CHAPTER 5

CONSIDERATIONS FOR GREEN INFRASTRUCTURE
IN THE GATED COMMUNITIES
IN THE STUDY AREA
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5.1 Introduction

The focus of this research is the study of green infrastructure with respect to a few selected gated communities in the Bangalore Metropolitan Area. The term green infrastructure is relatively new in land use planning and urban design having gained currency from the last two decades only. It deals with the increased importance given to the environment in land use planning and urban design decisions.

Gated communities are privately developed residential enclaves. In the Bangalore Metropolitan Area they are much sought after housing destinations mainly by the IT/ITES community. They have been developed by private developers and are located in the suburbs. This research work is particularly significant because the green infrastructure of the gated community is initially developed by the private developer and later maintained by the respective resident welfare association.

The data for this research work has been gathered from both primary and secondary sources. The data collected has been analysed with respect to factors like location, existing Zoning of Land use and Regulations, legal issues, housing types, design themes, provisioning utilities and their management, safety perceptions amongst others especially with a view to enquiring how such factors influence the development of green infrastructure in the gated communities.

Parameters like density, built-up area open space ratio amongst others have been analysed with respect to the select gated communities again oriented towards and focussing on the relationship to the green infrastructure development in the gated community.

5.1.1 Location of Gated Communities in the Bangalore Metropolitan Area

The Bangalore Development Authority sanctioned 96 residential group housing development plans from July 2000 to March 2011. All such developments are located in the Third Ring Planning districts which are the suburban areas. They are developed as gated communities by private developers. The list of the 96 sanctioned residential
group housing development plans along with details of the Promotor/Developer/Owner/GPA Holder, location, area, year of sanction, page number in the BDA register is furnished in Annexure 1, Table 7.1 of the Appendix

5.1.2 Gated Communities and Zoning Regulations

Gated Communities are sanctioned by the Bangalore Development Authority as per the Zoning and Land use Regulations, Volume III of the Revised Master Plan 2015. They are classified as Group Housing (Development Plans).

The developer submits to BDA a residential development plan of the project for sanction. As per the Zoning of Land use and Regulations, Volume III of the Revised Master Plan 2015 a residential development plan is defined as, “Plan containing proposal for construction of one or more residential buildings on a plot measuring more than 20,000 sq m in extent”.

Rain water harvesting is mandated in the Zoning of Land use and Regulations as per the “3.16) General notes: xiii. Rain water harvesting: Provision for Rain Water Harvesting is mandatory for all plots which are more than 240 sq. m in extent. A 5 % rebate on the property tax is offered for residential property and 2 % for non residential buildings within BMA for the first 5 years, when rain water harvesting is made as an integral part of the building constructed.” The developer has to show the rain water harvesting details on the development plan submitted for sanction. The site development process involves the location of the rain water harvesting pits as also the surface drainage and storm water management.

The use of solar energy for lighting and water heating is recommended with incentives as per “3.16) General notes: xiv. Solar energy: Solar lighting and solar water heating is recommended for all new development/constructions. If the solar lighting and solar water heating is adopted, then refundable security deposit on fulfilling the conditions shall be returned along with 2 % interest.” This recommendation is meant for the developer to use solar lighting in the public open spaces of the community as well as the pedestrian and vehicular circulation network and on-street parking areas. The use of solar water heating is an important aspect of design of the residential units.
Trees are the most visible elements of the community’s green infrastructure. The impetus to planting trees for the developer of the community is clear in the following mandate, “3.16) General notes: xv. Tree Planting: Planting of minimum one tree is mandatory for a site measuring more than 2400 sq ft and minimum of 2 trees for a site measuring more than 4000 sq ft. The concerned authorities shall ensure that the trees are planted before approval of building plan and tax shall be assessed only after confirming the existence of trees in the site in question. The trees shall be planted only in the rear set back area.”

The following quoted regulation is particularly significant for the development of the gated community’s green infrastructure, “7.1.1: 10 % of the land shall be reserved for Park & Open space. The open space (park) shall be relinquished to the authority free of cost and the same may be allowed to be maintained by the local residents association (registered), if the Authority so desires.” This regulation ensures that the onus of developing the gated community’s green infrastructure assets lies with the developer of the gated community. Subsequently the maintenance of the gated community’s green infrastructure lies with the Residents Association of the community as per the regulations.

The other significant regulation pertains to civic amenities and is quoted, “A minimum 5 % of total plot area shall be provided for civic amenities and the owner or developer shall develop such civic amenities which finally shall be handed over to the local residents association for maintenance. The mode of such handing over shall be decided by the authority.” This regulation ensures that civic amenities are provisioned by the developer for the community. It is important because gated communities are located far away from the city’s amenities and the community members cannot easily access the city-scale amenities and facilities. Thus provision has to be made for the same by the developer of the gated community and the responsibility of its subsequent maintenance is the Resident Welfare Association.

5.1.3 Gated Communities and the Legality of the Perimeter Walls

There has been much controversy on the legality of the perimeter walls of the gated community in the media. There are no regulations pertaining to the construction of the perimeter wall. In fact, as per the following regulation, “7.1.5. Roads as shown in the
Revised Master Plan 2015 shall be incorporated within Plan and shall be handed over to the authority free of cost” the responsibility of creating trunk infrastructure as per RMP 2015 lies with the developer and the same has to be handed over to the authority.

