

Geographical study of Botanical Garden landscape Sarangpur, Chandigarh

^aPramod Singh, ^bAshish Kumar

^aAssociate Professor, Government Degree college Dharamshala, India

^bResearch Scholar, Department of Geography, Panjab University Chandigarh, 160014, India

Abstract

Botanic gardens and their functions in society have developed through the years. Originally established for study of medicinal plants in the mid-sixteenth century, they morphed into active sites for introduction, cultivation and dissemination of economically important crops during European expansion of colonies in Asia, America and Africa during the seventeenth–nineteenth centuries. During the second half of the twentieth century, importance was placed on the need for conservation and sustainable use of biodiversity. The increasing urbanization and human population growth during recent decades have resulted significant loss of habitats in the urban landscape and accompanied by many environmental problems. The main aim of the study is to study the physical landscape of the botanical garden and to examine the facilities prevailing over there. The data has been gathered through both primary and secondary sources. Quantitative data collection methods are used dominant in the present study and Qualitative study also used to know the perception of visitors. Data processing has been done on the basis of various quantitative techniques. The data has been represented in the form of tables and Maps.

KEYWORDS: Landscape, Botanical Garden, Plant Species, Facilities.

Introduction

Study of landscape was a core topic of geography. It was seen as a unique synthesis between the natural and cultural characteristics of a region (Marc Antrop, 2001). Landscape is generally considered as a visual phenomenon that has many layers like landforms, land cover, land use etc., and it's the composition and perception (thinking, understanding, preferences) of these different layers that all get together and, their interactions form the landscape. Cultivating plants for food and pleasure is as ancient as the civilization of human societies. Early botanic gardens, dating back to the middle of the sixteenth century, were physic gardens established for the study of medicinal plants at European universities. Early on, botanic gardens were defined as 'places open to the public and in which plants were labelled' (Powledge, 2011). Avery (1957), described botanic gardens as primarily being outdoor collection of labelled living plants in aesthetic landscapes, playing passive roles in their communities. Botanic Gardens Conservation International (BGCI), the world's largest plant conservation network and the lead organization for the Global Strategy on Plant Conservation (GSPC), defines botanic gardens as institutions holding documented collections of living plants for the purposes of scientific research, conservation, display and education and identifies the following criteria that an organization needs to meet to be considered a botanic garden (BGCI, 2016). The presented study has tried to study The Sarangpur, Chandigarh Botanical Garden with the help of landscape approach. The objectives of the study are to study the physical landscape of the botanical garden and spatial composition of the flora in the botanical garden. Another objective is to examine the facilities provided in the botanical garden which

will help us to understand the views and expectations of the people visiting a botanical garden. To achieve the goals of the study the primary as well as information from secondary data sources has been collected. Field observation, intensive field surveys, focused consultancies has been conducted with the target groups.

General Characteristics of Botanical Garden

Chandigarh, the 'City Beautiful' is located inside the foothills of Shivaliks and is blessed with a weather that is appropriate to accommodate the variety of species of plant life of various climatic areas. It is profitable putting in place a Botanical Garden right here as a way to conserve the plants of the vicinity as well as those uncommon and close to extinct species. With this historical past Chandigarh Administration has Entrance Gate mounted a Botanical Garden near village Sarangpur. This garden spreads over 176 acres of land and has been connected with the character reserve called Patiala-ki-Rao wooded area through a causeway. Patiala-ki-Rao wooded area spreads over 350 acres of land. Gen. (Retd.) S.F. Rodrigues, Governor of Punjab & Administrator, U. T. Chandigarh, the champion of the cause of environment and keen nature lover, guided the project through his constant inspiration and guidance H.E. Inaugurated the lawn in January, 2007. This lawn whilst absolutely advanced would be one among the biggest in this place. The garden consists of 15 Botanical Sections. The primary aim of putting in of the Botanical Garden is to sell studies, schooling, ex-situ conservation of plants and to spread attention about our floral historical past. In addition, the garden would assist promote eco-tourism in Chandigarh.

Location: The botanical garden is situated in village Sarangpur on Kurali-Chandigarh road about 6 km from Chandigarh bus stand and 80 km from Patiala. It spreads over an area on 176 acres. The place is identified in the study of the flora of the region (Fig. 1).

