



Proceedings of Seminar on

GREENERY & LANDSCAPING

April 5, 2019



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(The Views expressed are purely of the authors and not of the editor or their organizations)

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MESSAGE

It gives me immense pleasure to note that CPWD is organising a one day National Seminar on "Greenery and Landscaping" on 5th April, 2019 in New Delhi, as a part of its continued effort for green and clean sustainable development, which is essential for all of us as it has substantial impact on the environment.

I am given to understand that the Seminar will be broad based comprising of Civil, Electrical, Architecture and Horticulture aspects of green development including aesthetics and landscaping.

I hope that the Seminar will give an opportunity to the participants to deliberate on various aspects of the green development in the country. Knowledge disseminated through presentations and discussions will benefit the participants and takeaways will help in furthering the objectives of green development.

I congratulate Shri Prabhakar Singh, Director General, CPWD for the novel initiative and wish the Seminar all success.

(Durga Shanker Mishra)



PRABHAKAR SINGH
Director General



सत्यमेव जयते

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MESSAGE

Central Public Works Department as a Premier Engineering Organization of Government of India has been pioneer in creation of sustainable built environment and has taken a number of green initiatives such as construction of green buildings, adoption of new green and clean technologies, solar roof tops, energy efficiency measures, waste water recycling plants, rain water harvesting systems, increasing tree cover and greenery by massive plantation drives and many more.

To take forward the ongoing green initiatives further, CPWD is organising a National Seminar on "Greenery and Landscaping" in Vigyan Bhawan, New Delhi on April 5, 2019 with the support and guidance of the Ministry of Housing and Urban Affairs.

I am happy to note that experts form Horticulture, Landscape Architecture, and Civil Engineering streams from within CPWD and from other Government and Private Organizations shall present their papers in the Seminar. I am sure that the knowledge disseminated through this day long deliberations will benefit all participating in the Seminar.

I appreciate the sincere efforts of Dr. K. M. Soni, Additional Director General (TD), Dr. B. N. Srivastava, Dy. Director General (Hort.) and their team of officers and staff for organizing this Seminar in a most successful manner.

(Prabhakar Singh)

Place: New Delhi
Date: April, 2019

DR. K. M. SONI
Additional Director General (TD)



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MESSAGE

CPWD being the Principal Technical Adviser to Government of India is committed to disseminate knowledge to its officers as well as officers of other engineering organisations. CPWD has been organising various Seminars and publishing documents for the benefit of those engaged in Civil construction.

It is a matter of pride that CPWD is organising Seminar on 'Greenery and Landscaping' which will be attended by CPWD Engineers, Architects and Horticulturists from all over the country. The Seminar aims to encourage green practices and provide platform to the delegates to gain knowledge and share their experiences with the experts.

I am sure that the knowledge disseminated through this Seminar will benefit to all attending the seminar in particular and society in general.

I wish the seminar all success.

(Dr. K. M. Soni)

Place: New Delhi
Date: April, 2019



सत्यमेव जयते



CPWD

Dr. B.N. Srivastava
Dy. Director General (Hort.)

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FOREWORD

It gives me great pleasure to announce one day seminar on “GREENERY AND LANDSCAPING” being organized by CPWD. This is an attempt to highlight the contributions and innovations in the field of Horticulture and Landscaping. CPWD is one of the premier organization in this field and owns the responsibility to adopt new innovations, new techniques are encouraged, promoted and used for creating a green environment with aesthetic values.

The need of the day is to save our environment and the best way to contribute is by growing plants. The modern world is posing lots of challenges due to climate change. With urbanization & migration to urban areas, the world is turning into a concrete jungle. It is thus our responsibility to come up with new ideas and means to work for environmental protection. This seminar has myriad of solutions to this problem by way of Vertical gardening, Nutraceuticals, Greenscaping, Terrace gardening, Rooftop gardening, Bottle gardening, Exotic vegetables, Temperate flora to Indoor air quality improvement, travelling through all the lanes of horticultural development.

About thirty seven articles have been published in this book which cover varied field of horticulture, plantation and Landscaping such as vertical gardening, Indoor Plants, Tree translocation, protected cultivation, organic farming, medical plants etc.

I express my deep appreciation to Dr. Manoj Kumar, Director of Hort. (NDR), Dr. P.K. Tripathi, Director of Hort. (WR), Shri Yogendra Singh, DD(H) Div.-I, Shri Ram, Singh Meena, DD(H), Div.-II, Shri A.K. Deshwal, AD(H), Dr. Deepti Saxena, AD(H), Shri Satveer Singh, AD(H), Shri Sanjay Singh, AD(H), Ms. Shahna Shamim, (Asstt. Architect), Shri Y.K. Gaur, SO (H), Shri Mahesh Kumar, SO(H), Mrs. Pratiksha Kumari, SO(H), Ms. Meenu Kumari SO(H), Shri Navdeep Singh, SO(H) for their contribution in compilations and editing of proceeding in present shape.

Place: New Delhi
Date: April 2019

(Dr. B.N. Srivastava)

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FUTURE FLORA OF URBAN LANDSCAPING

Dr. H. P. Sumangala, Sr. Scientist, Indian Institute of Horticultural Research

Growing population, rapid urbanization and changing climate have created a global challenge to meet food and nutritional and cleaner environmental needs. Rapid urbanization is not only taking place in larger cities, but satellite towns are growing, competing for food, water, transport and above all adding to pollution of the environment. Minimizing these impacts through adaptive measures is therefore unavoidable. Cities have a key role to play in the global agenda for addressing the challenge of climate change and urbanization. Action is needed now to steer urban development towards green cities that contribute to environmental security, and clean environment for urban dwellers. We need to think more sustainable approaches by bringing all the developmental agencies to create more resilient cities. Growing native plants in urban areas is one such approach to create more functional landscapes.

Native plants have evolved and adapted to local conditions over thousands of years. They are vigorous and hardy, so can survive all adverse climatic conditions. Thus native plants suit today's interest in "low maintenance" gardening and landscaping. The diversity of native plants includes interesting flowers and foliage. Native shrubs and trees provide a variety of heights, shapes and textures in the landscape. There are several nontraditional and unexploited species available in nature. Plants, from their natural habitats can be selected for the beautification of parks, public and private places in urban as well as in rural areas.

The Indian subcontinent holds prominence as one of the twelve regions of diversity in crop plants in global perspective. All known types of agro climatic, ecologic and edaphic conditions are met within India. India is one of the 12 mega biodiversity countries in the world. Two of the world's 18 biodiversity hot spots are located in the Western Ghats and Eastern Himalayas. India is rich in all the three levels of biodiversity—such as species diversity, genetic diversity and habitat diversity. There are about 426 biomes representing different habitat diversity that gave rise to one of the richest centres in the world for plant genetic resources. The total number of flowering plant species is 17,000, the intraspecific variability found in them make it one of the highest in the world.

In spite of great biodiversity, the floricultural industry of India concentrates mostly on the non-native plant species. We lack information on scientific and technical knowledge about potential wild ornamental plant species indigenous to India. No comprehensive work has been carried out on the assessment of variations in different populations of potential species and their improvement and ex-situ multiplication. National Bureau of Plant Genetic Resources (NBPGR), Delhi and National Botanical Research Institute, Lucknow, are working on conservation and sustainable utilization of the wild genetic resources. NBPGR is mainly a germplasm collection center concentrating on the crop species and the NBRI has broad objectives and working on various areas starting from the wasteland development to the plant biotechnology.

Western Ghats of India, one of the eight hottest hot spots of the world is known for its rich biodiversity. Western Ghats harbor about 4000 flowering plants which includes ornamental trees, shrubs, climbers,

herbs, succulents, of which only few are utilized to some extent for their economic values. There is a need to identify new ornamental species suitable for landscape gardening. As part of the study, for sustainable utilization and conservation of these important resources, efforts are made in the form of exploration collection domestication and evaluation. Our plant introduction project includes also several native plants, which have not been introduced into commercial cultivation yet. The introduction projects include many research stages, starting with the collection of the plants in their native habitat and finalizing when the product is introduced commercially. The native ornamentals were collected from northern parts of Western Ghats, domesticated and evaluated for their potential as a landscape ornamentals. Among them following plants were suitable for landscape purpose are, Jasmin ummalabaricum, Artemesianilgairica, Artemesia japonica, lavendualllawii, ixoraparviflora,, Seneciobombayences, Seneciobelgaumenis, Seneciodalzilli, clematis guariana and Lepturusradicans ferns, ground orchids, small shrubs and trees. In an another project we have domesticated about 56 species from BiligiriRangana Hills. It lies at a spot where the Eastern and Western Ghats meet and create a diverse eco-system. And is known for its diverse species of flora and fauna. The hills are covered with more than 800 species of plant life, including scrub, dry deciduous, moist deciduous, shola forests and montane grasslands.

This information has given very encouraging results and clearly demonstrated adaptability of native plants is significantly superior to introduced plants for landscaping. Cost effective, environment friendly and economical landscaping is possible. Abundant scope and opportunity to breed promising material for different needs of landscape to cater needs of domestic market.

To conserve biodiversity in urbanized areas, the increased use of native plant species in designed landscapes needs to be introduced. A major challenge to scaling up the use of native species in landscaping is providing ornamental plants that are both ecologically functional and economically viable. Environmental restoration, through native plants must be introduced in to managed landscapes. Sustainability, biodiversity and low maintenance are the current trends in landscape designing. We need to rethink about the sustainability while designing green spaces and landscape gardens in the cities. Because they are not only aesthetically appealing but more functional in supporting the diversity.

ENERGY EFFICIENCY THROUGH LANDSCAPING

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ABSTRACT

Landscaping is about making the best use of available space in the most attractive way by creating relationship between the land, buildings, plants and people. Trees and vegetation control erosion, enhance ground water recharging, provide food, create habitat for wildlife, clean the air by absorbing carbon dioxide and releasing oxygen. In fact, landscaping may be your best long-term investment for reducing heating and cooling costs, while also bringing other improvements to your community. Attractive and functional landscape can be developed by using living, natural, human and abstract elements. A combination of hard and soft landscape is required to fulfill the functional as well as aesthetical aspects.

Energy efficiency concepts have given rise to innovative landscaping like pervious paving, minimizing hard areas, taking advantage of natural shading, vertical gardens or green walls and terrace gardens. Use of water bodies for production of solar energy are also being used in the form of floating solar panels and solar panels over canals to serve the dual purpose of energy production besides saving water by avoiding evaporation. Green spaces help to mitigate the microclimate and is important for the sustainable development as well as to provide healthy quality of life. In addition, landscaping vegetation will beautify the city environments and transform microclimates to make it health favorable for dwellers.

INTRODUCTION

Landscaping (Fig 1 & 2) is an activity that modifies the visible features of an area of land, including nature for the development of outdoor space with focus on beautification of outdoor terrain and some interior settings to provide enrichment like Privacy, comfort, beauty and ease of maintenance. It also results in sculpting the soil and the natural lay of the land. It involves lawns, shrubs, trees, plants and flowers, structures such as seating, pools, rock gardens, trellises or pergolas, and paved surfaces.

Landscaping is the practice of creating a plan to make the best use of available space in the most attractive way by creating the relationship between the land, buildings, plants, trees and people. It is therefore very important to maintain the landscape as attractive and functional as intended in the original design.



Fig 1



Fig 2

Studies have shown that 2500 sft of turf grass releases enough oxygen for a family of four. A well-planned landscape can reduce an unshaded home's summer air-conditioning costs by 15% to 50%. Carefully positioned trees can save up to 25% of a household's energy consumption for heating and cooling. All of us have noticed the coolness of parks and wooded areas compared to the temperature of nearby city streets. Shading and evapotranspiration (the process by which a plant actively moves and releases water vapor) from trees can reduce surrounding air temperatures as much as 5°C. Studies have found summer daytime

air temperatures to be 2°C to 3°C cooler in tree-shaded neighborhoods than in treeless areas.

A well-designed landscape provides energy efficiency in the following ways;

- Cut your summer and winter energy costs dramatically by protecting your home from winter wind and summer sun.
- Reduce consumption of water, pesticides, and fuel for landscaping and lawn maintenance by choosing right kind of plants .
- Help control noise and air pollution.

It combines the principles of art and science, requires good observation and design skills, Hence the knowledge and understanding of the elements of nature and construction(human elements) to blends them accordingly is very essential for Landscape Architects / landscapers.

LANDSCAPEELEMENTS

The elements used in landscaping can be Living elements e.g. flora or fauna / gardening plants with a goal of creating a beautiful environment within the landscape.

Natural elements e.g. landforms, terrain shape and water bodies.Human elements e.g. structures, buildings, fences including other material objects created and/or installed by humans.Abstract elements such as the weather and lighting condition.

Any and all the above factors can be used to develop a landscape that is both attractive and functional.

HARD AND SOFT LANDSCAPE

The term hard landscape is used in landscape architecture and garden design to describe the construction materials which are used to improve the landscape by design. A wide range of hard landscape materials can be used, such as brick, gravel, rock or stone, concrete, timber, bitumen, glass, metals, etc. 'Hard Landscape' can also describe outdoor furniture and other landscape products.



Fig 3 : Soft Landscape



Fig 4 : Hard Landscape

The term soft landscape is used to describe the vegetative materials which are used to improve the landscape by design e.g. aquatic plants, semi-aquatic plants, grass and herbaceous plants, shrubs and trees. More the soft landscape, better will be the aesthetics and microclimate.

SELECTION OF LANDSCAPING

Landscaping through right selection of plants has numerous advantages as shown in Fig 5.

Aesthetics – Plants can act as sculpture when placed against a blank wall

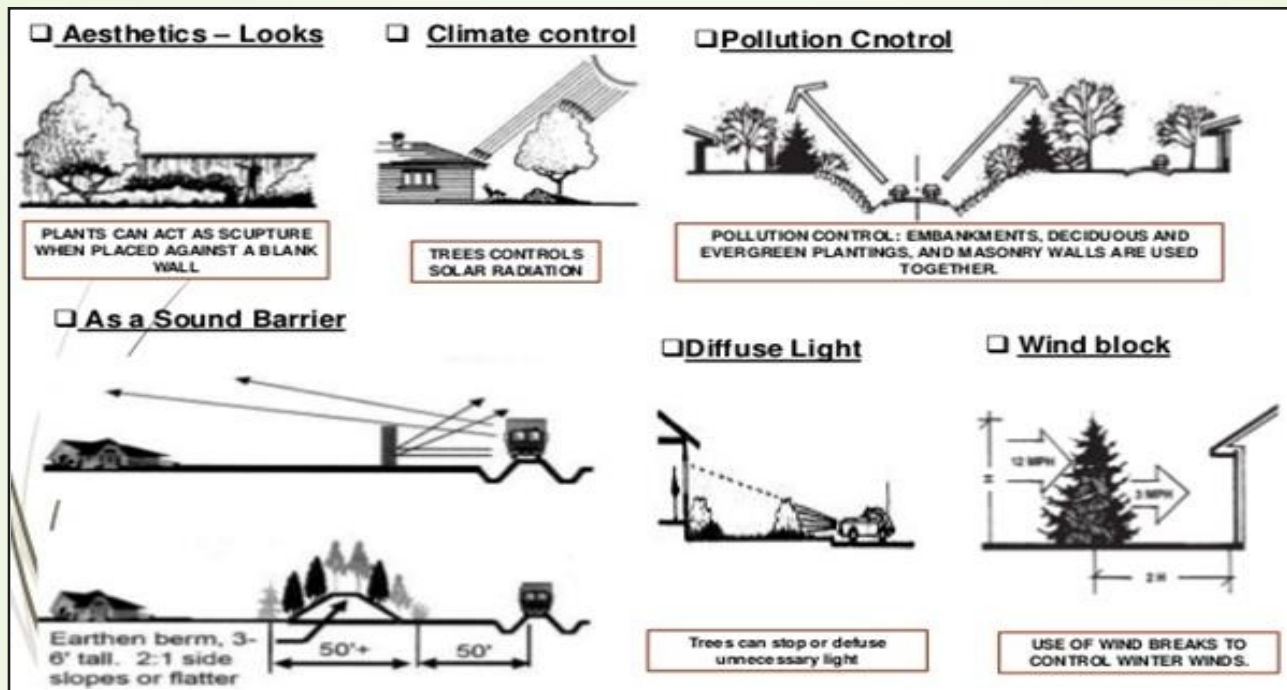
Climate control - Trees controls solar radiation

Pollution Control - Through deciduous and evergreen planting.

Sound Barrier - Earthen berm. 3-6 tall 2:1 side slopes or flatter

Diffuse Light - Trees can stop or defuse unnecessary light

Wind Block - Use of wind breaks to control winter winds.



SPACE ANALYSIS

Basic Analysis of the space/ area to be landscaped is required to be taken up before preparing any Landscape scheme like determining size / scale, existing plants, orientation, sunlight path, water slope and required of space / area i.e. Public area – street front, outdoor Living area or service area and function to be served i.e. Attraction for birds or Butterflies or Wildlife, Fragrance, Privacy or Meditation and tranquility?

Based on the analysis, scheme is prepared considering the principal of design to be followed e.g. Symmetrical, Asymmetrical or Out of Balance. It is advisable to use not more than 3 or 4 species, plant tall trees in back and short in front and use odd number of plants. Proportion of different plantations used not only at the time of plantation but ultimate growth needs to be kept in mind. Line plantings of trees create walls of outdoor spaces and are often used along property boundaries. To create rhythm in boundary, variety in size & shape is needed. Taller plants are generally used near corners of plot / boundary and shorter plants under windows of the building.

SCOPE OF THE LANDSCAPE DESIGN

The scope of the Landscape Design includes;

- Urban design;
- Site planning;
- Storm water management;
- Energy efficient landscaping / Green infrastructure planning / Environmental restoration
- Gardens, Parks and recreation planning including Visual resource management;

Urban design ; Is the process of designing and shaping cities, towns and villages, whereas architecture focuses on individual buildings. Urban design address the larger scale of groups of buildings, of streets and public spaces, whole neighborhoods and districts, and entire cities, to make urban areas functional, attractive, and sustainable.

Urban design is an inter-disciplinary subject that unites all the built environment professions, including urban planning, landscape architecture, architecture, civil and municipal engineering. In more recent times different strands of urban design have emerged such as landscape urbanism.

Site planning; Is an architectural plan (Fig 6) landscape architecture document and a detailed engineering drawing that shows a building footprint, travel paths, parking, drainage facilities, sewer lines, water lines, trails, lighting, landscaping and garden elements”

It is a graphic representation of the arrangement of building, parking, drives, landscaping and any other structure that is part of a development project.



Figure 6

Storm Watermanagement ; Storm water is the water that originates during precipitation events. Storm water that does not soak into the ground becomes surface runoff, which either flows directly into surface waterways or is channeled into storm sewers. Storm water management of sites utilizes a variety of non-structural (source control methods) storm water best management practices (BMPs) which can be used to intercept, retain and infiltrate local runoff and storm water that originates on the site. Best Management Practices (BMPs) are guidelines for landscape maintenance that keep landscapes visually attractive while conserving our water resources, reducing pollution, and protecting our fragile environment. During site design and planning for any development of property. It is very important to define where storm water is coming from, how much storm water is coming and, how to manage that storm water.

Energy efficient landscaping ; Is the landscaping designed for the purpose of conserving energy. There is a distinction between the embodied energy of materials during constructing the landscape, and the energy consumed during maintenance and operations of a landscape.

Energy –efficient landscape design includes

1. Planting trees for the purpose of providing shade, which reduces cooling costs.
2. Planting or building windbreaks to slow wind pressure near buildings, which reduces heat loss.
3. Wall sheltering, where shrubs or vines are used to create a wind break directly against a wall or landforms as windbreaker
4. Earth sheltering and positioning buildings to take advantage of natural shading.
5. Reducing the heat island effect with previous paving, high albedo paving, shading, and minimizing paved areas.
6. Site lighting with full cut off fixtures, light level sensors, and high efficiency fixtures.
7. Construction of green / living roofs and green/ living walls



Fig 7 Green Wall



Fig 7A Green Roof

Green roof / wall is the roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane., that cools the building with extra thermal mass and evapotranspiration. Most green walls include an integrated water delivery system. A green wall is also known as a living wall or vertical garden.

Green roofs serve several purposes for a buildings, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, and helping to lower urban air temperatures and mitigate the heat island effect. There are two types of green roofs i.e.

intensive or extensive based on the depth of growing medium. An extensive roof has 6 inches or less of growing medium. It also has lower weight, plant diversity, costs and Maintenance. Extensive roofs are covered with a light layer of vegetation and are lighter than an intensive green roof.

Intensive roofs, are thicker and have more than 6 inches of growing medium and tends to have greater plant variety and diversity, as well as higher weight and requires more maintenance.

Container gardens on roofs, where plants are maintained in pots, are not generally considered to be true green roofs, although this is debated. Rooftop ponds are another form of green roofs which are used to treat grey water.

Gardens, Parks and recreation planning ; Garden design is the foundation of any great landscape. A garden is a planned space, usually outdoors, set aside for the display, cultivation, or enjoyment of Plants and other forms of nature. The garden can incorporate both natural and man-made materials.

Principles of garden design are order, unity, time, diversity, dominance, balance, scale and proportion, vista
Order can be defined as the overall organization and structure of the design: i.e. the skeleton of the design. Without order a design becomes fragmented into unrelated parts that results in disjointed, uncoordinated appearance. The design should create a theme which carries on throughout the composition. Garden Styles are often used to create order throughout a design.

Use of too many materials used in a small spaces is considered as disorder. Maximum of 3 hard cape materials is considered appropriate in a design.

Unity can be defined as the harmonious relationship among all elements and characteristics of a design. In

addition to the overall design, Unity can be spoken of in terms of form, material, color and texture. Unity is a visual quality that may not always be consciously perceived, but is always sensed. The easiest way to establish unity is to limit the complexity and number to one. Most composition require the use of more than one element. Combination of two similar elements tend to destroy unity because competition between the two is established. Your eye can become unsettled because your attention is taken from one element to another without setting on either. It's a little like watching a tennis match Three elements of the same type balance and equalize one another. The eye does not settle on one element but relates to the cluster as a whole. That is why plant groupings are usually in threes or other odd numbers. This avoids the competition of two.

Unity can also be maintained with shape and texture to create interest by varying size. Another way to provided unity is to simplify the diversity or differences among the elements.

Time laps Change in view / picture with time is known as time laps. Use of spring flowering plants changes the picture dramatically (Fig 8) over time whereas use of green plants will keep the picture same throughout the year (Fig 8A).



Fig 8



Fig 8 A

Diversity of size, tone and texture creates interest (Fig 9) and focal points to the landscape whereas same size and shape becomes boring as can be seen in (Fig 10)



Fig 9



Fig 10

Dominance is quite similar to the unity of one. Due to the dominant elements size, shape, tone, texture or location, all other elements are subordinate to it. The eye is continually drawn back to the dominant element This dominant element is usual known as the focal point(Fig 11 & 12).



Fig 11



Fig 12

Balance can be achieved through symmetry repeating the same featured on either side of a dividing line. This is used in formal gardens. Balancing volumes (Fig 13) or shapes on opposing sides of the garden (but with less attention to the strict centre line of a space). This is used in informal garden. It is important to keep the features in the garden to a human scale and in proportion to each other (Fig 14) Paths need to be wide enough and spaces large enough for people to move about freely.



Fig 13



Fig 14

Vista is also known as “framing the view” where you deliberately plant or construct something to lead the eye where you want it to go (Fig 15 & 16).



Fig 15



Fig 16

Other principles of garden design include;

- ▲ the garden should appear that it 'belongs' to the building, campus and the wider environment.
- ▲ it should be an enjoyable space to be in- whether designed for excitement or calm contemplation.
- ▲ it should look as though each element was 'meant' to be where it is.
- ▲ the simpler the design the better will be the aesthetic value.

Gardens can be designed with formal or informal landscaping. Formal landscaping (Fig 17) is best described as structured, orderly, perfect or clean. Hedges are often used in formal landscaping. Some hedges are straight, some have curves, but they tend to have a great sense of symmetry and balance. Formal gardening attempts to fight with nature to make it stay growing and stay perfect. The planting design is symmetrical on both sides of the walk.



Fig 17 : Formal landscaping



Fig 18 : Informal landscaping

Informal landscaping (Fig 18) is more relaxed than formal landscaping. If hedges are used at all, they are not sheared flat, but instead they are left fluffy and soft. Informal landscaping is more in-step with nature, it looks more natural. Informal Landscaping includes the organic form.

Gardens can be of various types e.g.



Zen garden



Botanical garden



Xeriscape garden



Mughal garden



Zoological garden



Puzzle garden



Roof garden



Vertical garden

These gardens possess the qualifiers like decoration, temperature control, Architectural enhancement and offer recreational opportunities besides energy efficiency.

CONCLUSIONS

- Landscaping is the best long term investment for achieving permanent energy efficiency.
- More the soft landscape, better will be the aesthetics and microclimate.
- Trees and vegetation control erosion, enhance ground water recharging, provide food, create habitat for wildlife and Help control noise and air pollution.
- It creates relationship between land, buildings, plants, trees and people.
- Gardens offer benefits like decoration, temperature control, Architectural enhancement and recreational opportunities.
- We must protect and maintain our green areas for sustainable development and providing healthy life.

VERTICAL GARDENING

Dr. R. K Dubey, Professor Department of Floriculture and Landscaping
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INTRODUCTION

With the Industrial Revolution, urban spaces expanded dramatically, much faster and with much more significant changes than in their previous evolutionary periods. These changes have a direct effect on the local climate of urban spaces, especially the central parts of the city, causing a significant rise of the urban temperature and other alterations, known as the heat island effect. This has led to very unpleasant local climatic conditions which have a negative effect on human health. General lack of vegetation in existing cities is one of the factors affecting the formation of raised urban temperatures. In most urban spaces, appreciable amounts of vegetation exist mostly concentrated in parks or recreational spaces. Although parks manage to lower temperatures within their vicinity, they are incapable of thermally affecting the concentrated built spaces where people live, work and spend most of their urban lives. By placing vegetation within the built space of the urban fabric, raised urban temperatures can decrease within the human habitats themselves and not only in the detached spaces of parks. Therefore, with the advent of the modern industrial city planners, designers and urban advocates are once again turning to plants – green infrastructure – as a key strategy to provide cleaner air and water and to improve living environments, human health and mental well-being. Vertical gardens are another way of seeing gardens and of implanting them in unexpected locations within the cities. Besides adding to the aesthetic value of the house and improving the insulation of the building, a green wall offers immediate environmental advances in reducing existing greenhouse and other volatile organic compounds from our polluted cities. Plants act as bio-purifiers and can play a dramatic role in improving the quality of city air through a number of biochemical processes by removing and breaking down airborne contaminants from both inside and outside a building. When combined with plant photosynthesis, which produces clean, oxygen rich air, it becomes easy to see the value of employing living plants as bio-purifiers in polluted urban environments. Introduction of vertical farming and incorporation of different type of plant species will also help in providing them with the same feeling and closeness to mother earth and nature. This concept is becoming popular although it is still evolving and more scientific research on this aspect is desired.

IMPACT OF VERTICAL GARDENING

Vertical gardening is basically growing plants upwards on vertical surfaces (the wall of a home, office, hospitals or on a large facade of a building). As there is a lack of horizontal space for many urban areas in the present era, installation of a vertical garden is undoubtedly a favourable option to include some greenery in the house / building. Vertical green walls can even be installed along highways, expressways, metros, railway lines, airports etc. to bring down the deleterious effects of noise pollution. Vertical gardening is more than just aesthetics; it can aid in cooling and insulation of buildings, and reduces the need and cost for high voltage air-conditioning units. Growing plants in the building can also help to filter air particulates and improve air quality as well as add some humidity. Vertical gardening also helps to save water by reducing the need for irrigation and watering. The greenery in vertical landscape system also softens the hard and rough look of concrete buildings in urban areas.

There are many benefits of Vertical farming:

1) Aesthetic Value:

Plants are considered one of the most cost effective agents for remedying negative views of an area, thereby adding to its aesthetic value and significantly improving the visual amenity, economic,

and social conditions of the city.

2) Mitigation of the Urban Heat Island Effect:

An urban heat island (UHI) is a metropolitan area which is significantly warmer than its surrounding rural area, especially in late afternoons and nights at winter season. There are several reasons that may explain the Heat Island Effect, but the main reason is the excessive urban development. Green Walls can help in cooling buildings and combating the Heat Island Effect and greatly reduce this effect by absorbing a lot of the heat through the evaporation process.

3) Reduces CO₂ levels and increases O₂ and improved air quality:

Vertical Gardening helps in reducing the existing greenhouse and other volatile organic compounds from our polluted cities. Plants act as bio-purifiers and can play an important role in improving the quality of city air through a number of biochemical processes by removing and breaking down air borne contaminants from both inside and outside a building. When combined with plant photosynthesis, which produces clean, oxygen rich air, it becomes easy to see the value of employing living plants as bio-purifiers in polluted urban environments. Studies have proven that approximately 1 square foot of vegetated wall area will filter the air for approximately 100 square feet of office area.



4) Covers up the obnoxious walls and provide building protection:

Reducing temperature fluctuations of the building envelope helps in building protection. This helps in reducing the expansion and contraction of building materials and extends the building's lifespan. Green Walls shield the building envelope from ultra-violet rays and acidic rain by reducing cracking and carbonization of the building envelope, the buildings durability is improved and its service-life

extended.

5) Decrease voice level:

Soil and plants used in vertical gardens, have a sound absorption feature. Green Walls provide a better noise buffer which significantly reduces outside noise and vibration (up to 40dB) inside our homes and workplaces. A small indoor hedge placed around a workspace will reduce noise by 5 decibels.

6) Conserves water and watering takes less effort:

For starters, watering is very efficient as it is done by using a drip irrigation system or a hydroponic system. Any waste water can be collected at the bottom of the garden in a special tray from where it is drained away. It can also be recycled and put back on the garden. Indoor farming in a controlled environment also requires much less water than outdoor farming because there is recycling of old water and less evaporation. This means that practically all the water is used up by the plants and there is very little waste.

7) Acts as natural insulation for hot and cold air and a save energy for your building:

Vertical green walls can help in reducing air-conditioning requirements and energy consumption of urban buildings. Vegetation on walls can assist in cooling building in summer and insulating them in winter. In winter, evergreen species offer a degree of insulation by trapping a layer of air against the facade and reducing convectional heat loss. During the summer, hot walls cause temperatures to rise inside buildings, increasing demand on cooling systems and consuming more energy. Green Walls can reduce wall temperature as much as 15°F which results in significant air conditioning savings.

8) Decreases stress levels:

The magnificence of a green wall (covering concrete and steel) can rejuvenate our minds and physical fatigue is greatly reduced. The presence of plants in the office not only reduces stress but also helps increase workers productivity

9) Increases value of home/building:

The application of vertical gardens is shown to increase property values by dramatically increasing the pleasantness of buildings and establishing higher public acclaim.

10) Biodiversity conservation:

Loss of natural habitats is the number one threat to wildlife today. Green Walls can be a great an effective solution in helping to restore wild life habitats. By carefully choosing and planting attractive plant species, a Green Wall will attract birds and butterflies. Green Walls can be designed to provide the ideal conditions for birds, bees and butterflies to survive. It can provide water, food sources, protection, and places to bear and raise offspring.

11) Local Job opportunities:

Vertical Green walls draw upon several professional disciplines for their design, installation and maintenance - such as landscape architects, architects, irrigation consultants, interior designers etc. Demand for a local supply of planting materials suited for vertical gardening, growing media for living wall system / green wall system, greenhouse production, and fabrication and installation of structural frames for vertical gardening creates further job opportunities for enthusiastic entrepreneurs.

NASA CLEAN AIR STUDY

According to National Aeronautics and Space Administration (NASA), greening work places with indoor plants can soak up the toxic pollutants which are found in home and working environments like Benzene, Trichloroethylene, Formaldehyde, Xylene, Carbon monoxide, Ammonia etc. In the NASA Clean Air Study to demonstrate the effectiveness of plants to purify air, the researchers tested the air

filtering qualities of several indoor plants against toxic chemicals found in home and working environments. The results suggest that efficient air cleaning is accomplished with at least 1 plant/100 sq.ft. of home/office space. NASA has recommended the following ornamental plant species for mitigating indoor air-pollution.

- Peace-Lily (*Spathiphyllum*)
- Pot mum (*Chrysanthemum morifolium*)
- Golden Pothos (*Epipremnum aureum*)
- *Dracaena reflexa*
- Snake Plant (*Sansevieria trifasciata*)
- Lady Palm (*Rhapis excelsa*)
- Flamingo Lily (*Anthurium andraeanum*)
- English Ivy (*Hedera Helix*)
- Barberton Daisy (*Gerbera jamesonii*)
- Boston Fern (*Nephrolepis exaltata* 'Bostoniensis'),
- *Dracaena marginata*,
- Bamboo Palm (*Chamaedorea seifrizii*),
- Spider Plant (*Chlorophytum comosum*)
- These plants recommended by NASA could be effectively used in Vertical farming systems for lessening the harmful effects of toxic pollutants which are found in home and working environments.

