganga at Allahabad;
vii. A large number of the traditional water bodies(excluding areas of unintended water logging along railway tracks, highways and canals etc.) have been encroached or have otherwise become defunct.

b) Groundwater is one of the major sources for water supply in many parts of the country. In Delhi too, ground water contributes a substantial quantity of water supply, but little is known about its quantity or quality. Especially in new development areas, groundwater is largely being used as drinking water resources, mainly because of the insufficiency of the Yamuna water share for Delhi. The Central Ground Water Board (CGWB) assessed the total groundwater potential to be 292 million cubic meters (MCM) in 2003 as compared to 428.07 MCM in 1983, showing an overdraft and reduction of around 130 MCM over the past 20 years. Out of the 6 blocks into which Delhi is divided, significant

overdraw/ reduction has been observed in the Najafgarh and Mehrauli blocks. Rapid urbanization leading to reduction in recharge of aquifer, increasing demand in the agriculture, industrial and domestic sectors, stress put on groundwater resources in periods of drought/deficient rainfall, and unplanned withdrawal from the sub soil aquifers, have been mainly responsible for decline in groundwater levels.

c) The average annual rainfall in Delhi is 611 mm. However, recharge of ground water gets limited due to decreased availability of permeable surfaces owing to urbanization, and the runoff getting diverted into the sewers or storm water drains that convey the water into the river Yamuna. The annual rainwater harvesting potential has been assessed at 900 billion litres or 2500 million litres per day. Even if 25 percent of this could be harvested it would imply availability of 625 mld, which would be nearly equivalent to the presently estimated deficiency. This is in addition to the potential for roof water harvesting assessed at around 27 mld.

d) The existing drainage basins shall have to be made self-sustainable in water management by integrating water-sewerage-drainage systems. New projects and upgradation of present infrastructure should be taken up in addition to promotion of water conservation through an integrated and a community driven model. Complementary short term and long term strategies as mentioned above will need to be initiated.

Air

Despite various initiatives and measures taken over the past few years, like introduction of CNG and EURO II norms etc., the air quality in the city, in terms of pollution levels, has continued to be a matter of concern, and has been responsible for a number of respiratory diseases, heart ailments, eye irritation, asthma, etc. The three main sources of air pollution in Delhi are vehicular emission (around 70 percent) industrial emissions (around 20 percent) with a major element of this coming from the three thermal power plants, and from other sources such as diesel generator sets and domestic cooking, burning of biomass, etc. Looking at the seriousness of industrial pollution in Delhi, the Supreme Court of India during last decade issued several orders.

Apart from the issue of pollution on account of industries, the major area of planning and intervention would relate to transportation planning. Apart from the phenomenal growth in the number of vehicles, almost 8-10 times in the last two decades in absolute terms, the most significant aspect, in the context of congestion and pollution, relates to the growth in personalized transport as compared to the availability of public transport. It has been estimated that buses, which constitute barely 1.2 percent of the total number of vehicles, cater to around 60 percent of the total transport load, while personal vehicles –cars and scooters, though almost 93 percent of the total number of vehicles, cater to around only 30 percent of the travel demand. Such a huge share of private vehicles in Delhi, while serving a relatively limited purpose in terms of the transportation modal split, obviously creates tremendous pressure on road space, parking, and pollution directly and through congestion.

Public transportation planning must, therefore, drive the future policy. So far public transport is largely seen as the transport mode for the not so well off and poorer sections of the community, who cannot afford to own/use personal transport. An important element of policy would now also have to aim to make public transport a mode for personal vehicle owners and users through a mix of incentives and disincentives. Apart from aspects like frequency, inter-modal integration, a possible single ticketing systems, use of parking policy as a means to influence vehicle use, etc., the quality of public transport, particularly buses, would need to be significantly upgraded, inter-alia, keeping the element of clean transport in view.

Another issue which has been raised in the context of vehicular congestion and pollution relates to the policy of mixed land use, which will also have to be carefully considered. The other elements which would need carefully thought out policy measures would relate to the operation of existing Power plants to significantly reduce the pollution arising from them, and industries, both in terms of pollution control in designated industrial areas, and relocation of non-conforming industries.

The present population of Delhi is about 15 million which is increasing at a rapid rate. This is causing large footprints on the

on eco-system of the National Capacity Region and the issues of water, power, sanitation, transport, drainage, waste management, land use, industries, forestry, etc. can not be tackled in isolations. The NCR plan postulates the policy of decentralization and dispersal of industries, government offices and other work centers from Delhi. Delhi Master Plan stipulates various environmental measures including shifting of heavy and large industries from Delhi. Simultaneous action is necessary in enforcing pollution control in the Region that impacts and articulates the environment of the city and vice-versa.

Power

Delhi's requirement of power in the year 2021 is estimated by Delhi Transco Limited to be 8800 MW based on 16th Electricity Power Survey of India, CEA. To meet the demand, the concerned agencies need to augment the power supply and improve the transmission and distribution system. The additional power requirement would be met from local generation and allocated share from the grid system.

In the reform process for power sector, the Delhi Vidyut Board has been formally unbundled into successor companies for managing the distribution, transmission and generation functions. After the privatization of distribution system the power generation may also be privatized with regulatory controls on tariff structures. Load management techniques should be adopted and schemes to minimize power thefts/losses by improved metering arrangements should be enforced. Non-conventional energy sources like recovering energy from sewage, solar energy should be used for street lighting, traffic signals, hoardings etc.

Solid Waste Management

The problem of solid waste management in Delhi is assuming serious proportions due to increasing population, urbanization, changing lifestyles and consumption patterns. The garbage from unauthorized developments, slums, JJ settlements, etc. is not collected which further adds to the environmental degradation. The projected average garbage generation upto the year 2021 is @ 0.68 kg per capita per day and total quantum of solid waste works out to 15750 tons/day. Management of solid waste involves waste generation, segregation and storage, waste

collection, waste transfer/transportation, treatment, recycle, reuse, recovery, and disposal. For effective waste management, its segregation at the community and neighbourhood level is imperative. The waste should be segregated and collected, in separate chambers at talaos. For this, involvement of rag pickers, along with RWAs, CBOs and NGOs, is to be encouraged.

Sewerage

The areas where immediate regular sewerage system is not available, low cost sanitation system by individual families could be adopted as a short range provision. These should be planned in such a way that in the long term regular sewerage could be provided. To improve the sewerage and sanitation system, surface drainage and sewerage may be integrated along with provision of land at appropriate locations for sewage treatment plants (STP's), sewage pumping stations, common effluent treatment plants (CETP's) etc. Recycling Plants for treating waste water for supply of non-potable water are to be provided at all STP's and CETP's with supportive distributive infrastructure. The liquid waste would be taken care of, by augmenting the capacity of existing treatment plants as well as through new systems. The progress is to be monitored with provision of water recycling infrastructure and mini/ decentralised treatments.