The issue of the perimeter wall is linked to security for residents of the community. Gated communities are located in the suburbs where there is probably no surrounding development. The perimeter walls primarily ensure safety for the residents of the community, delineate and define the gated community’s area and extent, regulate ingress and egress to specific uniquely identifiable points located on the existing trunk infrastructure and along with the community’s gates establish community identity.

Plate 5.1: Perimeter wall and Entrance gates as symbols at Jade Garden gated community

5.1.4 Gated Communities, Housing Types and Green Infrastructure

Gated Communities are promoted and developed by private developers to cater to the housing needs of the relatively rich and affluent class of people perhaps employed with the IT and ITES sectors. The housing types include villas, condominiums, row-houses and apartments. The emerging trend appears to be the villaments that combine merits of the apartment and the villa and are advertised to be affordable. A few examples of early gated communities are identified with restricted number of type designs from which the owner has chosen and subsequently the house has been built by the builder. Irrespective of the housing type the initial development of the community’s green infrastructure has been undertaken by the developer or promoter of the community. The services of design consultants including landscape architects are utilized by the developer in creating the community’s green infrastructure assets. The residents’ welfare association subsequently maintains and develops the gated community’s green infrastructure assets.
5.1.5 Gated Communities, Design Themes and Green Infrastructure

Gated communities are developed by private developers and are targeted at the relatively affluent class. A distinct trend in the gated community design is the adoption of an exotic theme meant to attract potential buyers. The themes that appear to have a distinct impact on the visual aspects of the gated community’s green infrastructure are usually based on evoking images of exotic foreign landscapes. Purvankara Venezia evokes images of Venice with its waterways. Almond Tree evokes images of the seasons. Other popular examples evoke images of Mediterranean landscapes or of places like California. This imagery is partly brought out in the built form but mainly in the choice of elements of landscape including the most visible elements of green infrastructure namely trees, shrubs, trellises and other plant material. There is a considerable effort which is visible on the part of the landscape architects and designers at using native plant types which look like their foreign counterparts as the native types are hardier and better adapted to the local climatic conditions.

5.1.6 Gated Communities and Solid Waste Management

In Bangalore city the municipal corporation that is the Bruhat Bangalore Mahanagara Palike is responsible for the solid waste management. Within the city limits the BBMP manages solid waste through door-to-door collection. Gated communities are classified as bulk generators and the BBMP mandates that bulk generators are responsible for their own solid waste management. The solid waste management of the gated community thus becomes a comprehensive, combined effort of the entire community. Families classify the waste at source primarily into wet and dry waste. The wet waste, mainly kitchen waste, along with other organic waste of the community like the garden waste is composted at site. The BBMP encourages the establishment of a community level bio-gas plant. The dry waste is collected at community level and is disposed off with the help of waste disposal agencies for a price. There are several community level initiatives, formal as well as informal and spontaneous, that encourage the residents of the community on the three R’s of waste management, REDUCE, REUSE, RECYCLE.
5.1.7 Gated Communities and Storm Water Management

Gated communities are privately developed and located in suburban areas that initially lack the needed and expected urban development. The physical infrastructure for storm water management is designed and executed by the private developer as a part of the development package for the community. The storm water is usually drained off into the closest water body which may not be within the gated community site. As the surrounding areas get urbanised the trunk infrastructure for storm water management is built by the municipal authority namely the Bruhat Bangalore Mahanagara Palike. The lack of synchronization in storm water management infrastructure of the privately developed gated community and the trunk storm water management infrastructure of the municipal authority can lead to unpleasant situation including blocking of the gated community drains by the municipal authority. This results in poor environmental conditions within the gated community due to the stagnant water causing physical distress as well as unhealthy conditions. The range of possible solutions to overcome the situation would first of all start with its initial anticipation and concurrence and consultations with the municipal authority during the design and engineering phase of the community, draining of rain water into rain water harvesting ponds located in the lower contours of the community itself and designing them to be a part of the landscape of the community and using a combination of bioswales and rain water harvesting ponds.

5.1.8 Gated Communities, Rain water harvesting and Green Infrastructure

Rain water harvesting is mandatory as per the Zoning of Land use and Regulations of the RMP 2015 for the BMA. The development plan submitted to the Bangalore Development Authority by the developer/promoter of the gated community has to show the proposed rain water harvesting details. As part of the site development process the rain water harvesting pits have to be located to facilitate the surface drainage for an effective storm water management. In some communities rain water is harvested and collected in ponds integrated into the community’s landscape and as a part of the mandatory 10% site area for the parks and open spaces. Rain water harvesting ensures water for the maintenance of the community’s green infrastructure assets.
5.1.9 Gated Communities and Water Supply

Gated communities are located in suburban areas lacking surrounding urban development as well as water supply and sewerage infrastructure. The water supply and sewerage infrastructure within the city is managed by the Bangalore Water Supply and Sewerage Board (BWSSB). The city has a distribution of surface reservoirs as well as overhead tanks which are supplied with water mainly from the river Cauvery. Water from these reservoirs is then distributed to the consumers through the water distribution network.

Most gated communities in Bangalore depend on bore-wells for their supply of water. Gated community residents in drier parts of Bangalore have never had city supply or groundwater to tap, relying instead on private water suppliers for their everyday needs. There are situations when there is no water in the bore-wells. This water scarcity has given rise to a new term, "water mafia." The private water supply to water-thirsty gated communities is controlled by water tanker operators believed to be backed by the local corporator, the legislator or a powerful politician, who appear to work in perfect tandem. The politician, the gated community residents believe, ensures that the community doesn't get city water, leaving the private suppliers to step in to fulfil what is a desperate need.