RESEARCH AT PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA

One of the important criteria on of selection of plants to enrich the environment using vertical gardening can be done by evaluating the plants on the basis of their oxygen release into the environment. An attempt is being made by us to evaluate plants on such parameters. Therefore, the desired plants suitable for vertical gardening along with some larger species of trees and shrubs are also being analysed which will prove beneficial in choosing better species in terms of oxygen enrichment in the environment through vertical farming or by simply planting for the avenues, gardens, industrial areas etc. (e.g. trees, shrubs and climbers). There are following plants could be used in vertical garden, as these are hereby and require less maintenance:-

Foliage Plant :- *Chlorophytum* Jade plant, *Zebrina pendula*, *Ophiopogon*, *Tradescantia*, *Asparagus*.

Flowering Plants : *Petunia*, *Pansy*, *Sweet Allysum*, *Mesembryanthemum*, *Candytuft*, *Verbena*, *Kalanchoe*.

Conclusion :

The basic aim is to install many vertical gardens in cities in order to improve the concrete landscapes, thereby adding to the quality of living by offering green landscapes that have visual as well as health benefits. The importance of this concept must be realized among the population in the cities as well as outside. In the process of implementation, it is also essential to clear out the misconceptions related to the concept. For example, people believe that vertical farming will involve a lot of daily attention and costly maintenance. As vertical gardening has many benefits, thus there is need of institutional support along with interest in people to participate in it. This is possible by spreading awareness of benefits associated with it, strengthening policies like incentivizing farming for making it attractive to the urban dwellers, financial and technological support by government. One can see a progressive growth of vertical farming in India once all these are done.

BAMBOO USED IN INDIA PAVILION FOR STRUCTURAL APPLICATIONS AT SHANGHAI EXPO

Dr. K. M. Soni, Addl. DG(TD), CPWD, New Delhi

Abstract: Plants have multifunctional objective in buildings and their surroundings. Apart from aesthetics, they help in pollution control, bringing down surrounding temperature down and in making the buildings green.

In India Pavilion at Shanghai Expo 2010, plants were showcased in large way, first by using bamboo in large scale applications and then through rooftop plantation.

Use of non wovengeotextiles was made to hold the plants and to help irrigation without using soil at the top of dome of the pavilion. India Pavilion had largest bamboo dome constructed anywhere in the world and more than 2 lakh plants were planted on it. Details of the same are discussed in the paper.

Introduction

India pavilion was constructed in Shanghai World Expo 2010 with a large bamboo dome. Green plants were planted on dome surface as well as on vertical walls of the boundary wall. Non woven geotextiles were used in holding the plant roots and for irrigation system with copper pipe network. The focus of presentation was to create and demonstrate green building concept which has minimal adverse environmental and ecological impact and reduced building impact on human health and environment. This was implemented through appropriate planning, design, construction and maintenance complete cycle of built habitat. Bamboo, a sustainable material, was used in structural and other applications. Emphasis was given on rainwater and sunlight also. Solar panels and wind generator were installed over the dome. No soil and solid manure was used in the plants. Nutrients were directly supplied to the roots of the plants. The Expo was held from May 1, 2010 to October 31, 2010 and during entire period these plants were maintained.

India Pavilion at Shanghai Expo 2010

Brief of the India Pavilion

The India Pavilion was constructed on a plot of 4000 m² having dimensions of 80 m x 50 m (Soni, 2010). The Pavilion was conceptualised and designed to showcase the Indian culture and the concept of green building construction. It had three main components as entrance, plaza and theme area. Use of bamboo was envisaged in the Pavilion on a large scale to spread a message of its being an environment friendly material and substitute of reinforced cement concrete and steel generally used in beams. The entrance was designed based on traditional arch concept under avaulted portal with *Tree of Life* carving inspired from the *Siddi Syed Mosque* of Ahmadabad (Fig.1), India. Cladding of terrace ottatiles depicting *Jatak Stories* was provided on the boundary wall of main entrance.



Figure 1 : Entrance vault

The open plaza was conceptualised based on old traditional courtyard, concept of Indian architecture

from the *Palace of Rampurin Varanasi, India*. Accordingly, the stone floor (Fig.2) was provided in the plaza. The plaza area having commercial space had the corridor of shops had carved colonnade, a collage of various Indian column spreaded from glass fibre re inforced boards(Fig.3).



Figure 2: Plaza Flooring



Figure 3: Carved Colonnade

Main the me was exhibited inside the dome area. The the mepavilion was built in a circular form for easy circulation and its roof conceptualised in the form of a dome, intended to be a strong statement of amalgamation of diverse Indian culture and religions. The design of the dome was derived from the *Sanchi Stupa*. Bamboo was used as a main construction material in the dome having a diameter of about 34 m making it world's largest bamboo dome. Display was planned along the periphery of the inner space while in the centre, holographic display was organised. The seating for enjoying holographic display was also made from the bamboos. Green building concept was depicted through solar panels, as mall windmill and green ornamental plants provided on the roof of the dome. The plants also help edin reduction of the air- conditioning load.

General Structural Arrangements

The dome was supported on steel piles while other area founded on isolated/combined footings. Steel/composite framework (Fig. 4) was used upto beam levels for the entire structure. Bamboo was then used for construction of the vault (Fig.5).RCC slab was provided in the commercial area as the roof was used for the assembly of the visitors. Bamboo assembly was provided in the dome (Fig.6) for supporting roof, water proofing system, ornamental plants and live loads. As shown in Figure 7, bamboo was used in both the directions in the dome like a basket placed on ring beam.



Figure 4 : Steel Framework



Figure 5 : Bamboo Vault

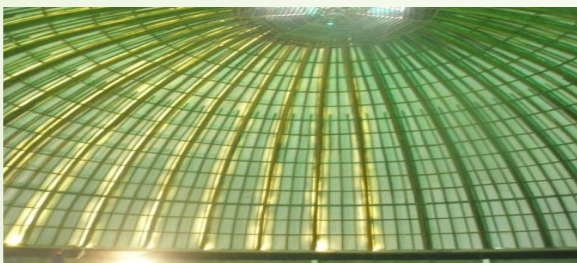


Figure 6 : Bamboo assembly from inside



Figure 7: Bamboo structure

Over the bamboo assembly in the dome, wiremesh (Fig. 8) was used to support ferro-cement layer provided with nominal reinforcement. Membrane waterproofing was then provided over the ferro-cement layer. A PVC board was fixed over the water proofing membrane on which three geo textile layers were provided for irrigation assembly and the plants. Copper pipes having nozzles as shown in mock up in Fig.9 were inserted inside upper two geotextile layers to irrigate the plants. *Tree of Life* was then made on the top of the dome made from coppers sheet and in the remaining portion ornamental plants were planted except in the area where solar panel were installed. To show case energy efficiency, solar panels were installed on the roof in a small portion and a small wind mill provided in the central portion (Fig. 10).



Figure 8 : Wire mesh for ferro-cement layer



Figure 9 : Irrigation assembly



Figure 10 : Tree of life and plants on dome



Figure 11 : Jatak stones on terracotta tiles

Terracotta wall
The pavilion hinted at futuristic materials i.e. low energy consuming materials in place of steel and glass and evolved around use of ecological friendly materials like bamboo, ferro-cement, plants, stone flooring and earthen materials like terracotta.

Use of Bamboo

Mature *Mosobamboos (Phyllostachysedulis)* were used in the Pavilion sourced from Anjidistrict near Shanghai. The bamboo was treated in hotboric acid/borax solution and shaped as per the requirements in a pre-fabricated jig. Main beams of the dome were fabricated by joining six bamboos which were like ribs. Bamboo was used in dome, entrance vault, staircases, benches, auditorium and corridors. The bamboo assembly for the dome was designed for its dead load, waterproofing system, irrigation system, solar PV panels, wind mill and ornamental plants planted over the dome including live loads. Mock-up structures were erected before the construction to check the feasibility and efficacy of the structure (Fig. 12 & 13) due to non-availability of codes of practices for such a design.



Figure 12 : Mock Up For Dome



Figure 13 : Mock up for bamboo main beams

Since the dome was having diameter of about 34 m, length of a single bamboo was not enough. To joint wo bamboo sasper required length, RCC concept was adopted. The same concept was used for the joint connectivity of the bamboos with ring beam. Steel bolts were used for joining the bamboos together in required numbers for beams. Stainless steel covering plates/sockets were used to house/seat the bamboo to avoid splitting and slippage eat the junction no fbamboo and the ring beam. Overall, about 30 km length of bamboo was used in the Pavilion. The bamboo was required to be bent according to the shape of the dome. The process of fixing the bamboo sin the dome included selection, drying, treatment and shaping of bamboos. For the same, mature round bamboos were first sorted out having sufficient length of required diameter without anysplits. Thesortedbambooswerestoredfordryingandtreatment. Forthechemical treatment, two holes were drilled in each bamboo inter node between the nodes in oppositedirectionsothatchemicalmixtureenterstheinnerhollowspaceandremains filledup. Afterdrillingtheholes, thebambooswereimmersedinthehotwatertank filled with bori cacidand borax mixture in the ratio 1:1.5. After treatment, the bamboos were taken out and air dried on horizontal support sprepared for the specific purpose. In case the bamboo swere to be shape dasper the curvature of the structure, the bamboo swere clamped in the specifically prepared arrangement of steel flats(jig) having clamps. The heated bamboo was placed and kept clamped for a certain period to obtain the desired shape/curvature and prevented it to return in to its original shape.

For the structural members in the dome, bamboos of different lengths were prepared. Since the diameter of the dome was about 34m, the bamboo swere required to be jointed. For this purpose, are in forcement bar was inserted inside both the bamboos to be jointed. Thereafter through the holes made in both the bamboos, microcon crete was inserted making it as RCC joint inside. The bamboo swere also jointed together in a bunch as per the requirements of the beams. Main beams had six bamboos. These bamboos were jointed together by the galvanized iron bolts. Three bamboo swereon upper layer, two be low and one in the lower most. To join the beam of the sesix bamboos with the steel ring beam on which cement concrete was laid, six reinforcing dowel bar swere grout edin the concrete. The bamboos were inserted directly first in reinforcing bars in the mock up exercise. Micro concrete was then in serted through the holes so that RCC provided inside the bamboo gets connectedwiththeringbeam.

Thisprocedurewasfollowedinthetrickupstructure, but realising that the bamboo may split, stainless steel covering plate/socket was inserted into each reinforcing bar and thereafter bamboos seated in the covering plate. With this arrangement, bamboos go tho used adequately. The stainless steel covering plates were used to avoid corrosion. Other aspects of the assembly were designed like rafters and purlins. The assembly included bamboos in both cross and transvers edirections of the dome. Some bamboos were terminated in the middle as shown in Fig. 14 and also visible in Fig. 15 due to shape of dome as less number of bamboos were required towards top portion of the dome. Finally, bamboos were painted from inside to enhance the durability and aesthetics. Bamboos were used in the similar way for the vault portal.



Figure 14 : Bamboo dome from inside

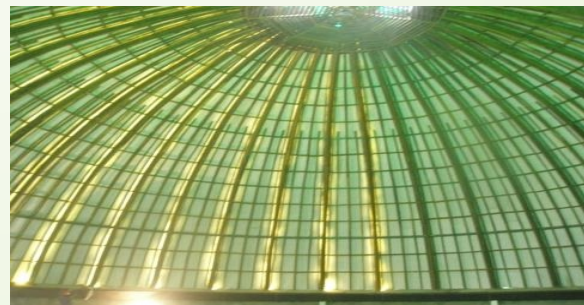


Figure 15 : Bamboos terminated

Over the bamboo assembly, a layer of wire mesh was laid to hold mortar. A layer of ferro-cement was provided with nominal reinforcement on the bamboo assembly. To avoid leakage and seepage, water proofing membrane treatment was provided on ferro-cement layer. Over the water proofing membrane, the plantation system was laid. Earlier it was assessed that geo textile layers will be laid over the waterproofing membrane directly but during fixing of the geo textile layers, geo textile layer was found susceptible to slipping and also there were chances of waterproofing layer getting damaged due to planting assembly, copper pipes and nozzles for irrigation system. To avoid such problems, a PVC board was laid over the water proofing membrane.

Over the PVC board, a non-woven geo textile layer was stapled and then their irrigation system laid. There after, non-woven geo textiles were laid in three layers, one for supporting the roots over which network of copper pipes was laid for irrigation and other upper one to hold the plants. A cut was made in the upper layer in which the plants were inserted as shown in mockup in Figure 16 so that roots remain between upper two layers and only the plant's upper part exposed. Non-woven geo textiles were used as they had both filtration and drainage characteristics. Following this the copper *Tree of Life*, solar panels, windmill and signage were provided along with plants.



Figure 16 : Mock up for plantation



Figure 17 : Bamboo false ceiling

Use of bamboo in other applications

Bamboos were also used for seating in the amphitheatre for benches and also inside the dome to view holographic display. Again, bamboo were used in the false ceiling of the corridors leading to commercial area and dome (Fig. 17) on which even services like fire detectors, lights and signage were installed. Bamboo railings were provided at various places like near amphitheatre, first floor and stair cases etc.

Plantation and Irrigation Assembly

As explained above, bamboo was used in the structural elements of the dome to take the dead load and live load. The roof being accessible for visitors was designed for a live load of 0.75 kN/m^2 as per IS 875-1987 but the same was also checked as per the Chinese codes according to the Expo requirements. Over two lakh plants were provided of the size ranging from 200mm to 300mm height at a distance of 150mm to 200 mm on the dome. The species used for planting on the dome and vertical surface of the boundary wall included *Euonymus alatus*, *Gardenia jasminoides*, *Calli brachoa*, *Dianthus chinensis* etc.

For irrigating the plants, liquid nutrients were circulated in the network of copper pipes laid over first layer of the geo textiles (Soni and Dhusia, 2011) in which nutrients were pumped from the ground floor level. The nozzle were protruded above the second layers that water/nutrient is sprinkled on and around the plants. In the liquid nutrients, Plantex, a water soluble fertiliser, nitrogen based liquid plant nutrient of 0.50% concentration was used, mixed @ 180ml in 200 litres of water.

Plantation (Fig. 18 & 19) on dome and on outer wall was conceptualised for lowering the temperature as well as due to aesthetic considerations and green building concept. Since, the dome was spherical in shape and also to supplement the concept of green buildings, no solid manure or soil was planned to be used on dome. Also, there was a requirement of water tight dome so that there was no leakage, special precautions were required to be taken for water proofing and avoiding damage to waterproofing as Shanghai has a lot of rains during the Expo period.



Figure 18 : Plantation on wall



Figure 19 : Actual plantation on wall and dome

India Pavilion was visited by over 53 lakhs visitors and by many VVIPs. It was also awarded “Peoples Choice Award”. It was one of the most popular pavilions. A complete view of the pavilion is shown in Figure 20 in which tree of life and plantation are also visible on dome.

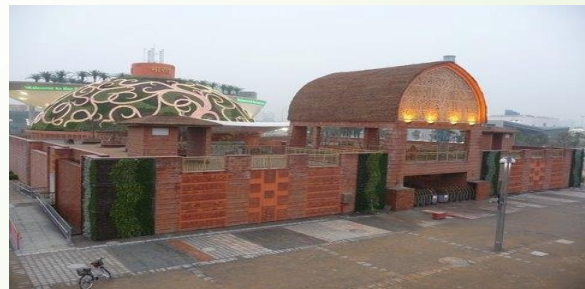


Figure 20: A complete view of India Pavilion

Conclusions

India Pavilion at Shanghai had largest bamboo dome in which non woven geotextiles were used for planting large number of plants, probably first of such application. Also, bamboo was used as structural members in the world's largest bamboo dome which clearly indicated that treated bamboo can be used in structural applications for which codes are required to be developed. Special care was taken not to use soil or manure for the plants and thus zero bacteria approach was adopted.

Bamboo was used in a big way both in structural and non structural applications in beams, roofing members, railings, and false ceiling.

ADVANCE TRENDS IN GREENERY AND LANDSCAPING

Robert Fernandes, Associate Vice President (Hort.), Mumbai

Landscape Horticulture around the country has been evolving with new trends and we need to keep in pace with the developments of the International world of green practices in order to keep up with the influx of Landscape developments in this country.

We are very agriculture focused as far as research is done in this country what need to do is strengthen our research in the field of Landscape Horticulture like have great water resistant grasses for drought resistant places as is done in some countries as well as salt resistant grasses to grow well in coastal areas or near creek areas.

We need to look into the design aspects right from the correct project brief, then the concept, to the construction development of the project to understand the sustainability. Projects need to be consistent to sustainability and projects needs to have a balance to the local ecosystems and environment that it surrounds.

We need to relook into the Planting process. Places which are arid and need a great deal of water should adopt soil conditioners such as Terra cotten during the planting process which can save a great deal of water assuring good growth pattern of the plant.

Good machinery needs to be imported and used for Lawn Harvesting or proper tree transplantation and such is the need for us to import as we need this to save our precious trees.

Good Nurseries having mature trees need to be created around the country as a national policy where we can create "Tree Banks" with the local and indigenous trees which are relocated due to heavy infrastructure developments like highways, dams, metros etc. where along with progress comes the displacement of these precious species which need to be saved.

Tree arborist need to be trained with the proper gear and equipment so that they can work effectively. This is the need of the hour since we all need to understand as professionals that we need tree doctors to understand the age, growth and the disease of the tree as well as the relocation process so that we can save our beautiful collection of indigenous trees which may become extinct if we do not adopt these new practices.

We are a country that most of the metros are growing rapidly and growing vertically having very high rise buildings needing different styles of landscape which will be on concrete slabs so we need to have the proper system of installation of these new drain cells , pave turfs and root liners so that when we plant mature trees they don't affect the building system, yet create an ecological and green environment. We have green buildings which are designed to accommodate good practices for energy conservation as well as drought resistant plantation which need less grey water for their survival.

Conclusion :-

"Landscaping must be perceived as an Investment rather than an expense Measure returns are generated, impacting the final product"

We must keep up with the times and use whatever available technology to achieve high standards of Landscape practices even if we have to burrow that technology from our neighboring countries as this is the only way we can save the environment, the ecology and be a progressive nation. This will bring about a new generation looking out for sustainability as a model for success and growth for a better India, through automation design and proper planning.

MINIATURE GARDENING : THE ART AND PASSION

Dr. B. N Srivastava, DDG(Hort.), CPWD, New Delhi

Human life today is full of competition and stress. We rarely find time for ourselves. In such a busy lifestyle, expression of our inner art as well as talent is suppressed somewhere. We ponder upon finding ways to connect to nature and our soul. Gardening has since time immemorial served as human interest and hobby. But with limited space and resources, the practice of gardening has also been modified to suit the same. Miniature gardens attract everyone's attention and curiosity. Coming across a miniature garden, one is not only amazed but also inspired. There are many forms of miniature gardens: Terrarium, Bottle garden and Miniature Bonsai Garden.

Terrarium: Terrarium is the artistic arrangement of plants grown in small sealable glass container having soil/soil less media that supports the growth and development of plants. It is one of the elements of indoor gardening, usually kept on centre tables. Terrarium offers mini indoor gardens that are perfect for people who want to decorate their home or office with houseplants, but don't have time to care for them. These garden may be developed theme based, desert themed one with cacti and succulents or tropical themed one filled with plants like African violets and ferns.



Closed terraria create a unique environment for plant growth, as the transparent walls allow for both heat and light to enter the terrarium. The sealed container combined with the heat entering the terrarium allows for the creation of a small scale water cycle. This happens because moisture from both the soil and plants evaporates in the elevated temperatures inside the terrarium. This water vapour then condenses on the walls of the container, and eventually falls back to the plants and soil below. This contributes to creating an ideal environment for growing plants due to the constant supply of water, thereby preventing the plants from becoming over dry.

In addition to this, the light that passes through the transparent material of the terrarium allows for the plants within to photosynthesize, a very important aspect of plant growth.

Requirement for developing Terrarium: We need Clear glass or plastic container, activated charcoal, sphagnum moss, plants, decorative objects and small pebbles. Most of terrariums are made from a clear glass jar/rectangular block with a wide mouth. Wider opening of container serves the easier placements of the plants.

There are several other types of plants that can be used, depending on the size of the terrarium and theme, including Begonias, Miniature violets, Coleus, Pilea (baby tears), Sedum, Echeveria, Peperomia, Ferns and others.

Steps to be followed for developing Terrarium:

Place a thin layer of small stones in the bottom of the terrarium to help drainage. Place a thin layer of activated charcoal over the stones. This acts as a filtration substrate and keeps the water cleaner. Place a layer of potting soil approximately 2 cm. deep Place a thin layer of sphagnum moss or a fine screen over the charcoal to act as a barrier to prevent settling of the soil. Make small holes for roots and carefully plant your plants in the soil For giving finishing touches – add ornaments, small coloured pebbles to give terrarium a special theme.



Bottle Garden: A bottle garden is a container similar to a terrarium in which plants are grown. They usually consist of a waste plastic or glass bottle with a narrow neck and a small opening. Plants are grown inside the bottle with little or no exposure to the outside environment and can be contained indefinitely inside the bottle if properly illuminated. The oldest bottle garden in existence is alleged to have been planted in 1960, and to have remained sealed from 1972 until at least 2013.



Vertical arrangement of bottle garden : Bottle gardens are commonly used as a form of decoration, or as a substitute garden in areas with little space, such as patios or high rise apartments. Being easy to create and maintain, bottle gardens are also used in schools as an economical way to study miniature ecosystems within the confines of a classroom. They can also be used as a control mechanism, enabling the internal environment of the bottle to be effectively controlled and isolated from outside stimuli. Bottle gardens have also been used for vegetable production in dryland areas and areas with a shortage of water, allowing water to be conserved for other uses. Plants that do best in bottle garden are: *Dracaena sanderiana*, *Dracaena godseffiana*, *Pilea microphylla*, *Begonia rex*, *Sedum*, *Ficus pumila*, etc. **Miniature Bonsai Garden:** Bonsai is the Japanese tradition of growing an artistically shaped miniature tree in a container. These can be developed into a miniature garden by adding certain tangible garden ornaments and features. It is also called as micro shaft, or a small landscape. In contrast to natural terms like microclimates or small, naturally occurring ecosystems, Miniature Bonsai Garden applies to man-made objects and habitats like ecosystem, etc.



Conclusion: Urbanization is increasing day by day and land for greenery is limited. Miniature gardening plays an important role to follow our passion and hobby which not only help in providing greenery but also adds to the aesthetic value and improves the air quality by acting a cherry on the cake as it require very less space. Each and every one can develop this miniature garden and can save the environment.

POT PLANTS FOR AESTHETIC AND BLISSFUL INDOOR AIR QUALITY

Dr. Alka Singh, Professor, Department of Floriculture and
Landscape Architecture, Navsari Agricultural University, Gujarat

Vital role of ornamental plants directly on environment, psychological and emotional status and indirectly on human feelings associated with work performance and work productivity has been recognized. Rapidly growing urbanization and population explosion with hasty life style have created space paucity for living, wherein pot plants offers some relief with a great scope for urban greenscaping. Consequently, the potted plants are becoming increasingly popular though out the world. Urban flat dwellers can use such plants in various forms like container gardening, window-box gardening, gardening in hanging containers, roof gardening, etc. They not only add beauty and biological comfort but also improve the aesthetic outlook. Plants remove VOCs (Volatile Organic Compounds) from indoor air through stomatal uptake, absorption, and adsorption to plant surfaces. Several indoor species have been screened for their ability to remove benzene, in addition to other VOCs (e.g., toluene, TCE, m-xylene, hexane). The efficiency of VOC removal varies substantially among species and with the molecular characteristics of each compound.

Besides, plants add freshness and cheerfulness reduce allergies and act as stress buster. Viewing green plants and their proximity at home or office may provide ample involuntary attention, increase positive feelings, block or reduce worrisome thoughts and promote restoration from stress. Further, dwelling and working in an environment having flowers and plants is refreshing and energizes human force to work with more optimistic approach.

How Urban environment is Deteriorating?

In the last decade *i.e.* 2001-2011, the urban population of India grew annually by 2.8% adding 9.1 crore people to India's population residing in cities. India is the second most populous country in the world with 1.35 billion people after China with over 1.41 billion people. The figures show that India represents almost 17.31% of the world's population, which means one out of every six persons is Indian and looking to the annual population growth of 1.58%, India is all set to take the number one position by 2030 with the prediction of more than 1.53 billion people. Urban life is constantly deteriorating with exploding problems of atmospheric pollution and massive population explosion, resulting in a disastrous effect on our life style, health and psyche. Thus, rapid urbanization and growth of large cities with deforestation has been accompanied by expansion of highly vulnerable urban communities living in informal settlements, creating high environmental pressures with poor air quality indoors as well as outdoors. Deforestation has also been impacting disruption in the natural water cycle, higher water runoff, as well as adversely affecting local rainfall and drought like conditions and thus, causing disruption in human life by affecting the quantity and quality of drinking water and irrigation systems and even aquatic life.

A high proportion of the population and economic activities are at risk from climate change are in urban areas, and a high proportion of global greenhouse gas emissions are generated by urban-based activities and residents. Suspended Particulate Matter (SPM) is the main problem of urban air pollution in India, caused mainly due to fast growing population of automobiles and poor traffic control, congested roads as well as factories in the periurban areas. The most watched pollutants include particular matter (PM), Nitrogen dioxide (NO₂), Sulphur dioxide (SO₂) and Carbon dioxide (CO₂), that are continuously degrading the ambient air quality in major cities in India. The annual average concentration is very high in Indian cities. In particular, many cities have exceeded the officially designated critical levels of ambient air quality standards set by the World Health Organization (WHO) owing to high suspended particulate matter (SPM), Use of pesticides, though the most important factor

How is the indoor air quality?

Indoor pollution refers to the physical, chemical and biological characteristics of air in the indoor environment within a home, building or an institution or commercial facility. Indoor air pollution is of greater concern in the highly developed urban vicinity, where energy efficiency improvements sometimes make indoor environment in houses as well as offices relatively airtight, reducing ventilation and raising pollutant levels. Indoor air pollution is one of the world's largest environmental problems. Based on figures from the Institute for Health Metrics and Evaluation (IHME), 2.6 million people died prematurely in 2016 from illness attributable to household air pollution (www.healthdata.org). Indoor air pollution is caused by the inefficient use of solid fuels for cooking and cleaning. Around the world, more than 3 billion people in developing countries still cook and heat their homes using solid fuels (wood, crop waste, charcoal, coal and dung) in open fires and leaky stoves and as per a WHO report, smoke inhaled by women from unclean fuel is equivalent to burning 400 cigarettes in an hour. In urban areas, exposure to indoor air pollution has increased due to various reasons, including the construction of more tightly sealed buildings, reduced ventilation, the use of synthetic materials for building and furnishing and the use of chemical products, pesticides, and household care products. Indoor air problems can be subtle and do not always produce easily recognized impacts on health. Although many hundreds of different chemicals have been identified in the smokes coming from bio fuels. The four most serious pollutants are particulates, carbon monoxide, polycyclic organic matter, and formaldehyde (carpets, particle boards and insulation foams). Besides, these Nitrogen dioxide, Carbon monoxide, and lead are a number of other pollutants that affect the air quality in an enclosed space. In buildings having lack of ventilation, asbestos and radon are major pollutants. Many offices and new homes have tighter construction, sealing the building from the outside air that further raises the indoor air pollutants to dangerous levels.

Plants improve Indoor Air Quality

A variety of foliage plants with ornamental foliage can be grown indoors. Foliage plants are those plants with attractive foliage and/or flowers that are produced in containers under shaded greenhouses or other structures. Foliage plants are valued for their foliar variegation in different combinations of colours and patterns, overall plant forms and styles. Most of them have a capacity to tolerate shade or thrive under indoor conditions. Urban flat dwellers can use such plants in various forms like container gardening, window-box gardening, gardening in hanging containers, roof gardening, etc. They not only add beauty and biological comfort but also improve the aesthetic outlook.



Sansevieria



Areca Palm

A study by the National Aeronautics and Space Administration (NASA), USA has revealed that houseplants can purify and revitalize air in our homes and offices, protecting us from the negative effects of such common toxins as ammonia, formaldehyde and benzene. Research has also revealed significant decrease in the levels of CO₂ and CO in indoor environment under AC as well as non AC conditions with the placement of potted indoor plants. In a study at the University of Technology, Sydney, Australia, it has been revealed that plants like *Aglaonemabrevispatum*, *Pachira aquatic* and *Ficusbenjamina* reduced the levels of VOC's like methane, toluene, ethyl benzene and formaldehyde.

Many indoor plants species viz., *Aspleniumnidus*, *Ficuselastica*, *Hedera helix*, *Nephrolepisobliterata*, *Sinningiaspeciosa*, *Ocimumbasilicum*, *Yucca massengena*, *Spathiphyllumwallisi*, *Diffenbachiaspp.*, *Rhapisexcelsa* can effectively reduce the VOCs (viz., HCHO, Toluene, Xylene, Acetaldehyde etc.) and CO₂ from indoor air and increase aesthetic value.



Money Plant



Peace Lily



Sansevieria



Areca Palm



Euphorbia Mili



Aglaonema

Further plants like succulents like Haworthia, Sansevieria, etc having CAM metabolism are highly beneficial for improving indoor air quality with the added benefit of requiring less water. Thus, plants in the home or office can filter out toxins, stale air, pollutants, harmful viruses and mould spores. Plants act as filters because they absorb the toxins through their leaves, especially those with the largest leaves.

Plants for good health and happiness

Happiness and health are well associated with flowers and plants as people involved in landscape designing as profession or having hobbies of flower arranging, bonsai making, home gardening and kitchen gardening are healthier and happy. Flowers are considered symbols of beauty, joy, vitality, blooming, romance, serenity, tenderness etc, all that represent positive facade of life and nature, influencing positive emotions, indirectly. The presence of flowers triggers happy emotions heightens feelings of life satisfaction and affects social behaviour in a positive manner. Researchers who have assessed the impact of nature and plants on human health have suggested that people-plant/flowers interactions provide physiological stress reduction. Flowers have a long-term positive effect on the mind frame. People in a natural environment having plants and flowers in the surroundings not only show faster physical recovery from stress, but also improve psychological, emotional and cognitive health. Viewing nature/ plants is linked to positive health outcomes of individuals, such as in pain reduction, less need for analgesics, and a quicker recovery from surgery as revealed from scientific studies. Presence of flowers, plants and green scapes trigger happy emotions with feelings of life satisfaction that ultimately improve work performance. Further, it has been found that workers idea generation, creative performance and problem solving skills improved substantially in workplace environments that included flowers and plants. Thus, a small walk in an environment having flowers and plants is refreshing and energises human force to work with more optimistic approach.

Conclusion

Pot plants represent significant portion of floriculture production looking to the global scenario and the increasing popularity of potted plants at National level also. Rapidly growing urbanization and population explosion with hasty life style have created space paucity for living, wherein pot plants offers some relief with a great scope for urban green scaping. Consequently, the potted plants are becoming increasingly popular though out the world. Ornamental plants are not only important for environmental conservation, microclimate regulation, bio-aesthetic outlook but also for stress busting effects. Thus, vital role of ornamental plants directly on environment, psychological and emotional status and indirectly on human feelings associated with work performance and work productivity has been recognized and the business of pot plants is the new upcoming industry in the country. Ornamental Pot plant Industry holds great promise with immense investments and employment opportunities along with several challenges. This industry and inspite of several constraints at production and marketing ends, is striving to flourish and escalate with the support of Government. Efforts are needed to generate authentic trade figures, popularize pot plants in offices as well as homes, market survey and market research. Besides, research based on pot plant technology, identification of indigenous plant species for pot, soilless based media standardization, packaging and transportation, need to be focused and innovative approach and ideas among growers need to be encouraged. The potential of pot plant industry as money spinner is needed to be realized and recognized.

“In every walk with Nature one receives far more than he seeks.” John Muir

UTILIZATION OF TEMPERATE FLORA FOR URBAN LANDSCAPING

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Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan,

Introduction

(During the past one decade) the diversity of ornamental plants in the temperate zone of our country has assumed greater significance. Himachal Pradesh, Jammu & Kashmir, Uttarakhand, Sikkim and Arunachal Pradesh have most favourable cooler agro climatic conditions, suitable for growing temperate ornamental plants. During past 10 years, demand for finished flowering potted plants, both for local consumption and for north Indian plains, Delhi, Pune, Bangalore and other big cities during winter months is on the constant rise. This has forced some of the progressive professional growers located in temperate zone of Uttarakhand, H. P. and Sikkim to opt for exclusive large scale production of ornamental plants, mainly under protected conditions.