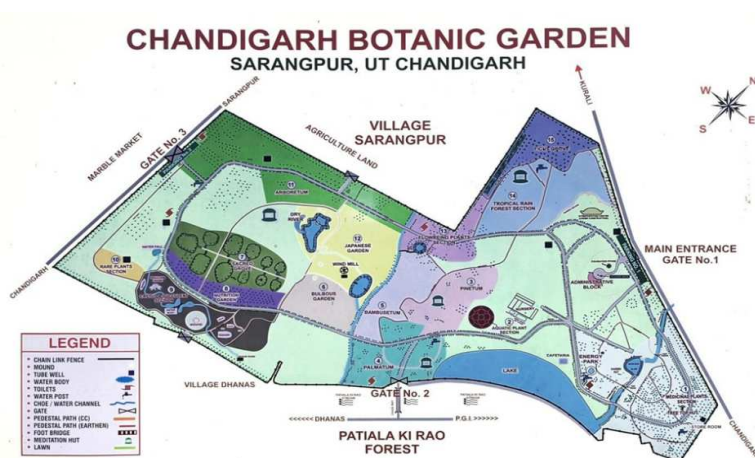


Figure 1: Locational map of the study area
Source: Forest Department, Chandigarh

Spatial Organization of Botanical Garden

1. *Administrative Block (Office-cum-nature-interpretation-centre)*: The office building near gate no. 1 has been constructed as Nature the Interpretation Centre. The exhibits related to medicinal plants and other kinds of flora and wildlife will be displayed here to create awareness amongst the masses about the nature, environment, medicinal plants, forests and wildlife. A conference hall with a capacity to accommodate more than 100 persons would be utilised to educate the students, farmers, NGO'S and other interested groups. Workshops and other activities related to environmental education will also be carried out in the conference hall.

2. *Library*: There is a small library in administrative block with books on medicinal plants, forestry, wildlife, environment and set of magazines related to ecology and environment. The visitors will have free access to the library.

3. *Energy Park*: The Chandigarh energy parks also built in the botanical garden by Department of Science & Technology & Renewable Energy, the Chandigarh administration. The energy park constitutes a Cafeteria with 500 LPD solar water heating system, solar cooker, solar drum, solar slide, solar still, solar pump, water, flapping wind mill, solar PV plant 5 KW to power exhibits in the conference hall and library.

4. *Lakes*: Two lakes have been developed along Patiala-ki-Rao and in botanical garden covering 15 & 8 acres of land respectively. These have been so designed as to harvest rain water. These aesthetically designed water bodies will also act as a percolation tanks. *Water bodies*: In addition to the lake, 5 more water bodies have been developed inside the garden. These water bodies will also harvest the rain water and add to the beauty of the garden. Besides, the purpose here too is to recharge the underground water aquifers.

6. *Nursery-cum-Research-Block*: An exclusive nursery for botanical garden has already been developed over 2 Acres of land. It consists of a green shade net-house and a poly-house too. Saplings of medicinal plants are already being distributed to the individuals/organisations for the promotion of medicinal plants/herbal gardens in UT Chandigarh. An area of 1.5 Acres has been kept reserved for herbarium and the research block.

7. *Fern House*: The first-ever Fern House, created by the Department of Forest and Wildlife, Chandigarh, contains 22 species of fern plants to be found throughout Shivalik Hills. The plants include the lypteris, Pteris cretica and black maiden hair fern.

8. *Roads and Pathways*: To go round the garden, a five km. Cycle track and 6 km. Concrete pathways have also been constructed to have close access to each section of the botanical garden. Six *meditation huts* have been erected/ constructed in the botanical garden. There is a provision of toilets and water posts all along cycle tracks and Pathways.

Botanical Section: The garden is consist 15 botanical/plant species sections. The sections are; Medicinal plants section, Aquatic plants section, Pinetum, Palmatum, Bambusetum, Bulbous garden, Sacred Grove section, Nutrition Section, Cactus & Succulent Section, Rare plant section, Arboretum, Japanese Garden, Ornamental/Flowering plant Section, Tropical Rainforest Section 15.Ficus Grove Section.

Floral Composition of Botanical Garden

The garden comprises with 15 Botanical Sections.

1. *Medicinal Plants Garden*: Medicinal Plants Garden/ Herbal Garden has been developed over 40 acres of land. More than 75 species of medicinal trees and 55 species of medicinal shrubs, herbs & climbers have already been planted in this section (fig. 2).