Recycling and Regeneration

In view of the undue strain on the resources and services, the city has to be based on the concept of recycling (e.g. water, solid waste, land), regeneration (dilapidated, old areas), recovery (wastelands, encroached areas), restructuring (networks, landuse, transport), recharging (traditional areas) and rejuvenation (river, water bodies, parks etc.). The land use should interface with an efficient and comfortable multiple public transport system. It is time to think of schemes to minimize water transmission losses, theft and leakages. One of such proposals will be laying an underground pipeline/tunnel to transport water from Yamuna (Tajewala) and Ganga to Delhi, which will supplement or replace the Yamuna and Ganga Canals. As a new concept, instead of conventional drainage, the concepts of micro runoff, bio-swales

and bio-drainage need to be adopted. Ponds/reservoirs and sediments traps are to be identified in the catchment zones on low-lying grounds. The concepts of watershed development, harvesting and conservation of rainwater and recharging of underground water have to be adopted as the basis of planning, design and development. Various other options can be explored for augmentation of physical infrastructure, such as technology upgradation, dual piping system, rain water harvesting, energy audit and exploring alternative sources of energy.

Technology Up gradation and Protection from Natural Hazards

The revival of the age old concept of watershed development, harvesting and conservation of rain water and recharging of underground water can substantively resolve the water crisis of Indian cities. Several technologies, such as decentralized and compact water treatment units, solar/aerobic/ oxidation and root zone cleaning systems can be employed to purify potable water from the natural sources. Drinking water, sanitation, solid waste treatment and drainage are important aspects of the human environment. The performance of present technological system needs to be reassessed with reference to environment, hygiene and their accessibility. Various alternative technologies based on decentralized services, like Extended Aeration Technique, Biogas production, Bubble Diffusion process, Flotation, Anaerobic Reactors, etc., which are already in vogue in the industry, can be explored for urban sanitation.

Widespread method of land filling for solid waste disposal is an environmental disaster. Decentralized systems based on recycling, energy generation and organic decomposing can be explored for solid waste treatment. Bio-reactor composting and vassal system (Tunnel Reactor) are new generation technologies which can be employed for treatment of urban solid waste.

In view of the City's vulnerability to Seismic hazards, its development, land use and habitation must be based on thorough understanding of the scientific and technical requirements of natural disasters and their prevention. It is possible to protect against

some natural hazards through engineering and the use of planning techniques. Redefining the byelaws keeping in mind the vulnerability of Delhi to earthquake and floods, and ensuring effective and impartial enforcement, is crucial. Indian Metrological Department has taken up preparation of micro-zonation maps of Delhi. A network of Disaster Management Centres and a contingency plan for disaster mitigation are the essential requirements for Delhi.

Conserving the Ecology and Greenery

Delhi has a much larger green cover than any other metropolitan city in the country, and Delhi could be called a "Green City". The green / recreational use constitutes 8,722 ha of land as per MPD 2001, which is around 19% of the total urban land area of 44,777 ha. This includes 1577 ha. under the Northern, Central and South Central Ridge (the remaining area of the Ridge is in the rural area). The balance area under recreation / green use i.e. 7145 ha. is in the form of District Parks, City Parks, Community Parks etc. comprising around 15% of the total urban land area. In addition to this, a large chunk of green area is provided in the form of Neighborhood Parks / Tot lots in the gross residential use zones, plantations / greens in large campuses like President's Estate, JNU, IARI, Delhi University, plantations along drains and roadside plantations. In addition to above, two Bio-diversity parks are under development. In the proposed urban extensions the green cover is to be provided at the rate of 15% of the total land, excluding the Ridge/ Regional Park. Out of this, some area shall be developed in the form of formal parks for the community and the rest shall be developed as woodlands and incidental greens for balancing the environment. This will be in addition to the development of specialized parks like Bio-Diversity Parks, plantation along the roads, drains, riverbank, etc. MPD-2021 has proposed to following norms for Green areas:

S.No	Category	Planning Norms & Standards	
		Population / Unit (Approx.)	Plot Area (Ha)
1.	City Park	10 lakh	100
2.	District Park	5 lakh	25
3.	Community Park	1 lakh	5
4.	Neighbourhood Park	10000	1.0
5.	Housing Area Park	5000	0.5
6.	Tot lot at Housing Cluster Level	250	0.0125

Note: 5 to 10 % of the Multipurpose Ground area will be under use for rainwater harvesting / water body.

The open space at the neighbourhood level shall be provided @ 4.5 sq.m. per person minimum size of tot lot at cluster level as 125 sq.m. Suitable landscape plans for the neighbourhood shall be prepared, indicating in reasonable detail the landscape development of the parks and roadside plantation etc.

Delhi has a number of drains and canals, which are highly polluted and act as corridors of filth and encroachments. MPD-2021 has proposed landscape development of drains and canals and control of pollution by proper waste management system, provision of effluent treatment systems, regular desilting, etc. along with public awareness and campaigns. It is proposed that environmental study of existing major drains should be conducted before their covering. The environmental study of the existing major drains should be conducted before their covering. The drains and waterfront should be landscaped in the form of interconnected parkways. There is no need for elaborate gardening of the greenways, but wild, simple and natural stretch by itself would be ecologically important. Such trails could be one of the cheapest forms of drainage and recreation. Drainage should be linked with the ecology and green networks or "bio-drainage". Regular de-silting of drains and control of dumping of solid waste / malba into the drains should be taken up. Public awareness program need to be taken up in association with NGOs and RWAs to make the people aware about the consequences of dumping malba in the drains.

Conservation of Heritage

Delhi is a unique repository of traditional urbanism. The variety of its built environment – settlements, heritage structures, artifacts, streets, parks, water bodies and precincts of historic, aesthetic, cultural and religious significance is amazing. Unfortunately in the recent decades, by the 'property' oriented approach of development, the treasure of traditional urbanism has often been trampled upon. Borrowed concepts of urban 'aesthetics' have overlooked Delhi's historic, cultural and symbiotic heritage.

The reasons for overall decay of the heritage are more than population growth, changing life styles, urbanization and the forces of economic growth. The malaise is much deeper – which includes the lack of awareness, sensitivity and concern for the traditional values, incapacity of institutional framework, non-responsive organizations, flaws in planning, design and development control process, legal and enforcement inadequacies and deficiencies in implementation and maintenance. There is a dire need to conserve unique heritage resource by an integrated policy and local planning framework.

Need to adopt Clean Development Mechanism

While the Ministry of Environment has mandated EIA for certain level and scale of construction, the local bodies and developers in Delhi do not have any Clean Development Mechanism protocols and practices. It is necessary to evolve local Clean Development Mechanism (CDM) and Energy Efficiency protocols at local level, which should be adopted at various stages of planning, development, building design, specifications and construction. Attention at an early stage is vital, because the environment can not be redeemed, if the basic concept does not address sustainability issues.

Conclusion

The cornerstone in making Delhi a low carbon is city is to adopt integrated approach towards urban planning, transport, natural resources, ecology and environment. There is a need to evolve and adopt innovative and mandatory norms and practices in urban planning and development, such as, water conservation and recycling, dual-pipe system, balancing lakes and reservoirs, recovery of the river and water bodies and blue networks and green corridors. The concepts of Bio-drainage, Zero Run-off, energy efficiency, use of solar energy, the concept of Zero-fossil Energy Development (ZED), bio-fuel recovery, waste recycling and reducing ecological footprints should form the basis of low carbon development strategy.