Ornamental germplasm collection consists of temperate pot plants, landscape plants and bulbs. Some important ones are given below:

Flowering Pot plants	Bulbous ornamentals	Herbaceous perennials	Climbers	Flowering Trees	Foliage Trees	Temperate Grasses	Shrubs
Pelargonium	Alstroemeria	Achillea	Clematis	<i>Rhododendron sp.</i>	<i>Salix babylonica</i>	<i>Poa pratensis</i>	<i>Chaenomele speciosa</i>
Fuchsia	Agapanthus	Aquilegia	Ivy	<i>Bauhinia sp.</i>	<i>Pinus longifolia</i>	<i>Poa trivialis</i>	<i>Chimonanthus praecox</i>
Begonia	Allium	Bergenia	Jasmine	<i>Malus baccata</i>	<i>Anogeissus acuminata</i>	<i>Festuca rubra</i>	<i>Cryptomeria japonica</i>
Cyclamen	Anemone	Campanula	Honeysuckle	<i>Citharangulare</i>	<i>Ulmus alata</i>	<i>Agrostis tenuis</i>	<i>Philadelphus coronarius</i>
Calceolaria	Begonia rex	Delphinium	Passion flower	<i>Cercis canadiensis</i>	<i>Tamarix chinensis</i>	<i>Agrostis palustris</i>	<i>Erica carnea</i>
Lisianthus	Begonia (tuberous)	Digitalis	Climbing rose	<i>Cercidium floridum</i>	<i>Araucaria cookii</i>	<i>Lolium</i>	<i>Forsythia suspense</i>
Orchids	Clivia	Hypericum	<i>Solanum jasminoides</i>	<i>Ulmus alata</i>	<i>Grevillia robusta</i>	<i>Agropyron</i>	<i>Buxus sempervirens</i>
Primulas	Crocus	Limonium	<i>Tecoma capensis</i>	<i>Tamarix ramossiana</i>	<i>Quercus rubra</i>	<i>Dactylis glomerata</i>	<i>Sambucus nigra</i>
Primrose	Crinum	Primula	<i>Vitis tribolata</i>	<i>Pyrus communis</i>	<i>Cedrus deodara</i>		
	Freesia	Rudbeckia	Wisteria	<i>Prunus persica</i>	<i>Cupressus macrocarpa</i>		
	Gladiolus	Salvia		<i>Prunus sergenlii</i>	<i>Juniperus chinensis</i>		

	Hippeastrum	Solidago		<i>Magnolia</i>	<i>Picea smithiana</i>		
	Iris	Hydrangea		<i>Michelia champaca</i>			
	Narcissus			<i>Ornamental plums</i>			
	Ornithogalum			<i>Ornamental Peaches</i>			
	Kniphofia			<i>Ornamental cherry</i>			
	Ranunculus			<i>Quince</i>			
	Tulipa						
	Zantedeschia						
	Iris						

Today these ornamental plants have become very popular and are highly cherished among people due to their fascinating appearance, attractive colours, long lasting nature, vivid, vibrant and vivacious flowers/foliage and their overall presentibility.

Famous temperate ornamental plants include:

1. Azalea

Dwarf Azaleas with single multi coloured varieties or Belgium hybrids with double attractive flowers in an array of colours. They remain in flowering throughout winter and even last upto spring. Thousands of Azaleas are purchased by nurserymen of J and K, H.P., Uttrakhand from Sikkim and its surroundings. They are propagated by cuttings and layering.

2. Begonia tuberos

They are excellent summer flowering plants, valued for their giant attractive flamboyant flowers of various colours. They are grown in pots, tubs, troughs, window boxes or hanging baskets in green houses, conservatories, balconies and window sills protected from the direct sun and rain during summer and rainy season in places where average day temperatures during this period hover between. 15-25° C (Wazir, 2006).

The commercial method for building huge quantities of tuberos begonias is chiefly through seeds which are very small, reddish in colour, containing approximately 25,000 seeds per gram. Tuberos begonia seedlings require higher humidity levels (80-95 percent) and a longer growth period than most other seedlings.

3. Calceolaria

This is a seed propagated seasonal which can be made to bloom in Autumn and Early winter from June planting and in spring from October planting. Its common name is "lady's purse" because small vibrant, colored small flowers in the shape of purse look very attractive colour range varies from Red, yellow to several intermediate shades including bicolors.

4. Camellia

This is another famous. Which flowers from winter to spring (temperate pot plant) and is propagated from cuttings or layering. Camellia must be grown in acidic compost just like Azaleas and other ericaceous plants for getting plentiful blooms in various attractive colours like white, pink, red and mostly bicolors. This is a perennial plant and can be made to rebloom every year (in greater sized pots.)

5. Cyclamen

It is most popular and colourful flowering pot plant blooming from late autumn to spring. Numerous flowers are produced on individual stalks, 15-22 cm long or more, comprising of several twisted reflexed petals, usually 5 in number which stand almost erect. They may be pure white, deep red or various shades of pink, salmon, mauve or purple. It is propagated mainly from seed and has a long juvenile period of 8-10 months and is mainly grown in India and abroad for Christmas day celebrations in 10-15 cm pots. The own seed produced by the old plants after flowering in fat spherical capsules does not come true to type and loses vigour. Thus, it is better to purchase the hybrid seed every year.

(Mashobra Cultivars) More than 20 cultivars of cyclamen have been introduced at Regional Horticultural Research Station, Mashobra since 1994 and performance studies over a period time have indicated the suitability of these cultivars for commercial purposes : Research conducted at RHRS, Mashobra has revealed that varieties Cut Fire, Junior White, Junior Rose, Senior Rose with eye, Senior Deep Rose and Senior Salmon with eye responded very well to 8-10 months crop schedule

Climatic Requirements

a) Light

Cyclamen should be given bright light without direct sunlight from March to October and direct full sunlight during winter months.

b) Temperature :

Cyclamen should be kept cool at all times. A temperature of between 13°C to 18°C is considered ideal. Temperatures above 25°C will greatly shorten the life of these plants. Maintain a night temperature of 15°C from seed sowing to seven unfolded leaf stage (130 days from sowing) and a temperature of 16-17°C from unfolded leaf stage till flowering. Day time temperatures should be 20°C (cloudy), 21-24°C (Sunny).

c) Humidity:

Maintain high relative humidity of 80-90 % during germination of seedlings. Keep humidity at 70-80 % during most of the times except during dormancy by keeping the upper surface of potting mixture moist. At temperatures above 22°C, high humidity of 75-80 % can be maintained around plants by standing pots on trays of moist pebbles, so as to increase the shelf life of plants.

Production Technology:

- a) **Propagation:** Today world over propagation is primarily from seed that is sold by count. The optimum temperature for germination of cyclamen seeds was 20°C under dark conditions. Under glasshouse conditions, with September sowing, 87% germination was recorded at a soil temperature range of 15-25°C. Propagation by corm splitting is laborious and not

practical.

6) **Cymbidium hybrids**

Cymbidium hybrids Grown in North East (are exclusive) commercial scale. These are long lasting magnificent pot plant. They are mainly propagated from pseudobulbs and through tissue culture. Cymbidium hybrids in pots are novel items and fetch very high prices to the growers. The main flowering period is from September to January – February.

7. **Pot carnation**

This is another perennial flowering pot plant which blooms in two flushes first in March-April and then again in October-November under temperate conditions but in hot weather the plants do not survive in the open. There is a great demand from consumers of big cities for this plant. Carnation as pot plants are genetically dwarf and are propagated from cuttings under sterile and control conditions. Dutch companies like Hilverda, Kooij P and Zonen B V are main cutting suppliers. Recently Sakata seed corporation from Japan have launched a seed propagated series of pot carnation namely **Lilliput** mix F₁ which has totally revolutionized the flower nursery industry. Professional growers are buying hybrid seed of this series every year because of the large attractive fully double flowers in various colour shades. The seed raised plants take 4-5 months to come into full bloom.

8. **Pot chrysanthemum**

Dwarf spray varieties of chrysanthemum with large colour range and different flower shapes are preferred by nurserymen for growing in 15 cm pots for early autumn sales in Delhi, Chandigarh and other cities. Due to altitudinal advantage, growers in the hills manage to obtain early flowering pots in September – October and thus get good remunerative prices from their sale in Delhi and NCR. It is propagated from cuttings and by seed which is being supplied by companies like Sakata from Japan.

9. **Bulbs as potted plants**

Preparation of Easter lillies for Christmas Day is long routine practice among the pot plant growers of Europe and western countries including USA. Tulips, Narcissus and Hyacinth are raised in pots for winter and spring sales. Recently seed propagated Anemone from **Monalisa** series of Pan American seed company has also become very popular among growers for spring sales. **Bloomingdale** F₁ seed mix and **Mache** mix F₁ from Sakata seed Japan is the most precious and highly priced seed raised dwarf ranunculus which has a rich colour range with different flower shapes. The uniqueness of this series is its 100 % double flowers. This ranunculus in pots is the hot sold item among consumers both in the hills as well as in the plains. It takes 5-6 months to come into bloom from seed and usually blooms in February – April. Dwarf Alstroemeria varieties from Konst BV. of Netherlands have also emerged as potential flowering pot plants along with coloured Ornithogalum and coloured Zantedeschia.

10. **Primula species**

These are excellent winter and spring flowering herbaceous plants, with a collection of over 400 species, found throughout the temperate regions of the Northern Hemisphere, both hardy as well as some requiring protection from severe winters and frosts. Their compact dwarf habit of growth and their freedom of flower production make them especially desirable. They are almost indispensable in gardens where a spring display of flowers in formal or informal beds is wanted.

Production Technology

Cultivation

In general, Primulas prefer a neutral or slightly acidic soil. The plants likes a damp, humid atmosphere, which is never stagnant except in the case of bog-loving species; they require a well-drained porous soil that is also moist. In the majority of cases, they prefer partial shade.

Propagation

All primulas are primarily propagated from seed.

Seed Germination

In order to find the most appropriate temperature for germination of primula seeds, the seeds were kept for germination at five temperature regimes: 8°C, 13°C, 18°C, 23°C and 28°C in the temperature gradient chamber under dark and light conditions. Nearly 95 per cent germination was recorded with *Primula obconica* seed when sown in August- September. It took 25-30 days for germination at a temperature range of 18-23°C.

11. Pelargonium

Pelargonium is the genus of plants which we commonly called as geraniums. The common multi coloured profusely blooming Geraniums are actually hybrid pelargoniums with zonal leaves (Wazir, 2006). They make excellent 15 cm pots from cutting or seed just in 3-4 months and always remain in high demand due to their floriferous nature. In hills, they keep on blooming for almost throughout the year with greater profusion in April – May and October- November. The most preferred seed series in hybrid zonal pelargoniums are **Maverick** mix F₁, **Multibloom**, **Orbit**, **Pinto**, **Elite**, **Horizon Picotee** and **Horizon Ripple**. Each series has 5-8 separate colours. Seed propagated pelargoniums are genetically dwarf, basal branching, early blooming and more floriferous than cutting propagated pelargoniums. Another group of pelargoniums although less in demand, include Regal, scented leaved, fancy leaved and Ivy leaved pelargoniums.

Growing Media: Media should be low in soluble salts and high in aeration. Commercial mixes for pelargoniums contain 2 to 4 of the following components-Sphagnum peat moss, Vermiculite, Perlite, aged pine bark, Calcined clay, sand, and mineral soil. Most commercial mixes also contain some fertilizers such as calcium nitrate, potassium nitrate, super phosphate, trace elements and a wetting agent. A compost containing equal parts of sieved soil, sand and FYM produce best presentable pots of pelargonium. The pH should be 5.5 to 6.5 for zonal pelargoniums, 5.3 to 5.8 for ivy leaved pelargoniums and approx 6.0 for regal pelargoniums.

(PROPAGATION)

1)Vegetative Propagation:

Stock plant cuttings can be started as early as May to August for cuttings the next spring, though usually stock plants are received after the Christmas crops are finished. Rooted cuttings are placed in 1 to 1.25 gallon containers or directly in benches. Spacing should be one plant per square foot. Bench planting provides the easiest management of nutrition and moisture, but the use of containers allows better air movement among plants and fewer disease problems. Plants must be pinched regularly to develop as many shoots as possible.

Seed Propagation:

Under natural environmental conditions, the best time for seed sowing is April-May for hills of North India and in the Northern plains, seed can be sown in August- September. The Germination medium which was developed successfully at Regional Horticultural Research Station, Mashobra, Shimla, consists of sieved mixture of garden soil, farm yard manure, leaf mould and sand in equal proportions .

Role of Environmental Factors

a. Temperature: Temperature has a great effect on the growth rate of pelargoniums. Pelargoniums can

POT FLOWERING PLANTS BY TISSUE CULTURE

Shri Kishore Rajhans, Director KF Bioplants, Pune

KF Bioplants Pvt. Ltd. is the country's largest Plant Tissue Culture Company located at Pune. We are pioneers in Plant Tissue Culture and Floriculture in India for the last 25 years.

Infrascture: Includes 52 acres of area operations Four ultra modern 12,000 m² state-of-the-art tissue culture laboratory

6.5 Ha. of fully automated greenhouses cum plant hardening units.

32 fully monitored Growth Rooms

We predominantly produce various elite ornamental flowering plants of Gerbera, Carnation, Gypsophila, Dendrobium, Limonium, and Calla Lily along with fruit plants of Strawberry. KF Bioplants is a Dutch joint venture company associated with Florist Holland; The Netherlands. We also take pride in producing novelty plant species for 14 different breeder companies worldwide through contractual production of their varieties.

We also export various flowering plant species to 30 countries across the Globe.

A giant share of 90% of the same in the country is undertaken by us.

Tissue Culture technique in Flowering Pot Plant industry-

The present review emphasizes the application of biotechnology – in vitro propagation of pot plants over conventional method of propagation is preferred for

The better quality of planting material is the basic need of the industry for boosting the productivity.

Characteristics such as uniform growth and synchronous flowering are preferred.

Unique opportunity to develop new germ plasm and its conservation and mass scale propagation.



The Industry of Flowering Pot Plants-

The commercial production of ornamental Flowering pot varieties is growing worldwide. The monetary growth value has significantly increased over the last one decade and there is a great potential and continuous future growth in both domestic and international market, making this endeavor, a highly profitable and novel one.

Planting material of ornamental flowering plants is in great demand for commercial production, as well as for domestic garden and landscaping. The sector of flowering pot plants in landscaping is a very large segment where flowering plants are propagated via Seeds/ Cuttings and tissue culture techniques. Important list of flowering pot varieties propagated through seeds and cuttings are Petunia, Portulaca, Geranium, Impateins, Lantana, Chrysanthemum, Dianthus etc. Important list of flowering pot plants via Tissue Culture are Phalanopsis, Dendrobium, Gerbera, Calla Lilies, Anthurims etc. Tissue Culture Flowering Pot plants are mostly confined to indoor or house landscaping. Indoor gardening is the art of growing and arranging plants indoor or in the house for its best use for beautifying the area.

Importance of Indoor growing of Pot plants are

Indoor gardening brings an intimate and natural association of men and plants.

Its matter of joy to many especially living in cities where they don't have enough open space for gardens and gardening, so maintaining few plants itself makes a garden.

Indoor plants add charm to the architecture beauty of the house and complements interior setting.

It is now common to find flowering plants inside homes, offices, shops, banks, hotels, restaurant, clubs and hospitals.

KF's Pot plants venture-

KF Bioplants has developed an exotic pot plants series, which includes Gerbera, Phalaenopsis, Dendrobium and Calla lilies. These species are specially produced for homes, offices and landscape gardens beautification. Supplying hardened plants of this assortment is our undertaking.

Pot Plant of Gerbera

We are producing Garvinea series and Patio Series by Tissue culture technique. Both the series are patented species of Florist, Netherlands. These series are exclusively supplied worldwide as Pot Gerberas.



Pot Plants of Phalanopsis

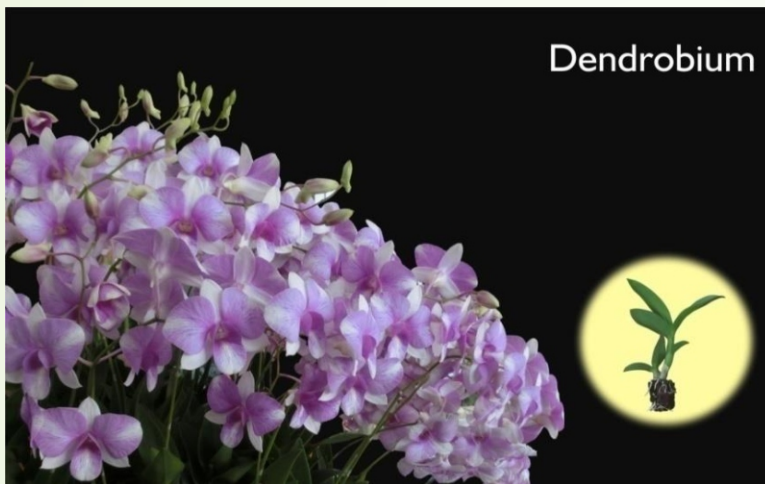
Our association with Floricultura BV, Holland helps us to supply their pot varieties of Phalanopsis to the Indian market.



Phalaenopsis

Pot Plants of Dendrobium

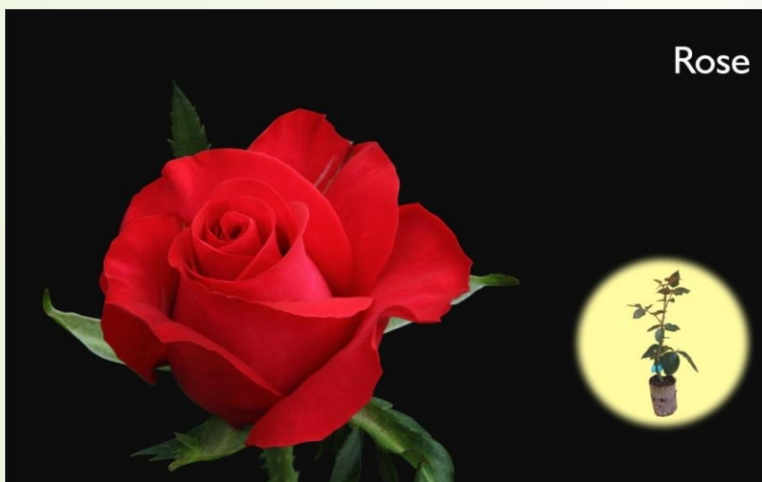
We import tissue culture Pot Dendrobium varieties from well known tissue culture labs in Thailand for supplying in India.



Dendrobium

Pot Plant of Rose

Tissue culture technique helps us for the production of rose which are used for pot plantation. The rose plants which are formed from the tissue culture techniques are diseases resistant, petals are of thicker quality, vigorous in nature and the shelf life of these plant do increase to variable extend.



Rose

GREENERY DEVELOPMENT USING VERMICOMPOST PRODUCED FROM ORGANIC WASTE

Dr. Minakshi Karwal, Assistant Professor K.I.E.T. Group of Institution

With the enhancing industrialization, urbanization, population rise, mining and other anthropogenic activities there is a decline in green cover of landscape. These development activities results into deforestation and devegetation which not only cause soil pollution but also deteriorates the quality of air & water severely. Another side effect of the self-centric developmental activities is the generation of enormous amount of solid waste. There is a need of multi targeting approach to find a solution of solid waste management while strengthening the scope of proliferation of green cover for achieving sustainable development. The environmental degradation problems originated from unscientific management of solid waste is a concern point to rethink. The two major realms where this mismanagement of waste is affecting us are:

1. The impact of biodegradable waste mismanagement like open dumping which has following significant environmental and public health issues-

Ground water contamination by leachate generated by waste dump

SURFACE WATER CONTAMINATION BY THE RUN-OFF FROM THE WASTE DUMP

BAD ODOR, PESTS, RODENTS AND WIND-BLOWN LITTER IN AND AROUND THE WASTE DUMP.

STRAY ANIMALS INGEST PLASTIC ALONG WITH THE FOOD WASTE, THEREBY AFFECTING BIODIVERSITY

RELEASE OF GREENHOUSE GASES

FIRES WITHIN WASTE DUMP

EPIDEMICS THROUGH STRAY DOGS

ACIDITY TO SURROUNDING SOIL

OPEN BURNING OF SOLID WASTE CONTAINING PLASTIC, BATTERIES OR CHLORINATED WASTE LEAD TO EMISSION OF TOXIC GASES LIKE DIOXINS, FURANS AND PCB.

2. The rich nutrition in biodegradable organic waste could be recovered and recycled through green technology called vermin composting can increase the productivity of the soil while enhancing the green cover of landscape. This would on one hand solve problem of overburdening of sanitary landfills and on the another hand would give nutrition and growth to green cover.

These above mentioned problems of solid waste disposal problem could work as a solution to enhance the green cover of the landscape. This could be done through composting which provides an eco-friendly solution. Municipal solid waste (MSW) is largely made-up of the kitchen and yard waste, and composting has been adopted by many municipalities in India. Composting yard waste and kitchen waste are seen as a method of diverting organic waste materials from landfills while creating a product, about almost low cost that is suitable for agricultural purposes. Large scale management of huge amount of yard as well as biodegradable kitchen waste emitted from different sources could be converted to bio fertilizer.

Vermicomposting improves soil's physical quality like porosity, CEC (Cation Exchange Capacity), humus content and contribute to heavy metal bioremediation. Vermicomposting also contributes to climate change mitigation too.

Therefore vermicomposting project is benefitting us in the following ways:

We are recycling biodegradable waste and reusing it to lawn, parks gardens that replaces the cost of chemical fertilizers. In addition, we are providing environmental benefits by following 4 R rules of solid waste management i.e. Reduce, Reuse, Recycling and Rot.

Financial gain through production of good quality of vermicomposting.

Enhancing the Green reputation of our area while taking one step ahead towards ecofriendly sustainable management.

We are providing the solution for the ultimate disposal of waste.

WORK PLAN

1. Collection and segregation of the waste: The collected waste is segregated at the source of generation and it's classified in dry and wet waste. In dry waste, we will segregate different types of wastes such as metal, plastic, glass, tetra packs, and packing material etc. On the other hand, wet waste contains organic wastes like flowers from temple, vegetable and fruit waste from hostels and the yard waste.

2. Transportation to the processing unit through carts and rickshaws from the source of generation.

3. Wet waste will be subjected to vermicomposting and bio composting.

a. Vermicomposting: Vermicomposting is the process by which earthworms (*Eiseniafetida*) are used to convert organic materials (usually wastes) into a humus-like material known as vermicompost. The goal is used to get a bio fertilizers in the term of vermicompost, for agricultural uses and a high quality protein (earthworm biomass) for supplementing the nutritional energy needs of animals, at a faster rate. Vermicomposts, specifically earthworm casts, are the final product of vermicomposting.

It is an aerobic, biooxidation and stabilization non-thermophilic process of organic waste decomposition that depends upon earthworms activity to fragment, mix and promote microbial process. During this process, the important plant nutrients such as nitrogen, potassium, phosphorus and calcium present in the feed material are converted through microbial action into forms that are much more soluble and available to the plants than those in the parent substrate. Earthworms are voracious feeders on organic waste and while utilizing only a small portion for their body synthesis they excrete a large part of these consumed waste material in a half digested form. Since the intestine of earthworms harbour wide range of microorganisms, enzymes hormones that decomposes the substrate very rapidly and transformed into a form of vermicompost with in a short time.

Advantages

Vermicomposting is a cost effective technique that cuts down the usage of chemical fertilizers.

Vermitechnology is a green technology which is ecofriendly, low energy consuming and minimizes odour of decomposing manure. It is a safe conversion process of conversion of biodegradable waste into a valuable nutrient rich humus fertilizer-Vermicompost.

Faster to produce compared to traditional composting, Less labor required and good quality compost product (fine texture and no foul odor).

It provides carbon credit as to some extent, it reduces the global warming.

It helps to reduce the amount of waste that is being directed into our landfills. This means a reduction of concentrated, toxic leachates and methane gas that is being released into the, which equates to a decrease in overall pollution.

b. Biocomposting: Biocomposting is the process of aerobic decomposition and stabilisation of biodegradable organic matter by the action of microorganisms like bacteria, yeasts, fungi etc. which results into the production of biocompost. Biocompost is rich in macronutrients (nitrogen, phosphorous and potassium) as well as micro-nutrients which can be utilized for the growth of plants. Biocomposting can be carried out in two ways: aerobically (in the presence of oxygen) or anaerobically (in the absence of oxygen) or vermi-composting or by any other biological mechanism. Some parameters of concern in the biocomposting process are temperature (optimum temp is 70 °C), C/N ratio (optimum range is 30), phosphorous, sulphur, moisture (optimum moisture 50-60%), particle size, oxygen flow, etc. In biocomposting process, aerobic micro-organisms oxidize organic compounds to carbon-dioxide, nitrite and nitrate and sulphate. Whenever anaerobic decomposition occur it lead to emission of carbon-dioxide, methane, hydrogen sulphide, ammonia.

In general biocomposting process consists of four decomposition phases when a suitable environment is provided:

Mesophilic phase (I) : In this phase, slightly rotted material exists, in which mainly bacterial degradation of easily degradable substances takes place. In this phase, temperature raises up to 42 °C.

Thermophilic phase (II) : In this phase, fresh compost is produced through degradation of easily degradable materials as well as degradation of cellulose with the help of thermophilic fungi and bacteria. In this phase, temperature raises up to 65 °C which causes self-limitation or decrease in reproduction of micro-organisms.

Cooling phase (III) : In this phase, finished compost is produced formation of humus substances by further degradation of cellulose by fungi and bacteria, and takes place. A decrease in microbial activity and temperature occur in this phase.

Maturing phase (IV): Matured compost is produced in this phase, with further decrease of temperature w.r.t. surrounding temperature. There is further formation of humus substances take place.

CONCLUSION

So through vermicomposting along with biocomposting we could not only give way to the solution of biodegradable solid waste management but also could contribute enhancing green landscape via biofertilizer produced through vermicomposting.

MODULAR LANDSCAPING SOLUTIONS

Dr. P. K. Tripathi, Director of Horticulture (WR), CPWD, Mumbai

People have practiced landscaping for centuries. As far back as the ancient civilizations, humans were manipulating the land for both aesthetic and practical reasons. The addition of plants, changes to the existing terrain and the construction of structures are all part of landscaping. Today landscaping refers to the planning, laying out and construction of gardens that enhance the appearance and create useable space for outdoor activities around our homes.

With the growth of urbanization the cities are converted into concrete jungles day by day and consequently greenery is reducing rise to global warming, here the needs is to bring about greenery in the every little available area along with its beautification.

Landscaping products which can bring about greenery vertically as well as horizontally as per your need and available spaces as all of them are modular system. Followings are the some key Features & General Information about Various Landscaping Products.



DRAIN MAT

Sheet Drains for single side drainage applications are prefabricated products that consist of a solid, formed, three dimensional core covered with a geotextile Sheet Drains for single side drainage applications are prefabricated products that consist of a solid, formed, three dimensional core covered with a geotextile filter fabric bonded to the dimple side of the core. The filter fabric is securely bonded to prevent soil intrusion into the core flow channel while allowing water to freely enter the drainage core. Sheet drains solid cores allow water entry from one side and are typically used to collect and re-direct water from a structure or site. Sheet drains are designed for use in both vertical and horizontal drainage applications.

HONEYCOMB GRASS PAVER



Each Honeycomb Grasspaver Unit made with a High-density recycled and UV rays-stale polythene (PE-HD), Weighing 1kg. and available in green or black colour. The Load bearing capacity is 200 tons/m² & Dimensions of the unit is 500mm x 430mm x 45mm.

Instant lawn effect with minimal labour.

Makes maintenance operations, including lawn moving very easy.

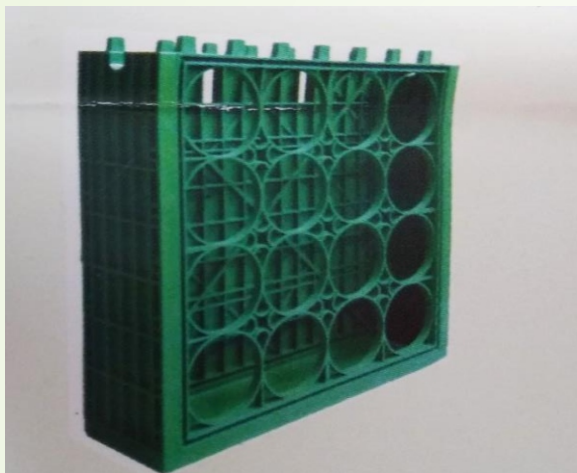
Mobility to your lawn patch. Takes ample foot traffic.

Eliminates heavy ground and soil preparation.

Water logging is eliminated with the special studs provided below the trays.

The unique interlocking trays allow replacement of damaged lawn instantly with matured turf.

GREEN WALL



Each Greenwall Unit made with a UV rays-stable RC Polypropylene (PP),

Weighing <3.5kg. and available in green or black colour. The load bearing capacity is 150kgs/module & Dimensions of the unit is 500mmx125mm.

Modular Planting System

Very Little framework Required

Self Supporting & Strong Structure

Easy for Creative Planting Design & Easy Maintenance

Quick Construction & Plant Installation

Both Vertical & Horizontal Expansion possible

Each Plant can be Accessed & Maintained Individually.

BIWALL



“BIOWALL” it's a kind of Greenwall made from the shown product. Where we can create most beautiful Greenwall using our choice of plants, herbs etc.

As Highlighted above one of the main feature of BIOWALL is its flexibility in the sense of giving it a shape.

It gives freedom of having greenwall in the required shape like Round, Half Circle, Square, Angular and Curve in addition to normal horizontal and vertical. Each Biowall Unit is made with a UV rays-stable RC Polypropylene (PP), made in black colour, Dimesions of the unit is 450mm x 150mm x 125mm.

Available in box containing 4 frames + 12 pots and it covers area of 3 Sq.Ft.

DRAIN CELLS



Draincell Unit is made with 100% recycled Polypropylene available in black colour. Can take compressive load of $> 100t/m^2$ Above 1200 KN having Discharge Capacity of 350 lit./min @1% Gradient Available in Dimension of:

610mm x 410mm x 30mm

450mm x 450mm x 30mm &

450mm x 450mm x 20mm

GEO TEXTILES



Geotextiles are permeable fabrics which, when used in association with soil, have the ability to separate, filter, reinforce, protects or drains. Typically made from polypropylene. Geotextile forms an integral part of drain cell system.

Available mainly in Gray, Black and White Colours in diff. GSM.

ROAD SURFACE CELL



Basic Structure and Specifications are same as Multi Growwall. The Cells can be used in any situation where low to medium & heavy use parking surfaces, access roads for mining sites and driveways are required.

MULTI GROWWALL

Each Multi Growwall Unit is made with a High-density recycled and UV rays-stable polythene (PE-HD), Weighing<1 kg. and available in black colour, The Load bearing capacity is 200 tons/m² & Dimensions of the unit is 480mm x 260mm x 51mm.

	<p>Modular Planting System & Easy Maintenance Easy for Creative planting Design Quick Construction & Plant Installation Both Vertical & Horizontal Expansion possible</p>
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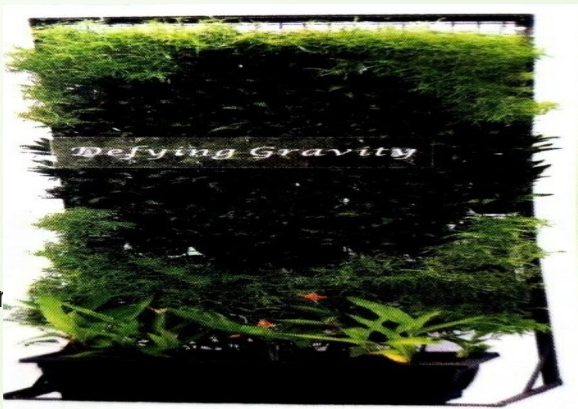
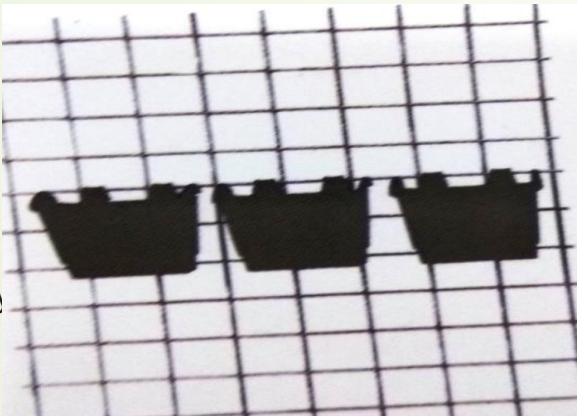
ARTIFICIAL SPORTS SURFACE



With the modular landscaping solutions, we have successfully completed sports grounds related projects for various surfaces for sports centres and gymnasiums.