Botanical Name	Common Name	Botanical Name	Common Name	Botanical Name	Common Name
Acacia	Khair	Pterospermum acerifolium	Kanak champa	Emblica officinalis	Amla
Adina cordifolia	Haldi	Pithecolobium dulce	Jungli jalebi	Erythrina vanegate	Indian coral tree
Aegle marmelos	Bel	Pongamia pinnata	Karang	Eugenia cuspidate	Jamoa
Albizia lebbek	Siris	Prosopis spicigera	Khejri	Ficus bengalensis	Banyan tree
Alstonia scholaris	Sataparna	Psidium guajava	Amrood	Ficus religiosa	Pipal
Artocarpus heterophyllus	Kathal	Putranjiva roxburghii	Putranjeeva	Ficus glomerata	Gular
Artocarpus chaplasha	Barhal	Salvadora persica	Jal, Pilu	Garcinia indica	Kokum
Artocarpus lakoocha	Dheu	Saraca indica	Ashoka	Ginkgo biloba	Ginkgo tree
Artabotrys odoratissimus	Hari champa	Salix babylonica	Weeping willow	Gmelina arborea	Gambar
Anona squamosa	Sitaphal	Santalum album	Sandalwood	Grewia asiatica	Phalsa
Anogeissus latifolia	Chhal	Sapindus mukorossi	Ritha	Holopterna antisyntica	Kurchi
Anogeissus pendula	Dhok	Schleichera trijuga	Kusam	Kigelia pinnata	Balamkhira
Anthocephalus cadamba	Kadam	Shorea robusta	Sal	Lannea coromandelica	Jhingan
Azadirachta indica	Neem	Sterculia urens		Madhuca indica	Mango
Bauhinia variegata	Kachnar	Swietenia mahagoni	Mahogany	Mesua ferra	Nagkesar
Boswellia serrate	Salai	Syzygium cumini	Janua	Melia azedarach	Bakain
Bombax ceiba	Red silk, cotton tree	Taxus baccata	Texus	Mimusops elengi	Maulsiri
Butea frondosa	Dhak, Palas	Tecomella undulate	Rohida tree	Mimusops hexandra	Khirmi
Cassia fistula	Amaltas	Tamarindus indica	Imli	Moringa opeifera	Sohanjana
Caesarea tomentosa	Chila	Terminalia bellerica	Bahera	Morus alba	Shahtoot
Cedrela toona	Tun	Terminalia chebula	Harar	Murraya koenigii	Curry patta
Cinnamomum camphora	Camphor tree	Terminalia tomentosa	Sain	Oroxylum indicum	Pharrai
Cinnamon tamala	Tejpatta				
Cordia dishotoma	Lasura				
Cocculus laurifolius	Tilpara				
Commiphora wightii	Guggulu				
Crataeva adansonii	Barna				
Dalbergia sisoo	Shisham				
Diospyros Montana	Kendu				
Elaeocarpus ganitrus	Rudraksha				

Figure 2: Medicinal plant garden, Plant species.

Source: Department of Forest, UT. Chandigarh

2. Medicinal shrubs: 55 species of medicinal shrubs, herbs & climbers have already been planted in this section (fig. 3).

Botanical Name	Common Name	Botanical Name	Common Name	Botanical Name	Common Name
Abrus precatorius	Rati	Carissa congesta	Karonda	Iberia amara	Chandni
Abutilon indicum	Kanghi	Cassia tora	Panwar	Jasminum grandiflorum	Chameli
Acorus calamus	Vacha	Centella asiatica	Manduparni	Justicia gendaussa	
Achyranthes aspera	Apamarg	Clitoria ternatea	Aparajita	Lawsonia intermis	Mehendi
Adhatoda vasica	Vasaka	Coleus barbatus	Patharchat	Mentha species	Mint varieties
Aloe barbedensis	Ghrit kumara	Curcuma longa	Haldi	Mimosa pudica	Lajwanti
Asparagus racemosus	Satavari	Cymbopogon citrates	Lemon grass	Mucuna pruriens	Kaunch
Andrographis paniculata	Kalmegh	Cymbopogon nanus	Citronela	Nerium odorum	Kaner
Bacopa monnieri	Brahmi	Datura metel	Krishna datura	Nyctanthes arborescens	Harshringar
Barleria prionites	Kala bansa	Datura alba	Dhatura	Ocimum basilicum	Kali tulsi
Barleria lupuliana	Kalabansa	Eclipta alba	Bhringraj	Ocimum gratissimum	Ram tulsi
Boerhaavia diffusa	Punurnava	Ginger officinal	Adrakh	Ocimum kilimandscharicum	Kapur tulsi
Cassia angustifolia	Sena	Geranium	Geranium	Ocimum sanctum	Tulsi
Calotropis procera	Aak	Glycyrrhiza glabra	Mulethi	Piper longum	Pippali
Calotropis gigantea	Aak	Gymnema sylvestre	Gurmar	Phyllanthus niruri	Bhui amla
Catharanthus roseus	Sadabahar	Hibiscus robasinensis	Gurhal	Plumbago zeylanica	Chitrak
Spilanthes acmella	Akarkara	Vetiver	Khus	Rauwolfia serpentina	Sarpagandha
Thevetia nerifolia	Pili kaner	Vitex negundo	Nirgundi	Ricinus communis	Ayarn
Tephrosia purpurea	Sarpunkha			Sida cordifolia	Mahabala
Thuja compacta	Mayur pankh			Solanum xanthocarpum	Kantkari
Tinospora cordifolia	Giloe			Woodfordia fruticosa	Dhatki
Tribulus terrestris	Gokhru			Withania somnifera	Aswagandha
Tylophora asthmatica	Anatamul				