Water supply is yet another area where the situation and scenarios need to be anticipated at the development, design, engineering and construction stages of the gated community by its private developer. There has to be a consultation with and concurrence with the BWSSB officials for managing the water supply to the gated community.

5.1.10 Gated Communities and Sewerage

In the Bangalore Metropolitan Area the city-scale sewerage facilities are provisioned by the Bangalore Water Supply and Sewerage Board (BWSSB). The gated communities are located in the suburbs with little or no surrounding urban development. Such areas also lack the trunk sewerage infrastructure.

The private developers of the gated community have to develop the sewerage infrastructure for the community. The development of the sewerage infrastructure has
to be in consultation, concurrence of the Bangalore Water Supply and Sewerage Board (BWSSB) who will ultimately extend the city-wide sewerage system as the area urbanizes. The private developer should anticipate future connections to a city-wide sewerage system in establishing the community’s sewerage system and more specifically in the location of the sewerage treatment plants (STP) in the lower level areas of the gated community.

A common accusation of the Bruhat Bangalore Mahanagara Palike against some gated communities has been mixing of the sewage with storm water and its subsequent drainage into a water body outside the gated community. The private developer should be vigilant and guard against such happenings by ensuring through design and engineering so that there is no mixing of storm water and sewage.

5.1.11 Gated Communities, Waste Water Recycling and Green Infrastructure

The sewerage system of the gated community is developed by the private developer or promoter. It is interesting to note that waste water recycling is actively done in the gated communities. The treated waste water or grey water is piped and used for washing the vehicles and pavements. Water is a primary resource for developing the green infrastructure assets of the gated community. The recycled waste water is used to maintain the gated communities’ green infrastructure assets.

5.1.12 Gated Communities and Energy

Gated communities depend on the Bangalore Electricity Supply Company (BESCOM) for electric power. The working of diesel generators ensures uninterrupted power supply to the community. The gated communities by virtue of their suburban and non-dense location have an opportunity in exploring alternative sources of energy. Solar energy has been explored for lighting the open public spaces of the community as also for heating water by using solar water heaters. The gated communities are generally located in pristine undeveloped locations and there is definite possibility of exploring wind energy especially because of the open spaces in the community which allow an unhindered air movement or wind.
5.1.13 Gated Communities as Real Estate Developments

Gated Communities are developed by private developers, generally for the more affluent class and are primarily real estate developments. The developers are members of Confederation of Real Estate Developers' Associations of India (CREDAI). The developers are bound by the Code of Conduct of the CREDAI. This has specific benefits for the customers some of whom maybe overseas buyers with less time for the legal and other statutory formalities. As per the CREDAI code there has to be a description of amenities. This description of amenities is also a description of the anticipated green infrastructure elements proposed for the community.

5.1.14 Gated Communities and Safety Perceptions

Gated Communities are much sought after housing facilities by a certain class of buyers with small children. This perception is based on the following factors:

**Planned Layout:** Gated communities are professionally planned layouts and this ensures that way-finding within the community is easy. This is especially important for the children and they are able to easily find their way back home within the community.

**Street Safety:** The internal streets of the community have traffic limited to the community members only as in most communities guest vehicles are restricted at the entrance area only. Further there is a system of pedestrian ways with no vehicular access and at all and there is no risk of vehicles at all for small children and the elderly. Children and the elderly can stroll freely and safely within the community.

**Parks and Playgrounds:** As per the bye-laws 10% of the area has to be left for parks and playgrounds. This ensures that children have safe open spaces for playing. The elderly also have safe and accessible open-to-sky passive recreation spaces.

**Reduced Community Access:** The perimeter wall with specified point of entry and exit contribute significantly to the community’s safety and more so as the gated communities are located in the suburbs with little or no surrounding urban development.
Reduced Home Access: The security at the entrance along with the intercom system ensures that homes are accessible with permission only. This contributes significantly to home-bound children and elderly peoples’ safety.

5.2 Case-Studies of Few Selected Gated Communities
Six gated communities were selected and studied with reference to their sanctioned development plans. Parameters like population density in the gated communities and factors like the nature of vegetation, reduction of urban height island effect amongst others have been analysed.

5.2.1 Density of Population in Gated Communities

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Gated Community</th>
<th>Site Area (sq.mt)</th>
<th>No. of units</th>
<th>Population</th>
<th>Density of Population (persons/sq.mt)</th>
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<tbody>
<tr>
<td>1</td>
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<tr>
<td>3</td>
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<td>123</td>
<td>615</td>
<td>0.01</td>
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<tr>
<td>4</td>
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<td>118</td>
<td>590</td>
<td>0.02</td>
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<tr>
<td>5</td>
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<td>1375</td>
<td>0.05</td>
</tr>
<tr>
<td>6</td>
<td>Adarsh Serenity</td>
<td>98238.30</td>
<td>171</td>
<td>885</td>
<td>0.01</td>
</tr>
</tbody>
</table>

The selected few gated communities have extremely low density of population.
5.2.2 Built-up Area Open space ratio in the Gated Communities