- Sports surfaces for sports centres and gymnasiums.
- Artificial grass for both elite football and lower divisions/training pitches
- Sports and gymnastics mats
- Surfaces for Cricket, Volley Ball, Badminton
- Synthetic surfaces for tennis and multisport (outdoor) Skating etc.

EASSY WALL A New Concept in Greenwall



Easy

n mar

y

the Modular Landscaping Solutions.

Just like other products, we can incorporate drip irrigation system in the Green wall made with help of Hook Easy module. With this facility we required less external irrigation elements and thus gives us enhanced irrigation efficiency and reduced cost, water flows smoothly throughout the system maintains the green wall evenly.

TECHNICAL SPECIFICATION OF THE MODULE:



Height: 130 mm Base : 90 x55 mm Top : 115 x 125 mm

New Modular Design: Better design gives elegant look to the green wall

- Simple Method: Easy to build method.

Eco Friendly: Made with UV stabilized recycled polypropylene material

- Instant Wall: We can create an instant wall by placing pre grown plants in the pots.
- Drainage Holes: Holes at the bottom allows excess water to flow next level.

BIOWALL ULTRA USED AS KITCHEN GARDEN SYSTEM



How it works: it consists of two trays kept one over the other, with lower one providing the water to the upper tray where the plantations are done, the lower tray comes with a water level meter which helps to adjust the water level required in the lower tray.

Where it can be placed: A corner of Kitchen Balcony or Verandah
On the Terrace Area Backyard
Window Cutouts.

CROP DIVERSIFICATION THROUGH EXOTIC VEGETABLE CROPS

Umesh Thapa, Professor, Department of Vegetable Science

Bidhan Chandra Krishi Viswavidyalaya, West Bengal

Horticultural crops are considered as the best suitable alternative to the urgently needed balanced diversification of Indian Agriculture. The vegetable crop is well established weapon in solving the problems of food security. Our country is endowed with a wide range of tropical, sub-tropical and temperate vegetable crops. But still there are some vegetables which are lesser known or rare to most of our growers and consumers. Our farmers can earn a lot of profit by growing these rare or unusual vegetables in nearby big cities (peri-urban areas) and towns as they attract very high prices in cosmopolitan markets, star hotels and places of tourists' interest.

Recently a number of exotic vegetables including Broccoli, Brussels sprouts, Chinese cabbage, Red cabbage, lettuce, celery, parsley, Leek, Pakchoi have been introduced and there adaptability studies have been undertaken in different parts of the country. These vegetables have been successfully grown in different climatic conditions and fetch better return for the growers. These have increasing demand in the five star hotel of the cosmopolitan cities for better quality. The cultivation of exotic vegetables are gaining popularity with Indian growers for the last couple of years, obviously, due to the awareness of its higher nutritive value and for its increasing export potential.

The agro-climatic conditions prevailing in several parts of North –Western Himalayas of J&K, Himachal Pradesh, Nilgiri hills, Kumaun and Garhwal division of Uttaranchal, are very favourable for growing these exotic vegetables. Besides, they may also be grown during winter season in plains of north India. Few multinational companies have also started processing of few exotic vegetables. As the demand of exotic vegetable are increasing owing to the quality and awareness and living standard, cultivation of these vegetables will provide employment, boost the income of growers apart from diversity in food basket and nutritional security. Due to the introduction of these new vegetables, rich diversity is available in food baskets. Due to better health education and flow of information on nutrition, people are paying much attention to these vegetables which are good source of antioxidant.

Recent scientific investigations have indicated that certain foods, when consumed regularly can promote health and even prevent some chronic diseases such as osteoporosis, cancer, diabetes and heart diseases. It has been well known that diet can play a major role in maintaining health. This has given rise to new class of products called functional food sometimes referred to as nutraceuticals designed foods. Functional food generally indicates to foods that provide health benefits beyond their traditional nutritional value. One of the main benefits of including exotic vegetables in our diet is the presence of antioxidants in abundance. Antioxidants are group of substances that help to counteract the oxidizing activity of free radicals. Another reason for eating lots of exotic vegetables is because they contain phytochemicals. Phytochemicals are naturally occurring plant chemicals, which give the plants their colour, smell, flavour and texture and they have healing properties.

Globalization and some market trade have promoted the demand and scale of exotic vegetables particularly of European origin in the Indian Market. There is a need to replace traditional crops and adopt high value export oriented exotic vegetable cultivation in a scientific method to achieve a global share in the export. In view of increasing demand for exotic vegetables it is time to take up their cultivation in home as well as commercial gardens.

Despite the various offerings available, and the promising growth in Metros and Tier I cities, the penetration of exotic vegetables is still at a nascent stage, especially in smaller cities. The exotic vegetables market is still expected to grow at a higher rate largely due to the growth of the organized foodservice sector, its premium nature, and the higher consumer demand. Investments in developing

distribution and supply chain capabilities, especially in smaller cities, will certainly help convert non-consumers to consumers, and enhance the reach and usage of these vegetables. The following exotic vegetable has to be popularized for diversification and commercialisation:

Broccoli (*Brassica oleracea* L. var *italica* Plenck)

The cultivation of sprouting broccoli is gaining popularity with Indian growers for the last couple of years. Obviously due to the awareness of its higher nutritive value and for its increasing export potential. The plant of broccoli produces a kind of head consisting of white, green or purple buds and their fleshy flower stalks. Like cauliflower, it is consumed as a cooked vegetable as well as used in soup, salad and as a mixed vegetable. The consumption of broccoli has been steadily increasing for the last couple of years and lately the health promoting properties of broccoli have been strongly focused. Glucosinolates (thioglucosides) are sulphur containing compounds present in broccoli. The National Research Council Committee on Diet, Nutrition and Cancer has recommended that increased consumption of vegetables especially broccoli to decrease the incidence of cancer. Broccoli also plays an important role in reducing the serum cholesterol.

Chinese cabbage (*Brassicarapa* L. subsp. *Pekinensis*)

Chinese cabbage is another exotic vegetable of the brassicaceae family. Chinese cabbage is also used like common cabbage in form of cooked, soup, etc. Raw succulent white midrib of the leaves are also sliced or coarsely shredded for salad. In India, it is not popular and its cultivation is restricted to kitchen garden. Leaves of Chinese cabbage are very soft, crisp and contain a fairly high amount of vitamins A and C.

Red cabbage (*Brassica oleracea* sub group *rubra*)

Red cabbage has an attractive dark red colour head which is very compact. Red cabbage has become popular for colour in salad and cooked dishes. It is cultivated in Himachal Pradesh in a limited scale. Red cabbage is a rich source of anthocyanin pigments.

Brussels sprouts (*Brassica oleracea* var *gemmifera*)

Brussels sprout is a type of cabbage in which a large number of miniature heads are borne in the axil of each leaf instead of a single head at the top of the stem. Small heads are distributed all along the stem, which is crowded with a cluster of loose leaves. The little heads 3-5cm in diameter are quite solid, tender and delicious. Brussels sprouts are rich in Vitamin A and ascorbic acid content. It also contains appreciable amounts of riboflavin, niacin, calcium and iron. Brussels sprouts are also a good source of fibre and low in calories.

Lettuce (*Lactuca sativa*)

Lettuce is the most common leafy salad crop of the family Asteraceae. Lettuce occupies the largest area of the salad crop worldwide. In India lettuce cultivation appears to have been introduced by the British in the 19th century, its production for a long time remained confined to grown nearly in all kitchen gardens only but now its cultivation to some extent adopted by a large number of commercial growers to meet the growing demand of continental hotels. The loose leafy type of lettuce is more nutritious than head type lettuce, mainly because of its high Vitamin A and Vitamin C values.

Celery (*Apium graveolens*)

Celery is a cool season crop. It can successfully be grown during winter season in plains of Northern India. Celery cultivation in India has been taken up by the progressive farmers of Punjab, Uttar Pradesh and Haryana. Besides, it is also produced to a limited extent in the hills and in plains in kitchen gardens for its leaves and roots used as vegetables. It is eaten mainly as a salad crop but can

also be used in soups and dehydrated. Celery leaves are quite rich in Vitamin A and C content. Leaves are also good source of iron. The caloric value of celery is very low, suggesting that celery is an ideal food for people that are dieting.

Parsely (*Petroselinum crispum*)

Parsely is well-known for its use in numerous culinary preparations such as flavouring salads, soups and stews. Its beautifully curled leaves are much preferred for adorning the salads, sandwiches, cooked dishes and as a flavouring for soups and pasta and as an ingredient of salad in small quantity because of its pungent flavour. It is one of the best vegetable sources of iron, potassium, vitamin A and C.

Leek (*Allium ampeloprasum*)

Plants of leek resemble large onion plants with flat leaves. Unlike onion and garlic, leeks do not form bulbs or produce cloves. The edible portion is a pseudostem consisting of elongated base and lower blade parts of the foliage leaves. Leek may be eaten raw or cooked. Leek are used primarily for flavouring soups and stews in place of onion.

Asparagus (*Asparagus officinalis*)

Asparagus is a perennial vegetable grown or its edible, tender, unexpanded shoots commonly called Spears. The shoots can be boiled or steamed and served with melted butter, olive oil and cheese. Asparagus is the leading supplier among vegetables of folic acid.

Globe Artichoke (*Cynarascolum*)

Globe artichoke is a tender herbaceous perennial grown for its globular immature flower head or flower bud which is used as vegetable.

Cherry tomato (*Lycopersicon esculentum var. cerasiforme*)

Cherry tomatoes are small, round, cherry-sized fruits of the Solanaceae family. They are popular due to their versatility and ease of combining with a wide variety of uses in salads, appetizers, snacks, sauces, and soups. This species is characterized by its relatively high contents of lycopene, vitamin-A, vitamin-B, folic acid, fructose, and minerals such as phosphorus, potassium, calcium, and magnesium. Cherry tomatoes are also an excellent source of antioxidant compounds such as polyphenols and carotenoids which help to prevent cancer and cardiovascular and circulatory diseases caused by oxidative stress.

Pakchoi

Pak choi is a cool-season vegetable that belongs to the cabbage and cauliflower family. It is also known as pokchoi, or pakchoi. It originated in China and has been cultivated for thousands of years. Pak choi has thick white leaf stems and large, spoon-shaped, dark green leaves. Pak choi has rapidly been gaining popularity due to its mild flavor, suitability as a stir fry vegetable, and wide acceptance among consumers.

CONCLUSION:

Growing and harvesting one's own vegetables is one of the most satisfying gardening experiences. People are also waking up to the benefits of eating farm fresh and chemical free food. It is well known that vegetables are an essential component of traditional foods. It is important that the quantity and quality of vegetables used should be of the highest possible standard. Based on the evidence gathered from the studies of contemporary health experts, there appears to be a general trend that

suggests a role for phytochemical from vegetables in protecting human health from several types of chronic diseases. Though large numbers of studies have proved that health benefits of a specific phytochemical, the benefit cannot be attributed to one component or even to one vegetable but of different types of vegetables year-round enables the consumers. Exotic vegetables market is growing at the rate of 15 to 20% per annum and is increasing day by day. India is importing more than 85% exotic vegetables. Exotic vegetable has major two niche market hotel industry and export. Growing of exotic vegetable & fruits is more profitable business than cultivation of traditional Indian vegetables. Demand-driven exotic vegetables production is suitable for the farmers as they have assured market through contract with consumers.

In this regard, to make these vegetable acceptable and popular, initially farmers can be encouraged to grow them in their household purpose in small scale to realize the proper way of cultivation of these crops in their locality and to make them familiar with the good taste and quality of these crops, so that later on they can take initiative by themselves for growing and marketing of these crops, as an interesting and lucrative proposition.



NUTRITIVE VALUE OF SOME EXOTIC VEGETABLES (per 100gm of edible portion)

Crop	Moisture (%)	Protein (gm)	Fat (gm)	CHO (gm)	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Sodium (mg)	Potassium (mg)	Vitamin A(I.U)	Thiamine (mg)	Riboflavin (mg)	Ascorbic acid (mg)
Broccoli	89%	3.6g	0.30	5.9	103	78	1.1	1.5	382	2500	0.10	0.23	113
Chinese cabbage	95.0	1.2	0.1	3.0	43	40	0.6	23	253	150	0.05	0.04	25
Red cabbage	90	2.0	0.2	6.9	42	35	0.8	26	268	40	0.09	0.06	61
Brussels sprouts	85.2	4.9	0.4	8.3	36	80	1.5	14.0	390	350	0.10	0.10	102
Lettuce	93.4	2.1	0.3	2.5	50	28	2.4	9.0	264	970	0.06	0.06	8
Celaves	88.0	6.3	0.6	1.6	230	140	6.3	35.5	210	3990	-	0.11	62
Parsely	85	3.6	0.6	8.5	203	63	6.2	45	727	8500	0.12	0.26	172
Leek	85	2.2	0.3	11.2	52	50	1.1	0.5	347	40	0.11	0.6	17
Gherkin	95.1	0.9	0.1	3.4	25	27	1.1	6	160	250	0.03	0.04	4
Asparagus	91.7	2.50	0.20	5.0	22	62	10.2	2	278	900	0.18	0.20	33
Globe Artichoke	77.3	3.6	1.2	16	120	100	2.30	43	430	1630	0.23	0.01	11



PLATES : 1 PHOTOGRAPH SHOWING LETTUCE, CHINESE GABBAGE, BROCOLLI & RED GABBAGE IN SOILLESS CULTURE



PLATES : 2 PHOTOGRAPH SHOWING CELERY, PAKCHOL, LALA ROSA AND CHERRY

TREE TRANSLOCATION

Ramachandra Appari, Expert in tree transplantation,
M/s Green Morning Horticulture Pvt. Ltd. Hyderabad

Large Infrastructure projects need large areas to be cleared for setting-up different project. Mostly trees are affected and we all know the ill effects of cutting dountrees. The importance of trees increases many fold in

Urban areas and its protection becomes more difficult vowing to many development projects.

With technological advancements, Tree transplantation is emerging to be a desirable option to save trees and is becoming a solution to couple the benefits of growth and development by relocating them to new destinations.

Green Morning Horticulture Services was established in 2010 with a motto of giving second life to trees and have translocated more than 9000 trees till date with an average survival rate of 85 per cent. Out of the 93 different species translocated by Green Morning more than 50 percent have survival rates of 90 per cent and above thus stating that tree transplantation is a successful method of saving trees.

A scientific approach is to be carried out for tree transplantation and strict guidelines should be adhered to for a successful transplantation. The process should start right from selecting the right kind of trees, and right time and season for transplantation. Proper health assessment of transplanted tree should be taken up and only trees which are fit for transplantation should be considered. Handling of trees while transplantation should be done with utmost care using scientific methods. Right chemicals and growth promoters should be researched and used for successful transplantation and post care of tree. High level of importance should also be given while selecting the receptor site as this has a tremendous effect on the success of transplantation.

Another aspect to be taken care is while pruning. Pruning the tree should be done on sound scientific principles and care should be taken not to disturb the overall structure of the tree. Pruning forms are basis for further healthy growth of tree after transplantation. Poor pruning techniques would lead to irreparable damage to the tree. Post transplantation care becomes critically important and care should be taken to for at least one year after transplantation.





Pictures depicting the process of Tree Transplantation done by Green Morning Horticulture Pvt. Ltd.

Documentation of best practices, methods and experiences from all across the globe and in India should be taken up and SOPs to be developed and circulated to all the agencies involved in the process of transplantation.

There are many myths as to which trees are transplantable and which not to be used in running huge in our country. These myths are to be properly addressed in scientific ways and a common knowledge platform should be setup.

The cost of large tree transplantation still remains a major concern and can be addressed by achieving economies of scale and by adopting new and specialized techniques. Standardization of cost need to be taken up by including the tree transplantation process in SSRs and FSRs depending on Size of tree, distance to be transplanted, species and number of trees.



TROUGH CULTIVATION AND HYDROPONICS : AN INNOVATIVE TECHNOLOGY FOR URBAN HORTICULTURE

Dr. G. L. Sharma, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh

Today a large proportion of the urban population is very health conscious and due to increased use of various types of pesticides more and more people are interested to grow fresh vegetables and desired to maintain ornamental plants in their small land, roof top or available space in the balcony of their home. In view of above various types of containers are designed and are being utilized by many people enthusiastically but these types of containers are having their inherent pros and cons owing to this the house hold cultivation is very cumbersome. The various containers utilized at present includes cement pots, earthen pots, poly bags, plastic pots even old gunny as well as plastic bags. Moreover some people have got constructed permanent reinforced cement concrete (RCC) structures. The various types of pots have a limited rooting zone where as the RCC structure have wider rooting zone but they are immovable structure which are having higher cost as well as maintenance. Further, in the sphere urban landscape planning maintenance of greenery is a challenging task due to lack of soil strata to support root system for active growth of various types of plants.

Positive Aspects of New Technology :

In view of these types of urgent requirements of the present era, the Centre of Excellence on Protected Cultivation & Precision Farming, (CoE on PC & PF) established at Indira Gandhi Krishi Vishwavidyalaya, Raipur during 2015 has standardized an innovative trough cultivation technology and hydroponic structure for home scale as well as for urban horticulture interventions. This innovative technology has mitigated many disadvantages and limitation of technology described in earlier paragraph to a considerable scale. This technology has a wider and better rooting zone as well as can be shifted to any place after completion of the crop cycle. Moreover, the material has a longer life of about ten years. It is light in weight and has a high flexibility in operation as well as very low maintenance. This material can be utilized for growing of wide range of vegetables as well as annual and perennial ornamental plants. Further, this material can have the flexibility of either utilization of low cost media (2:2:1 mixture of Soil:FYM:Sand) or coco peat also.

The Working of the Technology :

The technically the material is flexible poly propylene. This is having a two stripes of 60cm and 36cm width each. These stripes can be folded in the form of a roll and can be shifted at any place. The lower strips of the trough is made in the form of a 'U' shape and supported by galvanized iron sheet clamp of the same size. The width of the lower strip is 24 cm and edge are of a 6cm high. The inner width of trough is 20 cm and it is folded on the form of U again. This is having depth of 20 cm and the trough is filled with rooting medium and actually utilized for the rhizosphere development of the targeted crops. The lower trough is spread with 0.5 cm ballast between the inter space of the upper lower through. The lower trough gives the required strength to the upper trough for proper growth of the root zone of the crop grown.

The Potential for Adaptation :

The innovation technologies standardized at the Centre of Excellence on Protected Cultivation & Precision Farming, IGKV, Raipur, Chhattisgarh has a very high potential for adaptation for the house hold as well as wide spread urban horticulture landscape development in various climate condition of our country. The few potential area which is having scope for the application of the innovative technologies are enumerated as here under:

The rooftop of residential area can be utilized for growing of various type of seasonal vegetables as well as various types of ornamental plants.

The balcony area in multistoried apartments has a huge potential to adopt this technology due to its light weight, flexibility and easy shifting as per the requirements.

In the side of pathways, divider of roads, below the flyovers, in public gardens and other places where the soil surface is not available to support the root system.

In the airport ports, railway platforms, metro stations, hotel lobbies this technology can be easily utilized by making suitable modification of its size as per the requirements of the space.

This trough cultivation technology has also a good future potential for maintenance, proper care and growth of the plants for further utilization in landscape development.

The movability of the structure make its suitable for various specific landscape site as per the needs of the situation.

Conclusion:

The new technologies of trough cultivation and hydroponic is mainly available for commercial utilization in the protected cultivation structures. But our centre has tested and standardized its utilization in the natural conditions outside the protected structures. We have studied various types of rooting medium as well as crops and at the outset we can say that with our initial experiences this technology has a high degree of flexibility for adaptation in the residential as well as urban horticulture project for making our motherland more beautiful for the human cultivation in particular and whole ecosystem in general.

Acknowledgement:

Acknowledge the facilities protected by Indira Gandhi Krishi Vishwavidyalaya authorities as the Centre of Excellence on Protected Cultivation & Precision Farming and my associates for standardization of the innovative technology of trough cultivation and hydroponic.



GOOD HORTICULTURE PRACTICES: FROM THE OTHER SIDE OF THE TABLE

Jyotsna Dayal, Director Rocks 'n' Roots

'Why is the grass always greener on the other side? I always wondered as a child.

After 23 years of working as a landscape designer and horticulturist, I have probably now, found an answer. It is one thing to study about landscaping, architecture, horticulture or botany, and totally another to actually execute the job.

The hands on experience of executing around 65 projects is what I am going to share with you all today. This is not a theoretical lecture on how best to grow plants, but to share with you the rules that we all forget to follow when faced with reality.

Rocksroots has had the privilege of greening the Delhi airport roads at present and we actually began our early years with dividers, and Lutyens Delhi roundabouts. The message here is that if we actually go by the book and follow every single rule we were taught, then there is no reason that our green areas should not look healthy and good.

So let us review step by step what do we do wrong in our horticulture projects :

Step 1 : Turning the soil at least by 1.5 ft to aerate it and to kill all the weeds etc.



Step 2: Thoroughly dressing and fine dressing the soil. Often, a project is completed in a rush and lots of debris remain mixed with the topsoil. This is inadvisable, as not only will it break your lawn mowers, but your grass will never look like fine green carpet.



Step 3: We need to thoroughly mix all the ingredients in the soil before the earth is ready to accept the plants. There should be no compromise here on quantities and ratios. Any deficiency of even one micronutrient will show itself later in the health of our plants.





Step 4: The pits prepared for trees, shrubs and groundcovers should be of the standard sizes, with no shortcuts taken in its construction, as this would leave us wondering why our trees simply not growing, or why the flowering is delayed etc.

Give it space and it will happily spread its roots. How many times do we see untrained labour pushing roots down compact soil layers. Another common blunder is to pack the new plant into the soil, along with the polybag and the gunny bag. We as greening agencies are here to reduce pollution, so we should be the last ones to be adding to it. An important input here can be to give the gardeners frames or moulds to measure the pits as they work.

Step 5 : As we move along doing large projects we also come across obstacles and problems that push us to innovate. The biggest challenge while working for the airport roads, was constructing the perfectly smooth and rounded mounds. These had to be broken twice, because each time they would resemble large graves, so we decided to make an iron frame as a

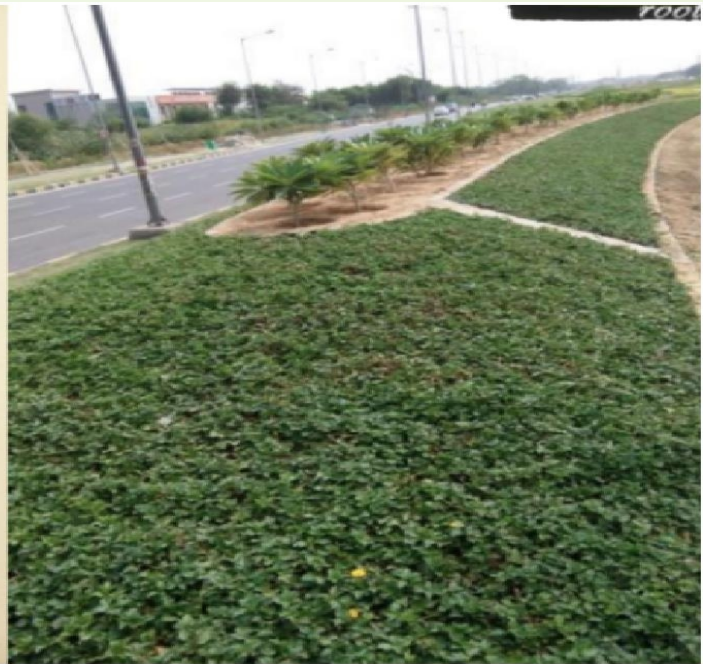
guideline for the gardeners to fill in the soil.

The farmaas we call it, was a big hit, we carried it all along the airport road making sure all the heights and tapers were balanced and standardised. This was a great discovery for us, but at the same time, our project budget went totally haywire, as no tender or no agency takes these other expenses into consideration. Perfection comes at a price. Also I think we are constantly learning on the job.

For landscape designers, it is best to keep learning from the local gardeners, who are the ones who actually soil their hands and get the real feel of the soil.

Step 6 : Proper spacing and grooming of plants is very crucial. Most public spaces in Delhi look unkept and unruly due to haphazard planting. Ideally one should put lime markings and tie strings to plant in straight lines.

Spacing And Grooming



The most essential thing to keep in mind is that we must stake the plants after plantation. Just how a baby needs hand holding and support till it can stand on its own, and our plants are equally needy. If good sized trees with sturdy stems and good girth are selected, our work becomes much easier. A big problem in the field of horticulture is that no executing agency gives importance to plant girth, canopy, spread etc. All the attention is only on the height of the plant, while no one is concerned about its thickness, as that is where the money part comes in. A thin straight stick which is not multi branching, does not have a crown of leaves and is swaying in the wind, will create no impact. Since small plants are cheaper, a client with a smaller budget would say that these will soon fill up and start looking good.

The answers to the above would be, that the risk is high with weaker plants as the maintenance cost goes up. The plant should have been nurtured for longer in the nursery and then brought to the site. If the budget is less, we have to question the planning process. Often the costing is not properly done and little details missed out.

A very crucial mistake made by most planning teams is calculating the water requirements of plant stretches. Many tenders state that the water is in the scope of the contractor, but provide no specific quantities or numbers. So, in such cases the water expenses will vary from agency to agency, which will then corners to save money.

So I come back to the point I started with; we have to go by the book. We all know the per liter water requirements of trees, shrubs, grass and ground covers, and we know the soil conditions of our sites. Then why can't the tankers and litres be specified for one and all. Why do we have to adhere to open ended maintenance clauses?

With this I come to the most important part of this whole landscaping exercise, that is MAINTENANCE.



the weakest part of our country's landscaping plan. We cannot plant and move away, we cannot compromise on food, equipment and care. Plants need regular grooming, weeding, pest control etc. If we feel uncomfortable and sick at a construction site, and hate the smell of paint and dust and cement, then so does the plant.

'Will the tree damage our building????' is what most are concerned with, but what about the buildings damaging our trees? if we are scared of services being affected, then plans must be made for these trees. Like using root barriers, studying the trees and their growth patterns and so on.

It is surprising that we do not have trained Arborists in our country. Very recently we decided to tie up with the Arborists International society (US), to work on tree assessments and analysis, before we actually decide to shift them.

Here again planning and a proper Tree mapping for a whole city is required to see what moves where and what is to be uprooted.

So in conclusion I can state here that let us not treat plants, trees and horticulture so casually. All we need is passion, good intention, innovation and proper qualification. Then we can actually say that the grass is greener on our side too.



TURF GRASS PRODUCTION & MANAGEMENT PRACTICE

Dr. Manoj Kumar, Director of Hort., CPWD

The turf grasses belong to family Poaceae and there are more than 600 genera and 7500 species of turf grasses. The Poaceae is the most ubiquitous of the higher plant groups found on this earth. Turf grasses are the plants which form a continuous ground cover that persist under regular mowing and traffic. The turf grass industry in India is expanding rapidly owing to wider application in homes, sports, fields, golf courses, landscape projects, real estate projects, roadside and highways plantations etc. Turf grasses provide arena for functional, recreational and social activities. With increased emphasis on recreation and urbanization in the recent past, the high quality turf has gained prime importance.

With increased emphasis on recreation and urbanization in the recent past, the high quality turf has gained prime importance. Since the use of turf grass is gaining importance for the aforesaid purposes, it has become imperative to incorporate and initiate research on different aspects of this important area. The turf grasses with different landscape use and they are evaluated for their morphological characters as well as for management practices like weed management, mowing, fertilization etc. Presently we have about fifteen turf grass germplasm namely Tifdwarf-419, Bargustso, Palma, Panama, Panam and Selection-1 of *Cynodondactylon* species and other species like *Zoysia*, *Paspalum*, St. Augustine, Dichondra, Crowfoot Grass etc. which of different characteristics like warm season, shade tolerant, drought tolerant, variegated leaves and with different pattern of texture. The turf are being maintained through frequent mowing in summer and rainy season where as less mowing required during winters. Fertilizer application is indicating that applying nitrogen in splits of three is more beneficial to turf grasses than either single application as basal dose or two split applications. The regular application of fertilizer keeps the grass to grow luxuriantly and maintains the lush green colour of the lawn. Turfgrass provides a forgiving and resilient surface for many recreational activities and is the traditional "green carpet" visitor's associate with parks. Sod is also effective in increasing cooling of surfaces, improving air and water quality and assisting in flood prevention by draining water. It's the same plain old ordinary sod, the kind a great number of golf courses, nurseries, landscape contractors, and private parties are always eager to buy.

A vital aspect in any business venture is profitably potential thus sod production is no exception to that. With a growing suburban population, demand for sod remains strong. Grass can really and truly be a cash crop that does pay USA farmers over \$6,000 an acre. Turfgrasses are ubiquitous in the urban landscape round the world and turf industry is a consolidated sector of the economy in some countries such as USA, China, Australia, UK, Netherland and Denmark. Globally, this industry is serving more than 700,000 athletic fields, over 17,000 golf courses. The turfgrass industry is expanding all over the world and has annual associated revenues in excess of \$20 million each year. Currently, in the USA, there are more than 62 million acres of maintained turfgrass including lawns, parks, golf courses, highway, etc. For 2009, the United States Department of Agriculture reported 1,412 farms had 368,188 acres (149,000.4 ha) of sod in production. The total number of international cricket grounds in India is 46, more than 500 domestic cricket grounds and athletic fields are also in operation. According to the scarce data gathered by golf associations, sports experts and Association of Indian Nurserymen, turfgrass industry covers more than 30,000 acrea, in which around 4500 acre is under turfgrass cultivation and sod production. Ganu Farm Group, the largest sod producer and supplier of India, having an area of 300 acres under high quality turfgrass production. Indian turfgrass industry is growing at the rate of 10 per cent annually. Due to varied agro-climatic conditions in India, abundant sunlight and water, availability of skilled and semi-skilled labour as well as technical knowhow, sod production business can prove to be a boon to farmers.

ROLE OF LIGHTING IN LANDSCAPE

C. K. Varma, Chief Engineer CSQ (E), CPWD, New Delhi

Abstract

Lighting gives altogether new dimensions to Landscaping. While the external aesthetics of a building gets expression through properly planned Landscaping, Landscaping itself gets further expression by becoming visible and beautified during night time by proper planning and designing of Lighting. In a way, Lighting is essentially required for any Landscape conception. This paper analyses the different lighting aspects which need to be associated with Landscape Planning.

Introduction

Lighting is like rewriting the landscape on nature's canvass when sunlight is non-existent. Besides preventing theft etc, Lighting also provides many mesmerizing effects to the building's green extension called landscaping. Before coming to different aspects of Lighting, broad aspects of Landscaping needs to be understood. Primarily landscaping is Nature's footprints suitably made or modified by humans as per their needs of habitation to reduce environmental stress arising out of built habitat. These are therefore properly planned giving due consideration to all factors like presence of trees, their sizes, usefulness in providing shelter, absorbing CO² and noise pollution, shrubs, plants, Paths and stairs, Water bodies (pools, fountains and channels)- Natural or artificial, sitting areas- vast or in small patches, grassy area again vast or in small patches, special areas filled with sand and small stones etc. All such features of Landscaping can be given different lighting treatments to make them visible or prowl in darkness depending on one's thought process. Thus there can be numerous ways these features can be lit depending upon the imagination of the lighting designer, availability of lighting options, economy/availability of budget etc; however, broadly speaking following Lighting aspects cover the landscape lighting.

Different Lighting Aspects

- Perimeter and wall lighting
- Direct Lighting
- Indirect or Reflected Lighting
- Path Lighting
- Stair Lighting
- Up Lighting
- Down Lighting
- Silhouetting
- Shadowing
- Moon Lighting
- Grazing
- Washing

These aspects are now covered briefly with real-life images for proper comprehension:

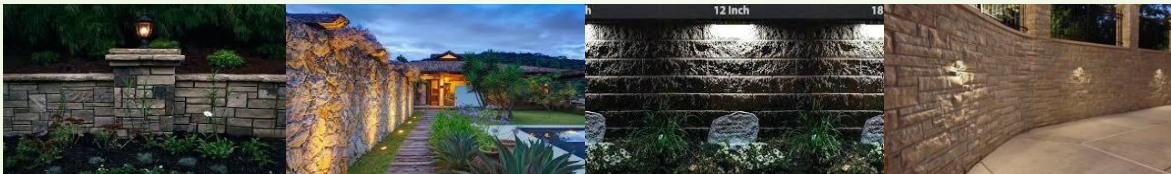
Perimeter and wall lighting

Perimeter lighting is sometimes called the security lighting and is desirable from the viewpoint of security reasons. The choice of lighting depends upon the level of security, type of fencing/boundary, economy of operation and geographical considerations. Many a times the walls are illuminated only from inside to give the features of walls an artistic expression and sometimes these are lit up with focus on outside of the wall/fence. Pole mounted LED lighting with Solar panel on top is an ideal solution but many other variants are also possible depending upon the feasibility and other considerations.