Figure 3: Medicinal shrubs in the botanical garden

Source: Department of Forest, UT. Chandigarh

3. Aquatic plant section: The aquatic plant Section built in the form of a Lotus with 25 Sub-compartments, the aquatic plant section spreads over an area of 0.12 hectares. This section has a collection of various aquatic plant species varying from commonly found Ipomoea species to rare Victoria plant. The notable aquatic plant species in this section are;

Botanical name	Common name
Echhornia crassipes	Jal kumbhi
Hydrilla verticillata	Jhangli, Kureli
Ipomoea aquatic	Swamp cabbage
Lemna perpusilla	Duckweed
Monichoria vaginalis	Nanka
Nelumbo nucifera	Kamal
Nymphaea nouchali	Bhenght
Salvinia natans	Salvinia
Typha angustata	Elephant Grass
Victoria amazonica	Giant Amazon water lily

Figure 4: Aquatic plant section

4. Pinetum: Pinetum section spreading over an area of 9.88 hectares. This section has a collection of various Pine or related Conifer species. In India

most of the conifers are found in temperate Regions as they prefer cold conditions. However, this Pinetum section is an attempt for providing an opportunity for its visitors for getting familiarised with a few coniferous species (fig. 5).

Botanical name	Common name
Agathis robusta	Queensland kauri
Araucaria <u>bidwilli</u>	Bunya –bunya
Araucaria columnaris	Cooks araucaria
Araucaria <u>cunninghamii</u>	Hoop pine , Moreton bay pine
Cupressus funebris	Weeping cypress
Cupressus torulose	Himalayan cypress
Juniperus procero	African pencil cedar
Pinus <u>roxburghii</u>	Chir pine
Podo carpus <u>gracillior</u>	Fern pine
Taxodium mucronatum	Mexican cypress

Figure 5: Pinetum species section

5. *Palmatum*: Palmatum spreading over an area of 2.80 Hectares, the section has a collection of various palm and related plant species(fig. 6).

Botanical name	Common name
<u>Cycasirevoluta</u>	Sago palm
Dypsis lutescens	Arecea palm
Livistona chinensis	Chinese fan palm
Phoenix humilis	Dwarf date palm
Phoenix sylvestris	Khajuri
Ravenala madagascariensis	Traveller's palm
Roystonea regia	Royal palm, Bottle palm

Figure 6: Palmatum section

6. *Bambusetum*: Bamboo is a woody grass belonging to the family Poaceae worldwide; there are more than 1250 species of bamboos. Almost 130 species of bamboos are found in India, of which two- third is found in the North-Eastern states. In bambusetum 22 species of Bamboos have been planted along two seasonal Nallahs passing through the botanical garden (fig. 7).

Botanical name	Common name
Bambusa balcooa	Baluka
Bambusa bambos	Kanta bans
Bambusa vulgaris	Yellow Bamboo
Dendrocalamus strictus	Lathi bans
Melocalamus maclellandii	Climbing bamboo

Figure 7: Bambusetum species section

7. *Bulbous Garden*: This section is developed over 2 acres of land. It consist variety of bulbous plants of this region like - Gladiolus, Dafodil, Nargis, Lillium, Iris etc.
8. *Sacred grove*: This section has been developed in the form of a cosmic tree/'Sarva Dharma Vriksha'. This 'tree' comprises 11 branches and each consist variety of bulbous plants of this region like - Gladiolus, Dafodil, Nargis, Lillium, Iris etc. branch represents a specific religious vatika. In these vaticas, the trees associated with various religions have been planted. The 11 vaticas are; Ram vatika, Krishan vatika, Guru-ke-bagh, Kurani vatika, Christian vatika, Navgrahavatika, Vishnu vatika, Brahma vatika, Jain vatika, Budh vatika.