References

Agarwal, Anil & Sunita Narain (eds.) (1997 *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems*. New Delhi: Centre for Science and Environment.

Delhi Development Authority (2007), *Delhi Master Plan 2021*, New Delhi.

Development Alternatives (1998) *Environmental Priorities of India*, New Delhi.
Girardet, Herbert, (1997) "Sustainable cities – A Contradiction in Terms", *Architectural Design*, London.

Government of India (2007) *National Urban Housing and Habitat Policy*, Ministry of Urban Housing & Poverty Alleviation, New Delhi.

Govt. of India (2006) *National Urban Transport Policy*, Ministry of Urban Development, New Delhi.

Hough, Michael (1995) *Cities & Natural Process*. London: Routledge.

Jain, A.K. (1990) *The Making of a Metropolis*. NBO: New Delhi.

Jain, A.K. (1996) *The Indian Megacity & Economic Reforms*, Management Publishing Company, New Delhi.

Jain, A.K. (2003) "Making Planning Responsive to and compatible with Reforms", *Cities Journal*, U.K., Vol. 20, No. 2.

Jain, A.K., (2003) "A Blueprint for Energy Efficient City", *Indian Buildings Congress*, Annual Seminar, New Delhi.

Jain, A.K. (2001) *Ecology and Natural Resource Management for Sustainable Development*. New Delhi: Management Publishing Co.

Jain, A.K., (2007) "The Indian Habitat – Between Livelihoods and Lifestyles", *Shelter*, Vol. 10 No.2, August 2007.

Jain, A.K. (2007) *Water – A Manual for Architects, Engineers, and Managers*. Daya: N. Delhi

Jain, A.K.(2009) *Low Carbon Cities-Policies, Planning and Practice*. New Delhi: Discovery Publishers.

McHarg, Ian (1969) *Design with Nature* New York: Natural History Press.

Urban Redevelopment Authority (1991), *Living the Next Lap Towards of Tropical City of Excellence*. Singapore.

Rees,William (1997) *Ecological Footprints and Urban Transportation*. Barcelona: Velocity.

NATURALIZING DELHI

Manu Bhatnagar
Advisor, Natural Heritage Division, INTACH, New Delhi.

The National Capital Territory of Delhi is becoming increasingly urban and correspondingly hostile to flora and fauna as manifest in the disappearance of habitats, reduction in species richness and population sizes. With 750 sq. kms out of 1485 sq. kms already urbanized, another 450 sq. km. to be urbanized by 2021, and ongoing re-densification of existing urban areas the urbanization thrust is compounded by a rapid accretion of paved surfaces driven by a glass and steel juggernaut. This enlarging footprint for a projected population of 25 million people by 2021, has been accompanied by a corresponding receding of the countryside and natural features.

The Rich Natural Past

Environmental issues as we perceive them today were of little concern to our predecessors. Thus, indirect environmental references must be culled out from the historical records. The river Yamuna was plentiful in fish. The 1975 Gazetteer states that there were 65 species of fish in the river. The earlier Gazetteers mentions the availability of edible fishes such as *mahseer*, *rohu*, *bachwa*, *mulley*, *tengra*, *silund*, *mohi*, *mirgal*, *lalbans*, *chilwa*, *gunch*, *katla*. Ornamental fishes were to be found as well as turtles and large numbers of *gharials* and *magars*. In the floods of the rainy season the river has a considerable breadth swelling in places to several miles, with a maximum depth of some 25 feet. The Gazetteer records the river to be navigable all along except at Okhla weir because of lack of locks – barges laden with brushwood occasionally come into Delhi. Other history books mention the dispatch of cargo by boats to Delhi carrying a load of as much as 100 tons from as far away as Calcutta. The vast floodplain formed due to the meandering of the river contained several waterbodies left by the river receding after the monsoon. The area lying in the *doab* of the Yamuna and Hindon was especially marshy due to the very high water table.

Flora

The Ridge forms the regional watershed of Delhi with the drainage to its west discharging into the Najafgarh Drain whilst the drainage on its east is directly into the Yamuna. The Ridge, in earlier times was host to scrub vegetation and gave rise to several seasonal streams in the monsoon season such as Tekhand and Barapullah. The forestation work was taken up in 1913, initially with indigenous trees, and later *prosopis juliflora* (a hardy Mexican species introduced in 1878) was extensively propagated. This completely dominated the local vegetation and the indigenous species such as *dhak* (flame of the forest) have by now become rare.

The Delhi Gazetteer of 1912 comments "—the landscape during hot season is scarcely pleasing. The district contains very little in the way of forests — the banks of the two state canals constitute a long strip of forests. The finer of the timber and shade trees that thrive in the district are not abundant, and are only found in any quantities in places where they are afforded protection from grazing cattle when in the young stages of growth". Other historical records inform us that in other than Ridge areas trees were in profusion and the countryside well wooded. Forests surrounded Shajehanabad as could be seen from the ramparts of Purana Quila.

Forests also receded with the advent of the north cantonment in 1828 and thereafter with the clearance of the Raisina Hill for the Viceroy's Palace and again with the establishment of the present cantonment in 1935. Formally designated forests began to be confined to the most inhospitable and infertile lands. The forest cover was 26 sq. km. in 1997, 88 sq. km. in 2000 (Forest Survey of India) and has attained 200 sq. km. coverage by now.

Fauna

The woodlands around Delhi supported the Black buck (antelope) and chinkara (gazelle) in the Najafgarh area and wild pigs in the khaddar area. Hyena, wolf, fox, jackal, hare, monkeys, porcupine, hyena, leopards were found in the kohi tract in stony ravines and the deserted monuments as well as nilgai and hog deer in small numbers. Even as late as 1953 there was a hyena scare in the city leopards were still around and the NGO

Kalpvriksha records the spotting of a pair of leopard cats in 1987. The faunal life was rich even till the late 1940s including species like civet cats, pangolin, leopard cats, flying fox, long eared hedge hog and leopards, the last named being a species close to the top of the food chain. Kalpvriksha has recorded in the 1980s the existence of 70 species of butterflies.

Avifauna consisted of partridge, rock pigeons, sand grouse, bush quail, grey quail (migratory), pea fowls, teal and duck, barbets, sunbird, blue jay (nilkanth), kingfisher, hornbill. If one turns to the successive editions of the Gazetteer of Delhi and other literature there is reference to plentiful avifauna in the waterbodies and the Yamuna. Seasoned Delhiites recall going for duck shooting to Najafgarh Jheel and hunting in the outskirts of the city even as late as the mid-70s. According to the Zoological Survey of India's report [1997] Delhi had 32 species of mammals, 25 species of reptiles, 434 species of resident and other birds. In all there were 585 species of vertebrates and 1202 species of invertebrates.