Different examples of Perimeter lighting

Wall lighting is again writing on the wall with light. The lighting needs to be designed in such a way that the focus of the lighting remain entirely on wall thus highlighting the texture of the wall and features of the stones etc from which the wall has been formed.



Different examples of Wall lighting

Direct Lighting

It is the simplest form of lighting of any landscape and covers the entire area indiscriminately. It may be simply called area lighting and there is no imagination involved in this. Nevertheless, it is sometimes a necessity to give bright coverage during night time.

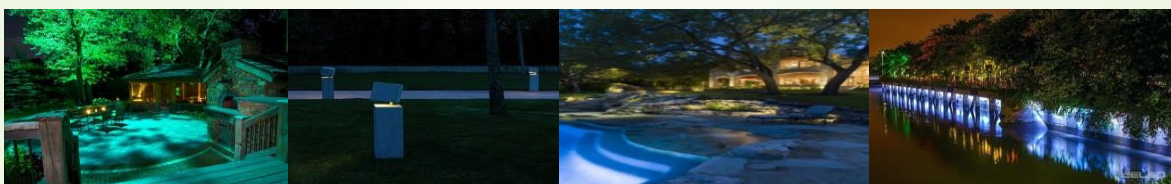


Different examples of Direct lighting

The Direct Lighting however involves wastage of energy as the entire landscape is lit up and many useful feature of the landscape may not get highlighted. This form of lighting may therefore be avoided for large landscapes having multiple features like big trees, large sitting areas, multiple water bodies etc.

Indirect or Reflected Lighting

Indirect or reflected lighting gives a soothing effect to the environment as well as visitors and is the lighting obtained through reflection of light from surrounding surface. This gives a pleasing effect because the harshness of light is eliminated due to reflection and is normally provided where bright light is not required. This can come in different shades and colors or combination of these.



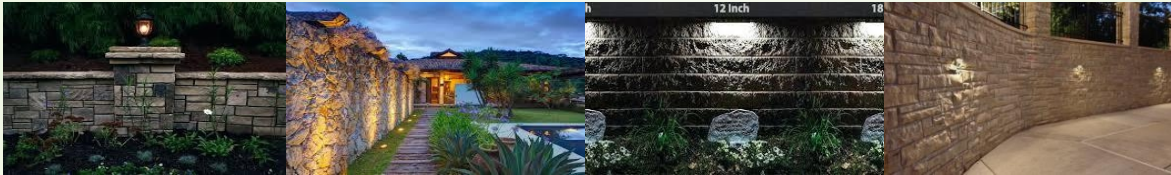
Different examples of Indirect lighting

This form of lighting also involves wastage of energy and should be employed only in a limited space. Nevertheless the effect is very magical and soothing if properly devised.



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Path Lighting

Any landscape generally involves pathway for pedestrian's movement which may pass through the entire area or may be limited to a restricted area. It may therefore be very essential to lit up this path to guide the movement of the people during night time. The lit up path also adds beauty to the entire landscape and should be done with utmost care and imagination. Many choices of path lighting are available and right choice is based on the individual's perception, taste and conservation of energy. The lighting can be provided either on one side of the path or on both sides and in zig- zag manner depending on one's design. These lightings can be provided on small poles called lighted ballards or flush with the ground. It is essential to arrange lights in such a way so as to avoid shadow on the path.



Different examples of Path Lighting

Stair Lighting

Small footsteps are essential part of any landscape which is not plain but having many levels. Sometimes these steps are part of the path and sometimes they join different levels of the landscape. The creativity of the designer and variety of lighting choices available decide the selection of stair lighting.



Different examples of Stair Lighting

The right selection of stair lighting blends with the other lit up features of the landscape. It is very essential to avoid any shadow on these stairs to avoid stumbling of the pedestrian.

Up Lighting

This form of lighting is generally used to highlight any special object and in case of landscaping, up lighting is provided by fixing lighting fixtures in the ground and focusing towards the object to be highlighted. In case the object is large enough the number of up lights may be more to provide various viewing angles. In a landscape generally large trees are up lighted to highlight their expression into the landscape.



Different examples of Up Lighting

Down Lighting

Down lighting provides a very mesmerizing effect if taken up with due care. In this form of lighting, fixture is normally mounted on the tree itself or on a pole nearer to the tree and is focused downwards. The lighting effect generated is very pleasing if done properly. Lighting of different shades and color can be used in this type of lighting.



Different examples of Down lighting

Silhouetting

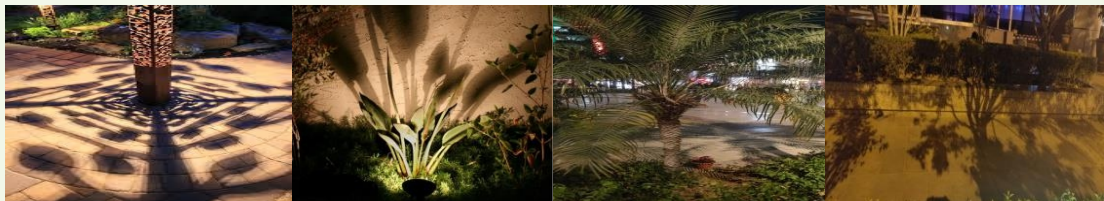
This form of lighting is generally used for showing something as a dark shape and outline against a brighter background. In case of landscaping this form of lighting is generally used to highlight stem of a tree which is very prominent or some other feature of the landscaping which is prominent enough to be highlighted in a reverse manner i.e. back ground is illuminated while the feature to be highlighted is in shadow of this illumination. Silhouetting thus provides a very interesting type of lighting particularly in landscape lighting design.



Different examples of Silhouette lighting

Shadowing

Beautiful shadow effects can be provided by this form of lighting which provides altogether a different effect.



Different examples of Shadow lighting

Moon Lighting

Moon lighting is the mimicking effect of landscape lit up by moon light. Thus a white light piercing through the trees can give the effect of moon lighting. A single white light standing high on a pole above the tree lines can duplicate this effect.



Different examples of Moon lighting

Grazing

It is one type of outdoor lighting for highlighting beautiful or unique textures or irregular surfaces. Bark on trees, Stones of the wall and fountains including water bodies can be lighted up by using this form of lighting. Grazing works very well on natural stone or wood; duly emphasizing the unique textures and the detail of the material. The weathered surface of stone is particularly suited for this form of landscape lighting, creating little shadows in the natural indentations of the rock and highlighting raised areas. Even simple concrete walls look more interesting as grazing accentuates its rough surface.



Different examples of Graze lighting

Washing

By this effect, any surface or feature can be lit up with lights to give the effect of washing. There can be single color washing or washing with different colors. All options are available now.



Different examples of Wash lighting

There can be numerous other effects and techniques which can be used creatively for landscape lighting. However, above mentioned effects provide a useful guide for the design of landscape lighting with associated advantages and limitations. In fact, it is not the lighting but the effect, lighting provides to the landscaping is important and is the result of many permutations and combinations, trials and errors and also the outcome of one's imagination and ingenuity.

Role of New Technology in Landscape Lighting

New technology can play a very crucial role in giving new and different dimensions to the lighting. Already LED lighting has demonstrated the variety of effects and shades available at the command of the designer. If equipped with suitable controls, switching on and off can also be achieved automatically as per set time or occupancy for energy conservation.

Conclusion

Lighting in landscaping enhances the effect of landscaping many times during night besides providing visibility to move around. People wish to see everything not only in the sun light but after sun light also. This compels the Landscape designer to take care of this important aspect i.e. lighting in Landscape. It is also preferable to use LEDs for this purpose because LED comes in different colors around 30000 plus and have a long useful life over other types of lamps. Moreover, LEDs are low voltage devices thereby problem of shock to the human beings and the birds etc can be avoided. LEDs are available in two variants i.e. wide angle and narrow angle beam to give different lighting effects to the green features of the Landscape.

It is also suggested to have different combination of lighting to provide wide range of choices to the user to suit the mood and preventing monotony. New Technologies like IOT and Artificial Intelligence which are emerging vary fast can also play a very crucial role in Landscape Lighting. The concept of solar tree can also provide the dual purpose of harnessing solar energy and expression of Nature through man-made electromechanical tree giving power and reducing CO² emissions.

GREEN INDIA MISSION AND INITIATIVES BY CPWD

Namita Nitesh, Architect, CPWD, Mumbai

Abstract :

Green India is a national Mission commonly called as the Green India Mission (GIM), which was launched in February 2014, is one of the eight missions outlined under the India's Action Plan to address the climate change. It is in response to the climate change by protecting, restoring and enhancing India's diminishing forest cover. We all are aware of the various environmental problems such as air pollution, water pollution and water scarcity, global warming and so on. It is our conscience that we switch to the sustainable development to prevent further deterioration of the environment.

INTRODUCTION : It is rightly said "Cleanliness is next to Godliness." Living in healthy environment and clean surrounding is must for quality of life. Today Indian city with dense development has become urban heat island which is full of dust, noise and pollution. The earth's natural resources have been exploited to such an extent that it has given dangerous consequences to the environment with the overall climate change. The Human Activities are directly responsible for Global warming through Green House Gas emissions. To mitigate these harmful consequences, " The Green Movement " in India is an emerging movement which emphasises on environmentally friendly practises in all spheres of life like transportation, construction, law and order etc. Our country has taken up a large number of green initiatives by switching to renewable resources of energy to minimise carbon footprints.

HISTORY OF ENVIRONMENTAL MOVEMENTS IN INDIA : The change in Climate has a great impact on Earth's ecological, biological and geological balance. These changes have led to many environmental hazards such as depletion of Ozone layer, loss of biodiversity, spread of infectious diseases and extreme weather conditions. The emission of greenhouse gasses like carbon dioxide is the main cause of climate change as the atmospheric temperature increases due to it. Water level has increased due to melting of Polar ice and as a result many coastal areas have inundated in water. Thus, due to such devastating environmental impacts, the Green Movement came into existence.

Green Movements can be defined as a social movement for the conservation, protection and restoration of the environment. There were many Environmental movements that took place in the last few decades for the protection of the environment.

Bishnoi Movement : This is one of the earliest Green Movement. Bishnoi is a religious sect found in western Thar Desert and was founded by Guru Maharaj Jambaji in 1485AD in Jodhpur, Rajasthan. It is a non-violent community of Nature Worshipers. The Bishnoi movement was started by a sage Sombaji in 1700 AD, against the deforestation and region was declared as the protected area, till date.

Chipko Movement : It was a Forest Conservation movement also called Chipko Andolan, which began in 1973 in Chamoli District, Uttarakhand. In this movement people went to embrace trees to prevent them from being cut.



**FIG. 1 CHIPKO MOVEMENT
(SOURCE : THE HINDU BUSINESS
LINE.COM**

- **Silent Valley Movement** : This movement was led by the local people against the setting of Hydel Power Project in the evergreen forest of Kerela in 1973. The forest is very rich in Biodiversity.



FIG. 2 SILENT VALLEY MOVEMENT
(SOURCE : CONSERVATIONINDIA.ORG)



FIG. 3. NARMADA BACHAO ANDOLAN
(SOURCE : LEGALINDIA.COM.)

- **Narmada Bachao Movement** : The local people and the environmentalists protested against the building of Dams for hydro-electricity in 1985 on the River Narmada.
- **Tehri Dam Conflict** : This movement was also started by the local people against the construction of Dam, being constructed in seismic region which could cause submergence of Tehri Town and Forest area of the region. These movements were the efforts of Local People to change the policies of Government for the protection of environment.

GREEN INDIA MISSION : The Green India Mission was launched to fulfil the broad objectives of :

- Increasing the forest cover to the extent of 5 million hectares and to improve the quality of forest cover in another 5 million ha of forest/non forest land in 10 years. It envisages a holistic greening by preserving the Biodiversity, Water bodies, Wetlands, Critical habitats etc.
- To enhance the Carbon Sequestration.
- To increase the forest based Livelihood income.

The mission proposes the holistic view of Greening with the emphasis on “Landscape approach” by involving the local communities in planning, implementation and decision making. The local people have been skilled up as Green Volunteers to act as a bridge between the community and the implementing agencies. This Landscape approach includes both the forest areas and non-forest areas to widen the scope of the mission.

At the national level, the mission is set up as an autonomous Society under the Ministry of Environment and Forest (MoEF). Our Country is switching to renewable energy for its many upcoming major projects. The trade ports, railway stations and Zoological gardens are smartly and creatively being developed with Renewable energy resources to minimise carbon emissions.

INITIATIVES BY CPWD FOR GREEN INDIA :

The Central Public Works Department is one of the largest Central Government Organisation serving the nation by creating sustainable built environment and is a part in Green India Mission. CPWD has published a document - the Guidelines for Sustainable Habitat for taking decisions on Architectural Design, materials and equipments for building a sustainable habitat with sustainable technology in a comprehensive manner. The department is taking a number of green initiatives like switching to renewable energy resources by investing in green technologies, encouraging sustainable housing projects and opting for Solar Energy. The department is committed in designing buildings confirming to 3-Star GRIHA rating for Green buildings and 3 Star rating for energy efficiency.

CPWD is also pioneer in construction industry to prohibit the wood in construction materials and promote the use of Fly ash generated Cement. A detailed directive has been issued by the CPWD to its field units for Recycled Construction and Demolition Waste materials. Waste-converter Compost machines have been installed in GPRAs and GPOAs maintained by CPWD for Reuse and recycling of waste generated. The compost generated from it would be used for horticultural purposes. To conserve water, the department has decided to install sewage treatment plants to recycle waste water, in all General Pool Residential Accommodations.

It is mandatory to Install Rain Water Harvesting System and Waste Water Recycling Plant in all the major projects taken up the department for the water conservation measures. Solar Panels for generation of Renewable Energy has been installed in almost all Central Government Buildings. E-office has been adopted for promoting paper less work. CPWD has also planted 60,000 trees in Delhi and National Capital Region as part to enhance tree cover, under the guidance of MoH&UA. To reduce carbon footprints and speedy construction, the department has adopted new construction technologies like Monolithic Concrete Construction System using Plastic and Aluminium formwork. Thus, CPWD has shifted to Green Construction Technology.



FIG 4. SOLAR PANELS AT GOVT. BUILDING SOURCE : SAURENERGY.COM)



FIG 5. TREE PLANTATION BY CPWD

CONCLUSION :

The Green India Mission is a tool to minimise wastages and maximizing reuse for saving our mother earth. The mission helps in connecting us with the nature by using locally able materials. Emphasis on planting more and more trees would increase the forest cover for preservation of ecological balance and to increase “Carbon Sinks”. A smallest effort in this field is capable of improving planet Earth and providing a better place for all of us.

ENVIRONMENTAL VALUE OF PLANT MATERIAL & ITS SELECTION

P.S. Sodhi, Architect, NDR, CPWD, New Delhi

With the advent of technology, the man is becoming isolated from nature day by day. The rapid urbanization has resulted in diminishing the landscape features. The early culture of India is full of plant love, intimately concerned with the day to day life. With the increase in population and large scale Urban Development has begun to heavy toll of the green areas and an alienated the people from nature. Apart from the aesthetic aspect the loss of vegetation cover effects the Soil, Air & Water balance adversely Plants provide significant values to all sectors of natural environment in cities.

One of the major values of plants is improving of urban soil conditions. Urban soils are often buried beneath the side walks, streets and buildings. However, a significant portion in many urban areas remain exposed to environmental conditions which helps is improving Urban Soil conditions by building the Soil with roof system, by checking the loss of surface particles, by increasing the organic material contents in soil and retaining the water for longer period, to increase the ground water table.

It also helps to control the extreme fluctuation in temperature and reduction of pollution level in urban atmosphere. Plants have a useful effect upon the climate e.g. a comparison of the temperature difference in summer, between a planted area of urban landscape and built-up central area is likely to be 2-3 C lower with a 5% increase in relative humidity. Plants whether trees, shrubs, climbers, ground covers or grass have to be placed suitable location so that the desired purpose is served.

Planting is much more than a cosmetic treatment to be applied to in different or insensitive architecture and engineering etc. It plays a major role in integrating structure into environmental, providing a setting and reducing their visual intrusions within the functional requirement of any single area plant are growing, ever changing, interacting organism and plant communities are in a construct State of flux. The efficient and successful choice of plants should be made on the following basis of their design characters.

1. **Functional & Structural Characteristics:**

Plants in combination and individually, creates space beneath, between & sometimes within the bulk of their canopies. It creates Landscape structure, which both defines spaces and serves the required function. Trees, in the city are living building material used to establish spatial boundaries. They create spatial rhythms to heighten the experience of moving through the out door spaces, its ability to shelter, screen or shade, density of roof growth which will determine its ability to bind the soil and protect against erosion. Also provides a fitting environment for human activities whilst avoiding damage to ecology of the landscape.

1. **Visual & Other Sensory :**

Plants after an enormous wealth of aesthetic characteristics, the appearance of their leaves, twigs, bark, flower & fruit the fragrance of flower and aromatic foliage, the Physical texture of bark & leaves even the sounded of they when stirred by the wind of beaten by the rain.

2. **Plant Growth habit & Cultural Requirement:**

There is enormous diversity of size, habit foliage & other characteristics among the range of species; it helps to determine the habitat & ecological niche. In the first place, planting design can help us make the best use of our environment, secondly it helps to restore the balance between people, nature and in some extent to the wild life and finally it may provide opportunities for enjoyment of aesthetic delights. Plants are positive design elements in any environment and they can enhance the environment if used with proper understanding.

Plants and their uses :

TREES (basic planting) : this relates to the contemporary requirement in Landscape Design for mass planting of large groups, woodlands, which with the topography or landform, produce the large scale spatial arrangement of the Landscape. The species selected for this group should be hardy, vigorous in growth, indigenous for ecological reasons and exotics which have become established as part of local scene e.g.-*Acacia auriculiformis*, *Lagerstroemia flos reginae* (pride of India), *Pterospermum acerifolium* (kanak champa), *Alstonia scholaris*, *Putranjiva roxburghii* (jalpatri), *Azadirachta indica* (neem), *Dalbergia sissoo* (shisham) etc. etc.

TREES (special effects) : trees in this section should include those sufficiently individualistic, spectacular or strong in character to occupy the isolated positions, either because of these qualities or because they do not mix easily in visual sense with other trees e.g.- *Ficus bengalensis* (banyan tree), *Cassia fistula* (amaltas), *Bombax malabaricum* (silk cotton tree), *Cassia nodosa* (pink javanica), *Jacaranda mimosaeifolia* (neeli gulmohar). *Chrosia speciosa*, *Mimusops elengi* (mulsari) *Callistemon lanceolatus* (bottle brush) etc. etc.

TREES (barriers) : barriers formed with plants are needed in Landscape for screening the unpleasant views, for dividing up the landscape into spaces, for providing shelter from wind, for protection against pollution, for defining boundaries and for assisting in the creation of beautiful landscape e.g.- *Casuarina equisetifolia*, *Grevillea robusta* (silver oak), *Ficus benjamina*, *Polyalthia longifolia* (ashok), *Putranjiva roxburghii*, *Schleichera trijuga* (kusum), Golden bamboo etc.etc.

SHRUBS (basic planting) : the use of shrubs in the mass as a basic constituent of the planting of Landscapes. It should have the qualities of hardiness, vigorous growth with a greater emphasis on evergreen plants e.g.- varieties of *Acalypha*, *Bougainvillea*, *Cassia biflora*, *Cassia alata*, *Duranta*, *Ficus panda*, *Euphorbia*, *Thevetia*, *Taberneamontana* (chandni), Palms such as areca, china, phoenix, rhaps etc. etc.

SHRUBS (special effects) : similar principles of selection apply to this as for trees (special effects), but at the same time it should be noted down that a number of shrubs planted together can produce special effects specially at the time of flowering. e.g. – *Caesalpinia pulcherrima* (peacock flower), *Calliandra haematocephala*, *Poinsettia*, *Mussaenda*, *Justicia*, *Ixora*, Bamboo-budha valley, *Franciscea latifolia* (yesterday, today and tomorrow), etc. etc.

SHRUBS (barriers) : impenetrability is essential unless the barrier is for visual purpose, thus the twigs or thorns are considered as an advantage. Another thing to consider the ability of the plant to accept pruning, either to control growth or to produce topiary effects e.g. – *Bougainvillea*, *Duranta plumieri*, *Duranta plumieri variegata*, *Duranta goldeana*, *Murraya* etc. etc.

SHRUBS (edging) : to outline the flower beds or other kinds of plants and to create line effect e.g. – *Duranta goldeana* etc.

FLOWER NUTRACEUTICALS

Ram Singh Meena, Dy. Director (Hort.)CPWD, New Delhi

For most of us, the presence of flowers such as roses, chrysanthemums, lilies and calendulas for instance represents an aesthetic uplifting of spirit. Some of these beautiful flowers have certain medicinal properties. It is believed that herbs act as a symbol of eternal love of our spirit. Everyone gives or receives a bouquet in a spirit of devotion to god, child birth, marriage, saying thanks or death. A bouquet of flowers may simply remain as an object of pure aesthetic delight to the beholder but the flowers hold high importance for our health and are used to prepare so many ayurvedic medicines.

Imagine instead of simply placing a bouquet in a vase of water until its treasure wilts and dies, we can use it for another purpose such as using organic red rose petals as a tea with honey for someone experiencing sadness or depression, pansy flower and honey tea for one who feels tense and irritated or has a cough or sore throat, calendula flower tea for a woman experiencing premenstrual discomfort or a tea of fresh or dried marigold flowers to treat symptoms of a colds, coughs or diarrhea, branches of flower decked honeysuckle vines taken as a tea for influenza, arthritis or rheumatic complaints. In our country tribal people have an ancient healing custom that imparts a whole new dimension to the meaning of a bouquet of flowers. Imagine picking or even purchasing a special bouquet of flowers whose assortment represents not only aesthetic beauty but a variety of physical healing benefits as well. Instead of presenting these to your loved one merely to be exhibited in a vase of water, offer them as a personally administered flower bath given with special words of praise, blessing and prayers.



Rose



Pansy



Calendula

Because our skin is not simply a boundary, but acts truly as a filter of outside influences both physical and subtle, the healing properties of plants are selectively absorbed through the skin membrane to impart their magic to our very soul. Some of the most successful treatments have been in the form of herbal foot, hand or whole body baths for such conditions ranging from colds, flu, fevers, skin diseases, inflammations, arthritic complaints, traumas, cramps and spasms to emotional and neurological imbalances such as depression and insomnia. There is no question, therefore, of the healing potential of such a Flower Bath especially when personally administered with affirmative devotion and love.

The experience of a flower bath is exquisite. A three or four gallon container filled with diverse healing flowers set out to infuse with pure water to commingle and absorb the essence of flowers and healing moonlight rays. The blessed infusion is administered generally before noon, accompanied with soft prayers and blessings. The entire ritual takes approximately 15 minutes. After that one can take a walk to let the surrounding air to evaporate the fluid on the body.

The feeling is empowering, uplifting, soothing, nurturing to body and spirit are some of the words and phrases that come to mind. The flowers used for ayurvedic bath should be organically grown, free of pesticides and chemical nutrients. In order to prepare our flower bath, lets backtrack for a moment to the moments when our ancestors and we personally became aware of the healing power of herbs. To do this, we need to consider deeply the profound and humble meaning of the simple wild plants and herbs that surround us and how their very existence is bound up in providing the basis of food for all creatures as well as in their ability to heal diseases, injuries and ailments. How forgiving they seem, despite the ignorant rudeness many of us display in our efforts to exterminate some of them as weeds, they persist beyond all our tilling and poisonous sprays, the Lantana for our skin itches the Makoi for muscular pain, the Dhatura for our stomach and intestinal pain and so on and so forth down through the ages the weeds keep reminding us of their mission of healing not only for our physical body but to bring up deep nutrients and minerals from the subsoil and to provide precious organic material to enrich the earth.



Lantana



MakoiDhatura



Not all medicinal plants have their origin as a weed however. I can imagine that a long time ago, when our ancestors began tilling the soil to selectively cultivate certain plants for food, some of those that might otherwise be deemed as useless weeds, attracted the special attention of certain household members who would transplant them aside for either medicinal or purely ornamental purposes. Today, the rate at which we are cutting for temporary profit, we should understand that we are destroying centuries of growth in a germplasm, knowing that so many species are going extinct every day. We need to be more responsible for our environment and preserve it for our future generations. Certain flowering plants under the disguise of being ornamentals have been passed down through generations by selective cultivation. These plants are known today to possess many healing virtues. This makes one wonder about how many medicinal plants we have lost in the past and are still losing. The medicinal property in some well-known garden and bouquet flowers is amazing. Calendula (*C. officinalis*) can be taken internally to promote blood circulation, treat surface diseases such as colds and fevers as well as relieve menstrual cramps. Externally it can be made into an oil for treating burns and injuries. Rose (*Rosa* species) the petals are cooling, blood circulating and anti-depressive. It is used to prepare rose water, attar, rose oil, pankhudi, gulkand and gulroghan. Rose water is used as an eye tonic. Carnation (*Dianthus caryophyllus*) used as a diuretic for urinary tract infections. Hibiscus (*H. sabdariffa*) A sour tonic, widely used throughout the Middle East and warm climates as a treatment for inflammatory diseases and fevers. Sadabahar (*Vincarosea*) roots contain the substances vinblastine and vincristine which are used in the treatment of leukemia in addition, the vincamine is derived from *Vinca minor*. Vinorelbine, a newer semi-synthetic chemotherapeutic agent, is used in the treatment of non-small-cell lung cancer.



Carnation



Hibiscus



Sadabahar

Chrysanthemum morifolium - is one of the best beverages to drink in hot summer weather. It is used for fevers, headaches, eye inflammations, and hypertension. Makoi (*N. sativa*) contains a saponoside, melanthine, a bitter compound, nigelline, an essential oil from which nigellone is extracted and tannin. The seeds have been used as a spice since early times and possess carminative, diuretic and antihelminthic (kills worms) properties. The seeds can be used as a pepper substitute. Morning Glory (*Ipomea jalapa*) the root is a powerful cathartic. Gardenia fruits (*Gardenia jasminoides*) in certain climates the flowers will evolve to a fruiting stage and are used to promote blood circulation, open the liver and detoxify the blood. Begonia (*B. fimbriatipulata*) The aerial portions are used as an alternative, to clear heat, eliminate toxins, promote blood circulation, treat coughing of blood, and externally applied for trauma, burns, pain and toxic sores.



Chrysanthemum



Ipomea



Gardenia

It is astonishing to find out that the actual psycho-physical healing properties of even our most common garden and bouquet flowers around us. Reminding us of Hippocrates who once said that – 'nature itself is the best physician.'

INITIATIVES TO MITIGATE THE CLIMATE CHANGE CHALLENGES IN AGRICULTURE

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Climate Change is a serious global environmental concern. It is primarily caused by the building up of Green House Gases (GHG) in the atmosphere. The global increases in carbon dioxide (CO₂) concentration are primarily due to fossil fuel use and land use change, while those of methane (CH₄) and nitrous oxide (N₂O) are primarily due to agriculture. Global Warming is a specific example of the broader term 'Climate Change' and refers to the observed increase in the average temperature of the air near Earth's surface and oceans in recent decades. Its effect particularly on developing countries is adverse as their capacity and resources to deal with the challenge is limited. Scientific studies have shown that the global atmospheric concentrations of GHGs mainly CO₂, CH₄ and N₂O have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values.

The key environmental challenges in India have been sharper in the past two decades. Climate change is impacting the natural ecosystems and is expected to have substantial adverse effects in India, mainly on agriculture on which 58 percent of the population still depends for livelihood, water storage in the Himalayan glaciers which are the source of major rivers and groundwater recharge, sea-level rise, and threats to a long coastline and habitations. Climate change will also cause increased frequency of extreme events such as floods, and droughts. These in turn will impact India's food security problems and water security.

India's emissions are estimated to be of the order of 1331.6 million tonnes of the carbon dioxide equivalent Green House Gas (GHG) emissions in 2007. The emissions indicate an annual growth of 4.2% from the levels in 1994. Whereas India's CO₂ emissions are only about 4% of total global CO₂ emissions and much less if the historical concentrations are taken into account. In pursuance of the obligations cast on parties to the United Nations Framework Convention on Climate Change (UNFCCC), India has undertaken to communicate information about the implementation of the convention, taking into account the common but differentiated responsibilities and respective capabilities and their specific regional and national development priorities, objectives and circumstances. The elements of information provided in the communication include a national inventory of anthropogenic emissions by sources and removals by sinks of all Green House Gases, a general description of steps taken to implement the convention including an assessment of impacts and vulnerability and any other relevant information.

Climate change impacts on agriculture are being witnessed all over the world, but countries like India are more vulnerable in view of the huge population dependent on agriculture, excessive pressure on natural resources, and poor coping mechanisms. The threat of climate change can be addressed in two ways, firstly, by reducing the impact of climate change on crops/ production systems including livestock, poultry, fishery sectors, and secondly by way of adoption of various practices which will reduce the severity of the impact (Adaptation to climate change) and to reduce the emissions of green house gases that are responsible for the climate change (Mitigation of climate change). For the country's preparedness for mitigating the challenges of climate change in agriculture sector; Ministry of Agriculture & Farmers Welfare has undertaken numerous initiatives. National Mission for Sustainable Agriculture (NMSA) is one of the eight Missions outlined under National Action Plan on Climate Change (NAPCC). It aim at promoting sustainable agriculture through deliverables focusing on ten key dimensions of Indian agriculture. These measures are embedded and mainstreamed onto ongoing/proposed Missions/ Programmes/ Schemes of all Departments of Ministry of Agriculture & Farmers Welfare through a process of restructuring and convergence. (View expressed are personal

A JOURNEY OF FLOWER TABLEAUX

Saphal Manakapure

One of the major functions of Horticulture unit is participation in Republic Day Parade held at Raj path in New Delhi, the capital city of India. The floral Tableaux based on different themes are fabricated every year specifically for the Republic Day parade. Each year the spectacular floral tableauxis prepared in-house in different design with variety of colorful flowers. The music adds to its overall splendor.

“Dreams have no boundaries nor are there any limitations for an artist”. Just imagine, lakh of colourful flowers in heap with all its fragrance and an artist's imagination give results which are spectacular and awe-inspiring. Only skill or mastery in drawing doesn't make an artist. A true artist encompasses a diverse range of activities including perception, creation, mediums of expression and deliberately arranging elements that appeals to the senses or emotions. The department who has been able to arrange the myriad hues of flowers into a perfect masterpiece is CPWD (Hort.) which every year forms floral tableaux.



“Picture depicting the formation of Floral Tableaux”

CPWD Horticulture float which is the most attractive part of the Republic Day Parade, year after year. The entire tableaux is made up of flower, painstakingly pinned to give the the most exquisite depiction. Making of a tableaux is a lengthy process which starts from june when, different themes and designs are set to the concerned department and the defence ministry expert commity apporves the concept and finalized one theme. Then one has to make the scale model as per the apporved design. However the actual work on the tableau start in the month of December, where carpenters

start working on wooden frames. Then mossing done by mossgrass is brought from Himachal Pradesh. For object with intricate design, thermocol model and wood are made.



“Picture depicting the pinning of fresh flowers brought from different states for shaping the Floral Tableaux”

According to experts preparing a tableau of flowers is an intrinsic affair requiring foresight and imagination. The delicateness of flowers limits the artist's flow of imagination to only certain themes that can capture the splendour of flowers and can be well depicted in colours of most available flowers. Thus, most topics are chosen keeping four colours in mind - White, Orange, Brown and Lemon Yellow. Flowers of blue and pink colour are rare. Only those flowers which retain their freshness for long are used. The most beautiful rose cannot be used as its petals turn black very soon.





