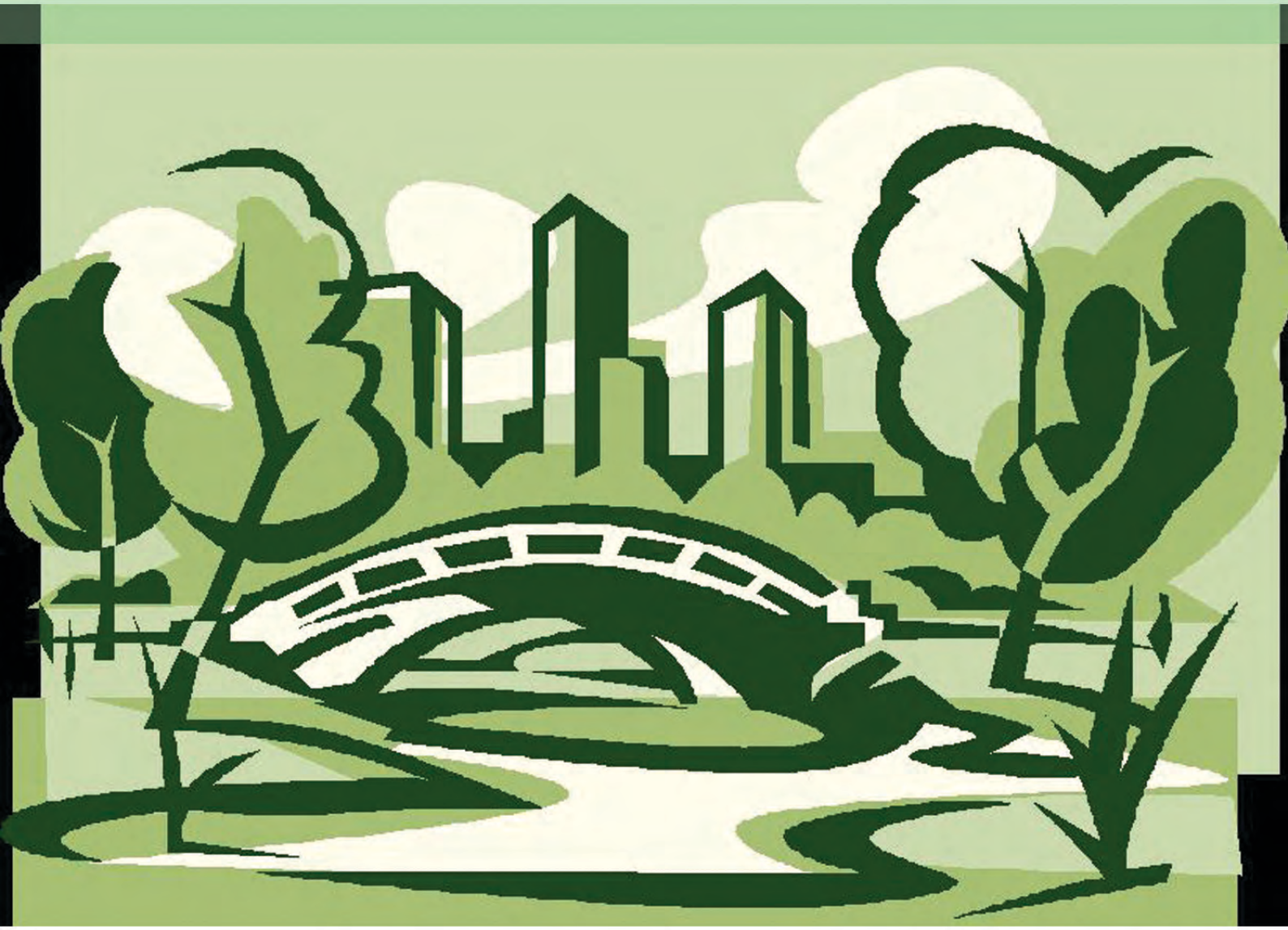
# Urban Greening Guidelines, 2014



सत्यमेव जयते

February, 2014

Town and Country Planning Organisation
Government of India
Ministry of Urban Development

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## PREFACE

***Urban Greening Guidelines, 2014*** is the outcome of blatant and random concretization of pavements in Indian cities. Of late, a number of Urban Development Authorities and Urban Local Bodies have undertaken large scale concretization of pavements which has resulted in destruction of a large number of trees by first rendering those weak and reducing their lives and consequently most of them falling down on account of moderate winds and storms. In 2000, Ministry of Urban Affairs and Employment had published *Guidelines for Greening of Urban Areas and Landscaping*. Prior to this, in 1980, TCPO had published *Guide on Plant Materials for Landscaping in India*. While preparing the Urban Greening Guidelines, both the documents have been extensively referred in the context of integrating urban greens in the overall planning and development scenario. The Guidelines suggests steps for protection of trees and enhancing their lives while undertaking concretization of pavements.

The Metropolitan and UT Division of Town and Country Planning Organization has done commendable work in bringing out the Guidelines, which will prove useful for State Town and Country Planning Departments, Urban Development Authorities, Urban Local Bodies, Academicians, Researchers and students as reference material.

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***February, 2014***

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# 1 Introduction

Census of India, 2011 revealed that 31.16% of the country's population resided in urban areas. In absolute terms, it was accounted for 37 crore population. The urban component is expected to rise to around 40% by 2026. As India's cities continue to grow demographically and spatially, the challenges and opportunities of managing them in terms of infrastructure provisioning are enormous. While the number of urban centers has increased manifold between 1901 and 2011, the urban population increased six fold, resulting in a top-heavy urban settlement hierarchy with a large number of primate settlements. It is expected that the number of towns and cities which was 7933 as per Census, 2011 is likely to cross the 10,000 mark in next decade.

Unprecedented urbanization has been fuelled by rapid economic growth and even more rapid industrialization especially in the past three decades or so. With globalization, this trend of rapid economic growth and urbanization is likely to accentuate further. In 1901, Kolkata was the only metropolitan city (million plus) in the country. The number of metropolitan cities has increased from 5 in 1951, to 12 in 1981, 23 in 1991, 35 in 2001 and 53 in 2011. The 53 metropolitan cities together accounted for a population of about 15.8 crore (158 million) in 2011, i.e. 42% of the urban population of the country. It is expected that their number would be about 100 plus in the next two decades.

By 2051, India would be most populous country with 170 crore (1.70 billion) people and per capita land availability would be 0.19 Ha. By 2051, 82 crore (820 million) people will live in urban settlements constituting about 48 % of the total population. Cities in the country would emerge as centers of both hope and despair: while being engines of economic and social development they may also be congested centers of poverty and environmental degradation.

The urbanization process will naturally lead to a large amount of prime agricultural land being converted to urban use, mostly at the periphery of settlements. However, at the same time, it is observed that a large majority of the new urban population does not have easy access to land and that much of the new development is not adequately serviced resulting in unauthorized and haphazard development particularly in the peri-urban areas.