9. *Nutrition Garden:* The nutrition garden section spreads over an area of 1.1 Hectares. This section includes fruit species suitable for temperate, tropical and sub-tropical region. More than 15 species have been planted in this section (fig. 8).

Botanical name	Common name
<u>Aegle marmelos</u>	Bael
<u>Embllica officinalis</u>	Amla
Mangifera indica	Aam
Psidium guajava	Amrud
Punica granatum	Anar
Pyrus communis	<u>Nashpati</u>
<u>Syzygium cumini</u>	Jamun
Ziziphus mauritiana	Ber

Figure 8: Nutritional plants species

10. *Cactus & succulent section:* Cactus section spreading over an area of 4.02 Hectares, This section has a collection of various cacti. This cactus section has different Rockeries & a polycarb cactus dome. Adding to provide hot& humid conditions suitable for cactus growth .This one of the biggest cactus done in the region. More than 100 Varieties of cactus & succulent plants have been collected from different sources to develop this section. A beautiful water body and water channel adds to its aesthetic value. Furthermore, a polyhouse, poly-carb house and a glass-house are being added. Some notable cactii species are: Chamaecereussilvestris, Copiapohypogaea, Echinocereusenglemanni, Echinopsisearsii, Gymnocalycium, Mammillaria saboae, Notocactusmammulosus, Rebutiaaureiflora, Sulcorebutia candida, Opuntia.

11. *Rare plant section:* An area of about 3 acres has been allocated to this section. This collection will include rare plants from India and abroad. In this section those plants are found which are endangered in nature.

12. *Arboretum:* Arboretum is a place where an extensive variety of woody plants are cultivated for scientific, educational, and ornamental purposes. This section spreading over an area of 6.51 Hectares. Some of the tree species are shown below (fig. 9).

13. *Japanese garden:* Japanese gardens are characterized by: the waterfall, of which there are ten

Botanical name	Common name
Acacia catechu	Khair
Adansonia digitata	Kalp briksh
Ailanthus Excelsa	Mahrukh
Anmona squamosal	Sitaphal or sharifa
Ashok serpantina	Ashok
Boswellia serrate	Salai
Chukrasia tabularis	Chukrasia
Dalbergia latifolia	Indian rose wood
Elaeocarpus sphaericus	Rudraksha
Erythrina blakei	Coral tree
Holoptelia integrifolia	Pahari papri
Litchi chinensis	Litchi
Melia azadirachta	Bakain
Platanus orientalis	Chinar
Quercus incana	Oak tree(<u>Baani</u>)
Shorea robusta	Sal
Tectona grandis	Teak

Figure 9: Arboretum section

or more different arrangements; the spring and stream to which it gives rise; the lake; hills, built up from earth excavated from the basin for the lake; islands; bridges of many varieties; and the natural guardian stones. The selection and effective distribution of the stones are a prime consideration in garden design. After endless experiment and deep pondering, the best and most subtle compositions were handed down by means of drawings. This section is under development over 5 Acres of land. Various features of a Japanese garden such as dry river, bridges, lawns etc. have been developed.

Various other features such as Pagoda, Lantern & tea houses *etc.* will be added to the section. Meditation hut also built in the Japanese garden. *Ornamental/flowering trees:* More than 35 species of ornamental trees like Acacias, Langerstroemia, Cassias and Bauhinias *etc.* have been planted in this section.

14. *Tropical rainforest section:* Number of tree species specific to rain-forest has been planted in this section. This section would be enriched further with more such species and also matching features.
15. *Ficus groves:* Ficus grove section spreads over an area of 3.51 Hectares. Ficus species are well known source of edible fruits for humans as well as for animals. In this section various species of ficus genus, ranging from wild varieties to the cultivars have been planted.