Table 5.2 Built-up Area Open space ratio in few selected gated communities

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Gated Community</th>
<th>Site Area (sq.mt)</th>
<th>Total Built-up Area (sq.mt)</th>
<th>Open space Area (sq.mt)</th>
<th>Ratio of Built-up area to Open space</th>
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</thead>
<tbody>
<tr>
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<td>Adarsh Palm Meadows</td>
<td>114094.96</td>
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<td>11407.49</td>
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<tr>
<td>2</td>
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<td>145641.17</td>
<td>360075.35</td>
<td>14825.78</td>
<td>24:1</td>
</tr>
<tr>
<td>3</td>
<td>Chaitanya Smaran</td>
<td>122330.08</td>
<td>54559.70</td>
<td>12628.03</td>
<td>4:1</td>
</tr>
<tr>
<td>4</td>
<td>Shriram Chirping Woods</td>
<td>37129.60</td>
<td>17859.36</td>
<td>3712.96</td>
<td>5:1</td>
</tr>
<tr>
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<td>75447.32</td>
<td>2814.04</td>
<td>27:1</td>
</tr>
<tr>
<td>6</td>
<td>Adarsh Serenity</td>
<td>98238.30</td>
<td>57125.69</td>
<td>9776.62</td>
<td>6:1</td>
</tr>
</tbody>
</table>

There is a wide variation in the ratio of Built-up area to Open space in the selected few gated communities.

5.2.3 The Nature of Vegetation

The most essential part of green infrastructure is all places and spaces that have water-pervious surfaces and/or soil to support plant material. The most visible elements of this infrastructure are the trees, shrubs and bowers.

The gated communities are located mainly in the suburbs and are remote from city-scale parks and passive recreational spaces. The residents of the gated community need breathing space where they can relax and enjoy the bounties of nature.

As per the Land use Zonal Regulations 10% of the site area has to be dedicated to parks and open spaces. This norm has been prescribed because the gated communities are suburban developments and access to the city’s parks for passive recreation is not easy. The developers of the gated communities have to develop the parks and other open spaces like playfields for the recreational needs – both passive and active- of the people.
The compliance of this regulation in the case-studies is given in the following Table 5.3

**Table 5.3** Ratio of Site area and Parks and open space area in the selected gated communities

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Gated Community</th>
<th>Site Area (sq.mt)</th>
<th>Parks and open space area (sq.mt)</th>
<th>Ratio</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Adarsh Palm Meadows</td>
<td>114094.96</td>
<td>11407.49</td>
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<tr>
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<td>Chaitanya Smaran</td>
<td>122330.08</td>
<td>12628.03</td>
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<tr>
<td>4</td>
<td>Shriram Chirping Woods</td>
<td>37129.60</td>
<td>3712.96</td>
<td>10:1</td>
</tr>
<tr>
<td>5</td>
<td>Sobha Amethyst Sobha Adamus</td>
<td>28,110.42</td>
<td>2814.04</td>
<td>10:1</td>
</tr>
<tr>
<td>6</td>
<td>Adarsh Serenity</td>
<td>98238.30</td>
<td>9776.62</td>
<td>10:1</td>
</tr>
</tbody>
</table>

10% of the site area has been left for parks and open spaces in all the selected few gated communities in conformance with the bye-laws.

A visual survey has been made to identify the prominent green elements which are also the green infrastructure assets of the community of selected case-studies.

Trees are the most frequent green infrastructure assets. Peripheral trees planted in the set-backs serve as a good visual definition or demarcation of the site boundary. The internal streets of the gated communities have avenue trees which provide shade and visually characterize or define the internal site connectivity system. Trees also constitute visual barriers for activity spaces which require visual privacy like swimming pool areas.
The environmental quality and the visual ambience of the open spaces have been enhanced by bowers as areas shaded by trees and other plants or as places enclosed by hanging boughs of trees. Topiaries and trellises covered with vines or arbours with flowering vines are also used to add aesthetics to the open spaces. Shrubs are used to divide and define spaces.

Seasonal flowering plants have been judiciously planted in the open spaces and parks in such a way that there are some flowers throughout the year i.e. during all the seasons. Lawns are laid in parks and serve as passive recreation space as well as lend considerable visual attraction through its colour and texture. Incidentally, lawns are used in the berms that separate the internal streets from individual homes as well as in the spaces between homes.

5.2.4 Sporting facilities

The gated communities are located mainly in the suburbs and are quite away from city’s general recreation and sports facilities. The range of recreational and sports facilities either provided by the private developer or developed by the community should cater to all age and social groups within the gated community.

A visual survey has identified sporting facilities in selected few gated communities. The identified facilities include tracks and trails for jogging and walking which also serve to link and unify the various areas and activities of the gated community. The internal streets of the gated communities also serve as cycling tracks mainly for the youngsters who choose to make use of the facility mainly in the evenings and non-school hours.

Tennis courts, basket ball courts are the other sports facilities found in the gated communities and these are in the mandatory park and open space area as per the existing bye-laws and constitute 10% of the site area. These areas are demarcated by shrubbery and trees and vines are used to aid privacy in such spaces. The use of vegetation also significantly contributes to the environment and enhances the scenic ambience. These spaces are mainly used in the early morning and evening hours.
The other outdoor recreational and sports facilities found in the gated communities are the swimming pools. Shrubbery is effectively used to demarcate as well as ensure privacy for the swimming pool areas.

5.2.5 Rainwater Harvesting

Rainwater Harvesting is the collection and storage of rain water for use before it reaches the aquifer. It is a mandatory requirement of the Land use zonal regulations of the RMP 2015.