Population growth and high densities in cities can adversely impact natural and environmental resources. Preservation of vegetated areas or green spaces improves the quality of life by providing residents with natural settings for leisure and recreation and by safeguarding the quality of basic resources such as air and water. In fact, adequate tree cover is an essential link in the bio-diversity chain.

The biggest challenge for urban development is not only to ensure greening of cities and towns but also to maintain and strengthen the existing green cover. Urban greening is an integrated approach to the planting, care and management of all vegetation in cities, towns, townships and informal settlements in urban and peri-urban areas. The planning for urban biodiversity presents a number of challenges; higher population densities, strong development pressure and competing demands on space need to be addressed. However, cities are dynamic landscapes that offer opportunities for regeneration and enhancement through incorporating innovative designs and adapting best practices. In the present scenario, in view of limited space in cities and towns, the objective of planning policies is based on optimizing the sustainability of urban areas, backed by promoting higher densities commensurate with augmented urban infrastructure. These trends are likely to continue in the immediate future as integrating land use and transport has become necessary in order to ensure compactness of cities and towns, encouraging vertical growth and mixed use along transit corridors to reduce dependence on personalized modes and encourage use of public transport.

Realizing the importance of maintaining and preserving urban greens, it is imperative to prepare ***Urban Greening Guidelines*** which will act as a model for States and Cities particularly the State Town Planning Departments, Urban Development Authorities and Urban Local Bodies who are responsible for managing them.

**Fig. 1.0:** ***General Illustrations of Urban Greens***

## 2 Objectives

The objectives of the *Urban Green Guidelines are* –

- To highlight the impact of urbanization on urban greenery.
- To suggest practices and methods for protecting and enhancing urban greenery in a sustainable manner.
- To identify the key stages in planning and development where urban greenery may be integrated with the built environment.
- To recommend suitable guidelines for enhancing urban greens.

## 3 Importance of Urban Greens

Urban Green Spaces are critical for making our cities sustainable, healthy and energy efficient. However, for Urban Green Spaces to contribute to the optimum, they have to be planned, designed, developed and managed/maintained appropriately so that they are accessible both in terms of area and population coverage. It is a fact that urbanization in India will continue unabated. The Urban Green spaces generate a diverse set of ecosystems of substantial significance for human well-being and their dynamics are shaped by human activities. Many green spaces in cities that have got disconnected from the wider environment tend to lose biodiversity characteristics due to continuous construction activities. Hence, protecting green spaces in isolation will often fail to sustain the capacity of urban ecosystems to generate value and they have to be well integrated in the overall city landscape.

**Ecological Benefits -**

- Trees absorb pollutants; moderate the impact of human activities by, for example, absorbing pollutants and releasing oxygen.
- They contribute to the maintenance of a healthy urban environment by providing clean air, water and soil.
- Green vegetation has been shown to lower wall surface temperatures by 17°C, which led to a reduced air conditioning load by an average of 50%.
- They improve the urban micro climate and maintain the balance of the city's natural urban environment.
- They preserve the local natural and cultural heritage by providing habitats for a diversity of wildlife and conserve a diversity of urban resources.

Despite the enormous benefits that urban green spaces provide there is a serious lack of information about the quantity and quality of urban green spaces. Data on per capita availability of open spaces is scanty and scarce. However, with new integrated approaches to combine strategic planning for green spaces with innovative design and delivery and the active involvement of the community at all levels, urban green spaces may be part of the ecological development of city. Ideally there has to be struck a right balance between the built and natural environment. Amidst concretization in the cities and towns in terms of building multi storied apartments, commercial complexes and institutional buildings, there has to be conscious efforts from Urban Local bodies and Urban Development Authorities to provide for adequate green cover.

**Physical Benefits -**

- Urban forests act as temperature buffers providing shade in the summer, and wind breaks in the winter in addition to reducing noise pollution and $CO_2$ levels, and providing a habitat for wildlife.
- Urban greening offers improvements in air, water, and land resources by absorbing air pollutants, increasing water catchment in floodplain surfaces, and stabilizing soils.

**Social Benefits -**

- Green spaces provide a refreshing contrast to the harsh shape, colour, and texture of buildings, and stimulate the senses with their simple colour, sound and smell.
- Particular types of green space may offer a bigger diversity of land uses and opportunities for a wide range of activities, help to foster active lifestyles, and can be of real benefit to health.
- Well-managed and maintained green spaces contribute to social interaction by creating opportunities for people of all ages to interact.
- Urban green spaces emphasize the diversity of urban areas by reflecting the different communities they serve and meeting their varying needs.
- They enhance cultural life by providing venues for local festivals, civic celebrations and theatrical performances.

- Urban green spaces provide safe play space for children, contribute to childrens' physical, mental and social development and play an important role in the basic education of schoolchildren with regard to the environment and nature.

**Planning Perspective**

- From the planning perspective, a hierarchy and network of quality green spaces integrating residential areas with commercial and other uses improve the accessibility and attractiveness of local facilities and employment centers.
- Well-designed networks of green spaces help encourage people to travel safely by foot or by bicycle for recreation.
- Furthermore, well-designed urban green spaces provide a barrier to noise and can effectively function as visual barriers.

**Economic Benefits -**

- Property owners value urban greenery by the premium they pay to live in the neighbourhood of urban green spaces and public parks. Plots and flats abutting park add to value. In densely populated areas this effect is even more pronounced. For example, view of green spaces and proximity to water bodies increases the real estate prices.
- Impact of neighbourhood parks on the transaction price of multi-storied residential units in cities illustrate the fact that neighbourhood parks could increase price.
- Urban shady trees offer significant benefits in reducing building air-conditioning load and improving urban air quality by reducing smog. The savings associated with these benefits vary widely by climatic region.

## 4 Types of Urban Greens

While preparing a Master Plan or a Development Plan, detailed analysis of existing land use pattern is done. Typically a land use plan is formulated indicating broad land uses and networks based on the projected population. The land use distribution norms are dependent on parameters of Density and Work force. Green areas are normally classified as Recreational use in the Master Plan. As per the UDPFI Guidelines, 1996 of Ministry of Urban Development , the proportion of recreational areas to the total developed area should be between 12-14% in small towns, 18-20% in medium towns and large cities and 20-25 % in metropolitan (million plus) cities. Generally, area under parks, playgrounds, botanical gardens, parks, open spaces, water bodies and other natural features are classified as *Recreational use.*

The types of urban greens in settlements are as follows:-

**Reserved forest:** ***Reserved Forest*** is an area duly notified under the provisions of the Indian Forest Act, 1927 or the State Forest Acts having full protection. In Reserved Forests, all activities are prohibited unless specifically permitted. Reserved Forest is notified under *Section 20 of the Indian Forest Act, 1927* [Act 16 of 1927] or under the reservation provisions of the Forest Acts of the State Governments.