Gardens and Orchards

The 1912 Gazetteer informs us that - "A characteristic incident of land tenure is the reservation of wood producing land in the shamlat deh as an enclosure whence no fuel or wood is to be cut. A religious association is made to this in the form of a *fakirs* hut and the prohibition is strictly enforced but this religious association is not always the case. These are known as *rakhyas/belas*." Sabzi Mandi was surrounded by rich orchards, as also Wazirabad, and overall the orchards of Delhi were supplying fruit in plenty. The 1996 Survey of India map shows several orchards in north Delhi and some are still in existence. Tis Hazari which was a planted area reputed to have 30,000 trees since Moghul times was partially cleared for a shooting range connected to the north cantonment. Old Delhi railway station was inserted, so to say, in what used to be the Jehanara Bagh or as the British called it, the Queen's Garden.

Groundwater

Owing to the high water table of the area the 1936 Survey of India map shows a profusion of dug wells dotting the country side. The water table in most parts of the territory was no where lower than more than 5m below ground level. But if one tracks the

disappearance of dug wells through a map time series one can observe the spatial changes in the ground water table. In the mid-1960s the water table rose by 2.5' -15' over the 1912 levels and a comprehensive scheme had to be made to lower the levels through pumping.

The arrival of the green revolution with its heavy demand for water in the late 1960s led to deep water extraction through tube wells. But in the past two decades the decline in the water table has been significant with many areas losing their fresh water strata. The fall in water table is significant for its impact on the vegetation species and the growth characteristic of the vegetation. Low soil moisture and deeper water table result in a gradual transition to arid zone vegetation.

Transition

Delhi was always the largest urban centre of north India. The shifting of the Capital to Delhi in 1911, the development of New Delhi, the post partition migration were some of the major urbanizing forces. Subsequently, planned development of Delhi with its various high level health and educational facilities, economic impact of globalization, employment opportunities resulted in massive growth of population. The ever increasing population leads to a greater demand for housing, infrastructure and other economic landuses. This generates a land hunger whereby the land is seen not from an ecological prism but through a commercial filter of land value. This land hunger, driven by powerful commercial interests, sucks in existing natural areas and does not find any merit in creating environmental landuse. Many a waterbody has disappeared making way for some facet of urbanization. [Mughul Tank, Narela, is an example of a large waterbody becoming a bus terminus]. Even the floodplain of the river is being nibbled away by colonization.

This increasing population's thirst for water has led to depletion of the aquifer as also the anemic flow in the Yamuna. The unsustainable extraction of groundwater has resulted in the exhaustion of freshwater strata and in due course will also have an adverse effect on the growth of vegetation and the species which

may colonize the area. Soft areas, forming the gateways to aquifers, are being increasingly paved resulting in decreased recharge. The Municipal Corporation of Delhi is thus keen on putting underground parking below parks and the Metro station in Connaught Place has sealed 15 acres of previously soft area. The vast volume of water used has resulted in commensurate discharges of waste water and the conversion of the river and storm water drainage system into open sewers is well known. This has transformed Yamuna into a dead river and also contributed substantially to the contamination of aquifers.

Air pollution in the city has contributed to a great rise in respiratory diseases. In the last few decades the city has also spilled out to the west of the Ridge and thus become exposed to the hot winds and sand from the western desert. The noise level, mainly from transport sector, is well above permissible levels at many locations. The increasing use of fossil fuel based energy by this affluent population (transport, power generation, use of generators) has led to a high carbon footprint society. The increasing trend of sealed buildings running on air-conditioning and growing use of steel, glass, aluminum, more for the sake of architectural fashion, and the emphasis on paving over all soft areas within the urbanized zone are resulting in heat islands within the city.

Cultivated gardens in the urbanscape, within large institutions and residences act as consumers of resources. Based on DDA's norm of 67,000 litres/ha/day for watering of gardens a district park (say Masterplan green in an area like Dwarka) of 100 ha would be consuming 6.7 MLD (more realistically 3.5 MLD) of water. In this regard the newfound emphasis on biodiversity parks with their use of indigenous species would reduce consumption of natural resources.

The increase in forest cover in the past few years is a welcome development. Nine new city forests have been announced recently and it remains to be seen whether these will bring net addition to the city's forest cover or whether they will only provide space for compensatory forestation. It may also be noted that while the loss of green cover is widespread the compensatory efforts are spatially lopsided. The future increase in

green cover would be critically constrained by land availability. With the runaway growth of urban areas the ecological shadow of a city no longer coincides with its geographical location. Thus Delhi requires 100,000 sq. km for food production and an area for carbon sequestration @ 0.5 ha per person = 75000 sq. km.

City Planning and Management

Colonial New Delhi was planned as a garden city. The subsequent era of planned development by DDA saw the creation of an extensive hierarchical park system. This is a 'gardens in cities' approach. The NCT Govt., too, has done a commendable job in increasing the green cover and encouraging the development of biodiversity parks. But, while Delhi has wildlife sanctuary, protected forest in Sanjay Van, City Forest in Jahanpanah, and assorted greenbelts under the Master-plan, these are fragmented patches which could be healthier if connected with natural corridors.

The problem of unsustainable urban growth trends is now beginning to engage the attention of planners and city managers. The MPD 2021 has devoted 5 pages to environment with a number of well meaning injunctions. Other organizations are focusing attention upon sustainability pertaining to water supply, transport, solid waste, power and buildings. The time has come to evolve from a 'gardens in cities approach' to a 'cities in the lap of nature approach'. The 1992 Convention on Biodiversity also enjoins every country to evolve a biodiversity strategy along with a reporting mechanism. In India various several states have evolved their biodiversity strategies. Delhi is one of the exceptions.

Delhi is a city state with a complex land-use and land ownership pattern, urbanizing rapidly with severe pressure on land. Thus, there is need for a creative strategy towards increasing the biodiversity resources of the NCT Delhi so as to endow the urban territory with increase in habitats, wildlife, green cover, reduction in usage of water while simultaneously improving quality of life of the citizens and reducing the carbon footprint of the city. The cooperation of several agencies – planning, civic, infrastructure, land owning agencies, entities and individuals would be essential to bring about the enhancement of green cover and in developing the connectivity corridors through the concrete jungle.

Urban Biodiversity

It may be noted that the present approach to have cultivated greens in urban areas drives the consumption of water, fertilizer and manpower resources. On the contrary natural greens, such as biodiversity parks, enrich soil, and retain monsoon runoff and provide habitats to diverse flora and fauna. There is also a critical need, in urban areas, for increased vegetation cover to sequester CO_2, generate more oxygen, cool the microclimate and thus enable greater precipitation especially in areas of mass vegetation.