The visual survey of the gated communities reveals that the water is used predominantly for maintaining the green infrastructure of the community. The water collected is also redirected to a deep pit with percolation.

The harvested water can also be used for domestic purposes if the storage tanks can be accessed and cleaned when needed. However, neither the developers of the gated communities nor the resident welfare association appear to be in favor of use of harvested water for domestic purpose.

5.2.6 Waste management and Sewerage system

Since the gated community comprises of highly qualified, affluent, upwardly mobile individuals and families there is expectedly a great sensitivity to the needs of waste management. The domestic waste is segregated at source into bio-degradable, non-degradable components and stored in appropriately color coded garbage bags. The segregated waste is collected from individual homes, stored at the community level and disposed off in BBMP garbage disposal trucks. In a few cases the garbage is collected by specialist contractors for conversion to manure at ex-situ sites.

Colour-coded mobile garbage bins have been placed in those areas where people are likely to gather in the open spaces as well as in the basement and stilt-parking areas. These are conveniently used by the community households. The resident welfare associations hire trained staff for the maintenance of the common areas of the community including the waste management.
The gated communities being located in the relatively distant suburbs the connection with the sewerage system of the community to the general city sewerage system has not been possible. The communities have their own system of soak-pits and septic tanks for sewage disposal. These are appropriately and discretely located in the open space areas of the community. There have been instances of specialist agencies dealing with sewage treatment, management and maintenance of soak-pits and septic tanks and conversion of soak-pit and septic tank residue into precious manure which becomes a resource for nurturing the green infrastructure assets.

5.3 Reduction of heat island Effect

The development of the gated community, which is an urban enclave, changes the landscape. The open land and vegetation is replaced by buildings, roads, and other infrastructure. Surfaces that were once permeable and moist generally become impermeable and dry. This development leads to the formation of urban heat islands—the phenomenon whereby urban areas experience warmer temperatures than their rural surroundings.

Green infrastructure reduces the impacts of higher temperature in different ways:

- Trees and shrubs provide protection from both heat and UV radiation by direct shading (both of buildings and outdoor spaces)
- Evapotranspiration reduces the temperature in the area around vegetation by converting solar radiation to latent heat.
- Lower temperatures caused by both evapo-transpiration and direct shading lead to a reduction in the amount of heat absorbed (and therefore emitted) by low albedo man-made urban surfaces. (Dimoudi and Nikolopoulou, 2003).

The vegetation and landscaping of the gated communities of which visual survey was made reveal that the green infrastructure was effective in the reduction of the urban heat island effect as expressed by the members of the gated community.
5.4 Role of NGO’s in enhancing Green Infrastructure

Taking the whole city, the role of NGO’s like Hasiru Usiru is worth mentioning regarding their efforts in conserving avenue plantations along the major roads that are under continuous threat by road-widening and transport sector projects.

The gated communities being privately developed and managed by the resident welfare associations play a vital role in the development of green infrastructure. The Laughing Waters community is one of the oldest planned/gated communities in Ramagondanahalli, Whitefield, Bangalore. It was developed by Prestige Builders in 1994 and consists of 360 households. It has a total area of 48 acres with 2 acres of common area developed as a park. The efforts of the Laughing Waters Owners and Residents Association (LWORA) is a good example of man trying to re-establish harmony with nature through the development of the community’s green infrastructure assets. Tree planting is undertaken for greening the precincts and recharging groundwater aquifers. The children of LW have formed a group - EcoLife and have started planting trees along the roads and plan to plant trees in the vacant slots. There are 1,188 trees and the goal is to plant 2000 trees. The trees include Gul Mohrs, Flame of the Forest, Asoka, Indian Cork Tree, Red Silk Cotton, Wild Almond, Jacaranda, Java Plum, Neem, Temple Tree, Mountain Ebony, Jack Fruit Tree, Pongam (Honge), Banyan Tree, Peepul, Drumstick Tree, Golden Champa, Goose Berry, Terminalia arjuna.

In the selected few gated communities the respective Resident Welfare Associations were active in maintaining and enhancing the green infrastructure assets of their community.

5.5 Departmental and Institutional role for enhancing Green Infrastructure

The peoples’ efforts at augmenting their community’s green infrastructure assets have departmental as well as institutional support. The Karnataka State Horticulture Department along with the Bangalore Mahanagara Palike offers horticultural services to the citizens. The BMP has 12 small nurseries located in the three zones, East Zone, West Zone and South Zone and a large nursery in Bommanahalli. People can procure for saplings from the nursery in their zone.
5.6 Funds for Green Infrastructure Assets

The gated communities being privately developed the residents themselves should generate funds for the development and maintenance of the community’s green infrastructure assets. Raheja Jade Garden, an upscale lifestyle residential layout, fully gated posh community, was developed by K Raheja Group in the 1990s. It is located off the 6 Lane high way leading to the Bangalore International airport. Jade Garden has truly captured the nature of great living. Tree-lined walkways, serene open space for a variety of outdoor family activities, parks and beautiful homes sheltered by a canopy of shady trees. The Jade Garden Plot Owners Association works hard on improving and maintaining the community facilities including its green infrastructure assets. A Contingency Fund of Rs 10,000.00 per plot is collected at the time of association membership which is used to build up the Reserve Fund. Maintenance charged @ Rs 1.25/- per sq. ft per annum are collected from the plot owners by the association for the betterment of the layout including the maintenance of the parks, green areas, avenue planting, hedges in addition to other maintenance work.