2006 (Sagar Sampada)



2008 (60th Years Of Independences)



Save The Tiger - 2011



SNOW VALLEY 2012



RAJPATH 2014



VANDE MATARAM 2019

“Picture of different FloualTableaux of different years with their themes”

For CPWD Hort tableaux that we have designed till now, 2-3 quintals of fresh flowers were brought from all over the India especially the ones from Kolkata,Ujjain, Banglore and Kashmir, which gets pinned only on 25th january so that the flowers don't lose their freshness. Thus, it's the only tableau that will not participate in the full dress rehearsal of the parade. Giving the final touches to the tableaux requires around 800 workers, who segregate the flowers according to colour and size and then each flower is pinned to the moss grass. The tableaux captures the splendour of nature with multi-coloured flowers,spreading a rich riot of colours.Flowers are bought in quintals and a tableau of 45 feet length, 14 feet width, 16 feet height, requires 3 to4 quintals of flowers depending on the design selected

The creative mind behind this, who came up with his concept under CPWD (Hort.) since 1983 is Late Mr. Anant Balkrishna Manakapure. He was an artist known for his abstract creativity and challenging imagination. His son, Mr. Saphal Manakapure, who is also an artist and a photographer joined his dad in this process at the age of 18. Gradually learning and understanding the process, he solely took over the prestigious work for the nation since 1999. It's a proud moment for both CPWD (Hort.) and Mr. Saphal Manakapure from past 13 years consecutively, winning the special award for Best Tableau in The Republic Day Parade at Rajpath.



Hon'ble Minister of Defence Smt. Nirmala Sitharaman giving away Special Prize for CPWD Floral Tableaux, 2019

NAKSHATRA VAN

J. K. Srivastava, Assistant Director (Hort.), CPWD, Lucknow

The nakshatras are one of the oldest references we have to astrology from the Rig Veda, dating back about 5,000 years ago. The Vedas are the religious scriptures of the great seers and sages of India. The nakshatras are like the zodiacal signs but more specific. Their meanings are derived from the constellations, fixed stars and the mythology behind these portions in the sky. They are rich in meaning and have ruling deities that reveal the stories or myths that bring to life the symbology referred to in our own lives.

The nakshatras are divisions of 13 degrees 20 minutes starting from zero Aries and ending at 30 degrees of Pisces, 13.20 divided into the 12 signs is 27. The nakshatras are referred to as the lunar mansions because the Moon moves approximately 13.20 per day, therefore, resides in one nakshatra per day. The personal planet in which the nakshatra resides will reveal deep information about the individual in relation to the meanings of the houses (area of life), and what houses the planet rules.



For example, the planet that rules the 7th house (indicating a person's spouse), will reveal detailed information about the spouse by the description of that nakshatra. If Aries is the sign of the 7th house, then Mars, the ruler of Aries (the nakshatra where Mars resides) will describe the spouse. If Mars is in the nakshatra Magha, the spouse would have all the kingly qualities of Magha.

Benefits



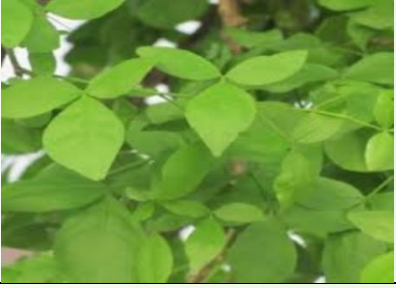

Like our birth stars each person is born during a particular Zodiac sign. How each one's luck is predicted according to the birth star similarly according to the Raasi (house) also the horoscope and luck of each person and how he is benefitted by these trees is mentioned in Astrology







Each tree here keeps giving energy to that particular person / people born during that particular star. So any ailments or health problems are set right / healed / cured when you spend / request / talk / meditate near or under that particular tree, corresponding to their star.

So the presence of the complete set of 9 planets, 12 raasi and 27 nakshatra, trees directly creates a healthy and sound physical, mental, psychological and spiritual beings. Which is the ultimate and absolute bliss to oneself and to the earth too. The details of plants are listed as under.

SL.No	Nakshtra	Common Name	हिन्दीनाम	Botanical Name	Picture
1	Ashviniमंत्र :-ॐअश्वयुगभ्यांन मः	Poison nut	कुचिला	<i>Strychnosnux vomica</i>	
2	Bharaniमंत्र :-ॐअपभरणीभ्योन मः	Amla	आंवला	<i>Embilicaofficinalis</i>	
3	Krittikaमंत्र :-ॐकृत्तिकाभ्योनमः	Fig	गुलर	<i>Ficusracemosa</i>	
4	Rohiniमंत्र :-ॐरौहिण्यै नमः	Jamoon	जामुन	<i>Syzygiumjambolanum</i>	
5	Mrigashirshामंत्र :-ॐमृगशीर्षय नमः	kadhira	खैर	<i>Acacia catechu</i>	

6	Ardraमंत्र :-ॐआद्रायैनमः	Agar wood	अगरू	<i>Aquilariaagallocha</i>	
7	Punarvasuमंत्र :-ॐआद्रायैनमः	Bamboo	बांस	<i>Bambusa</i>	
8	Pushyaमंत्र :-ॐपुष्याय नमः	Peepal	पीपल	<i>Ficusreligiosa</i>	
9	Ashleshaमंत्र :-ॐअश्लेषायैनमः	Naga kesar	नागकेसर	<i>Mesuaferrea</i>	
10	Maghaमंत्र :-ॐमघायैनमः	Banyan	बरगद	<i>Ficusbengalensis</i>	
11	Purvaphalguniमंत्र :-ॐपूर्वफाल्गुनीभ्यांनमः	Flame of the forest	पलास	<i>Buteamonosperma</i>	

12	Uttaraphalgunimंत्र :-ॐउत्तराफाल्गुनीभ्र यानमः	Juvvi	पिलखन	<i>Ficusinfectoria</i>	
13	Hasta मंत्र :-ॐहस्ताय नमः	Retha	रीठा	<i>Sapindusmukorrassigaetrn</i>	
14	Chitramंत्र :-ॐचित्रायैनमः	Bilva	बेल	<i>Aeglemarmelos</i>	
15	Swati मंत्र :-ॐस्वात्यैनमः	Arjun	अर्जुन	<i>Terminaliaarjuna</i>	
16	Vishakhamंत्र :-ॐविशाखाभ्यैनमः	Wood Apple (Kaith)	कैठ	<i>Limoniumacidissimum</i>	
17	Anuradhामंत्र :-ॐअनुराधभ्योनमः	Bakul	मौलसरी	<i>Mimusopselengi</i>	

18	Jyeshthamंत्र :-ॐजेष्ठायै नमः	chir	चीड़	<i>Pinus roxburghii</i>	
19	Mulamंत्र :-ॐमूलाय नमः	Black dammar	साल	<i>Canarium strictum</i>	
20	Purvaashadhamंत्र :-ॐपूर्वाषाढाभ्यां नमः	Salix	जलवेतस	<i>Salix trtasperma</i>	
21	Uttaraashadhamंत्र :-ॐउत्तराषाढाभ्यां नमः	Jack	कटहल	<i>Artocarpus heterophyllus</i>	
22	Shravanamंत्र :-ॐश्रावणायै नमः	Milk weed	आक	<i>Calotropis gigantea</i>	
23	Dhanishthamंत्र :-ॐ धनिष्ठायै नमः	Shami	शमी	<i>Acacia ferruginea</i>	

24	Shatabhishaमंत्र :-ॐ शतभिषजेनमः	Kadamba	कदम्बा,	<i>Anthocephaluscadamba</i>	
25	Purvabhadrapada मंत्र :-ॐपुर्वप्रोष्ठपदभ्यां नमः	Neem	नीम	<i>Azadirachataindica</i>	
26	Uttarabhadrapad aमंत्र:-ॐउत्तरप्रोष्ठ पदभ्यांनमः	Mango	आम	<i>Mangiferaindica</i>	
27	Revatiमंत्र:-ॐरेवत यैनमः	Ippe	महुआ	<i>Madhucaindica</i>	

FLOWER OIL: A USEFUL PRODUCT

Dr. Deepti Saxena, Asstt. Director (Hort.) CPWD, New Delhi

Value addition is a process of increasing the economic value of any Horticulture Commodity. The value addition for marketing flowers includes adoption of post-harvest technology and improved logistics. Working with flowers is of course a benefit, but a successful operation requires a great deal of highly specialized knowledge and skills. Value-added products from Horticulture includes essential oil from ornamental plants, extraction of dyes from plants and flowers, extraction of plant pigments, fresh flowers products (Bouquets arrangements, etc) and dried flowers and plant parts, etc.

- **Indian Scenario of Essential Oil** : - Indian ranks 26th in import and 14th in respect of export in the world in the trade of essential oil. India, along holds around 0.7% of import & 1.1% of export. Jasmine & tuberose have created a mark in world market for southern India region. The percentage (15%) of perfumery of India higher than America (7%) and Europe (5%) oil industry.
- **Opportunities in the essential oil industry**:- Perfumes, creams, lotions, soaps, detergents, shampoos, bath oil, hair oil, talcum powder and other cosmeceuticals are been manufactured food products which helps in flavoring agents are also the by products which can extracted by the flowers like candies, beverages, tobacco, soups, chewing gums, sauces, desserts, cake mixes, etc. As therapeutics, antiseptics, bactericides or germicides and are also used in making balms, tooth paste, deodorants, insecticides & aerosols. Also used in point and varnish industry as a solvent. It can also be used for manufacture of paper, plastics, textiles points as well as synthetic odour&flavours. Aromatherapy is also a process in which volatile plant materials, known as essential oils and other aromatic compounds which are used for purpose of altering a person mood, mind or health are used for formation of medicines.
- **Various oil extraction methods for flowers**
Mainly five methods are brought up for the extraction of oil from flowers they are:-
 - **Distillation**:- Usually three types of distillation methods are used:- water/Hydro distillation, water and steam or wet steam distillation and direct steam/dry steam distillation.
 - **Enfleurage**:- This is the method which is used to extract delicate floral scent from the flowers which produces essential oil. This process can also take place on those flowers which are being pucked up like jasmine, tuberose etc. or where the oil of flower can be affected by higher temperatures.

- **Solvent extraction** :- Whenever oil of natural flavor is required, then direct extraction with solvents are done such as petroleum ether or benzene.
- **Maceration**:- This method took up the successive batches of chopped plant materials which are digested with hot oil at the temperature of 45-80°C for several hours. Then the filtrate is heated with continuous batches of fresh flowers up to 20 times.
- **Adsorption**:- Aromatic plant material is passed over with hot air or inert gas which then again passed through the activated carbon from which the essential oil are recovered by solvents.

- **Flowers which yield essential oils**

The flowers which provides essential oil in abundance and are helping in increasing the export in Indian Oil markets are as follows:-

- **Rose sp**:- It is been estimated that approximately 10 tones of rose oil is produced in the world out of which Bulgaria is producing more than 5 tones (approx). Important constituents of rose oil are: Citronellol (40-65%), nerol, geraniol, linalool, eugenol, etc. In rose sp. *Rosa damascene* is yielding 0.05% of oil which is of highest quality and fetches highest price in India.



Desi Rose used for oil distillation process

- **Jasminum sp**:- Next to rose is jasmine, which is the most important perfumery raw material used. The word 'Jasmine' itself refers to fragrance. Jasmine is cultivated in all over the country in an about area of 8000 ha. Egypt is the largest producers of Jasmine essential oil followed by Morocco, France, Algeria, Italy and India. Main constituents of jasmine are:- benzyl acetate, benzyl benzoate, geraniol, eugenol, benzaldehyde, indole, nerol, methyl jasmonate etc. Juhi (*Jasminum auriculatum*) recovers highest oil (0.29%) Chameli (*Jasminum grandiflorum*) has best quality oil (0.25-0.30%)



Jasminum grandiflora

- **Polianthes tuberosa** :- Tuberose is also an Important cut flower for producing essential oil. It is also famous due to scent which is produced in its oil. Oil issued on heavier types of scents and



Tuberose

- **Lavandula angustifolia** :- Lavender flowers essential oil are used in the aromatherapy, baked goods, candles, cosmetics, detergents, jellies, massage oil, perfumes, powders, shampoo, soaps & tea. Yield which lavender flower earn through steam distillation is about 0.81% .



Lavandula

- **Future prospects of essential oil Industry** :- It is having a tremendous opportunities for India, as it is a upcoming sector which is becoming a favorite part in Economic era. The demand for flavors and fragrances which includes essential oil & other natural extracts is projected to get increase tremendously per year.

HOME GARDENING FOR GOOD HEALTH

D. T. Bhutia, Asstt. Director (Hort.), CPWD, Kolkata

As we move into era of technological advances, which are occurring at an outstanding rate. We seem to have an unquenchable thirst for the gadgets and technical wizardry that make our lives more productive and pleasurable. However, at the same time, we are struggling to preserve our links with nature and growing plants in our homes and workplaces which are widely accepted means of retaining that connection with the natural world. The cold, dead and impersonal reality of steel and concrete are softened by the cool, peaceful and soothing effect of live plants. Yet indoor houseplants can enhance the appearance of our surroundings. They play an integral role in improving the very essence of our lives – the air we breathe.

In order to conserve energy, our buildings have been ever more efficiently sealed from the air outside. While tightly sealed buildings reduce energy consumption, gases from synthetic materials are trapped inside with deleterious effects upon the well-being of their occupants as many people spend up to 90 percent of their time indoors and long-term exposure to these chemical vapors has brought dramatic increases in the number of cases of allergy, asthma, chemical hypersensitivity, depression and cancer.

Indoor air pollution is now considered by many experts to be one of the major threats to health. During pollution alerts people are generally advised to stay indoors. Yet, latest scientific research indicates that the indoor environment may be as much as ten times more polluted than the outdoor environment.

Common Indoor Air Pollutants: Sources and Health Impacts

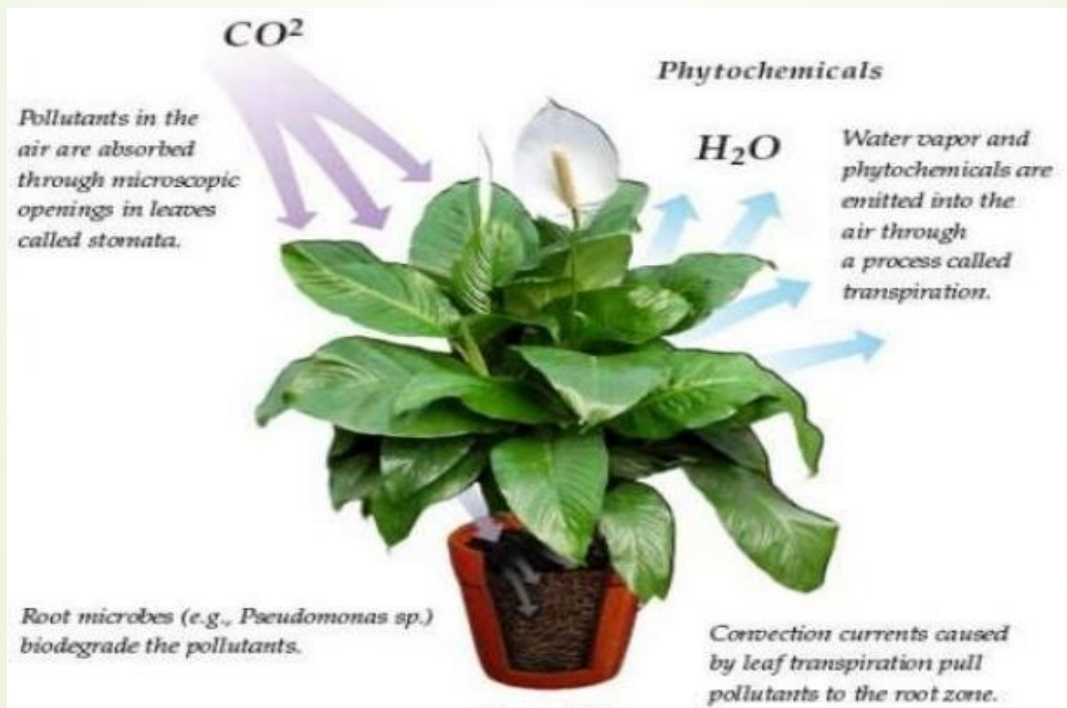
Pollutants	Sources	Health Effects
<p>Radon (Rn) <i>Colorless, tasteless and odourless gas that comes from the radioactive decay of uranium or radium.</i></p>	<p>Earth and rock under buildings Ground water</p>	<p>Lung cancer. Smokers are at higher risk of developing radon-induced lung cancer.</p>
<p>Biological Contaminants <i>Molds, mildews, bacteria, viruses, dust, mites.</i></p>	<p>House dust Infected humans or animals, bedding, poorly maintained air conditioners. Wet or moist surfaces, carpets and home furnishings.</p>	<p>Allergies and asthma, Headaches, Eye, nose and throat irritation, Cold, flu and pneumonia</p>

<p>Carbon Monoxide (CO)- <i>Colorless, odourless gas produced by incomplete combustion of all fuels.</i></p>	<p>Heating equipments, wood or coal stoves, fireplaces, ovens, charcoal grills, Tobacco smoke</p>	<p>Headaches, drowsiness, dizziness, impairment of human respiration, vision & brain functioning, nausea, mental confusion.</p> <p>Very high levels can cause death.</p>
<p>Nitrogen Oxides and Sulfur Dioxide <i>Gases formed by incomplete combustion of all carbon fuels.</i></p>	<p>Same as carbon monoxide.</p>	<p>Damage to respiratory tract and lungs.</p> <p>Irritation of eyes, nose and respiratory.</p>
<p>Respirable Suspended Particulates (RSP) - <i>Particles small enough to inhale that come in a variety of sizes, shapes and levels of toxicity.</i></p>	<p>Vacuum cleaning and house dust, tobacco smoke, soap powders, pollen, lint, dust, cleaning and cooking.</p>	<p>Eye, nose and throat irritation, Respiratory infections and bronchitis, Emphysema, Lung cancer.</p>
<p>Volatile Organic Chemicals (VOCs)- <i>Airborne chemicals contained in many household products.</i></p>	<p>Aerosol sprays, hair sprays, perfumes, solvents, glues, cleaning agents, fabric softeners, pesticides, paints, moth repellents, deodorizers and household products.</p> <p>Dry-cleaned clothing</p> <p>Mothballs, Tobacco smoke</p>	<p>Eye, nose, throat irritation, Headaches, confusion, damage to liver, kidney and brain.</p> <p>Various types of cancer.</p>
<p>Formaldehyde <i>Pungent gas released into air.</i></p>	<p>Pressed wood products, urea formaldehyde foam wall insulation, carpets, diapers, furniture fabrics, paper products, glues, adhesives, personal care products.</p>	<p>Allergic reactions.</p> <p>Eye, nose, throat irritation.</p> <p>Nausea, dizziness, coughing.</p> <p>Possible cancer.</p>
<p>Lead - <i>Natural element once used as a component in gasoline house paints, solder and water pipes</i></p>	<p>Household dust from lead paint, lead based paint, lead glazed ceramics ware</p>	<p>Damage to brain, kidneys and nervous system, behavioural and learning problems, slowed growth, Anaemia, hearing loss.</p>

How Houseplants Purify Air

The highest mission of plants is not merely to please our eyes with color, our mouths with delicious fruits. Not only do they do this and more, but they are ever silently but surely eating up what is impure and injurious to ourselves in the atmosphere and in the earth all around our homes; and any dwelling in which plants are well and healthily grown will be more likely to be a clean and healthy house than if plants were not there.

After more than 25 years of extensive research in both laboratory and real world environments, there is now a basic understanding of how plants function to improve indoor air quality. Most houseplants, whose origin began underneath the canopy of tropical rainforests, have evolved over millions of years. These plants naturally thrive in dimly lit, warm and humid environments. Nature has equipped these plants with the ability to culture microbes on and around their roots that can degrade complex organic structures found in leaves and other jungle debris. Plant leaves can also absorb gaseous organic substances and digest or translocate them to their roots where they serve as food for microbes. Transpiration is another means plants have of moving air-polluting substances to microbes around their roots. High transpiration rates create convection currents that cause air flow. As water rapidly moves from roots up through plants, air is pulled down into the soil around the roots. This is one means by which plants can supply oxygen and gaseous nitrogen to their root microbes. The ability of houseplants to improve the quality of the air we breathe is now accepted scientific fact.



At the national level, the mission is set up as an autonomous Society under the Ministry of Environment and Forest (MoEF). Our Country is switching to renewable energy for its many upcoming major projects. The trade ports, railway stations and Zoological gardens are smartly and creatively being developed with Renewable energy resources to minimise carbon emissions.

INITIATIVES BY CPWD FOR GREEN INDIA :

The Central Public Works Department is one of the largest Central Government Organisation serving the nation by creating sustainable built environment and is a part in Green India Mission. CPWD has published a document - the Guidelines for Sustainable Habitat for taking decisions on Architectural Design, materials and equipments for building a sustainable habitat with sustainable technology in a comprehensive manner. The department is taking a number of green initiatives like switching to renewable energy resources by investing in green technologies, encouraging sustainable housing projects and opting for Solar Energy. The department is committed in designing buildings confirming to 3-Star GRIHA rating for Green buildings and 3 Star rating for energy efficiency.

CPWD is also pioneer in construction industry to prohibit the wood in construction materials and promote the use of Fly ash generated Cement. A detailed directive has been issued by the CPWD to its field units for Recycled Construction and Demolition Waste materials. Waste-converter Compost machines have been installed in GPRAs and GPOAs maintained by CPWD for Reuse and recycling of waste generated. The compost generated from it would be used for horticultural purposes. To conserve water, the department has decided to install sewage treatment plants to recycle waste water, in all General Pool Residential Accommodations.

It is mandatory to Install Rain Water Harvesting System and Waste Water Recycling Plant in all the major projects taken up the department for the water conservation measures. Solar Panels for generation of Renewable Energy has been installed in almost all Central Government Buildings. E-office has been adopted for promoting paper less work. CPWD has also planted 60,000 trees in Delhi and National Capital Region as part to enhance tree cover, under the guidance of MoH&UA. To reduce carbon footprints and speedy construction, the department has adopted new construction technologies like Monolithic Concrete Construction System using Plastic and Aluminium formwork. Thus, CPWD has shifted to Green Construction Technology.



FIG 4. SOLAR PANELS AT GOVT. BUILDING SOURCE : SAURENERGY.COM)



FIG 5. TREE PLANTATION BY CPWD

CONCLUSION :

The Green India Mission is a tool to minimise wastages and maximizing reuse for saving our mother earth. The mission helps in connecting us with the nature by using locally able materials. Emphasis on planting more and more trees would increase the forest cover for preservation of ecological balance and to increase "Carbon Sinks". A smallest effort in this field is capable of improving planet Earth and providing a better place for all of us.

The list of indoor plants which are used to reduce Pollutions are as follows:-

1. Areca Palm (*Chrysalidocarpus lutescens*): Also known as yellow palm or butterfly palm, the areca palm is one of the most popular and graceful palms. It is tolerant to indoor environment, releases abundant amount of moisture into the air, and removes chemical toxins. When saturated, these branches die and should be quickly removed.



2. Lady Palm (*Raphis excels*): Lady palm is one of the easiest houseplants to care for and is highly resistant to attack by most plant insects. It is one of the best plants for improving indoor air quality. According to NASA, it removes formaldehyde (carcinogen, cancer-causing substance associated with most chemicals, plastics, cigarettes and off-gassing) and is also said to act as a natural humidifier.



3. Bamboo Palm (*Chamaedorea seifrizii*): The bamboo palm is no exception and is a long-standing favorite in homes and commercial establishments. It produces clusters of small, slender canes and reaches a height of about 6 ft. In terms of its atmospheric benefits, the bamboo palm has an excellent overall purifying qualities and one of the highest transpiration ratings.



4. Rubber Plant (*Ficus robusta*): Formerly known as *Ficus elastic*, the rubber plant is meant for its toughness, it will survive in less light than most plants. It will tolerate dim light and cool temperatures. This plant is easy to grow and is especially effective at removing formaldehyde. It is an excellent overall houseplant.



5. Dracaena "Janet Craig" (*Dracaena deremensis* 'Janet Craig'): It is one of the best plants for removing trichloroethylene. The mature plant can reach a height of 10 ft, but can be contained by pruning. It is also less demanding in its care requirements and can tolerate neglect and dimly lit environments.



6. Peace lily (*Spathiphyllum* sp.): An outstanding foliage plant that also produces beautiful whitespathes. This plant has a high transpiration rate and is one of the only a few plants that will reliably bloom indoors. Popular varieties include 'Clevelandii' which reaches upto 2 ft height and 'Mauna Loa', reaches about 3 ft. The peace lily excels in the removal of alcohols, acetone, trichloroethylene, benzene and formaldehyde.



7. Golden Pothos 'Money Plant' (*Epipremnum aureum*): Golden pothos or Money plant is arguably the easiest to grow of all houseplants. It can withstand neglect and is very resistant to insect infections. It can be commonly grown in hanging baskets but can be trained to climb. The cuttings are easily rooted in water can be commonly seen kept in bottles. Its help purify the air, ease of growth and resistance to insects.



8. Snake Plant (*Sansevieria trifasciata*) Mother-in-Law's Tongue Plant: It is easy to grow and tolerates a great deal of neglect and is almost indestructible. Any flowers should be removed as they release a sticky, honey like substances. The snake plant differs from most houseplants in that it produces oxygen and removes carbon dioxide at night.



Conclusions:

Most of the experts and now layman too agree that indoor air pollution is a major problem. Recent concept of "Green Building" has become an attractive concept with respect to minimal use of energies. However, the concept of using living indoor plants is not currently part of that concept and as per the TERI-GRIHA rating system, there is no mention of indoor plants, and Horticulture activity has been allocated 5 points for preserving and protecting landscape during construction and reducing landscape water requirement. It is high time that such experts, building architects and engineers take steps to include the design of houseplants into each building to help provide an environment that mimics the way nature cleans the earth's atmosphere and make our living and working environment a healthier one.

PROTECTED CULTIVATION OF FLOWER CROPS

Dr. Poonam Chand, Asstt. Director (Hort.), CPWD, Jaipur

INTRODUCTION :-

Floriculture is fast emerging money spinning component of agriculture sector, growing at a modest rate throughout world and has become the potential agricultural activity especially for the developing countries. Total value of different floricultural products at wholesale level has been estimated to be over 50 billion US\$ from about 2 million hectare area in the world.

In India, floriculture is also being viewed as a high growth industry in agriculture sector and this can be judged from the fact that the acreage under floriculture has increased from 30 thousand ha in 1990-91 to 2.64 lakh hectares in 2016-17. Indian floriculture industry is also fast becoming aware of the importance of offering products as per the wishes of consumers. But, with the fast changing trends and a constant urge for new innovative products in domestic and leading international flower markets, the flower growers have to respond promptly.

What is protected cultivation?

The basic objective of protected cultivation is to protect the crop against major biotic factors like viruses, insects/pests and abiotic factors like extreme temperature (very low or very high), extreme humidity (low or high), extreme light intensity (radiation) and rainfall. The protected cultivation of flower crops offers distinct advantages of quality, productivity and favorable market price to the growers. Greenhouse technology provides a controlled and favorable environment for the crops to grow and give high yield in all seasons. Save crops from cold in winter, from heat in summer and from rain in monsoon. Environment can be changed according to the need of the crop.

Need of protected cultivation:-

The demand of high value flower crops is increasing every year. Also, the demand of off-season flower crops is also increasing. Increasing consumer demand requires extra supply of horticultural produce, particularly of flower crops. Cultivable area is decreasing day by day. And the Productivity of land has become stable. In such a scenario, productivity of almost all the flower crops in India is very low as compared to other vegetable growing countries in the world. Thus we need protected cultivation to fulfil the daily demand of fresh and sustainable flower crops around metro cities.

Advantages of protected cultivation:-

Protected cultivation offers maximum productivity. It requires less labour. Input usage, particularly fertilizers and pesticides are controlled in protected system. Under controlled horticulture, water use is controlled and minimal. The major advantages of protected horticulture is high quality of produce, off season nursery production, protection from hails, rain, extreme weather, birds, rodents, animals with a covering which should be as cheap as possible. Three to four crops can be grown in a GH in one year due the availability of required plant environmental conditions. Protected cultivation of flower crops could be used to improve yield quantity and quality.

Objectives

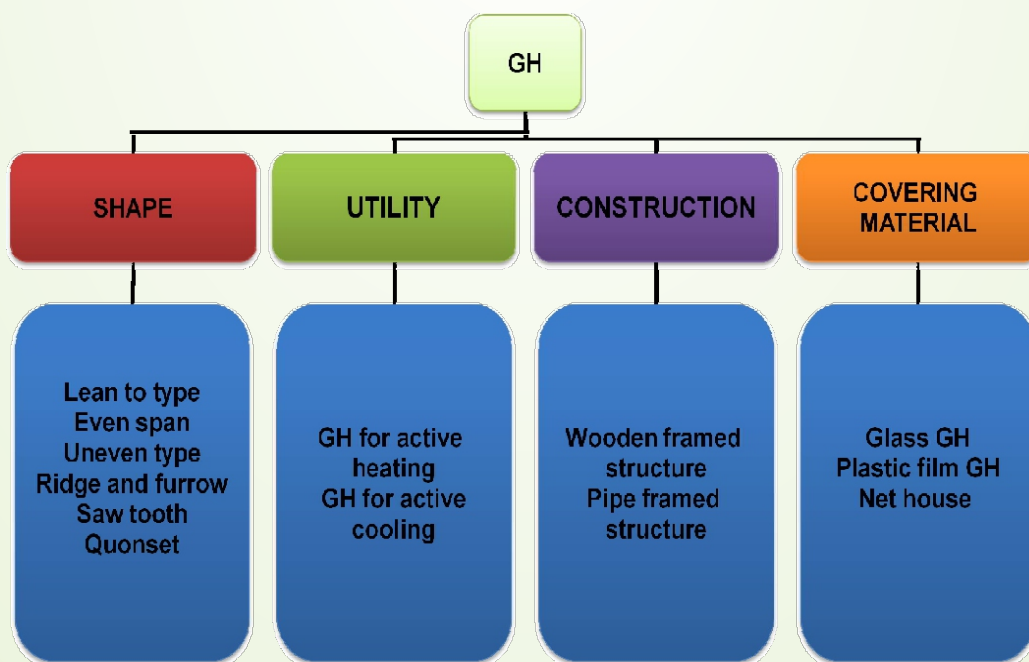
The main objectives in this regards are To increase the area under protected cultivation of flower crops.To minimize the constraints of growing flower crops under protected cultivation among people. We also need to increase awareness about protected cultivation of flower crops among people and increase quality and quantity of flower production.In the process we get opportunity for employing skilled and unskilled labour especially unemployment youth. Protective cultivation is a way to increase contribution of agriculture towards national economy by increasing export of flower crops.

GREEN HOUSE

A greenhouse is a framed or inflated structure covered with a transparent or translucent material in which crops could be grown under the condition of at least partially controlled environment and which is large enough to permit persons to work within it to carry out cultural operations.

Greenhouse is a structure just like a house in which only sunlight is allowed to enter. It has mainly two parts:

1. A frame or basic structure and
2. The covering material.
 - Frame can be made up of GI pipes, bamboos, woods or iron rods.
 - While the cover can be of glass or plastic films.
 - It allows precision farming and overcomes limitations of space and disadvantages of climate change.



Greenhouse Operations : -

A. Temperature Management

***To reduce temperature**

- 1) Use ventilation
- 2) Roof shading
- 3) Use fogger or mist
- 4) Sprinkler on the roof
- 5) Use cooling pads and exhaust fans

***To increase temperature**

- 1) Use heating pipes
- 2) Use thermal screens

B. Control of humidity

To increase humidity:

- 1) Total covered with polysheet
- 2) Use fogger or mist

To reduce humidity:

- 1) Sufficient venting
- 2) Heating
- 3) Use cooling pads
- 4) Irrigate the crop
- 5) Regulate ventilation

C) Control of light:-

- 1) Use good quality of polysheet
- 2) Use extra florescent electric tubes
- 3) Supplementary lighting

- 1) Training and pruning
- 2) Row orientation
- 3) Plant density

D. Control of CO₂ and O₂

- 1) Shut down ventilation and side covering during night.
- 2) Burning of charcoal.

E. Irrigation management:-

- 1) The availability of adequate quality water is very important.
- 2) Quality of water is determined by considering its composition.
- 3) pH of water should be 5.5 to 7.0
- 4) Drip irrigation method is commonly used.
- 5) for operating drip system requirement of pressure is depend on purpose of operation.

Points To Be Considered While Constructing Greenhouse :-

1. Single span GH should be constructed in East-West direction.
2. For Multiplan GH, direction should be North –South.
3. Pipe framed structure should be used.
4. The slope of the roof should be 20 to 27%.
5. Avoid direct contact of UV covering material with the frame.
6. Wind breaks should be planted.
7. Wash the film from outside by sprinkling water frequently.
8. Slope of gutter should not be more than 2%.
9. Always use white paints for painting the frames.