**Protected Forest:** They are found in urban and peri-urban areas generally secured by appropriate fencing or constructing a compound wall or combination of half wall and wire mesh. Areas under notified / protected forests are protected under the Forest Act, where no construction activity is allowed.

**National Park:** ***National Park*** is an area which is set aside for the protection and conservation of outstanding natural fauna, flora, geological formations and natural scenic areas. The park prohibits hunting, killing or capturing of fauna, or deprivation of any wild animal of its habitat, or destruction and collection of flora, and use of weapons except for the improvement and better management of wildlife therein, and on condition that these issues are handled by, or are under the control of, the park authorities.

**District Park:** ***District Park*** is a designated term as per the hierarchy of green spaces in a city. District Park is a prominent recreation use with a sizeable area

and is developed to provide vital lung spaces. As per Master Plan of Delhi-2021, a District Park has to be provided for a population of 2, 50,000 and normally developed at the city level with an area of 40,000 sqm.

**Neighborhood Park:** ***Neighborhood Park*** is developed at the neighborhood level for a population of 10,000. The Park is conveniently located within the developed residential areas at walking distance and is planned on an area of 2,000-4,000 sqm.

**Totlots:** ***Totlots*** are the lowest level in the hierarchy of green areas, planned for a population of 2,500 as play-areas for children with an area of 125 sqm.

**Playgrounds:** ***Playgrounds*** are provided normally in the educational institutions for the use of the school and college students. They are also provided at the neighborhood level for a population of 5,000.

**Green Belt (Buffer):** ***Green Belts*** Include green girdle, park belt, rural belt, rural zone, agriculture belt, country belt, agriculture green belt. Agriculture belt, rural and country belt are synonymous terms and they refer to a stretch of the country side around and between towns separating one from the other. These areas are predominantly farm lands and they support agriculture and related functions. They may or may not be in ownership of the town/city/local body.

Green girdle, rural zone and park belt represent a similar idea, concept and function as the green belt. A *green belt* is defined as an area of land predominantly agricultural in character and located around the proposed urbanisable limits of the urban centre (town/city/) and legally established in order to:

- Check the further growth of built up areas;
- Preserve neighbouring towns from merging into one another; or
- Preserve a special character of a town.

**Green Strip:** A ***green strip*** is developed on a vacant land for example land under high tension power supply lines. It is also developed along the arterial roads separating residential areas from other uses.

**Tree Cover**- Trees planted along the roads within the right-of-way and on the central verge (median).

## 5 International norms for Urban Green Spaces

The quantum of green space required per capita varies in different contexts of the world. In the 20th century, experts in Germany, Japan and other countries proposed a standard of 40 sqm green space of high quality or 140 sqm suburb forest area per capita for achieving a balance between carbon dioxide and oxygen so as to meet the ecological balance of human well-being. Currently, developed countries have tended to adopt a general standard of green space of 20sqm park area per capita. The World Health Organization (WHO) recommends that cities should provide 9 sqm of undeveloped (unpaved) open space for every inhabitant. The WHO also suggests designing green area networks so that all residents live within a 15 minute walk to an open space. There is yet another yardstick, which refers to London but has relevance to any other city. Sir Patrick Abercrombie formulated the Greater London Plan in 1946 proposing that 1.62 Ha of open space per 1000 population was a reasonable figure to adopt for London. The plan also explained that all forms of open space need to be considered as a whole, and to be co-ordinated into a closely-linked park system, with parkways along existing and new roads forming the links between the larger parks.

***Aarhus***, with a population of 0.3 million is the second largest city in Denmark. The Green Structure Plan was prepared as part of the planning reforms of the 1970s. The political vision of Aarhus surrounded by forest had strong public support. It has been used to control urban growth and to set standards; no dwelling should be more than 500 metres from a green area of at least 6,000 sqm. In terms of structural diversity, green spaces in urban systems should essentially be developed as networks. Three main components of urban forest and green spaces are: ***Patch*** *(urban domestic gardens, public and private parks, gardens, urban forest patches etc.),* ***Corridor*** *(roads, avenues, walkways and urban greenways), and* ***Network structure*** *(layout of all the patches and the corridors connecting the patches).*

Green space coverage in cities varied markedly, averaging 18.6% and ranging from 1.9% (***Reggio di Calabria***, Italy) to 46% (***Ferrol***, Spain). Availability of urban green spaces per capita varied by two orders of magnitude, from 3-4 sqm per person in Cádiz, Fuenlabrada and Almeria (Spain) and Reggio di Calabria

(Italy) to more than 300 sqm in Liège (Belgium), Oulu (Finland) and Valenciennes (France).

Urban tree cover in the ***United States*** ranges from 0.4% in Lancaster, California to 55% in Baton Rouge, Louisiana, containing approximately 3.8 billion trees with an average tree canopy cover of 27% of urban areas.

***Curitiba***, with a population of 17 Lakh (1.7 million), is one of Brazil's large cities. In the 1970s, growing population had reduced urban green space to 1 sqm per capita. A clear priority and consistent efforts by local authorities have successfully developed green spaces, which now measure 51.5 sqm per capita.

***Canberra*** planned by Sir Walter Griffin has an extensive integrated network of open spaces that harbor more than 40% of the nationally listed threatened ecological vegetation. Despite development pressures, Wellington in New Zealand has 200sqm per capita of green space.

***Tokyo*** suffers from a shortfall of open space which averages 6.1 to 8.5 sqm per capita, but it has a large forest of 21,630 Ha to conserve water.

**Fig. 5.1:** ***Panoramic View of Urban Sprawl***

**Fig. 5.2:** ***Panoramic View of planned Urban Greens***

## 6 Urban Green Spaces: The Indian Scenario

Due to unprecedented urbanization, the gap between city inhabitants and nature is increasing. The concretization of cities and towns has adversely impacted the natural environment. The space to be utilized for open green has become limited as the cities and towns experience growth. Urban greenery is one of the ways to bridge this gap between people and nature. High population density is also another reason for poor development of urban greenery. An attempt has been made to analyze the area under recreation/open space for different cities based on the data given in their respective Master Plans. A perusal of the following table reveals that the existing availability of per capita open space varies from 0.81 sqm in Chennai to 278 sqm in Greater NOIDA signifying the wide variation. Cities like Varanasi, Chandigarh, Jaipur, Bhopal, Allahabad and NOIDA have more than the WHO prescribed norm of 9 sqm whereas cities like Bengaluru, Ludhiana and Amritsar have less than the norm ranging from 1% to 5%. It is interesting to note that in Greenfield Townships like Greater NOIDA, the per capita availability of open space works out to 278 sqm which is very high. This is illustrated by the fact that Greater NOIDA Master Plan has provided ample space for urban greens with most of the residential sectors earmarking large chunks of land under green.