"The humdrum pressure of urban living makes human contact with the natural world more important than ever, so our towns and cities need to provide very easy access to relatively wild, green landscape. For urban folk, wildlife on the doorstep is almost the only wildlife that counts. Ironically, almost all the commitments to habitat management, from central government funding and statutory protection, to practical action by enthusiasts on the ground, is directed towards remote rural landscapes, keeping rare species in protective custody, for the pleasure of the privileged few. If these exclusive habitats are to survive, then they need championing by the urban majority, who in turn must be inspired through familiarity with the wildlife they can see every day of the week. However, even densely built-up places have open space in the form of private gardens, and the official green open space of sports fields, public parks, school playing fields, hospital and college grounds, road verges and golf courses occupies substantial areas. There is a third category of green open space in most urban areas - the 'unofficial' wild space, often labeled derelict, where nature has re-colonized neglected backyards and abandoned areas [railway land, worked out mineral quarries, demolished factories and tipped land has created a complex landscape of disturbed ground, mixed mineral substrates, and varied vegetation which is often rich in the wildlife that thrives best in pioneering communities]. A fourth category is the declared forest areas, wildlife sanctuaries and proposed forest areas. The extent of this unofficial wild space is immense, and is continually expanding and maturing too. [In some studies in UK it was found that the woodland cover had almost doubled

in a 12 year period, and that almost half the new woodland had emerged unaided, simply through natural colonization of neglected 'derelict' land']." (Bains, 1995)

Creative stewardship of existing green spaces, be they in the public or private domain, can generate additional space for habitats and foliage. Thus, substantial areas of large parks can be converted to woodlands, thereby reducing the demand for resources. Similarly, large campus areas need not have cultivated greens. A change in vegetation assembly can also increase the foliage surface – thus, hedges and creepers provide small habitats and very often, a much higher density of foliage and leaf surface area, as compared to trees.

Access to nature provides an antidote to the stresses of urban life. Large natural spaces have the potential to become major bio-diversity habitats which have psychological, educational and health benefits – these are indeed the needs of deprived urbanites in contemporary times. These values will become increasingly precious as the city densifies even further in the coming years. This leads to the emerging concept of **eco-psychology** which states that we have a built-in genetic blueprint that feeds our need to commune with nature. We know natural environs to be destressing – in experiments it has been noted that blood pressure drops by 10-15 points by exposure to landscape paintings - exposure to landscape cuts the need for painkillers and leads to faster recovery and office staff located adjacent windows overlooking greens are said to be less stressed and have fewer sick days. Anyone would testify from their experience in areas of Delhi such as Hauz Khas, Nehru Park, Jahanpanah City Forest, JNU Campus or the Jaipur Polo Grounds, where the harsh sounds and sights of the city vanish, and tranquility returns.

A major lacuna is the fragmented and isolated nature of urban greens which prevents gene flows through a lack of corridor connectivity thereby resulting in vulnerable disease prone populations of flora and fauna. It should be an objective of environmental planning in urban areas to bring about such connectivity to ensure healthy gene pools as well as increased species diversity through an enlarged resource base. A study undertaken by researchers at the University of Florida showed

that more birds were flying between natural areas that had a connection, than between natural areas that weren't connected. Birds eat berries, and are important dispersal agents for the seeds in the berries. In a similar study by the same group, it was shown that plants were more consistently pollinated between connected natural areas than unconnected ones. This means that the butterflies and bee pollinators could make it safely from one area to the other through the connecting corridor. Thus wildlife corridors (biodiversity corridors) are corridors of land planted with appropriate vegetation, which allow flora and fauna to move across a wider territory. This allows the wildlife to:

- Respond to environmental variability, e.g. move from food/water scarce areas to food/water plentiful areas
- Respond to population pressure - move from over-populated to under-populated areas
- Access a wider range of breeding partners, thus preventing inbreeding and loss of genetic diversity in a local population.

The concept of **wildlife gardening** is emerging where large parks are meant to reserve certain areas for woodlots, where large gardens include a variety of material for microhabitats as well as vegetation which looks beautiful with little maintenance. Gardens cover up to a quarter of the land surface in our towns and cities and act as a 'food supermarket' for visiting and breeding birds and mammals. They support great plant diversity and are a major wildlife habitat for invertebrates, on which most other animals – as well as essential life processes – depend. Insects pollinate plants, earthworms maintain garden soil, while other invertebrate species help to recycle organic matter.

The greening of vertical surfaces and vertical elements in the urbanscape offer opportunities for creating habitats while reducing cooling requirements and maintenance costs. Buildings can offer opportunities for plants and animals to colonize. Tall buildings are the urban equivalent of cliffs, and provide suitable nest sites for birds such as kestrel and peregrine. Increasingly, buildings are being designed deliberately to provide habitats for wildlife and contact with nature for their occupants. These initiatives

include traditional window boxes, climbing plants and roof gardens, as well as more innovative ideas such as providing suitable substrate on roofs to allow wasteland flora and fauna to colonize naturally. Even walls and paving can provide habitats for ferns, mosses and lichens.

Wetlands offer some of the most productive natural ecosystems as transitional areas between ter-restrial and aquatic environments. Wetlands could be incorporated into urban greening projects to provide particularly important habitats for local and migrating fauna contributing to maintaining a healthy biodiversity in the area.

Typology of Green Spaces and Corridors

The NCT Delhi offers a wide variety of green spaces which can be classified as:

i) Protected Areas—Wildlife Sanctuary, existing protected, reserved an, proposed forests
ii) Important Bird Areas—Okhla Bird Sanctuary
iii) District Parks and other large parks
iv) Large Campus and Institutional areas
v) Riverine wetlands and floodplain
vi) Marshes, lakes, ponds
vii) Buildings and parking lots
viii) Individual garden patches
ix) Quarries, flyash deposits, landfill sites
x) Natural drainage channels
xi) Roadside greens, railway track corridors

Apart from the first two categories other categories would fall into unprotected area classification designated as 'local nature reserves' or 'ecological services areas'. The designation would not result in change of landownership but would impose conditions regarding the vegetation characteristics in the designated area with the willing consent of the owner.

Planning for Delhi

The biodiversity plan for Delhi thus proposes to bring substantial area into the green area network, change the vegetation characteristics of existing areas insofar as possible, and increase the foliage density within the area constraints with a view to:

i) ensure ecological services from underutilized areas
ii) naturalizing of large urban greens to reduce resource inputs
iii) enhance density of green cover
iv) reduce 'heat island effect'
v) enhance habitat availability for flora and fauna
vi) connectivity amongst isolated green fragmented area through the urban landscape insofar as possible
vii) modify the micro-climate and thus impact the energy budget of the city
viii) enhance carbon sequestration locally and increase oxygen generation
ix) enhance sustainability

Delhi, with its floodplain and its 5 drainage sub-basins, each a minor bio-geographic region with differentiated vegetation characteristics and resource endowments, offers numerous possibilities a few of which are outlined below:

i) Campus: A major example is the Mahipalpur Defence Land. This is part of the South Ridge and is scattered with building elements of several army formations. About 2 sq.km. of pitted and open scrub area and assorted other open spaces in the individual campuses is available with a wetland near Mahipalpur village. As per INTACH's plan for the Army about 80,000 trees, several hedges and shrubs are to be planted here. This is contiguous to DDA's Aravalli Biodiversity Park and the intervening barrier would be in the form of a fence permitting movement of fauna. Or take the Central Road Research Institute on Mathura Road with its acres of manicured lawns which could provide

a large habitat through wildlife gardening, hedges, creepers and woodlots. Many more examples can be added – CRPF camps at Chhawla and Bijwasan, ITBF camp at Tughlaqabad, the entire Delhi Cantonment.