Site Selection:-

- The soil should have pH of 6.5 to 7.5.
- Availability of continuous source of quality water.
- pH of the irrigation water should be 5.5 to 7.0.
- The selection site should be pollution free (air & water).
- Facility of good roads for transport of green house produces to nearby markets.
- Sufficient land should be available considering future expansion.
- Easy and cheap availability of labours in surrounding area.

Bed Preparation :-

- Bed preparation is important task in greenhouse as it remains permanent for 3-4 crop.
- Media is prepared by mixing the red soil, sieved sand, and compost and rice husk in 1:1:1:1 proportion.
- Area should be clean and well leveled. Irrigate the area for loosening of the soil. Divide area in small bed of 4x4 m. size spread the soil mixture making layers one by one. Irrigate the each layer while layering. Fully saturate the whole area for a day to suppress the mixture before disinfection. Actual soil sterilization should be done on next day by means of any chemical disinfectant viz. with formalin, methyl bromide or chloropicrin. After sterilization it should be cut in to beds of convenient size making complete blocks.

Important flower crops commercially grown in greenhouses:-

Cut flowers (Rose, Carnation, Chrysanthemum, Liliium, Gerbera, Tulip, Anthurium, Orchids, Gypsophila, Statice, etc.)

Rose:-

Rose is the leading cut flower in the international cut flowers trade and is also the leading cut flower exported from India. In India, over 90 per cent greenhouses grow rose as cut flower. The leading export cultivars of rose are Cora, Corvetti, Diplomat, Femma, First Red, Grand gala, Kiss, Konfetti, Lambada, Laser, Nicole, Noblesse, Osiana, Papillon, Parea, Passion, Pavrotte, Rodeo, Rossini, Sacha, Samura, Sandy, Sangaria, Soledo, Susanne, Texas.

Tineke, Vivaldi. The salient characters of rose cultivars for cut flowers are:

- More number of petals
- Petals open slowly
- More longevity
- Attractive colour
- Long and strong stem



Carnation:-

Carnation is the leading cut flower grown in after rose under greenhouses in India. This has become popular on account of its following qualities

- Excellent vase life
- Wide range of flower colours and forms
- Ability to withstand long distance transportation.
- Rehydrate easily
- Lighter weight



Florist carnations:-

- Standard
- Spray
- Mini
- Micro

Popular carnation cultivars :

Dona, Pink Dona, Malaga, White Dona, Rony, Rhodos, Lipstick, Empire, Romana, White Tendra, Corleone, Design, Natila, Dark Tempo, Bagatel silvery pink, Solar, Cobra, Pendency, Lorella, Cabaret, Tanga, Sonsara, Dakar, Liberty, Solar, Green Lady, Tempo, Varna, Sun Shine and Charment.

Chrysanthemum :

Chrysanthemum has origin in Northern hemisphere in China. Chrysanthemum is grown for cut flower, loose flower, pot mum, hanging baskets and bedding and border plant. It has become popular on account of its excellent vase life, wide range of flower colours and forms and lighter flower weight. It is classified on the basis of inflorescence, photoperiod and temperature.



The important cultivars of chrysanthemum for export are Snow ball, Snow Don White, Mountaineer, Sonar Bangla, Bright golden, Anne, Chandrama, Ajay, BirbalSahni, Lehman, Nanako and Sonali Tara. Although, chrysanthemum is a short day plant flowering when the critical day length is less than 9.5 hours. However, now the cultivars have been developed which can flower in any season.

Gerbera:-

Gerbera is commonly known as Transvaal daisy or Barberton daisy or African daisy. Its name was coined in honour of German naturalist, Traugott Gerber and it has origin in Natal and Transvaal in South African and Asian region. Important species in genus Gerbera are given below:

- Asplenifolia
- Aurantiaca
- Jamesonii
- Kunzeana



Constraints:-

- Non availability of required technology for production of vegetable crops and their post harvest management.
- High initial cost of investment.
- Lack of awareness among the farmers pertaining to potential of protected cultivation.
- Lack of market information to enable advanced planning for production and marketing etc.
- Lack of capital formation, large, small and marginal farmers.
- High interest rates for vegetable investment and export finance.
- Lack of water resources.
- Non-availability of labour.

Future Potential:-

- The greenhouse technology is still in its preliminary stage in the country and concerned efforts are required to bring it at par with the global standards.

- Economically viable and technologically feasible greenhouse technology is needed.
- Greater information about greenhouses among the farming community in the country is required.
- The Govt. should encourage growers by providing timely subsidy/lawn facilities for taking up this new technology in a big way.

Conclusion:-

- From the above discussion it is concluded that, under greenhouse condition temperature, humidity and CO₂ level can be effectively maintained.
- Greenhouse technology is highly productive, amenable to automation and conserves water and land. It helps in increasing quantitative and qualitative production of flower crops as compared to open field condition.
- To achieve the foreign exchange, greenhouse cultivation is important to increase export potential of flower crops.
- In the 21st century, protected cultivation is likely to be common commercial practice because of its potential.



PLANTING AND MANAGEMENT OF LAWN

Satyavir Singh, Asstt. Director (Hort.), Vigilance unit, CPWD

A lawn can be defined as the green carpet for a landscape. It is an important feature for any type of garden. In a home garden a lawn improves the appearance of the house, enhances its beauty and increases conveniences and usefulness. The lawn provides a perfect setting for a flower bed, a border, a shrubbery, specimen tree or a shrub. Besides, the material value, a lawn has its spiritual value too. A lawn is the source of charm and pride and reduces tension of the mind after a day's hard work in the materialistic world.

It is not always possible to get the best site one would like to choose for the lawn. But a few points should be kept in mind before planting a lawn. These are

Soil - To obtain a luxuriant lawn, it is desirable to have fertile, loamy soil containing enough humus. The soil should retain enough moisture and at the same time the drainage should also be adequate. The ideal pH range for a good lawn is 5.5 to 6.0. If the pH is very low, about half a kilogram of chalk or grounded limestone should be added per square metre area on a sandy soil or a similar quantity of slaked lime should be added to clayey loam soil. In an alkaline soil, gypsum should be added at the same rate. At least a depth of 25-30 cm of good soil is required for obtaining a good lawn.

Drainage- Grasses are shallow-rooted herbs and therefore, no deep drainage is necessary, but no water should stagnate in the rooting zone too. In clayey soils, some kind of drainage must be provided. This may be done by drainage pipes or by putting a layer of broken pieces of bricks and gravel 60 cm below the surface. Ordinary drainage work can be carried out in conjunction with grading or levelling.

Preparation of Land - Rough surface leveling by eye estimation should be done prior to Trenching. After rough leveling is completed the trenching work should be taken up. Thorough preparation of the land is most essential in the success of a lawn. At each stage of trenching care should be taken to see that the clods of earth are broken and pulverized thoroughly. During the process of trenching, all stones, old masonry, grass roots, or any other foreign material, should be removed. In most parts of India, trenching is done during the hot months of April and May. After the trenching is completed the soil is left to dry in the scorching sun for a period of 7-15 days to kill the weeds or insects and for sterilizing the soil. After the trenching is over, the soil is to be manured and leveled. cow dung manure is used for this purpose. The manure is spread over the surface at the rate of 500 gm per 100 square metres of soil. This is then mixed up in the soil to a depth of 15-20 cm. The next step will be to flooding the soil thoroughly. The accumulation of water in pools will show the area of depression which should be smoothed by shifting soil from one place to another. The final leveling is done with the help of leveling pegs, It is always advisable to keep the level of the lawn 5 cm below the levels of paths and drives. The margins along the paths are raised by gradual slope of 15-20 cm, to form a turf edge of 3-4 cm higher. This method will help keep the paths dry when the lawn is flooded with water. It is not always necessary to have a perfectly leveled lawn. Lawns can be laid in undulated land also and such lawns look very beautiful. But there should not be any depression as the water will collect and kill the grass. Moreover, the slopes and mounds in a lawn should be gradual and artistic, simulating the nature.

Selection of grass - The most suitable grass for the climate and soil of India is the selection No.1 grass or Bermuda grass. However following varieties may also be considerable.

S.No	Botanical Name	Common Name	Suitable location
1	Cynodondactylon	Hariyali (or) Doob grass	Suitable for open sunny location; drought; tolerant
2	Zoysia japonica	Japan grass	Can grow well in poor sandy soil; open sunny situations
3	Z. tenuifolia	Korean grass or velvet grass or carpet grass	Suitable for open sunny situations
4	Cynodon sp.	Bermuda grass	Suitable for open sunny
5	Paspalumvaginatum	Paspalum grass	Suitable for shady situations

Method of planting - If irrigation facilities exist, a lawn can be laid out any time during the year. The different methods for planting of a lawn as following-

(a) By seed: If grass-cuttings or roots are not easily available, one should go for the seeds. It is important to secure good quality seeds free from weed seeds. Doobgrass seed is very light and fine and proper care should be taken during sowing. The sowing should be preferably undertaken on a windless day. The seed should be mixed with double the quantity of finely sieved soil and spread by hand. After sowing is completed the rake is drawn lightly to mix up the seed. The ground should then be rolled with a very light roller. It will also be advisable to cover the seeds with a thin layer of finely sieved soil. The ground should be watered at regular intervals with a fine hose. Sometimes, ants carry away the seeds and to prevent this soil should be treated with an acaricide (Lindane, Chlorpyrifos, Heptachlor, etc.). The seed germinates in about 3 to 4 weeks from sowing. When the grass is about 5 cm tall it is clipped with a pair of garden shears. Initially the lawn mower is not used as this will uproot the grass.

(b) By Dibbling- After the land is ready, well-matured rooted grass is obtained from a nursery. The grass thus obtained is dibbled (planted) in the ground when it is slightly moist at 5-7 cm apart. The soil is kept moist by frequent watering till the grass sprouts. Within 5-7 weeks the grass will be ready for first cutting by a lawn mower.

© By Turfing - The quickest method of developing a lawn is by turfing. Turf is a piece of earth of about 5 cm thicknesses with grass thickly grown over it. The turf must be free from weed and consist of the required rooted grass. These turfs should be laid closely to each other in a bonded alternate pattern in the already prepared ground. Any unevenness in thickness can be corrected by under packing or removing some of the soil before putting in position. Along the joints sandy soil should be filled as packing. The turf thus laid is made firm by a wooden beater made out of heavy block of wood and fitted with a handle. The grass is immediately watered copiously. By this method a lawn will be ready for use in a very short time.



Maintenance of lawn -Having raised a lawn by one of the methods described above, the maintenance comes next. If the lawn is not properly maintained, it will become useless with in no time. The various aspects of maintenance are discussed below.

- (a) **Weeding** - One of the main aspects of maintenance is the control of weeds. Without close attention or care a time will come when weeds will overcome the lawn grass, Therefore, as soon as a lawn is established weeding should start and continue at regular intervals or whenever the weeds come out. The frequency of weeding obviously will be more during the rains than in the colder months. All weeds should be removed with the roots and these should never be allowed to seed.
- (b) **Rolling, mowing and sweeping** -The object of rolling is to help to keep the surface levelled. Rolling should be avoided when the soil is wet. Mowing is another important operation. The first thing is to obtain a good machine, which will cut evenly at a correct height. The frequency of mowing is determined by the amount of growth and will vary from season to season. But grass should not be allowed to grow more than 5-6 cm in height during any season. Sweeping the lawn thoroughly after each mowing is essential to clean the cut grasses, which might have fallen from the mower box. Sweeping is also done every morning to clean the fallen leaves and other debris.
- (c) **Irrigation** -grass is shallow-rooted and, therefore, frequent irrigation is required. Labour as well as water can be saved to a considerable extent if sprinkler irrigation is used. The frequency of irrigation varies with the climate. Stagnation of water should not be allowed as it may kill the grass.
- (d) **Scraping and raking** -Continuous rolling, treading, and mowing may result in the formation of a hard crust and the lower part of the lawn may get matted and woody. For such lawns, the grass is scraped at the ground level with the help of a phawra. Scraping is followed by raking to break the crust. Where the condition of the lawn is good, hard and thorough raking is done both ways to loosen the old runners and to aerate the soil. Then the mower blade is lowered and the grass mowed close to the ground.

Manuring - After scraping or raking, a compost consisting of good garden soil, coarse sand, and leaf-mould or/ and concentrate organic manure in the proportion of 1:2:1. is spread over the lawn to a depth of 2-2.5 cm. Bone meal can also be applied at the rate of 1 kg per 10 square meters. The same compost is used as top dressing again during September to October. Application of fermented compost in liquid form is also very beneficial for lawns. After manuring, the lawn is soaked with water. This can be applied twice a year

Management of lawn -During the maintenance of lawn following problems / disease may occur. The can be managed as following

- (a) **Frost-injury** -In cold regions, the grass is injured due to frost. This can be avoided to a great extent if the grass is sprayed with water every evening and in the early morning after frost.

- (b) **Thatching** -Formation of straw like layers of dead stems, leaves and roots of grass is called thatching. It can be controlled by manual removal.
- (c) **Yellowing** -It is more prevalent in wet weather. It is controlled by drenching with copperoxychloride / Dithane M-45 @ 3g/litre or Bavistin 1g/litre
- (d) **Earthworms** -Affect lawn by depositing their excreta. Cause a circular ring of thin coloured or dead grass. They are controlled by drenching soil with Bavistin @ 1g/L or Dithane M 45 @ 3g/L. Oilcake of neem 500g/10 m² may be applied before rainy season.
- (e) **Termites**- They are controlled by the application of Phoret / Thimet / Chlorpyrifos.
- (f) **Fairy rings** - This disease is caused by a diverse family of soil-inhabiting fungi called *basidiomycetes*. They typically appear as dark green circles in the lawn ranging in size from a few inches to a foot or more in diameter. Often the disease will produce a thick fungal mat that prevents water from reaching the grass roots below. It can be controlled by application of any fungicide such as Physan-20, Exile, Def-guard etc.

BEAUTIFUL CLIMBERS & CREEPERS

Sudhir Kumar, Assistant Director (Hort.), CPWD, Mumbai

1. *Aristolochia fimbriata*

Native : Brazil and Argentina

Flowering: Autumn to spring.

It grows to around 2m tall and the unusually shaped and coloured flowers are around 25mm across. The leaves are up to 9cm across and often carry grey markings.



2. *Aristolochia argentina*

Native : Argentina.

Flowering: autumn to spring.

The flowers are small and not highly ornamental but its rhizomes yield several extracts, including one that may yield a synthetic fuel.



3. *Aristolochia gigantea*

Native : Panama

Flowering: autumn to spring.

It is easily capable of climbing 20m. The common name Birthwort comes from the use of some species in herbal medicines to aid child-birth.

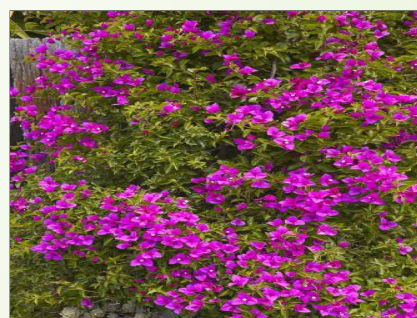


4. *Bougainvillea* spp.

Native : Brazil

Flowering: Summer

Bougainvilleas are the easiest to cultivate. It is a summer-flowering, spiny-stemmed shrub or scrambling climber.



5. *Clerodendron splendens*

Native: Tropical West Africa

Flowering: Summer

A vigorous, long-flowering, evergreen twining shrub that climbs to 3m or more, with panicles of brilliant scarlet flowers in summer.



6. *Clerodendrum thomsoniae*

Native : Tropical West Africa

Flowering : Summer

An evergreen twining shrub. The dark red flowers are often nearly hidden by the surrounding white bracts.



7. *Clematis montana* 'Freda',

Native: Western China and Himalayas

Flowering : Spring

This deciduous spring-blooming climber is a seedling of 'Pink Perfection' is notable for its deep pink flowers that have a lighter centre to each tepal (or petal). It was introduced in 1985 by well-known clematis breeder and author Jim Fisk.



8. *Hoya compacta*

Native: Unknown

Flowering : Spring

It is a pendulous shrub /climber with twisted and folded leaves. Its flower heads are smaller and not always pendulous. They have a slight almond fragrance.



9. *Ipomoea cairica*

Morning Glory

Native : Subtropical Asia and Africa

A tuberous-rooted climbing, twining perennial. It can be rather invasive, growing rapidly and self-sowing freely.



10. *Lonicera japonica*

Japanese Honeysuckle

Native : Temperate East Asia

Flowering : Summer

An evergreen, blue-black berries follow the flowers. This species naturalizes freely and is considered a weed in some areas.



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11. *Pandorea jasminoides* 'Rosea Superba

Native : Australia

A GLANCE THROUGH THE SEASONAL FLOWERS

Ashwini Kumar Deshwal, Assistant Director (Hort.) C.P.W.D, New Delhi

Flowers & Seasons are intimately bound to each other. Most of the flowers are seasonal. Though some flowers are found throughout the year, there are some not particularly affected by changing seasons. The bright, new leaves alone would be a happy sight with blossoms of every hue as well it is impossible to be untouched by the galaxy of colours.

1) Aster

Asters get their name from the Latin word for "star," and their flowers are indeed the superstars of the garden. Some the height of the plants varies from 30 cm to 75 cm according to varieties Aster has most cheerful different colours . It requires full sun for growth. The flowers attracts butterflies and drought tolerance plant and very easy to grow during winter in India.



2) Sweet William

The quintessential cottage flower, pinks are treasured for their grass like green foliage and abundant starry flowers, which are often spicily fragrant. Depending on the varieties of pink, red and other colours flowers appear in late winter and continue till spring. This is used as cut flower in flower vases. Plants height varies from 10 cm to 75 cm approx. The flowers attract the humming bird, butterflies.



3) Petunia

Petunias are fail proof favourites for gardeners everywhere. They are vigorous growers and prolific bloomers from mid spring through late fall. Colour choices are nearly limitless, with some sporting beautiful veining and intriguing colours. Many varieties are sweetly fragrant (sniff blooms in the garden centre to be sure.) Some also tout themselves as "weatherproof," which means that the flowers don't close up when water is



splashed on them. Height of the plant varies from 15 cm to 45 cm according to varieties. It is more useful in pots and border of the lawn.

4) African marigold *Tagetes erecta*

There's nothing subtle about an African marigold, and thank goodness for that! It's a big, flamboyant, colourful punch of colour for the sunny bed, border, or pots. Mostly it comes in orange, yellow, cream and white. Plants height varies from 30 cm to 90 cm according to different varieties. The foliage of the plants is dark green, fresh and tidy. They require full sun and are a common garden flower in India.



5) Marigold French

Shorter and not as upright as African Marigolds, French Marigolds form mounds that are often wider than they are tall. These aromatic annuals are easy to grow and brighten the garden with their cheerful shades of yellow, orange and red. They grow roughly 8-12 inches high with a chic, neat, little growth habit and elegant dark green foliage. They do best in full sun with moist, well-drained soil and will flower all summer long. They may reseed, coming back year after year, in spots where they're happy.



6) Phlox

Annual phlox is a good choice for gardeners in India because it's easy to grow and puts on such a great display for beginning gardeners who have to tackle a hot, dry spot. Remove the flower clusters as they fade to encourage more blooms and pinch the plants back in summer if they start to get leggy. The plant is grown easily in beds, pots and borders etc. Height of the plants varies from 10 cm to 45 cm and has the wider choice of colour white, pink, red, blue, violet, lavender etc.



7) Statice

Old-fashioned annual statice is found more often dried in crafts stores than growing in gardens. But this easy-to-grow plant is a great pick for containers or the middle of a border, especially if you want to harvest it for everlasting bouquets indoors.

The plant is also very drought-tolerant, so you can enjoy its blooms even if you forget to water it from time to time. In fact, static thrives in hot, sunny spots with well-drained soil. The plants to be planted middle of the border and height goes to 30 cm to 60 cm. This is a wider choice of floweriest because the flowers to be used for cut flowers and dry flower.



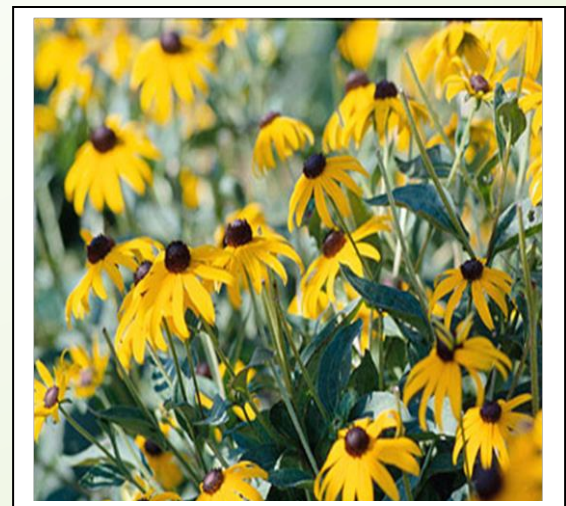
8) Begonia

Annual begonia is about as easy as it gets. It does well in a variety of conditions, but to keep it its most luxuriant best, give it light shade; rich, well-drained soil; and ample water. It also loves plenty of fertilizer, so be generous. The plant can be grown in semi shade or shaded area. The plant height varies from 15 cm to 45 cm according to the varieties. It is specially use in container, border as well as hillock also.



9) Black-eyed Susan *Rudbeckia* selections

Add a pool of sunshine to the garden with a massed planting of black-eyed Susan. From midsummer, these tough native plants bloom their golden heads off in sun or light shade and mix well with other perennials, annuals, and shrubs. Tall varieties look especially appropriate among shrubs, which in turn provide support. Add black-eyed Susans to wildflower meadows or native plant gardens for a naturalized look. The Plant ht. 60-300 cm tall, 3-11 plants, Width: 1-1/2 to 3 feet, Depending on variety flower color: Yellow or Orange Flower, Depending on variety Bloom,



Time: Bloom midsummer into fall Height of the plant varies from 20 cm to 75 cm according to different varieties

10) Calendula

The Calendula is a most common winter annuals after the African Marigold in India. Sometimes grown as an herb, cheerful calendulas look good in every garden. The cream, yellow, apricot, or orange flowers are edible, adding bright colour and tang to soups and salads. And they're great cut flowers, adding a burst of sunshine to bouquets. Cool-season annuals, these plants do best in early flowering.



11) California poppy

California poppy, a native wildflower, adds an easy going dose of color hot, dry sites. Beautiful, satiny flowers in sunset colors wave above ferny, blue-green foliage. They like poor soils, especially sandy soils. If soil is too rich and moist, they won't bloom well. California poppies are a cool-season annual, which means they offer great color early in the growing season but fade once the heat of summer hits. The Plant ht. 30 cm tall , width: 1 foot wide Landscape, Easy to Grow. California poppies will reseed easily; for more plants next year, allow some flowers to ripen to seed on the plant and scatter when you tear up those plants. Replant in fall if you like, especially in warmer-climate areas.



12) Hollyhock Alcea rosea

The ultimate cottage garden choice, hollyhock sends up tall spires that cover themselves in flowers in beautiful colors. They're easy to grow from seed - in fact, that's usually the only way they are found in garden centers. Most hollyhocks are biennials, that is, they grow only foliage the first year, flower the second, and die that fall. Interestingly, the flowers open from the bottom to the top of the spike throughout the summer. These tall (up to 8 feet) beauties are ideal against fences or buildings where



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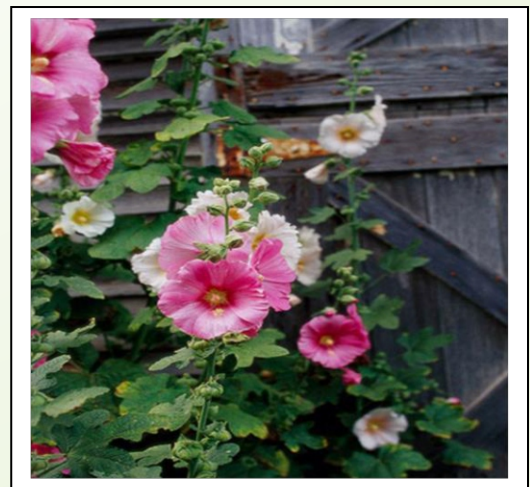
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they can get natural support. Red forms are especially attractive to hummingbirds and butterflies.

13) Cosmos

The simple, daisy like flowers appear in cheery shades on tall stems that are great for cutting. The lacy foliage makes a great backdrop for shorter plants, as well. Cosmos often self-seeds in the garden, so you may only have to plant it once, though the colours can appear muddy or odd in the re-seeders. The plant ht. 60-150 cm tall, 2-11 plants, width: 30-60 cm wide landscape, Easy to Grow Plant cosmos from seed directly in the ground in spring. Or start from established seedlings. This flower doesn't like fertilizing or conditions that are too rich, which causes the foliage to be large and lush but with fewer blooms.



14) Flowering kale

Thank goodness for kale. It's one of the few plants available to add a fresh burst of colour and life to the fall landscape! Its leaves come with beautiful variegations in pinks, purples, and reds that blend beautifully with changing autumn foliage. Plant it in spring or in the fall after you tear out tired or frost-damaged annuals such as marigolds and impatiens. It likes rich, well-drained but moist soil. The flower ht. 12-18 inches tall, width: 12-18 inches wide landscape, Easy to Grow.



15) Gazania

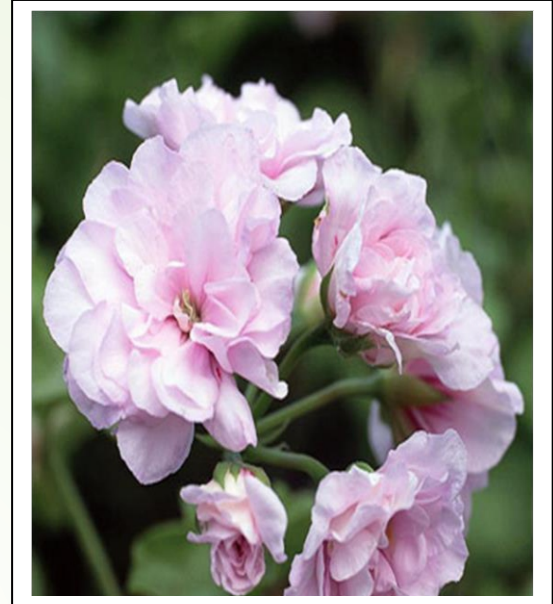
This tough plant endures poor soil, baked conditions, and drought beautifully and still produces bold-colour, daisy like flowers from summer to frost. A perennial in Zones 9 -11 - the hottest parts of the country -- gazania is grown as an annual elsewhere and blooms from mid-summer to frost. A summer plant often grown as an annual, gazania bears boldly coloured daisy-shaped flowers from summer to frost. Do not fertilize, and keep



soil on the dry side. The plant ht. 30 cm, width: 30 cm, 8-10 plant, Easy to Grow.

16) Geranium

Geraniums have been a gardener's favourite for well over a century. The old-fashioned standard for beds, borders, and containers, geranium is still one of the most popular plants today. Traditional bedding types love hot weather and hold up well to dry conditions; many offer colourful foliage. Regal, also called Martha Washington, geraniums are more delicate-looking and do better in the cool conditions of spring and fall. Though most geraniums are grown as annuals, they are perennials in Zones 10-11. Bring them indoors to overwinter, if you like, then replant outdoors in spring. Or they can bloom indoors all year long if they get enough light. The plant ht. 60 cm & width. 60 cm, Easy to Grow.



17) Gerbera

Gerbera daisies are so perfect they hardly look real. They bloom in nearly every colour (except true blues and purples) and produce fantastically large flowers on long, thick, sturdy stems. They last for a week or more in the vase, making them a favourite of flower arrangers. This tender perennial will last the winter in only the warmest parts of the country, Zones 9-11. In the rest of the country, it is grown as an annual. It does well in average soil; it likes soil kept evenly moist but not overly wet. Fertilize lightly. The plant ht. 30 cm, width. 60 cm, 10-11 plants, Easy to Grow.



18) Brachycome

Easy, always fresh, and always eye-catching, Shasta daisy is a long time favourite. All cultivars produce white daisy flowers in various degrees of double ness and size.



The sturdy stems and long vase life make the flowers unbeatable for cutting. Shasta daisy thrives in well-drained, not overly rich soil. Taller sorts may need staking. The plant ht. 60-150 cm tall, width. 30-60 cm wide landscape, 5-8 plants, Easy to Grow.

19) Godetia

This under-appreciated annual bears the most beautiful, satiny pink or white flowers for weeks in summer. It also goes by the charming name farewell-to-spring, perhaps because it blooms just as spring temperatures are rising. Plant it once and you won't want to go a growing season without it.

Native to areas of North America, this plant does best in areas with cool summers and in moist, well-drained soil. It's a great cut flower, too. Although you can sometimes find it as established seedlings, most gardeners will need to start it from seed. Plant directly in the ground in early spring; it dislikes transplanting. Don't fertilize. If it has too many nutrients, it will have lots of foliage and few flowers. The plant ht. 30-150 cm tall, width 30 cm wide landscape.



20) Larkspur

Larkspur is basically an annual version of delphinium, an all-time favorite perennial. Larkspur produces lovely spikes of blue, purple, pink, or white flowers in spring and summer. They look best clustered in small patches.

Like many cool-season annuals, it's a good winter-blooming plant for the Deep South. Larkspur is so easy to grow that it often self seeds in the garden, coming back year after year. Plant larkspur from seed directly in the garden in early spring. Larkspur doesn't like to be transplanted. It prefers rich, well-drained soil and ample water. The plant ht. 60-120 cm, width. 6-12 inches, Easy to Grow.



21) Shirley Poppy

The Shirley poppy was created from 1880 onwards by the Reverend William Wilks, vicar of the parish of Shirley in England. Wilks found in a corner of his garden where it adjoined arable fields, a variant of the field poppy that had a narrow white border around the petals. By careful selection and hybridization over many years he obtained a strain of poppies ranging in colour from white and pale lilac to pink and red, and unlike the wild poppies these had no dark blotches at the base of the petals. Further selection has given rise to semi-double and double forms, as well as flowers with a ring of contrasting colour around the edge: the picotee form.



22) Nasturtium

Nasturtiums are so versatile. They grow easily from seed sown directly in your garden's poorest soil and blooms all season until frost and are never greedy about food or fertilizer. Nasturtiums are available in either spreading or climbing types. Plant spreading types in large containers to spill over the sides. Plant them alongside wide paths to soften the sides for a romantic look. Use nasturtium to brighten a rock garden or between paving stones. Plant them at the edges of beds and borders to fill in between other plants and add soft, flowing color. The plant ht. Mounding varieties from 9-16 inches, width. 12-18 inches depending on type landscape, Easy to Grow.



23) Mesembryanthemum

Mesembryanthemum is a member of the family Aizoaceae: like many members of this family, it is characterized by long-lasting flower heads. Flowers of Mesembryanthemum protect their gametes from night-time dews or frosts but open in sunlight. There is an obvious evolutionary advantage to doing this; where sun, dew, frost, wind or predators are likely to damage exposed reproductive organs, closing may be



advantageous during times when flowers are unlikely to attract pollinators.

24) Helichrysum(Paper Flower)

This plant is attractive to bees, butterflies and/or birds, Average Water Needs; Water regularly; do not overwater Self-sows freely; deadhead if you do not want volunteer seedlings next season. This plant is resistant to deer Flowers are good for drying and preserving Suitable for growing in containers Height: 6-12 in. (15-30 cm) Width. 12-18 in. (30-45 cm)



25)Corn Flower(Centaurea)

The annual blue cornflower is a slender plant of great charm. Its rich shades of blue are much sought after, both for garden decoration and for flower arrangements. Garden varieties have added red, pink, lilac and white to the colour range, and even bright yellow is available in the closely related sweet sultan Amberboa moschatus. The wiry plants may need some discreet support, and deadheading helps to prolong the flowering season, as does autumn sowing, an option that will produce larger, earlier-flowering plants. This fully hardy plant requires a sunny site, growing in most well-drained soil types, even poor soil. The plant Height: 90cm, Spread: 30cm, Time to plant seeds: March to May.



26)Salvia

These annuals are easily grown from Salvia seeds, and they provide vivid color that lasts from summer through fall. Also known as Salvia Horminum Clary, this annual Blue Salvia plant is native to an area extending from the Mediterranean to the Crimea and into Iran. The botanical name Salvia Horminum is synonymous with Salvia Viridis. Salvia Blue Monday quickly grows up to 28



inches tall and about 12 inches wide. The brilliant purple-blue flowers last well as cut flowers or dried flowers. The plant prefers loose soil, good drainage, moderate water, and mostly sunny locations.