Further, it may also be seen that the Master Plans of selected Indian cities illustrate the fact that the proposed area under open space except for Chennai and Amritsar; most of the cities are in accordance with WHO norms and works out to more than 10% per capita of open space based on the projected population and proposed area under open space. However, it is for the city authorities to make conscious efforts for adhering to the WHO norms in future.

From a global perspective, although there are wide variations both in coverage as well as per capita availability of green spaces, cities in the world renowned for their urban green spaces often have 20% to 40% coverage of total geographical area and 25 sqm to 100 sqm urban green spaces per capita. Most of the Indian cities lag far behind in quality as well as quantity of urban open spaces than their counterparts in Australia, Europe and North America. (*Ref: Table 6.1, page 11*)

**Table 6.1:** ***Area under "Recreation" in Indian cities.*** (existing and proposed)

| Sl. No. | Master plans | Existing Scenario of Recreation/Open space | | | | | Proposed Scenario of Recreation/Open space | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Land use Year | Population | Total (Ha) | Recreational/Open space | Open space Sq.m/ capita | Proposed Land use Year | Population | Total (Ha) | Recreational/Open space | Open space Sq.m/ capita |
| 1 | Second Master Plan For Chennai Metropolitan Area only Chennai city | 2006 | 4509210 | 17553 | 366 | **0.81** | 2026 | 12582000 | 17617.7 | 1000.65 | **0.80** |
| 2 | Master plan Varanasi | 1999 | 1091918 | 14494.4 | 2705.76 | **24.78** | 2011 | 1201815 | 17927.22 | 984.47 | **8.19** |
| 3 | Draft Master Development Plan-Jaipur Region | 2011 | 3073350 | 30830 | 3461 | **11.26** | 2025 | 6495000 | 19800 | 5745 | **8.85** |
| 4 | Master Plan for Ghaziabad | | | 8445 | 399.5 | | 2021 | 2300000 | 15554 | 2484 | **10.80** |
| 5 | Master Plan for Bhopal | 2005 | 1571182 | 17500 | 2925 | **18.62** | 2028 | 352000 | 15572.12 | 646.46 | **18.37** |
| 6 | Draft Master Plan for portblair Planning Area | 2001 | 99984 | 1774 | 101.25 | **10.13** | 2021 | 4500000 | 41360 | 8400 | **18.67** |
| 7 | Master Plan for Lucknow | 2004 | 2358393 | 16270 | 2455 | **10.41** | 2021 | 1270000 | 21570 | 5000 | **39.37** |
| 8 | Master Plan for Greater Noida | 2011 | 107676 | 13570 | 3000 | **278.61** | 2031 | 149256 | 1500 | 240 | **16.08** |
| 9 | Master Plan for Tarn Taran LPA | 2010 | 72337 | 569 | 63.7 | **8.81** | 2031 | 149256 | 1500 | 240 | **16.08** |
| 10 | Master Plan Srinagar Metropolitan Area | 2000 | 1200000 | 11527 | 481.31 | **4.01** | 2021 | 2350000 | 23853.94 | 2853.01 | **12.14** |
| 11 | Master Plan Allahabad | 2001 | 1081622 | 21689.13 | 2602.696 | **24.06** | 2021 | 2043735 | 30917.38 | 4953.47 | **24.24** |
| 12 | Master Plan Ludhiana | 2007 | 1524081 | 127122 | 300 | **1.97** | 2021 | 4800000 | 127122 | 7416 | **15.45** |
| 13 | Master Plan Batla | 2010 | 190418 | 1474.19 | 11.9 | **0.62** | 2031 | 346651 | 3467 | 346.7 | **10.00** |
| 14 | Noida Master Plan | 2010 | 1068228 | 9210.74 | 1761.98 | **16.49** | 2031 | 2500000 | 15279 | 2432.82 | **9.73** |
| 15 | Master Plan Amritsar | 2010 | 1976050 | 139419.5 | 186.8 | **0.95** | 2031 | 3017936 | 16594 | 2489.1 | **8.25** |
| 16 | Bangalore Master Plan | 2003 | 6501343 | 42141 | 1310 | **2.01** | 2011 | 8015000 | 56463 | 7788 | **9.72** |
| 17 | Mysore Nanjagund LPA-Mysore city | 2009 | 7786510 | 27864.32 | 766.31 | **0.98** | 2031 | 2100000 | 27863.83 | 1584.2 | **7.54** |
| 18 | Master Plan Dehradun | 2004 | 753420 | 9698.97 | 222.8 | **2.96** | 2025 | 1530000 | 35867.2 | 928.17 | **6.07** |
| 19 | Master Plan for Kanpur City | 2001 | 2551000 | 89131 | 959.08 | **3.76** | 2021 | 4000000 | 33703.99 | 3221 | **8.05** |
| 20 | Master plan Trivandrum | 2012 | 989099 | 21586 | 54 | **0.55** | 2031 | 1032292 | 21586 | 101.64 | **0.98** |
| 21 | Master Plan Aizwal | | | | | | 2030 | 820000 | 15280 | 244 | **2.98** |
| 22 | Chandigarh Master Plan | 2011 | 1054686 | 6648.23 | 1838.26 | **17.43** | 2031 | 1600000 | 11400.00 | 3152.91 | **19.71** |

*Source: Compiled from Master Plans of Indian cities*

Green spaces comprise of the variety of parks and gardens that exist in a city - spaces to play, exercise or enjoy. These spaces contribute to the quality of life of the people of a city by improving air quality, reducing heat island effect, and improving the health of people, among other benefits. The quantity of green space that exists in a city is measured against its population.

***New Delhi***, the capital of India, is one of the greenest capitals in the world due to the consistent emphasis to greening and strict monitoring of tree cutting. This has been possible despite the infrastructure projects, which came up due to the demands of the Commonwealth Games 2010. As per Forest Department, Government of NCT Delhi, Delhi had about 300 sqkm of green area in 2009. It accounts for 20% of the total area of 1483 sqkm making per capita green space availability of around 22 sqm. Besides, Department of Environment and Forests of National Capital Territory (NCT) Delhi, there are many agencies working for "Green Capital" Mission e.g. Municipal Corporation of Delhi (MCD), New Delhi Municipal Council (NDMC) and Delhi Development Authority (DDA). Recently, the Parks & Garden society has been set up to coordinate the greening activities in Delhi. The city has some well-maintained parks and gardens like Lodhi Gardens, Mughal Gardens, Deer Park, Budha Jayanti Smarak Park, Indraprastha Millennium Park and The Garden of Five Senses besides the Ridge.