5.7 Inferences

Historically Bangalore is known as the Garden City of India. The green infrastructure assets of the city include the large number of parks as well as private gardens, roadside and avenue trees and the magnificent Lalbagh and Cubbon Park. Bangalore has several parks spread across the city in the form of small and medium sized parks as well as large parks. The parks having been publicly developed and maintained are located mainly in the core and intermediate ring planning districts. They are environmental assets catering to the needs of recreation of the people of the community.

Bangalore’s Vision for the year 2015 as conceived through the City Development Plan (CDP) and adopted by the city’s Local Self Government Institutions (LSGIs) is “to retain its pre-eminent position as a City of the Future through its cosmopolitan character and global presence and to enable and empower its citizens with: growth opportunities to promote innovation and economic prosperity; a clean green environment; high-quality infrastructure for transport and communication; wide-ranging services aimed at improving the quality for all; conservation of its heritage and diverse culture; and responsive and efficient governance.” (Bangalore Development Authority, Vision Document of RMP 2015).
The privately developed gated communities are located mainly in the suburbs and access to the developed parks therein is almost seldom for the general public. Therefore the onus of developing green infrastructure assets of such communities is entirely on the private developer and once developed its maintenance is the responsibility of the Residents Welfare Association. It is obvious adequate open space for both recreation and rest is a vital element in maintaining and improving the health of the people of the gated communities.

The prominent housing types in the gated communities include high-rise apartments, row-houses, and villas. Trees are the dominant green infrastructure assets of most gated communities. Other green infrastructure assets are the trellises and lawns.

As per the Land use Zonal regulations the gated communities have developed as sanctioned group housing projects with the residential development plan being submitted to and sanctioned by the Bangalore Development Authority. The site area as per the regulations has to be greater than 20,000 sq. mt. for consideration as a group housing project. A mandatory 10% of the area has to be made available for parks and open spaces in addition to the set-backs. The case-studies reveal that the Land use Zonal regulations are complied with and the gated communities are low density developments.

The green infrastructure of the communities has been planned and developed by the private developers. Special attention has been given to landscaping as this fetches a higher selling price for the developer. The green infrastructure assets have later been maintained and augmented by the respective resident’s welfare associations.

The cost of development of green infrastructure has been added into the selling price by the developer and later the residents bore the cost of maintenance and augmentation of the green infrastructure by paying an amount on a prorate basis of their residential units built-up area.
The selected few gated communities promoted green infrastructure through contemporary design elements like:

- Park with lawn for passive recreation;
- Berms with lawn to separate the circulation areas from the individual houses;
- Open jointed paving to allow water percolation through the joints and at the same time provide an impervious surface for walking;
- Jogging and bicycle trails;
- Waterways for visual relief as well as an input for the microclimate;
- Avenue trees for shade as well as visual definition along the internal private streets;
- Peripheral Trees for visual definition of the site boundary;
- Shrubs and lawn in the open space between the houses; and
- Trees as visual barrier for areas requiring visual privacy like the swimming pool.

The following is a brief account of a few of the contemporary design elements used for promoting green infrastructure in the selected gated communities. These elements contributed significantly to the environmental aesthetics of the gated communities as well as the recreational functions for the gated community members.
5.7.1 Green Infrastructure Contemporary Design Elements and Environmental Aesthetics

a. Berms

The berm is an inclined area that provides a smooth transition from the public space or the internal street of the gated community to the private space of the villa. Its geometry facilitates easy drainage. It is soft-scaped and the soil allows water to percolate into the ground. The lawn by virtue of its colour and texture provides visual relief and enhances the environmental aesthetics. It also helps in maintaining a pleasant micro-climate in the gated community.

Plate 5.2 Berm at the Adarsh Palm Meadows gated community

It is interesting to note that the shallow slope of the berm and the soft lawn was of considerable merriment for small children who enjoyed running and playing on it. However, if the treading on the lawn is not controlled it is detrimental to its growth and maintenance.

The berm, thus is an important contemporary design element of the gated communities’ green infrastructure.
b. Open-jointed Paving and Stepping Stones

Stone Paving with open joints provides an easy transition from the public space or the internal street of the gated community to the private entrance porch of the residence. It is laid at a slope that facilitates easy drainage. The open joints allow water to percolate into the ground at the joints. The paving stones form an impervious surface on which it is easy to walk. The joints are planted with grass. The grass by its colour and texture and its contrast with the colour and texture of the stone paving is visually pleasing.

Stepping stones are laid across the grass berm for easy transition without treading on the lawn.

Plate 5.3 Open-jointed Stone Paving and Stepping Stones at the Adarsh Palm Meadows gated community

It is useful to note that the open-jointed stone paving with grass joints provided an interesting access to the residence. Along with the stepping stones across the grass berm the open-jointed stone paving contributed considerably to the environmental aesthetics as it made the internal streets visually very pleasing.

Open-jointed stone paving with grass joints and stepping stones with contemporary design setting contribute significantly to the gated communities green infrastructure.
c. Avenue Plantation

Avenue Plantation of the internal streets of the gated community is strong element of character in the gated community. They provide the necessary shade and along with street furniture are convenient for the members of the gated community. Considerable visual interest arises out of the choice of trees, shrubs, vines and grass used. Flowering trees lend the necessary colour. Shrubs and vines are interesting for their variations of form, colour and texture. The grass provides the necessary green background.