ii) District Park/Large Park: District Park in East Delhi would have major elements of a tree woodlot and shrubbery. This vegetation assembly would be extended to Vivekanand College, Yamuna Sports Complex, through other institutions to Surajmal Park and as yet un-built CBD Shahdara all the way to Shahdara Drain.

iii) Riverine Wetlands and Floodplains: The entire area of the 97 sq.km. Yamuna floodplain is to be allowed to regenerate naturally especially along the water line to redevelop habitats for reptiles and amphibians. Wetlands along the remnants of the old Agra Canal and at the outfall of Barapullah Drain could be prime candidates for this category.

iv) Lakes and Ponds: The edges of lakes and ponds are to be maintained as natural shorelines with reed vegetation to encourage nesting of resident and migratory birds. The tendency to make hard edges has to be avoided and where existing needs to be undone. Examples could be Sanjay Lake, Bhalaswa Lake, village ponds at Ladpur and Karala.

v) Marshes: Jehangirpuri Marshes in north Delhi comprise of a 100 ha area. Again hard edges would need to be avoided and instead wetland vegetation would have to be regenerated to create terrestrial habitats for wildlife. The area can be extended to smaller marshlands further north and DDA would have to be persuaded to release some of the lands from other as yet un-built uses.

vi) Buildings & Parking Lots: Large paved areas devoted to parking are becoming heat islands. The growth of hedges and trees on verges and curbs, shading with supported creepers would reduce the heat island effect

while supporting wildlife populations. Nehru Place, with its acres of parking areas and paved plazas, could be a pilot for this. Its buildings, with their ugly facades, guzzle large amounts of electricity, could be co-opted for a demonstration of vertical greening.

vii) Patchwork of Individual Gardens: Owners of residences with large gardens could be persuaded to adopt wildlife gardening and reduce the manicured lawn area. For e.g. the 100 bungalows at Lodi Estate covering 50 acres could easily incorporate more hedges, trees and creepers in their gardens as well as in the wide road verges.

viii) Quarries, Landfill sites, Flyash deposition sites: Two good examples can be flyash site at Nagli Machhi, 40 ha floodplain area at the junction of Ring Road and NH 24 which should be available for specific vegetation planting as also 350 ha flyash deposition area for Badarpur power plant. Landfill sites at Ghazipur and Okhla are beginning to overflow and these should be converted to well vegetated green areas with an eye to habitat development and not necessarily an artificial beauty.

ix) Ecological Corridor: Delhi is blessed with major stormwater drainage channels. Chief amongst these are the Supplementary Drain, Najafgarh Drain, Shahdara and Ghazipur Drains and several others. These offer copious areas for connectivity corridors and aquatic habitats. INTACH is working with DDA on 4 km. of Palam Drain in such an exercise.

x) Railway Tracks & Arterial Roads: After leaving a safe gap for expansion the edges of railway tracks offer major scope for corridor development. An example is the eastward bound railway line passing through Anand Vihar which has plenty of neglected strips.

xi) Green Belt of NCT Delhi: Under MPD 2021 the green belt of Delhi on the west side is to be 1 revenue village

in depth. Here again, with cooperation of owners, typical consumptive farmhouse vegetation can be curtailed and incentives planned for maximizing foliage density and tree cover, with perforated boundary barriers allowing movement of fauna. The area under consideration is easily 40 sq.km.

xii) The proposed groundwater recharge strategy for Delhi worked out for Delhi Jal Board (DJB) by INTACH can incorporate several aquatic habitat areas in the drainage system.

xiii) Ecological Services Areas: Several neglected backyard areas are available in the city. For example there are large areas of scrub vegetation between Shooting Range at Sangam Vihar and Lal Kuan, areas around Rajokri Protected Forest which can be regenerated.

xiv) Lastly, connectivity should be attempted between existing Protected Areas (Pas), proposed forests, wilderness areas and local nature reserves proposed above.

A Methodology for Action

A short methodology for action is outlined here. This is confined presently to the basic action of identifying suitable sites and corridor possibilities. Satellite imagery and ground surveys would be used to identify suitable sites and their characteristics. This would be done on the basis of administrative units as well as sub-basins to facilitate implementation. The availability of the sites would be further validated with the Masterplan and the landowning authority. In the case of high potential sites an effort could be made to convince the planning authority to change the landuse. The map would be grided to facilitate planning and the identified sites would be assessed for their ecological baseline. Awareness of the concept would be raised through workshops with select stakeholders and media interaction. Community inputs would be obtained by interaction with neighbouring communities. Corridors possibility for connecting the isolated sites would be worked out and validated with various authorities. Detailed proposals for each site would be prepared by ecologists and landscape architects

References

Baines, Chris (1995) Urban areas. (In) Sutherland William J. and Hill David A. (Eds.) Managing Habitats for Conservation, pp 362 – 380.

ANNEXURES

Annexure A:

PROGRAMME

9:30 onwards **Registration**

10:00 – 11:00 **Opening Session**

Welcome - Mr. Samar Singh, Senior Advisor, INTACH.

Opening Address - Mr. S. K. Misra, Chairman, INTACH.

Address - Mr. Adam Grotsky, Director, USIEF.

Introduction - Dr. Amita Sinha, Sr. Fulbright Scholar, INTACH and Professor, Department of Landscape Architecture, University of Illinois.

Release of Publication - Peoples' Perception on river Yamuna (Yamuna Jiye Abhiyan/ Centre for Media Studies).

Inaugural Address - Smt. Sheila Dikshit, Hon'ble Chief Minister of Delhi.

Vote of Thanks - Mr. Girish Kaul, USIEF.

11:00 – 11:30 **Tea**

11:30 – 13:30 **Session I: Natural Environment of Delhi**

Chair: Shri. O.P. Jain

Speakers:

1. *Yamuna River Ecology:* Prof. Brij Gopal
2. *Delhi Ridge*: Dr. Surya Prakash (Jawaharlal Nehru University)

3. *Urban Biodiversity:* Prof. C.K. Varshney
4. *Lakes, Wetlands & Drainage Network :* Ms. Ritu Singh (INTACH)

Panelists:

1. Prof. Mohan Ram
2. Shri Manoj Misra (Yamuna Jiye Abhiyan)
3. Dr. Shah Hussain (Delhi University)
4. Dr. Faiyaz Khudsar (Delhi University)

Open Discussion

13:00 – 14:00 **Lunch**

14:00 – 15:45 **Session II: Policy, Planning, Documentation and Design Approaches**

Chair: Prof. K.T. Ravindran

Speakers:

1. *Conserving Historic Gardens*: Dr. Priyaleen Singh (School of Planning and Architecture)
2. *Monument Greens and Heritage Corridors*: Shri Tapan Chakravarty (School of Planning and Architecture)
3. *City Greens*: Ms. Savita Bhandari (Delhi Development Authority)
4. *Greenways* : Shri Akash Hingorani (Oasis Designs Incorporated)