*Lodhi Garden* *Indraprastha Park* *Deer Park*

*Buddha Park* *Mughal Gardens* *Garden of 5 senses*

**Fig. 6.1: *Urban Green Spaces of Delhi***

## 7 Impact of concretization of pavements

There is a keen competition for space in urban areas. Trees are often found growing in tree pits or planters surrounded with concrete in a paved area, with solid paving very close to the tree trunks. These trees often suffer from severely restricted growing space and the lack of air and water under impermeable surfaces. In some cases, tree roots grow vigorously and even damage the pavement. While in other situations, roots may be cut off or damaged during pavement repair work.

**Fig. 7.1: *Impermeable Tiling around trees***

It has been observed that many trees and tree branches have fallen in various cities owing to heavy rain and wind. Strong winds apart, concretisation of pavements has much to do with the falling of trees. Many of the trees are those planted on roadsides as well as on central verges. Over the years, the open area around them has shrunk, having been paved or cemented. This means the roots do not have enough room to spread or grow strong enough. There is no space for new roots to form either. Other weakening factor of roadside trees – regular pruning of branches to make way for overhead utilities, often lopsided due to height, they lose strength to withstand strong winds.

**Fig. 7.2: *Desirable root pits around trees***

## 8 Policy Guidelines for strengthening Urban Greens

### 8.1 Roads

The most common use of trees is on roads and avenues. If the wrong kinds of trees are planted at wrong locations or places, the safety of traffic is endangered. Therefore, it is necessary to lay down certain criteria before adopting any plantation scheme for roads.

While selecting tree species, the following criteria should be taken into account:

i) Species should suit the soil and climatic conditions.
ii) Species should be hardy, robust and should need little attention once they have achieved certain growth.
iii) Species having long life should be preferred.
iv) The species must be either evergreen or nearly evergreen or be leafy during summer.
v) The species must be fast growing and wind resistant.
vi) The trees should be deep rooted; shallow roots injure pavements.
vii) The species should not be allowed to grow into a very large size requiring expensive pruning or removal.
viii) The species should be capable of easy transplantation.
ix) The commercial, aesthetic and social values of species should also be considered while making choices.

The main function of a roadside avenue is shade. Hence, trees which are quick-growing and provide dense shade should be selected. The trees selected should provide shade not only on the sides, but also in the center of the road. From this point of view, trees with, an umbrella or semi-umbrella crown like Neem, Mahua, lmli and Mango are more suitable on National and State highways. If the trees selected provide shade they also yield valuable timber and fruit. The trees should be planted in such a way that their crowns may develop freely. Where the road is more than 30 meters wide, a double avenue of trees with the outer avenue near the edge of ROW line may be used.

Planting of trees along roads may be in the following manner:

1. Avenue Planting
2. Group Planting
3. Mixed Planting
4. Informal Planting

The planting should be suitable for different locations. The following general guide lines are useful in selecting tree types.

### 8.2 Avenue Plantation

Avenue planting consists of planting areas in single or double rows along highways. Long avenues may become monotonous and where travel speeds are high, may induce drowsiness. Loss or irregular growth of individual tree in long avenues is also noticed. These disadvantages may be overcome by planting at irregular intervals of say 30-75 metres and by off-setting the trees by 1 to 1.5 m from a uniform alignment. Avenue planting will take a distinct form of treatment on curves and undulating contours. In large cities and locations, where, land is available double avenues of trees may be provided. On divided carriageway having separate pedestrian footpath, the outer rows consisting of shady trees and inner row consisting of ornamental flowering trees may be adopted.

**Fig. 8.2: *Avenue Plantation***

## 8.3 Group Plantation

Group planting consists of planting a clump of 3 or 4 trees along the highway overcomes the monotony of avenue planting. To be more effective the spacing of group should not be uniform. This should be staggered on opposite sides of the road. The advantage of this system is that it helps in selecting tree types to suit exact conditions at each site. This system should be followed where availability of land is not an issue.

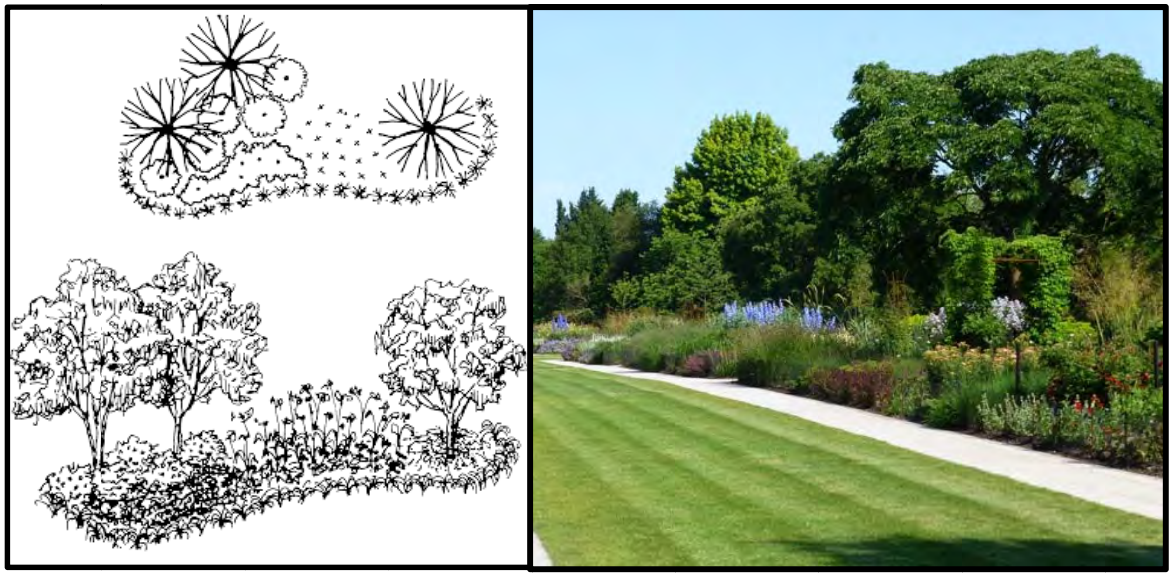

**Fig. 8.3: *Group Plantation***

## 8.4 Mixed Plantation

Mixed planting consists of selecting different varieties of trees, rather than one single variety. This system avoids monotony of single variety planting. The shedding of leaves takes place in different seasons. The plants provide flowers and fruit in different seasons and thus the aesthetic value of avenues is preserved throughout. During storm, when wind velocity is high, the harder varieties will survive and will protect the weaker varieties too.