![Plate 5.4 Avenue Plantation at the Jade Garden gated community](image)

The avenue plantation lends considerable visual interest and contributes significantly to the visual delight and environmental aesthetics of the gated community. The avenue plantation is also responsible for maintaining a pleasant microclimate in the gated community. By virtue of its qualities of shade and visual delight it also serves as a passive recreation space in the gated community.

Avenue plantation, thus, by virtue of its contemporary design elements and interpretation becomes a key asset in the gated community’s green infrastructure.
d. Green Infrastructure and Visual Privacy

Vegetation, trees, shrubs and herbs, are the key elements of green infrastructure both visually and functionally. In the gated communities, there are recreational areas like swimming pools that require visual privacy. Trees, shrubs and herbs can be effectively used as barriers and screens for visual privacy in such areas.

Plate 5.5 Green Infrastructure for Visual Privacy at the Adarsh Palm Meadows gated community

The choice of trees, shrubs and herbs used in screens and barriers will determine their contribution to the environmental aesthetics. Such screen and barriers being porous in nature improve microclimate by permitting air movement.

Thus elements for visual privacy like barriers and screens consisting of trees, shrubs and herbs and composed as per the contemporary principles of visual design with respect to line, colour, texture and form enhance visual aesthetics of the gated community and are key elements of the community’s green infrastructure.
e. Balancing Hardscaping and Softscaping

Green Infrastructure as a combination of hardscaping through paving and softscaping through vegetation contributes significantly to enhancing environmental aesthetics.

The green infrastructure assets of Sobha Althea Sobha Azalea gated community include a landscaped area combining hardscaping and softscaping. Hardscaping is in the form of open-jointed stone paving and the softscaping in the form of vegetation includes lawn, herbs and shrubs.

Plate 5.6 Balanced paving and vegetation at the Sobha Althea Sobha Azalea gated community

A subtle balance of hardscaping and softscaping as contemporary design elements contributes significantly to environmental aesthetics of the gated community.

It is a delightful visual amenity and a key green infrastructure asset of the Sobha Althea Sobha Azalea gated community.
f. Water feature as Visual Amenity

As the name suggests the landscaping of the Shriram Chirping Woods gated community evokes a strong imagery of literally chirping woods.

In keeping with this character a bubbling stream as a part of the landscape further enhances the imagery.

Plate 5.7 Bubbling stream at the Shriram Chirping Woods gated community

The use of a water stream with its form inspired from nature and its strong contrast with the contemporary building is interesting and visually engaging.

The water stream and its setting enhances environmental aesthetics and is a key visual amenity. It is an important green infrastructure asset of the Shriram Chirping Woods gated community.
g. Stepped Planter Boxes as Visual Amenity

At the Chaitanya Smaran gated community stepped planter boxes with colourful plants have been used. The contrast of planter box made of rough stone and finished with smooth stone and the colourful plants is visually pleasing. The curved geometry of this landscape element provides an interesting contrast with the rectilinear geometry of the buildings.

**Plate 5.8** Stepped Planter Boxes at the Chaitanya Smaran gated community

The colourful plants, elements of green infrastructure, enhance environmental aesthetics and are an important visual amenity of the community.

The contrast of texture of the hardscaping, stone planter boxes, and softscaping, the colourful plants, as contemporary design elements contribute significantly to visual aesthetics of the Chaitanya Smaran gated community.
h. Pedestrian Pathways as Visual Amenity

The pedestrian pathways of the Sobha Amethyst Sobha Adamus gated community are located amidst greenery which is also the green infrastructure asset of the community. The pathways themselves are paved with open-jointed stones the joints being rendered with grass. Street furniture including benches is located along the pathways for people to relax.

Plate 5.9  Pedestrian Pathway at the Sobha Amethyst Sobha Adamus gated community

There is an interesting contrast between the pathway and the greenery amidst which it is located in terms of colour and texture. This enhances the visual aesthetics of the community.

The pathway, by its geometry, setting and materials used as a contemporary design element contributes significantly to the visual aesthetics of the green infrastructure of the Sobha Amethyst Sobha Adamus gated community.
i. Driveway as Visual Amenity

An interesting feature at the Adarsh Serenity gated community is the detailing of the car driveway. The driveway is made of open-jointed stone paving. The joints are relatively wide and are rendered with lawn. The joints facilitate percolation of water into the ground. The contrast of the stone and the grass terms of colour and texture is delightful.

Plate 5.10 Driveway at the Adarsh Serenity gated community

There is an interesting contrast between the paved drive way and the greenery amidst which it is located in terms of colour and texture. This enhances the visual aesthetics of the community.

The driveway, by its geometry, design, detailing, setting and materials used as a contemporary design element contributes significantly to the visual aesthetics of the green infrastructure of the Adarsh Serenity gated community.
5.7.2 Green Infrastructure Contemporary Design Elements and Recreational Functions

a. Active Recreation across age-groups

The internal streets of the gated communities serve as active recreation spaces too by virtue of their green infrastructure elements. Elements like trees provide the visual transition from the public space of the internal street to the private space of the residence, define the street and along with the grass on the ground allow water to percolate into the ground. They also improve the microclimate and provide visual relief. The open-jointed paving provides the necessary physical transition from the street to the home.