Panelists:

1. Shri Ratish Nanda (Aga Khan Foundation, New Delhi)
2. Shri Neeraj Manchanda (Neeraj Manchanda Associates)
3. Dr. Jyoti Sharma (DCR University of Science and Technology, Murthal, Haryana)
4. Shri. Subhash Chandra (Dir. Hort., NDMC)

Open discussion

15:45 – 16:00 **Tea**

16:00 – 17:30 **Session III: Green Delhi Vision 2021**

Chair: Shri J.K Dadoo (Secretary, Environment, Delhi Government)

Speakers:

1. Shri. Manu Bhatnagar (INTACH)
2. Shri. A.K.Jain (Former Commissioner Planning, DDA)
3. Shri. Pradeep Sachdeva (Pradeep Sachdeva Design)
4. Prof. Vikram Soni (National Physics Laboratory)

Panelists:

1. Dr. Rohit Jigyasu (Ritsumeikan University, Kyoto, Japan)
2. Ms. Savita Punde (Indian Society of Landscape Architects)
3. Shri. Manit Rastogi (Morphogenesis)
4. Prof. Mihir Deb (Delhi University)

Open Discussion

Annexure B:

List of Participants

1. Shri A.K. Jain
   Retd. DDA Commissioner
   (Planning)
   New Delhi
2. Shri Akash Hingorani
   Oasis Design
   New Delhi – 110070
3. Ms. Alka Tomar
   Centre for Media Studies,
   New Delhi.
4. Ms. Ankila Hiremath
   Fellow & Regional Director
   Ashoka Trust for Research
   in Ecology and Environment
   (ATREE)
   New Delhi
5. Prof. Anne Feenstra
   AFIR Architects
   Visiting Professor
   School of Planning and
   Architecture
   New Delhi 110002
6. Ms. Ayla Khan
   Assistant Professor
   Faculty of Architecture
   and Ekistics
   Jamia Millia Islamia
   New Delhi
7. Mr. Balthazar Sieders
   Morphogenesis
   New Delhi 110 017
8. Ms. Bela Butalia
   Deputy Editor &
   Coordinator (Nature Group),
   India International Centre,
   Lodhi Estate, New Delhi.
9. Prof. Brij Gopal
   Professor of Ecology
   School of Environmental
   Sciences,
   Jawaharlal Nehru University,
   New Delhi.
10. Dr. C K Varshney
    Former Dean & Professor,
    School of Env. Sciences,
    Jawaharlal Nehru
    University,
    New Delhi – 110 085

11. Shri Diwan Singh
Natural heritage First
New Delhi

12. Mr. Faiyaz Khudsar
Yamuna Biodiversity Park,
Wazirabad, New Delhi.

13. Prof. H Y Mohan Ram
Former Head & Professor
Department of Botany
Delhi University
New Delhi – 110009

14. Mr. Ingo Wey
Certitude,
Auroville
Tamilnadu - 605101

15. Shri J K Dadoo
Secretary (Environment)
Govt. of NCT of Delhi
New Delhi – 110 002

16. Shri Janhwij Sharma
Director (Conservation)
Archeological Survey of India
New Delhi

17. Mr. John Stallmeyer
Assistant Professor,
School of Architecture,
University of Illinois at
Urbana-Champaign, USA

18. Commdr. K.B. Singh
Delhi Bird Group

19. Shri K C Johorey, IAS
(Retd.) &
Mrs. Sudha Johorey
Chairman,
Eco Development
Foundation, Parliament
Street, New Delhi 110001

20. Prof. K T Ravindran
Prof. & Head of Dept.
(Urban Design)
School of Planning and
Architecture, New Delhi
&Chairman, Delhi Urban
Arts Commission.

21. Ms. Kamal Preet
Dy. Conservator of Forests
(HQ)
Dept. of Forests & Wildlife
Govt of NCT Delhi
2nd Floor A Block
Vikas Bhawan, IP Estate,
New Delhi – 110 002

22. Dr. M.A. Haque,
Director,
Ministry of Environment &
Forests,
Paryavaran Bhawan,
C.G.O Complex,
New Delhi - 110003

23. Shri M. Shah Hussain
Scientist Incharge
Aravalli Biodiversity Park
New Delhi.

24. Shri Manoj Misra
Convener
Yamuna Jiye Abhiyaan
Delhi-110091

25. Prof. Mihir Deb
School of Environmental
Studies
University of Delhi
Delhi – 110 007

26. Ms. Munazzah Bilal
Center for Media Studies,
New Delhi.

27. Shri OP Jain
Sanskriti Foundation
New Delhi – 110 016

28. Dr. Priyaleen Singh
Dept. of Architectural
Conservation
School of Planning and
Architecture
New Delhi – 110 002

29. Ms. Priya Verma
Center for Media Studies,
Vatavaran
New Delhi

30. Shri Ravindran Bhan
Ravindran Bhan &
Associates
New Delhi – 110024

31. Mr. Rohit Jigyasu
Conservation and Risk
Management
Consultant

32. Dr. S.M. Nair
Programme Director,
Centre for Environment
Education, Delhi
New Delhi- 110017

33. Maj Gen S N Dubey
(Ret'd)
Soni Foundation trust
Roorkee,
Uttarakhand 247667

34. Dr. S.P. Bansal
Addl. Commissioner
(Planning)
Delhi Development
Authority
New Delhi

35. Shri Sharad Gaur
Regional Director
Centre for Environment Education
New Delhi – 110 049

36. Dr. Shikha Jain
Co- Convenor,
INTACH Haryana Chapter,
New Delhi

37. Shri Subhash Chandra
Director (Horticulture)
NDMC
New Delhi

38. Shri Surya Prakash,
School of Life Sciences
Jawaharlal Nehru Univ.
New Delhi

39. Ms. Swapna Liddle
Co- Convenor,
INTACH Delhi Chapter,
New Delhi

40. Shri. Tapan Chakravorty
Visiting Faculty
School of Planning and Architecture
New Delhi 110002

41. Shri Trilok Narayan
Jawaharlal Nehru University,
New Delhi – 110 085

42. Shri Ujan Ghosh
VP, Institute of Urban Designers
Noida, U.P. 201301

43. Shri V.K. Jain
TAPAS
Mehrauli, Delhi

44. Ms. Vibha Arora
Dept. of Humanities and Social Science,
IIT, Hauz Khas,
New Delhi

45. Mr. Vijay Dhasmana
Aga Khan Trust for Culture
New Delhi – 110 014

46. Shri. Vikram Soni
National Physical Laboratory &
Citizens for Preservation of Quarries and Lake Wilderness
New Delhi – 110 054

47. Mr. Vinod Sawle
Delhi Development Authority
New Delhi

USIEF

1. Mr. Adam Grotsky
Executive Director

2. Shri Girish Kaul
Program Officer - U.S. Program

INTACH

1. Shri S K Misra
Chairman

2. Shri Yogendra Narain
Member Secretary

3. Shri Samar Singh
Sr. Adv. & PD (NH)

4. Prof. Amita Sinha
Dept. of Landscape Architecture
Univ. of Illinois, Urbana Champaign &
Sr. Fulbright Scholar.
(based at INTACH from Feb to May 09)