Facilities provided in the botanical garden

There are many facilities provided in the garden which are:

Energy park- The Chandigarh Energy Park is an ambitious endeavour of UT Administration to promote and integrate the use of renewable energy. It is developed in the botanical garden. The outdoor exhibits like solar submersible pumps have been installed to supply water to garden through sprinklers. Biogas plant, solar water heating system, solar cooker, solar drum, solar slide, solar still, solar pump, water pumping wind mill among others has also been set up at the park. The outdoor exhibits also include solar street lights which aim to provide electricity for operating overnight lights on the streets. Also, a solar power plant has been installed at the park to generate solar power to run indoor exhibits like computers, solar lights, LCD display boards on energy environment.

Information Kiosk: An information Kiosk is placed in the Administration block. In that Kiosk we can get more details about the species and where they located in the garden. Information Kiosk offers visitors detailed information about the plant species.

Battery Operated Vehicles: Solar battery-operated vehicles also provided in the botanical garden. With the help of these you can take a ride & enjoy beautiful scenery of the garden. You can get these vehicles from the energy park in the botanical garden.

Ample Parking Space: There is plenty of space to park the vehicles. Parking is available at the side of the main entrance gate of the botanical garden.

Lawns: Botanical Garden has large lawn areas. These lawn areas are used for aesthetic pleasure, as well as for sports or other outdoor recreational use.

Resting Benches & Shelters: Benches and shelters are also placed in the botanical garden. Benches are found in large numbers and many shelters also constructed in the garden.

There are six meditation huts constructed in the garden where you can sit and do meditation.

Cycle track: To go around the garden, a five km. cycle track has been laid. It is planned that in future, the department will provide 'Bicycle' on a nominal rent to visitors.

Pedestal path: A network of cement concrete pathway of 6 km. Length crisscrossing the entire length & breadth of the garden has also been constructed to have close access to each section of the botanical garden. There is a provision of toilets and water posts all along cycle tracks and Pathways.

Cafeteria: An area of about an acre has been kept reserved and construction started in the cafeteria overlooking the lake in the garden.

Botanic gardens attract a wide range of domestic and international tourists, as well as regular visitors from their local areas. As both conservation and education are among

the objectives of botanic gardens, they are potentially well-placed to offer community education about conservation, to engender pro-conservation attitudes, and to encourage the public to support conservation efforts. In order to inform the development of appropriate interpretive strategies targeting conservation issues, information is needed regarding visitors' existing conservation awareness, interests and motives for visiting and improvements they wish to have in the garden. The major findings of the research are: Botanic Garden visitors reported having a relatively low level of interest in and commitment to conservation issues. The most important reasons given for visiting the Botanic Gardens were to enjoy oneself; to admire the garden's scenery; to spend quality time with family or friends; and to enjoy being outdoors/in nature. Visitors are also thinking that the garden played an important role in the economy sector as it provides employment for many people. There are more than 100 people working in the botanical garden including govt. Officers or employees. Visitors also reported that the botanical garden is ignored by the Chandigarh Administration as compared to other tourist places like Rock Garden & Rose Garden. Visitors think that the major contribution of botanical garden is conservation that helps to ensure biodiversity. If we hope to have thriving life on this planet we need to protect the degree of variation of life. Whether we are focusing on genetic variation, ecosystem variation, or species variation locally or globally biodiversity is our hope for the future and Botanical gardens play a key role in this effort. Conservation and protection of endangered species and those species, which are not at risk, require effort, long-term, concerted effort.

There are some issues in the garden and the visitors want such improvement for the betterment of the garden:

Drinking water facilities should be improved and water coolers should be used to provide clean and purified water instead of simply water taps. Ponds are empty most of the time, so they should be filled with water time to time to enhance the beauty of the garden. Street or solar lights should be increased in numbers because provide numbers is not sufficient to cover all the pathways of the garden. All the public amenities should be open because few of them not working and permanently closed. A cafe or a canteen should be open and working in the garden during the visiting time on the garden. A registration booklet should be placed at the gate of the garden to register the visitors.

Summary and Conclusion

Botanical gardens maintain a wide range of species as living plants, in seed banks and tissue culture. Thus, botanic gardens contain collections of plants for education, scientific purposes and display. The botanical garden plays an important role as the ex-situ conservation of plant and also in situ conservation site. Horticulture and cultivation skills allow us to grow plants that might be lost in nature, which means their plant diversity can be conserved in the gardens, but also allows us to consider restoration and rehabilitation of degraded habitats. Living collections of plants collect species under various groupings, to maintain a living store of genetic diversity that can support many activities in conservation and research. The conservation of plant diversity is critical for sustainable development and botanic gardens are playing a key role as centres of conservation action.

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