Plate 5.11 Active Recreation across age-groups at the Adarsh Palm Meadows gated community

It is significant to note that such streets also help in forging the sense of community by functioning as active recreation spaces across age-groups bringing together entire families in a variety of recreational activities ranging from playing with balls with children to cycling with them.
b. Jogging and Bicycling for Health

The internal streets by virtue of their green infrastructure consisting of visually pleasing elements composed as per the contemporary principles of visual design provide opportunities for activities like jogging and bicycling. The jogging trails are paved and are convenient for the activity. The hard-scape internal streets are used for cycling.

Plate 5.12 Bicycling for Health at the Adarsh Palm Meadows gated community

It is significant to note that the green infrastructure of the gated community promotes good health, feeling of family as well as community through providing opportunities for leisure and recreation activities. Families that play together stay together and happy, healthy families means happy healthy communities.

The above was a brief account of how green infrastructure promoted environmental aesthetics and recreational opportunities using contemporary design elements but only as an addition to the more conventional parks and organized open spaces like playgrounds which constituted 10% of the site area of each of the selected few gated communities.
5.7.3 Resources for Green Infrastructure in the Gated Communities

From the above study it can be inferred that the following have been identifiable as the main resources for the development of green infrastructure in the selected few privately developed gated communities:

- **Land** with soil to support vegetation
- **Water** for sustenance of plants
- **Funds** for the development of the green infrastructure assets
- **Micro climate** or conducive environmental conditions
- **Plant material** - Seeds and saplings
- **Specific Manpower** needed for development and maintenance

5.7.4 Strategies for Green Infrastructure in the Gated Communities

a. **Land with soil to support vegetation**

The Bangalore Development Authority approves and sanctions the development of gated communities through the residential development plan. The residential development plan is defined as “Plan containing proposal for construction of one or more residential buildings on a plot measuring more than 20,000 sq m in extent.”

One of the significant elements in regulations for the Residential Development Plan is “10 % of the land has to be reserved for Park & Open space. The open space (park) shall be relinquished to the authority free of cost and the same may be allowed to be maintained by the local residents association (registered), if the Authority so desires.” This regulation legally ensures the provisioning of land for the development of green infrastructure. It also secures man-power for its development and maintenance through the local residents association.

The strategy is to ensure that there is a greater percentage of land with soil to support vegetation through setting norms for pervious and impervious surface limits.
b. Water for sustenance of plants

Water is a key resource for the development and maintenance of green infrastructure. The gated community could be viewed as an opportunity for rain water harvesting, use of bioswales, as well as waste water re-cycling.

Rain water harvesting is the collection and storage of rain water for use before it reaches the aquifer. It is a mandatory requirement in the land use zoning regulations of the RMP 2015.

Visual survey of the gated communities reveals that the collected rainwater is used predominantly for maintaining the green infrastructure of the community. The water collected is also redirected to a deep pit with provision for percolation.

The harvested water has been be used for domestic purposes where the storage tanks can be accessed and cleaned as and when needed. However, neither the developers of the gated communities nor the resident welfare associations appear to be in favor of use of harvested water for domestic purpose.

The strategy is to ensure that the entire resource of water from rainwater harvesting, stormwater conservation and waste water recycling is utilized for the maintenance of the green infrastructure assets of the community through proper infrastructure development and management.

c. Funds for the Development and Maintenance of the Green Infrastructure Assets

The initial cost of development of the gated communities green infrastructure is borne of the private developer. Later, The gated communities being privately developed the residents themselves should generate funds for the development and maintenance of the community’s green infrastructure assets.

The strategy is to ensure a contingency fund for the development and maintenance of the green infrastructure assets of the community by the resident welfare association. The contribution to the contingency fund should be from the community members on a pro-rata basis with respect to their asset holding in the community.
d. Micro-climate and conducive environmental conditions

Bangalore enjoys a salubrious climate and has been historically referred to as the Garden City because of its numerous public parks of varying scales as well as privately maintained gardens.

The climatic conditions are conducive for a wide variety of flowering and non-flowering plants as well as sustaining biodiversity. The strategy is to ensure that the construction process of the gated community does not adversely impact the microclimate and that the local environmental conditions are not polluted which would be detrimental to the development of green infrastructure. Since the developers benefit from the development of green infrastructure by an enhanced selling rate they are generally inclined to develop it professionally.

e. Plant Materials: Seeds and Saplings

The peoples’ efforts at augmenting their community’s green infrastructure assets have departmental as well as institutional support. The Karnataka State Horticulture Department along with the Bangalore Mahanagara Palike offers horticultural services to the citizens. The BBMP has 12 small nurseries located in the three zones, East Zone, West Zone and South Zone and a large nursery in Bommanahalli.

The request for saplings can be made at “12 small nurseries located in 3 zones as well as one large nursery located at Bommanahalli”. In addition there are several private nurseries from where seeds and plant material can be procured.

The strategy is to ensure that the gated communities themselves should over a period of time become the sources for plant materials.

f. Manpower for development and maintenance

The initial development initiative of the green infrastructure lies with the developer of the gated community. The per sq. ft selling cost increases directly with the nature and kind of amenities provided including parks and open spaces or green infrastructure. The developer commissions professional consultants like landscape architects and agencies providing green infrastructure development services for the initial development of the community’s green infrastructure.
Later the responsibility of maintaining and further developing the community’s green infrastructure assets lies with the resident welfare association.

The strategy is popularize the gated community’s green infrastructure through programs and hosting of events like *Ritusamhara, Udyana Haasiru* and with associations similar to *Udyana Mithra* which function at the scale of the city.