5. Shri Arun Gupta
Advisor (HT)

6. Shri Jagdish Chander
Dir. (A&F)

7. Prof. R C Aggarwal
PD (AH)

8. Shri Manu Bhatnagar
Advisor (NH)

9. Ms. Ritu Singh
Consultant

10. Ms. Swati Kittur
Consultant

11. Ms. Adorin Amnghainem
Sr. Research Associate

12. Ms. Maya Pareva
Sr. Research Associate

13. Mr. JC Arora
PS to Sr. Adv & PD(NH)

14. Mr. Devendra Singh
Gr. Support Exe.

Annexure C:

DELHI'S STATE ANIMAL, BIRD, TREE & FLOWER

(INTACH's proposal to the Delhi Government)

State Animal - Delhi no longer has any large mammal, which makes the choice difficult. However, earlier the Blackbuck (*Antilope cervicapra*) was not uncommon around Delhi and some of these animals are still found in the Asola Wildlife Sanctuary. The species is highly endangered and hence could be considered for being declared Delhi's State Animal. The other option is the Nilgai (*Boselaphus tragocamelus*), but this species is quite common in the adjoining States and does not enjoy the same conservation status as the Blackbuck, which is also a far more attractive animal.

State Bird – The Indian Peafowl (*Pavo cristatus*) is the best candidate for this category, for obvious reasons. Besides, it is the National Bird and enjoys full protection under the Wild Life (Protection) Act. Although Delhi has a sizeable population of the bird, there are certain concerns about long term survival that need attention. The other options in this category are the Purple Sunbird (*Nectarinia asiatica*) and the House Sparrow (*Passer domesticus*). The Purple Sunbird is a tiny, attractive bird, mostly seen in gardens, parks and open forest areas; its main diet is the nectar of various flowers and, in the process, the bird has a role in the cross-pollination of plants. The House Sparrow is a well known bird that was very common, but this is no longer so, thereby raising fairly widespread concern and hence it has been short-listed.

State Tree - The Neem (*Azadirachta indica*) can be a good choice in this category. It is an indigenous species that is well known and to which people relate for a variety of purposes, including its medicinal values. The other suggestion is the Palikhan, also called Pakur (*Ficus virens*), also an indigenous species. Its well-shaped evergreen canopy makes an excellent shade tree, especially

suitable for gardens, parks, road-sides and other open spaces. The other attractive features of the tree are the foliage renewal in the spring season and the numerous fig-like fruits that attract lots of birds and squirrels.

State Flower – The Rose can be a suitable choice in this category. It is a very popular flower all over the country and Delhi is known for its rose gardens and rose shows. The Rose Society of India is also located here. No other State has chosen the Rose so far. The other option is the Lotus, an attractive flower, also the designated National Flower.

Annexure D:

NATURAL HERITAGE DESCRIPTION

The term 'natural heritage' finds mention in certain important policies adopted by the Government of India, from time to time, viz. National Forest Policy 1988, National Conservation Strategy and Policy Statement on Environment and Development 1992, and National Environment Policy 2006. The only Indian statutory law so far that mentions 'natural heritage' is the Scheduled Tribes and Other Forest Dwellers (Recognition of Forest) Rights Act 2006. The Biological Diversity Act 2002 refers to 'biodiversity heritage sites'. But, none of these provide any clear definition or description of 'natural heritage'. Hence, it is very necessary to attempt this before undertaking the exercise of listing and documentation.

The above-mentioned issue was addressed recently in the National Workshop on Natural Heritage organized by INTACH, with the support of the Ministry of Environment and Forests, on 4-5 September 2008. The workshop was attended by senior officials of the Ministry of Environment and Forests (MoEF) and State Forest Departments, representatives of UNESCO and IUCN offices in India, Wildlife Institute of India and other experts. A major outcome of the workshop was the following description of 'natural heritage'.

"Natural heritage consists of terrestrial or aquatic sites or features, including riverine, wetland, coastal or marine areas, along with their varied biota, processes and occurrences, that are essentially nature's creation and / or have ecological, scientific, cultural, spiritual or aesthetic significance for the present and future generations, and deserve conservation action".

Explanation

"Typically, a natural heritage area or site is representative of an ecosystem type, or a unique ecosystem,

or rich in species diversity, or critical to the provision of ecological services, or with exceptional aesthetic value, or manifesting strong eco-cultural links, or hosting interesting ecological occurrences.

Such a site could be pristine or near pristine wilderness area, regenerated area (with or without human intervention), or an area managed for scientific or conservation objectives.

Typically, a natural heritage species is a wild species or a relative thereof, or cultivated, or domesticated species (and only in exceptional cases an exotic species) that is threatened.

Knowledge and practice related to the conservation, regeneration, and sustainable use of natural heritage sites, occurrences and species would also be considered a part of natural heritage, deserving conservation attention.

For the purpose of listing and documentation, priority should be given to such sites and species whose conservation has the support and involvement of local communities, except where any threatened outstanding eco-system or species needs urgent attention".

The above-mentioned formulation has been circulated widely on the INTACH Natural Heritage e-Network, which has been established following a recommendation at the above-mentioned National Workshop, and has been found most acceptable. On this basis, further work on identification, listing and documentation can be undertaken. The exercise has to logically start at the district level in each State and Union Territory. The inventories so prepared should form the basis for the National List or Inventory, and then the World Heritage List.

USIEF promotes mutual understanding between the nationals of India and the nationals of the US through the educational exchange of outstanding scholars, professionals and students. Since its inception, USIEF has awarded approximately 15,000 Fulbright, Fulbright-Nehru, and other prestigious grants and scholarships in almost every academic discipline.

Tapping the talent of Fulbright students and scholars, USIEF holds dozens of academic or professional workshops each year. In addition to fellowship support, USIEF services include advising Indian citizens on higher education opportunities in the US. USIEF also consults with Indian and US universities interested in developing linkages and exchanges.

United States-India Educational Foundation (USIEF)
12 Hailey Road, New Delhi 110 001
E-mail: info@usief.org.in
Tel.: +91-11-4209-0909/2332-8944
Fax: +91-11-2332-9718
Website: http://www.usief.org.in/

INTACH

INTACH was founded in 1984 with the vision to spearhead heritage awareness and conservation in India. In the past two decades INTACH has pioneered the conservation and preservation of not just built heritage but also natural and intangible heritage.

Today INTACH is the nation's premier non-government organization working in the field of heritage conservation, with a countrywide network of about 140 chapters. Its various divisions work towards documentation and conservation of the nation's cultural and natural resources and initiate projects to sensitize the public, particularly the future generations, towards their heritage, giving the respect and dignity it deserves.

Indian National Trust for Art and Cultural Heritage (INTACH)
71, Lodhi Estate, New Delhi – 110 003
Email: intach@del3.vsnl.net.in
Tel. 24631818, 24641304, 24632267, 24632269, 24692774, 24645482
Fax 24611290
Website: http://www.intach.org/