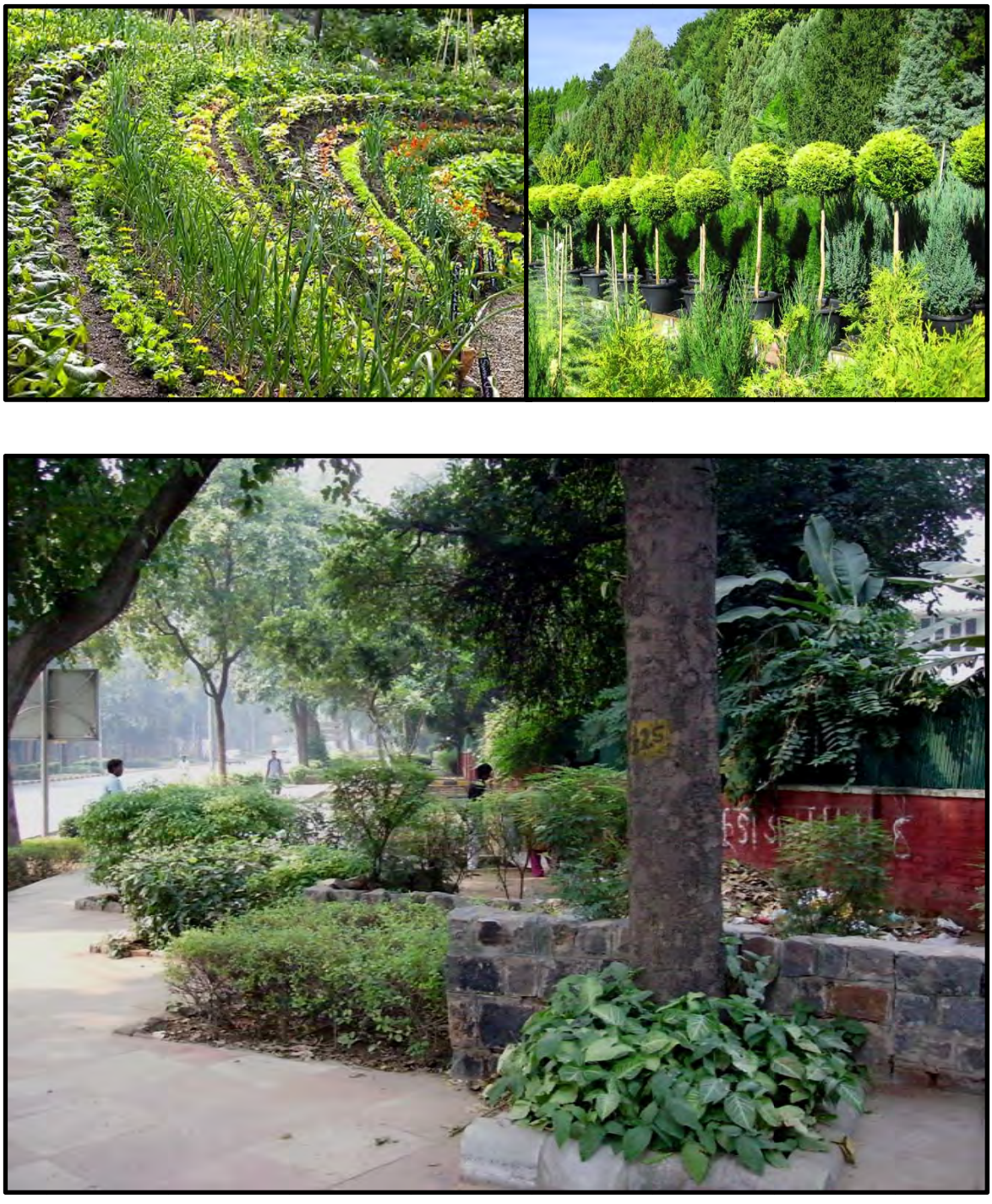

**Fig. 8.4: *Mixed Plantation***

## 8.5 Informal Plantation

In urban fringe settings, avenue planting may include formal landscape on an otherwise informal one. Single trees may be featured where practicable, providing visual interest.

**Fig. 8.5: *Informal Plantation***

## 8.6 Spacing of Trees

No hard and fast rule may be laid down for the spacing of avenue trees; it depends on the type of trees. A minimum spacing of 10-12 m should be followed. The trees in the formal avenue planting should be planted in rows on either side of the road in a staggered manner. At urban intersections the trees should be at least 3 mt away from the intersections for right viewing distance.

**(A)** Trees which provide thick cover and are also valuable from the economic and aesthetic point of view should be planted along the National and State Highways. Some of these are:

***NEEM*****:** *(Azadirachta indica)* It can grow in any type of poor but well drained soil. However, it prefers loam and sandy soil. It can tolerate alkali but cannot withstand water logging or sea coast conditions.

***MAHUA*****:** *(Madhuca latifolia)* It prefers light well drained soils but can also be grown on dry, rocky and sandy soil. It can withstand mild alkalies, but not water logging.

***IMLI*****:** *(Tramarindus indica)* It is a beautiful tree which withstands the dust on road very well; its fruits and timber are also valuable. *Suitable for dry areas.*

***SHISHAM*** **:** *(Dalbergia sisso)* It yields excellent timber. *Suitable for sub-Himalayan districts where rainfall is over 1,000 mm.*

***MANGO*** **:** *(Mangifera indica)* Suitable for clay or mixed soil with water level 10 m. or less.

***SUFED SIRIS*****:** *(Albizia procera)* A quick growing beautiful tree which grows easily on sandy soil. On account of the light yellow colour of the trunk, it reflects even weak-light: and is an excellent roadside tree.

***RAIN TREE*****:** (*Samanca Saman*) Suitable for moist districts with a rainfall of over 1000mm.

**(B) Trees Unsuitable for Roadside Avenues:**

On no account should the following trees be planted along the roadside:

**Brittle Trees-**

***Eucalyptus:***
All species- *Millingtonia hortensis*, *Albizia lebbeck, Cassia siamea*, *Ficus glomerata.*

All these trees have very weak wood, and consequently, break easily in a wind-storm. The result is that after the storm, roads become blocked and traffic is stopped for a considerable length of time, and during a storm, these trees are a menace to the travelers who happen to be on the road.

**(C) Thorny Trees:**
*Acacia nilotica*
*Acacia modesta*
*Ziziphus mauritiana*
These are thorny trees and their thorns are nuisance for pneumatic tyres.

**Trees Suitable For Town Roads:**

***Foliage trees for outer avenues***

*Averrhoa carambola*
*Pterygota alata*
*Callistemon lanceolatum*
*Samanoa saman*
*Anthocephalus cadamba*
*Azadirachta indica*
*Alstonia Scholaris*
*Eugenia operculata*
*Tamarindus indica*
*Polyalthia longifolia*
*Putranjiva roxburghii*

***Flowering Trees for Inner Avenues***

*Cassia fistula*
*Bauhina purpurea*
*Colvillea recemosa*
*Peltophorum ferrugineum*
*Spathodea nilotica*
*Jacranda acutifolia*
*Delonix regia*
*Crevillea robusta*

**Roads Passing Through Special Areas**

It is neither possible nor advisable to lay down the rigid standards for the landscape treatment to be given to roads passing through the different areas. It is, therefore useful if some general guidelines are provided for the treatment of special areas.

## 8.7 Water Logged Areas

The type of landscape treatment to be given also depends upon the extent of water logging in the area. Roads are generally on high embankments in water logged areas. It should have mild slopes and the surface should be covered with some shrubs so that road merges into the surroundings. Whenever possible some water

bodies may be developed and may be used as picnic spots. The species for such areas should be so selected that they can grow well under the waterlogged conditions not requiring much maintenance.

### 8.8 Sandy Areas

In sandy areas such species should be planted which have least water requirements and are wind-resistant.

### 8.9 Wooded Areas

As far as possible roads should be aligned along the outskirt of the forest and it should form a part of the road landscape; cutting of trees should be avoided. Even if it is necessary to cut certain trees, it should neither disturb appearance of the forest nor the animal life. The felling of trees should be done in stages i.e., first the thinning be done at the proposed road/ land boundary then the gaps from where thinning was done be planted with low and medium plantation and lastly when the new plantation comes up the central area be cleared from the road.

### 8.10 Industrial Areas

Where the roads are passing through the industrial area, screen planting should be done on both sides of the road so that views are addressed and they act as a buffer for noise and air pollution. In conditions where chemical industries are existing or are proposed it is advisable to have a thick green buffer which is resistant to obnoxious fumes.

### 8.11 Parking areas

The most desirable plant material in parking area is trees and shrubs. Trees provide shade in summer and improve the environment of a car park, provide a visual break to the appearance, screen off parking areas and define some of the rows of parking. In urban situations and particularly in congested areas where large parking spaces are required, planting may be affected by atmospheric pollution in several ways. In parking areas such trees should be planted which are suitable for situations where they will be exposed to pollution. It should be noted that deciduous trees shed leaves intermittently and maintenance is needed to keep drainage clear. Therefore, this aspect should be taken into account while planting trees, in parking areas. Shady and flowering trees are most suitable for parking areas.

## 9 Maintenance of Plant Material

Planting operations requires careful planning. Nursery will be economical where large scale planting is required. Such a nursery will select the seeds and nurture them to become- marketable. The plants should be allowed to remain in the nursery until they have become sufficiently hard to withstand transplantation. The nursery should be planned in an area of good soil and where water is adequate. It is suggested to plant double the number of plants required so as to account for losses.

Sites for pits should be planned and located beforehand, preferably three to four months before planting. Dwarf trees should be grown 1.5 to 3 m apart. Pits of a size 1.25m x 1.25m should normally be sufficient in ordinary soil though in hard soil the diameter of 2m is necessary. The pit should be filled with a mixture of soil and manure where water is available. The best time for planting deciduous trees is in January and February and for others in the pre monsoon months from July to September.

Immediately after planting, fencing of suitable size should be done. The plants should be adequately watered for 2-3 years and tended and careful digging done around the plants to prevent the soil from getting hard. Removal of weeds should be done periodically.

All the plants require good manure for the proper development. Good manure must contain nitrogen, phosphorous and potash, and hence a mixture of the manure from the above should be used. Nitrogen increases the plant growth, excess of nitrogen means plenty of wood and leaves and little flower and fruits. Phosphorus quickens maturity and assists in the ripening of fruits.

It is, however, worthwhile to remember that quantity of manure to be added also depends upon the type of soil available. Care should be taken that raw manure of any kind should not come in direct contact with plant. Regular manuring even with small doses is better than casual heavy manuring.

**i) Maintenance**

Careful maintenance of plant material consists of removing parasites, removing unhealthy branches, pruning, removing dead or dangerous plants and manuring from time to time. Constant watch and supervision is necessary.

**ii) Tiling of pavements: pervious material to be used**

Unnecessary and excessive tiling of the roadside pavements should be avoided. The area around trees should not be covered with tiling as it hampers the basic necessary functions and needs of the trees. In addition root aeration and availability of water gets drastically reduced. Whatever tiling is done, pervious tiles should be used. Roots of the trees should be protected, top soil should be preserved while taking up civic works. Indiscriminate tiling of road dividers and foot paths should be avoided.

**Fig. 9.1: *Perforated tiling for pavements***

Tiling is to be done only on pavements with heavy pedestrian traffic. In case of bridges and such areas where there are no pedestrian movements, tiling may be avoided and in case tiling is to be done, preference is to be given to pervious tiles. The species of trees may be chosen for their pollution reduction and abatement qualities including dust trapping and to avoid reliance of a single species, a combination of trees, shrubs, grass should be grown.

**iii) Growth of grass to be encouraged**

The necessity of grass playing a vital role in making the soil suitable for vegetation should be realized and unnecessary digging of soil should be avoided.

**iv) Excessive pruning to be avoided**

Practice of excessive pruning should be avoided. Pruning of plants in a well nurtured garden and pruning of roadside plants should be differentiated. Excessive pruning may lead to upsetting the root; shoot ratio. Leaf pruning should not be resorted to indiscriminately.

**v) Compost to be made of leaves**

Leaf is an excellent material for making compost and burning of leaves causes pollution. A system of composting of leaves in nearby parks should be adopted which will provide water retentive manure to civic agencies, some fallen leaves may be left near the tree base as water retentive mulch.

**vi) Adequate space to be left around trees**

A minimum area of 1.25 m x 1.25 m around the trees should be left un-cemented, widening of roads upto the trunk of trees is to be avoided as roots come under the asphalted roads which will gradually die. In case of storm, these trees may topple. Activities which adversely affect the roots are to be minimized.

**Fig. 9.2: Desirable *Space around tree roots***

**vii) Digging near trees to be avoided**

Digging near the trees by allowing telephone, electricity, sewerage lines should be avoided to avoid root injury; sufficient space should be left along the ground for the trees. In no case should roots be exposed. Washing of avenue trees foliage may be done on a tri-monthly basis to get rid of particulate matter from the foliage.

**viii) Use of Organic Compost**

Dead trees may be replaced by young plants after providing sufficient organic compost in the pits. Organic manure added with compost FYM mix with Nitrogenous fixing bacterial culture and neem cake should be spread on the green and poured into the soil before either irrigating the tree basin or before rains.

**ix) Planting of second line trees to be encouraged**

New trees which may be called as second generation trees must be planted preferably 2-3m behind the existing line of trees in an alternate position or inside the

bungalow compounds, a mix of foliage and fruit trees should be planted. Planting of fairly well established large trees should be undertaken as chances of their survival will be more. Species to be adopted may be similar to the old trees lining roads.

**x) Initiation of IEC activities**

Horticulture Department of the city concerned may initiate education/awareness campaign with School students and elders and users of the park where the different species of trees are present in a particular park and importance about preservation of eco-systems explained. School students may be taken for nature walks in major gardens to get them acquainted with the flora and fauna around them. Also the citizens of an area residing near a park may be involved for this awareness campaign.

**xi) Compactness of soil near trees to be avoided**

Compactness of soil should be avoided within at least 1.25 m around the tree trunk. Perforated metallic frame may be used for this purpose. Soil surveys around the trees should be done by removing stones,

**xii) Setting up of a Central Resource Centre**

A Central Resource Centre should be set up to aid and advice the State Governments, Municipal Corporations and other agencies dealing with matters pertaining to Horticulture and Landscaping.

**xiii) Stress on Shelter beds of thick trees**

Around the cities vulnerable to desert winds, shelter-beds of special design of thick trees should be planted.

**xiv) Updating technology of transplantation of trees:**

Technology for transplantation of trees should be updated to ensure at least 80 percent success rate. As far as possible, trees grown in the nursery with a height of four to six meters should be planted. Presently, survival rate of trees is less due to animal menace and neglect. Public participation in caring of trees planted may be ensured.

**xv) Setting up of a tree disease surgery unit in Horticulture Department**

A small tree disease/surgery unit should be created in the Horticulture Departments to cure tree maladies.

**xvi) Earmarking of some cost of projects for landscaping**

In any layout plan and housing development, at least two and a half percent of the cost of the project should be earmarked for landscaping and green development.

**xvii) Use of kitchen and garden waste for compost**

Technology to use kitchen and garden waste to fabricate building and landscaping material should be perfected and made available to all agencies.

**xviii) Recharge of aquifers**

Underground water does not get recharged sufficiently because of use of concrete. Efforts should be made to get recharge the underground aquifers.

**xix) Heritage buildings to be landscaped:**

Areas adjacent to heritage buildings should be suitably landscaped and beautified.

**xx) Encouragement for water harvesting technologies**

Information regarding water harvesting has to be disseminated to people at large and its use encouraged. !t should be ensured that quality of water does not get deteriorated for which measures are to be taken.

**xxi) For maintenance of greens internally**

Criss-cross paths should be provided in parks with connecting gates.

**xxii) Public participation to be ensured**

Public participation at present is poor in the maintenance of greens. This has to be sensitized through Residents *Welfare Associations* who need to be involved in planting of new trees and in their upkeep. User groups need to be activated. NGO's can play a catalytic role in this regard. Each NGO may earmark a selected area for its activities thereby dividing the entire area. A Committee with officials from various Departments may act as nodal contact and may review progress every month or as necessary.

## 10 Integration of Urban Green Spaces

Open spaces serve a very important purpose in the relationship of man and the nature. If planned properly, they help in maintaining ecological balance. Highlighting this, it is recommended that a system of open spaces be provided as part and parcel of the Master/Development Plan of the city. These open spaces, depending upon their function can be within the city and /or on its outskirts. They should include, apart from organized open spaces for recreation purposes, areas reserved as conservation areas, natural landscape areas and social forests.

Depending upon the requirement of the city, these open spaces should be adequately provided and should be well defined in area and land use. This will help in checking encroachments and changes in functional use. It is emphasized that a whole-to-part approach of spatial planning be practiced. This calls for delineation and preparation of spatial development plan of each city and its region showing the following before making the master plan of the city:

- Settlements, their hierarchy and functions.
- Transportation network.
- Areas to be protected and preserved including natural conservation areas, existing forests, historical monuments, mining sites etc.;
- Reserved forest areas (both existing and proposed)
- Area earmarked for social forests,
- Agricultural areas specifying areas generally reserved for gardens to serve the city and reserved for other agricultural purposes.

The entire area outside the proposed urbanisable limit of the urban centres in a city and its region may be designated as rural area and the Town and Country Planning Department/Urban Development Authority (whichever is in charge of the planned development of the city and the city region) should regulate its use.

As a basic principle, the agricultural area of the city and its region should not be permitted to be changed to urban use unless incorporated in the revised master plan of the city at the time of its periodic review or at the end of the plan period. With a

view to helping in implementation of the above, it is recommended that the zoning regulations covering the city region should specifically include the following provisions for the rural areas.

All residential activity shall be limited to the existing or extended boundaries of the urban fringe as proposed in the Master/Development Plan of the city and its region. No structure of a permanent nature for residential or any other purpose shall be permitted in the agricultural area.

With a view to preserving the rural–urban fringe and also for preventing it from ribbon development, it is recommended that a forest belt be provided on either side of all major roads passing through rural areas. For this purpose the right of the way of these roads may be appropriately earmarked.

Based upon the current practice of developing farm houses on the outskirts of the city and in the green belt zones where it is being permitted, It is observed that there exists a demand, particularly in metropolitan centres for low density residential development with large plots In case where this demand exists and where, as part of development objectives low density residential areas with large size plots are to be provided, the following two alternative strategies are recommended:

Design this low density residential zone as an integral part of the Master Plan/Development within the proposed urbanisable limits of the city; or design these areas as self-contained low density satellite communities around the metropolitan centre, with or without farms to be managed and owned by urban dwellers, which are located far beyond the expected future (atleast upto next 50-60 years) urbanisable limits of the city.

In order to sustain/preserve/conserve urban greens in long run, it is important to integrate urban greens at different levels. Typically a Master Plan of city needs to provide green spaces as per the hierarchy. The green spaces may be planned as well incidental. Following green spaces need to be protected/conserved and it is also to be ensured that they are not unnecessarily encroached upon or subject to construction activities:

- Area around flood plains
- Area around marine drive along coastal zones in case of coastal cities/towns,
- Area under mountainous slopes in case of hill towns
- Area around natural drains

In order to protect the above mentioned environmentally sensitive areas, it is necessary that following actions need to be taken by the city planning authorities:

- Declaring the environmental sensitive zone as no construction/development zone. This has to be ensured in the proposed/existing landuse plan of a city.
- While framing zoning regulations, it has to be ensured that only those activities are to be allowed which may not have any adverse impact on environment, and should not lead to addition of built up space.
- Cities /towns which are located in valleys or where remnants of old mountains like Aravalli, Shivalik, Satpura, Western Ghats etc. need to take measures for strengthening the slopes by aforestation and regulating construction activities without compromising the overall natural environment of the cities/towns in the said zones.

**SUBCITY /ZONAL LEVEL**

At the Zonal level, planned greens are generally found in the form of District Park/Sub-District Park/playgrounds, which may be located at various parts of the zone. It has to be ensured that the different open spaces need to be inter linked by providing connectivity/linkages and should be maintained/ developed in an integrated manner.

**SECTOR/NEIGHBOURHOOD LEVEL**

At the Sector/Neighborhood level, planned green spaces are provided in the form of neighborhood parks/tot-lots. These have to be properly maintained in terms of irrigating the plants /trees and making the provision of pruning at regular intervals.

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