27) Cineraria

These are herbaceous perennials that are often grown as annuals. There are three basic types: the large-flowered; the stellata or Star-flowered; the intermediate, with flowers similar to the stellata and having the compact growth of the large-flowered; and the dwarf intermediate strain, growing 1-foot tall and having a compact, free-flowering growth. They all come in a wide range of colors. There are two main types of the tall, small-flowered Cinerarias. The most popular is the Star-flowered, which produces an abundance of small flowers in blue, pink, salmon, white and other hues. The large-flowered Cinerarias come in a brilliant array of colors. Mixed seeds of a good strain will provide flowers in blue, purple, rose, pink and other gorgeous colors, many having noticeable white sections.



28) Pansy

The pansies are a large group of hybrid plants cultivated as garden flowers. Pansies are hardy annuals whose flowers have "faces." These plants offer colorful flowers for any season in your garden. They have one of the widest ranges of colors and are good for containers, borders, and ground covers.



29) Verbena

Verbena is a spreading plant ideal for cascading over retaining walls, pots, baskets, and window boxes. As long as the soil is extremely well drained, verbena will reward gardeners with countless clusters of small blooms all season. It's fairly drought-tolerant, making it a great choice for hanging baskets, rock gardens, planting in cracks between stones, and other tight places. The plant ht. From 9 to 18 inches tall, Width: From 12 to 20 inches Landscape, 7-9Plant.



30)Nemesia

Nemesia is a charming cool-season annual with pretty little snapdragon-shape flowers -- often fragrant -- that bloom in a wide range of colors. It does best in spring and fall (winter in mild-winter climates), though some varieties have better heat-tolerance than others. In cool-summer areas, such as the Pacific Northwest, nemesia will continue to bloom right through the summer into fall. Nemesia prefers moist, well-drained soil that's rich in organic matter. The plant ht. 60 cm, Width: 60 cm blooms best in spring and fall Landscape.



31) CandyTuft

Sparkling white candytuft, with its cool evergreen foliage, brightens any rock garden or wall for several weeks in spring. At bloom time, plants are covered with umbels of pure white flowers that fade to pink. Compact selections are now available. Where happy, this plant will spread. Supply good drainage, and cut back spent flowers to keep plants neat. The plant ht. 30 cm, width 8-16 inches, 5-9 Plants, Easy to Grow.



32)Antirrhinum

Season Winter Name Antirrhinum Common Name Snapdragon, dwarf Description These are bright, jolly flowers and look great in the garden or in big flower pots. If you look at their flowers carefully they look like a dragon's mouth! They like a sunny position in any garden soil. Seeds can be sown from January to March.



33)Tulip

The tulip is one of the most popular garden flowers. Tulips are hardy and require little care. Some types of tulips bloom for years, once established. Tulips generally are divided into 15 different classes, which



vary in appearance and season of bloom. The early bloomers include single early, double early, kaufmanniana, and fosterana tulips.

34)Carnation

The old-fashioned carnation name pinks comes from the serrated flower edges, which look as if cut with pinking shears. And the name of the color pink is said to come from these perennials, which have been popular in gardens for hundreds of years. The many dianthus species and hybrids come in red, white, orange, purple, cranberry, and of course, many shades of pink. Flower size ranges from less than an inch to several inches wide, and height ranges from just a few inches to several feet tall. How to grow: Dianthus prefers average to rich well-drained soil in full or nearly full sun. Refresh older plantings by dividing and resetting plants every few years.



35)Alyssum

Sweet alyssum, with its dainty, fragrant flowers, is often used in containers and hanging baskets to spill over the edges, creating a soft, frothy look. It's also a great edging plant because of its tidy, compact habit. Regardless of how you use it, sweet alyssum does best in spring and fall's cool conditions (or use it for winter color in very warm climates). In cool-summer conditions, such as the northern third of the United States, sweet alyssum will bloom steadily through the summer. It halts bloom in summer in warmer areas. The plant ht. 8 inches tall, width 30 cm, Easy to Grow.



36)Stock

Stock is best known for its spicy, sweet fragrance and as an excellent choice for flowerbeds and cut flower arrangements. Depending on the variety, stock can grow from about a foot tall to almost three feet, making it a versatile choice for any garden bed. Use taller varieties towards the back of a design to add height, or smaller ones



their wide range of colors; stock is available in shades of white, yellow, purple, pink, peach, and red. While many varieties are single, meaning that they have four petals per flower, some are double, giving them a softer, more ruffled and romantic appearance.

37) Primrose

Take a walk down the primrose path and you'll never look back! Primroses are a classic cottage flower and are popular with collectors. They covet the hundreds of different primroses available, especially some of the tiny rare alpine types. Many are staples of cottage gardens and rock gardens, while others provide spring color to damp places, rain gardens, and bog gardens. Their basal rosettes of oval leaves are often puckered or are very smooth. The colorful flowers may be borne singly or rise in tiered clusters, or even spikes. Provide humus-high soil that retains moisture and some shade for best results. The plant ht. 2 inches, width 4 inches, colour whites, pink, lavender, purple red, yellows, orange and green, 2-8 plant, Easy to Grow.



38) Dianthus

The species are mostly herbaceous perennials, a few are annual or biennial, and some are low subshrubs with woody basal stems. The leaves are opposite, simple, mostly linear and often strongly glaucous grey-green to blue-green. The flowers have five petals, typically with a frilled or *pinked* margin, and are (in almost all species) pale to dark pink. One species, *D. knappi*, has yellow flowers with a purple centre. Some species, particularly the perennial pinks, are noted for their strong spicy fragrance.



39) Daisy

Easy, always fresh, and always eye-catching, Shasta daisy is a longtime favorite. All cultivars produce white daisy flowers in various degrees of doubleness and size.



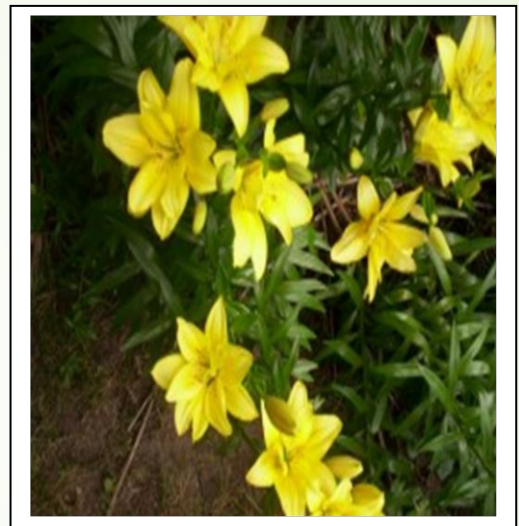
The sturdy stems and long vase life make the flowers unbeatable for cutting. Shasta daisy thrives in well-drained, not overly rich soil. Taller sorts may need staking.

Light: Sun, Part Sun Zones: 5-8 Plant Type: Perennial Plant Height: 20-30 cm tall Plant Width: 1-2 feet wide Landscape Uses: Containers, Beds & Borders Special Features: Flowers, Attractive Foliage, Cut Flowers, Dried Flowers, Attracts Butterflies, Drought Tolerant, Easy to Grow.

40) Asiatic Lilies

Asiatic lilies are one of the most beautiful flowers that you can grow. I love to walk in the garden and see the new blooms and my garden just wouldn't be complete without them. These are my favorite flowers next to daylilies which aren't really lilies at all. Here you will find all the information you need to grow asiatic lilies.

Once you plant lily bulbs or plants they will give you pleasure for years to come and multiply and become even more beautiful. They are grown from a hardy bulb that multiplies quickly and takes little care. They come in many sizes, heights and shapes. Lilies are called bulbs but are really tubers with fleshy scales that never go into dormancy like other bulbs that you might be familiar with.



41) Gladiolus

Gladiolus is a perennial favored for its beautiful, showy flowers. Its flowers grow on tall spikes and are often found in cutting gardens or in the back along the border (because they are tall). Gladioli have many different colored flowers, and grow between 60 to 180 cm in height. It's good for cut flowers.



42)Hyacinths

Hyacinth bulbs are planted in the fall and borne in spring. The Victorians revered hyacinths for their sweet, lingering fragrance, and carefully massed them in low beds, planting in rows of one color each. The loose to dense racemes of strongly fragrant flowers are closely packed with tubular-bell-shaped, single or double flowers. As well as growing in the ground, colorful hyacinths are excellent for forcing in containers and some are available for early flowering indoors.



Summer and rainy season flowers

The summer season start in India from the month of April and continues till the month of June, from July to September the season is rainy. In summer the temperature rise up to 45 c and winds are dry all around. After the sparky spring, where various choice of flowers are available, in summer season there are very limited variety available because of adverse weather conditions, which the gardener can grow for adding color and flowers in his garden. The way of planting by grow seedlings and planting them in beds or pots, secondly showing the seed directly in the beds or pots. During propagation for summer flower gardener should keep in mind to add the compost and sand in mixture to maintain the moisture during dry summer before planting seedling or seeds. The gardener should also keep in mind about the availability of irrigation water. Here, we are suggesting some popular summer and rainy season flowers for gardeners to choose from them.

1. Portulaca

Portulaca also known as Moss roses, they are excellent flowers to have if you live in a dry climate, since they can store water well, and also provide lots of low lying color for your garden. They also are very easy to take care of after you get started. Moss rose is the gardener's choice for the hottest, driest, most problematic spots in the garden. This succulent plant thrives in heat, drought, and lousy soil, rewarding gardeners with nonstop color. Coming in sunny warm reds, oranges, magentas, and yellows, moss rose looks at home in a sun-drenched area.



2. Cosmos

Cosmos are annuals, grown for their showy flowers. The flower heads may be bowl- or open cup-shaped and are atop of long stems. Cosmos are easy to grow and make



good border or container plants. The cosmos plants are able to flower from early summer and long lasting up to winter season. They make for good decorations in flower arrangements and also attract birds, bees, and butterflies to your garden. The height of the plants should be very from 15 cm to 45 cm according to the variety. Its commonly available in dark orange to yellow colour. It is easy to grow.

3. Vinca Flowers

Annual vincas aren't new or flashy flowers on the gardening scene, but recent cultivar developments warrant a new examination of this common bedding plant. Horticulturists have been hard at work bringing us new colors in plants with showier flowers that are easier to start from seed. The height of the plants varies from 15 cm to 45 cm according to variety, the common Vinca plants have only two colours white and dark pink. Now days various colours in hybrid varieties are available in single colour or contrast.



4. Sunflower

Sunflower is an annual plant, growing up to 4.6 m tall. It has large, rough and hairy leaves, oval to cordate in shape. Flower heads are also large, growing about 20-30 cm in diameter. It consists of numerous, densely arranged florets. Sterile ray florets on the outer side vary in color—they can be yellow, red or orange. The disc florets inside the circular head produce seeds. The florets inside the circular head are called disc florets, which mature into seeds.



5. Sunflowerdwarf

These dwarf sunflowers are free of pollen, making them perfect as indoor gift plants. They are also tolerant of



mildew to perform well in the garden. Miss Sunshine flowers uniformly about 7 to 10 days earlier than Ballad. It is shorter, and flowers are 25% smaller than Ballad's 4 to 5-in. (10 to 13-cm) blooms. Miss Sunshine displays warm golden flowers, and produces secondary blooms more quickly. For larger flowers and bright yellow color, Ballad excels.

6. Zinnia

Zinnias are one of the easiest annuals to grow, grow quickly, and bloom heavily. They make a massive burst of color in your garden. Zinnias have bright, solitary, daisy like flower heads on a single, erect stem. The most common zinnia is "dahlia-flowered" and grows up to three feet. Other types are "cactus-flowered." Use in an annual or mixed border. Smaller zinnias are suitable for edging, window boxes or other containers. The narrow-leaf zinnia also works well in hanging baskets. Zinnias are very popular for cut flowers.



7. Gaillardia

Gaillardia, or Blanket Flower, is a group of about 30 species that include both annuals and perennials. With bright and colorful daisy-like flowers it is no wonder this native wildflower has earned a spot on the heart of gardeners everywhere. The most common species for garden use is *Gaillardia grandiflora*. It is this perennial, and some of its most unique cultivars that we will discuss here. Hardy, sun-loving and easy to keep it deserves a place in every garden □



8. Gomphrenaglobosa

Gomphrena easily grown in average, well-drained soils in full sun. Although mature plants exhibit good drought



resistance, plants grow best with regular moisture throughout the growing season. Extremely good heat tolerance. Sow seed directly in the garden. Use ample amounts of seed since germination rate can be quite low. Set seedlings or purchased plants out. Pinch young plants to promote more foliage and flowering. The plants ht. 30 to 60 cm. The plant is hardy nature and easy to grow.

9. Cladium

Cladium is a very popular bulbous plant for rainy and summer season. It can be grown easily from April to September in north India plain. On onset of winter the plants leaves dried and bulb can be collected for the next season and they can be stored in cold storage during dormancy. The Cladium have very decorative leaves of different colours and shapes. It can be easily planted in semi shaded beds or pots. The lower dry leaves should be eradicated regularly for new shoots / leaves. The height of plants vary from 15 cm to 40 cm mainly leaves of the Cladium is a combination of red, white and green colour. According to the variety.



MANAGEMENT OF ORGANIC GARDEN : A MEDICINAL APPROACH

Pranay Kumar, Section Officer (Hort.), CPWD, New Delhi

Botanical pesticides are agricultural pest management agents which are based on plant extracts. In modern times these have been used as alternatives to synthetic chemicals in organic pest management. The practice of using plant materials against field and storage pests however has a long history in many indigenous and traditional farming communities across the world. The ecological pest management is a holistic method based on the combination of a variety of farming practices. Indigenous knowledge which is holistic, site-specific and experience based has therefore much to offer towards practice of a more sustainable agriculture and pest management strategies which consider the welfare of both humanity and the environment.

“Pests have been responsible for more loss of life and destruction of property than by wars, floods, earthquakes, fire and famine in the history of man. Pesticide usage in India is worth 800 crores. Insecticides like DDT, BHC, Allethrin, Methyl bromide, aluminum phosphide, Ethylene dibromide and Malathion cause severe health hazards. Moreover, crop has developed resistance against these chemicals.

Medicinal and aromatic plants are a group of plants having unique property in their parts certain chemicals (secondary metabolites) being utilized in curing ailments or as a source of flavors and fragrances, can also be used as biocides (botanical pesticides). Several components of essential oil have been identified as short term (Eg: linalool, menthol, pulegone) pesticides as well as long term (eg. benzaldehyde, carvacrol, carvone, cinnamaldehyde) pesticides.

Insect Pest is an insect whose population increases to such an extent as to cause economic losses to crops or a nuisance and health hazards to man and his livestock will be declared as pest. They thrive in favourable weather conditions. Large-scale monoculture of crops often leads to pest infestation. Accidental introduction of a pest into a new area is also a possibility. These not only kill natural enemies but also lift natural control. Last few decades has seen indiscriminate use of pesticides leads to destruction of ecological balance of nature. They cause danger to pollinators, wildlife & have deleterious effects on plants.

The Botanicals are plant products that have been used to control pests. Several classes of secondary plant substances present in medicinal and aromatic crops are responsible for pest management.

Ashwagandha

Scientific Name : *Withania somnifera*

Family : Solanaceae

Chemical Constituents : Withanine & somniferine

Uses : Insecticidal.



Ambrette

Scientific Name : *Abelmoshus moschutus*

Family : Malvaceae

Chemical Constituents : Farnesol, ambrettolidin.

Uses : Insecticidal



Patchouli

Scientific Name: *Pogostemon patchouli*

Family: Lamiaceae

Chemical Constituents: Eugenol, patchoulinol

Uses: Insecticidal



Rosemary

Scientific Name : *Rosemarinus officinalis*

Family : Lamiaceae

Chemical Constituents : Linalool, Thymol & carvacrol.

Uses : Antibacterial.



Thyme

Scientific Name : *Thymus vulgaris*

Family : Lamiaceae

Chemical Constituents : Thymol, linalool.

Uses : Insecticidal.



Ashwagandha

Scientific Name : *Withania somnifera*

Family : Solanaceae

Chemical Constituents : Withanine & somniferine

Uses : Insecticidal.



Adathoda

Scientific Name : *Adathoda vesica*

Family : Acanthaceae

Common name : Malbar nut

Chemical Constituents : Adtodine & adhavaasinone

Uses : Insecticidal.



Periwinkle

Scientific Name : *Catharanthus roseus*.

Family : Apocynaceae

Common name : Sadabahar, Kasikanagile

Chemical Constituents : Vincristin Vinblastin

Uses : Insecticidal.



Datura

Scientific Name : *Datura spp.*

Family : Solanaceae

Chemical Constituents : Hyoscyamine & hyoscine

Uses : Rodenticidal & Acaricidal.



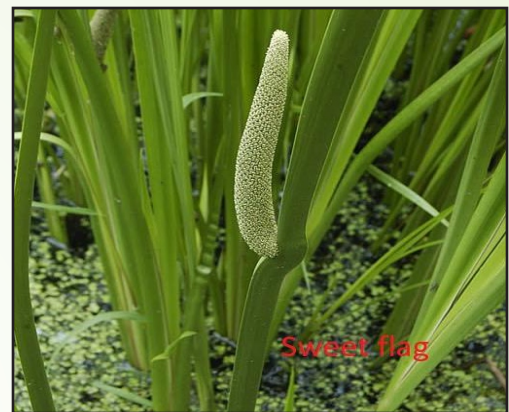
Sweet Flag

Scientific Name : *Acorus calamus.*

Family : Araceae

Chemical Constituents : Acorin Acoradin

Uses : Insecticidal.



Pyrethrum

Scientific Name : *Chrysanthemum cinerariaefolium*

Family : Astraceae

Chemical Constituents : Pyrethrin I & II Cinerin I & II
Jasmoline .

Mode of Action : Knock down effect.



Ocimum

Scientific Name : *Ocimum sanctum, Ocimum basilicum*

Family : Lamiaceae

Common name : Holy basil Sweet basil

Chemical Constituents : Ocimin, linalool

Uses : Insecticidal.



Lemon grass

ScientificName : *Cymbopogon flexuosus*

Family : Graminae

Chemical Constituents :Cymbopogone
Cymbopogonol.

Uses : Insecticidal



Conclusion

Botanical pesticides could play an important role in taking indigenous farming practices into a new and sustainable future. Not only are they considerably safer, both for humans and the environment, but could contribute to the fusion of the traditional and the modern, the indigenous and the global. With the realization that the Green Revolution has failed, the future of agricultural pest management focus should instead of looking to chemicals, high-technology and industry, be on the farmer's natural instincts and acquired experience. Botanical pesticides could no doubt be part of this shift to appropriate technology.

HEALING GARDENS- THE CONCEPT OF THERAPEUTIC LANDSCAPING

Virendra Shahi, Section Officer (Hort.), Chandigarh

'Health' and 'well-being' have always been indicators for the 'quality of life', while 'quality of life' could be perceived as a method of measuring the degree of 'community sustainability'. World Health Organization defines health as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity". Studies depicting the bond between nature and healing and health are as follows:-

Gall Bladder Surgery patients were studied in their recovery rooms. Some rooms had a view of nature while others had a view of a brick wall. It was found that patients whose rooms overlooked trees and greenery have had a faster recovery time, faster hospital departure, experienced fewer difficulties, suffered less pain and used less medication than those patients facing a wall.

A school in Germany conducted another similar study, students were observed in classrooms that contained plants and others in classrooms with no plants. It was found that plants reduced student health problems, and helped reduce the number of health complaints. This provided evidence that plants have a positive effect on the students' well-being.

(Health studies and horticultural therapeutic programs prove that there is a relationship between health and gardens)(Gardens are not only looked at as sources of physical healing but, as mental and emotional healing sources as well). The notion of Healing gardens should not just be restricted as a requirement for sick people, it is important for the healthy people as much as it is important for those who are sick.

The Notion of Healing Gardens (HG)

Sustainability and the notion of Healing Gardens

Greenery, as a sustainable form of landscape, has the potential of inducing active living and public health; thus linking the importance of the natural environment to the built environment and the citizen's health. In the Western and Eastern communities it has been noticed that greenery in the city is essential for the health of the city dwellers. The brain is capable of two types of attention; directed attention belonging to the higher cognitive centers, and soft fascination linked to the memorial part of the brain. In a natural environment, the higher cognitive centers rest while the old part of the brain is stimulated giving the sense of restoration, rest and healing. It is vital for public green areas to be located near residential areas. Studies have proved that natural environments outside a 50 meters radius from residential areas would result in a decrease in the amount of visits to the gardens, and an increase in stress levels. While designing a healing garden it has been noted that 'sight' is the most immediate physical sense that reacts to a garden. Sight is important because a person only needs to open his/her eyes to experience an ever-changing kaleidoscope of light and colour. The human sense of 'smell' is also very important in designing a healing garden. Scientists have discovered that sweet essences produce alpha, theta, and delta brainwave patterns which leads to a state of total relaxation. Other fragrances could stimulate beta brainwaves inducing a state of alertness in the human brain. If the produced fragrances of a garden is disliked it would block any effect upon the nervous system empowering the sense of alertness. It would thus limit the chances of a garden to promote its healing powers. This emphasizes the importance of providing the garden with the proper scents. If healing gardens are to symbolize health promoters, then they have to offer a considered balance between the body, the

mind, and the spirit Thus Healing Garden can be considered as a deep form of sustainable landscape where both humans as well as the environment are to mutually benefit from promoting it.



Picture depicting the herbal path and grass path made in healing garden

Defining Healing Gardens

A garden, in general, is portrayed as a heaven where people find a welcoming escape from the everyday stresses of the outside world. On some level all gardens have healing effects. Healing garden may also be defined as "instead of stressing the idea that they can cure a person, the benefits are related more to the alleviation of stress and the abilities of the space to soothe, to calm, to rejuvenate or to restore one's mental and emotional health". In other words healing gardens are not just for sick people, they serve the healthy and the ailing. A healing garden is able to restore the natural balance in humans so that they do not feel stress and other pressures. It is defined as a category that includes outdoor or indoor garden spaces. Healing gardens is defined as the broad collective term that encompasses various types of gardens that aim to promote health and well-being to the human life and the adjacent environment.

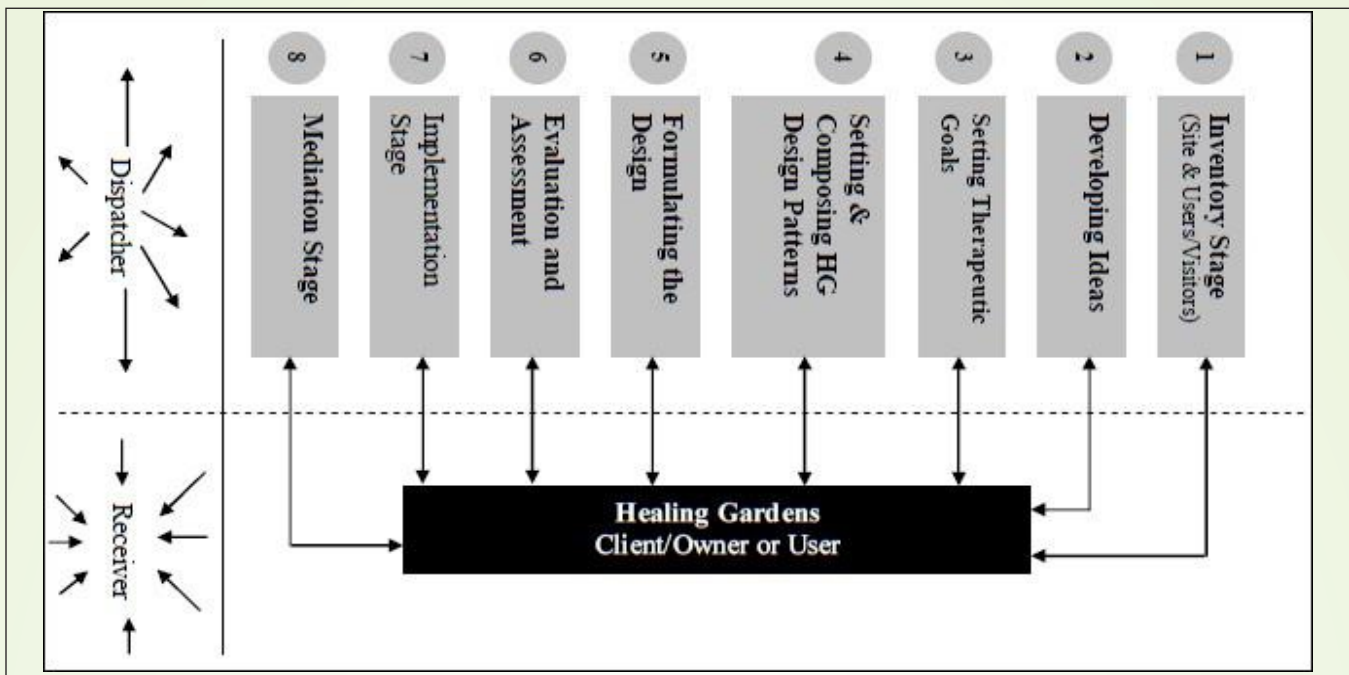
Types of Healing Gardens

The positive health effect of staying in urban green spaces has been recognized. If the goal of the community is to promote sustainable development, then in the heart of the sustainability process is the ability to promote better health for all city inhabitants. Consequently, the types of healing gardens can be classified as follows:

- a. The first type of healing gardens is like a sanctuary or a natural reservoir, where natural and wildlife are preserved. This is presented by the city's green infrastructure elements, encompassing the city's open spaces, green ways, nature parks and greenbelts.
- b. The second type is a meditation garden within the premises of a hospital or a health care centre.
- c. Finally, the third type is a privately owned garden. The third type is agreed upon by most healing researchers to be the best type of meditation garden with healing effect. This is based on the fact that the more time a human is in contact with nature; the more profound the healing results will be. A residential or a private garden is the climax of the healing garden typology. It allows the user(s) to gain the maximum benefit from the healing qualities of a garden because it is their own personal space where they express their individual identity, needs and level of engagement.



Healing Gardens Design Process/framework



Design Frameworks

* **Inventory Stage (Site and Users Visits)**-The inventory stage of the HG design process differs from any other garden design stage in that this stage has to include the user/client as one of the design members. This is to be achieved through a number of visits. The visits should aim to investigate and listen to the user/client's own ideas. The design team aims to identify client's needs to be able to profoundly analyze, categories and prioritize them.

* **Developing Ideas**- Based on the former stage the designer should start setting the first layer of ideas and thoughts regarding how to fulfill the user/client needs. The designer should keep their own vision into consideration, the one that has to be beyond the expectation of the user/client.

* **Setting Therapeutic Goals**- One may argue that this design stage should come before the previous stage of developing the ideas. It is arguable as the framework is not rigid. Some designers may find it more appropriate to consider setting the therapeutic goals before developing the design ideas. Others may argue that the therapeutic goals should be hidden between the designers and their design. The therapeutic effect on the receivers should be accounted on.

* **Selecting Healing Garden Design Patterns**- The design patterns aim to assist the designer in achieving his/her therapeutic goals. These patterns are already tested for their efficiency in achieving the therapeutic objectives. Table 1, presents a list of HG design patterns. Each design pattern stands for the elements of the language of design, they are the individual words or phrases that when joined form the final story.

*Formulating the Design (HG Design Stage)

The design formulation/creation is the heart of the design process of Healing Gardens. A healing garden needs to express and present nature and its forms. It should escape and avoid rigidity, conceptual thinking and preconceived notions of design. A successful Healing garden design should be able to achieve the following design objectives:

1. Maintain the spiritual character of the site
2. Accentuate the aesthetics values of the design

3. Create a variety of spaces
 4. Encourage exercise
 5. Minimize intrusion
 6. Encourage vegetation and wildlife
 7. Support the intention and care of its owners
 8. Prevalence of green material
 9. Provide positive destruction
 10. Minimize ambiguity

* **Mediation Process (HG users gardening)**- A healthy plant is a main factor in a successful HG, where the impact of these healthy plants is mediated to its user. HG is unique in its ability to engage its user in the gardening tasks, through which mediation is maintained, and the therapeutic goals are achieved.

▲ Conclusions

The architects must focus on integrating all key elements of healing garden and users' desire that create a quiet environment which reduce stress and promote patients' health. It needs special attention in the design and continual emphasis by the hospital. The following list is an important element which must be included in the design:

- 1) Climate-controlled areas (i.e., misters to cool and heated floor to produce warmth)
- 2) Strolling ways and exploring trails.
- 3) Improve the stream to take into consideration however much connection as could be expected.
- 4) Play area to take into consideration patients' and children's delight.
- 5) Open area to take into consideration different exercises.
- 6) Contemplation region for thought and reflection.
- 7) A few water highlights.
- 8) Different seating choices with the greater part in the one to three seating range.
- 9) Friendly/commonplace components (i.e., winged animal feeders, recognizable plants and scents).

LANDSCAPING AROUND RESIDENCES

Navdeep Singh, Section Officer (Hort.), CPWD, New Delhi

Landscaping is the appearance of that portion of land which the eye can comprehend at a single glance. A well-designed and functional home landscape can add to the family's joy and increase the value of the property. Landscaping is the practices that can improve the health and appearance of lawn and garden while protecting and preserving the natural resources. Garden adornments impart added advantages by enriching the surroundings. Also, water feature is the oldest art of gardening which added great charm and expression to the landscaped houses. Green walls or living wall are an innovative ways of greening a vertical surface and to show visual impact. Inclusion of lawn in landscaping is an added advantage to the surroundings as well as helps to soften and reduces the glare.

It is a combination of the art and science to create functionally and aesthetically indoor living to the outdoor area. The basic of a landscape design is to blend man's technology, i.e. house and building into natural surroundings. Landscaping with native plants improves the environment. Unfortunately we didn't understand that a native garden means, its not a low maintenance garden in which creating a bushland area. Native plants can be appreciated in any style of garden which added diversity of plants and attracting variety of birds, butterflies and others.

An ideal landscaping should boost natural beauty. This beauty must be created and sustained by environmentally-safe landscape practices. Some of these practices include:

- ▲ Cooperate with pre-existing natural conditions instead of working against nature.
- ▲ Conserve water and energy both indoors and outdoors.
- ▲ Landscape with native and suitable trees, shrubs and groundcovers that requires minimal maintenance when planted under appropriate conditions.
- ▲ Select plants that blend beauty with environmental benefits.
- ▲ Consumption of pesticides on need based.

Garden Adornments

The house looks incomplete without the garden and garden adornments. Garden adornments are needed to enrich the surroundings. Several garden adornments such as fountains, statues, ornamental pots, pillers, arches, pergolas, hanging baskets, tubs, vases, and urns with plants which make the garden more enjoyable.



Water Bodies in Landscapes

Water feature is the oldest art of gardening which adds great charm and expression. It gives beauty and pleasure in the form of running, still or dropping and falling water. These are constructed to enjoy the charm of water in many different ways in the garden. Garden pools are a very common feature in landscaping. These are charming and versatile parts of any landscape. It provides scope to utilize the wonderful world of aquatic plants.



Green Walls

Green walls have seen a sudden surge in popularity. Green walls or living walls are an innovative way of greening a vertical surface and are magnificent. The living wall is located at the entrance of the landscape to show visual impact and also be placed interior for cleaning the internal environment and keeps the living area comfortable.



Lawns

Lawns are a common feature of private gardens, public landscapes and parks which gives the view of green carpet. Lawns are created for aesthetic pleasure as well as for recreational purposes. The most significance of lawn in a garden has ability to stabilize soil against water and wind erosion. Beautiful lawn is pleasing to the eyes and relaxing in its appearance. Lawn helps to soften and reduces the glare. A healthy, well maintained lawn creates an exciting view and aesthetically pleasing.



CONCLUSION

The fundamental concept of landscape design is problem solving through the use of horticultural science, artful composition and spatial organization to create attractive and functional outdoor for different uses. For designing the landscape, the elements, viz. line, form, texture, color, visual weight and principles, viz. proportion, repetition, balance and unity are used to create spaces and make them visually pleasing to the eyes. Successful landscaping requires careful planning and some knowledge of landscape design.

HANGING BASKETS-SKYSCRAPER'S GARDENS

Dr. Pratiksha Kumari, Section Officer (Hort.), CPWD, New Delhi

Gardening is a hobby one can never get bored of. People living in skyscraper buildings have no option of gardening on land. So, they bring their gardens to their high rise buildings by putting Hanging baskets. These baskets are a means of container gardens that are suspended overhead. Here, plants are grown suspended over the balconies, porch ways, verandas, to walls, patios, basement areas, and similar places. Hanging plants all around the house, esp. in multi-storey buildings is a wonderful idea as it not only beautifies the dull surroundings but at the same time brings us close to our mother nature. Bringing colour high up in the building softens all hard lines of a building.

How to prepare hanging baskets :

Planting hanging baskets is not much different than planting containers that are on the ground. Lining a basket is important as most hanging baskets are wire based. Another lining that can be substituted for sphagnum moss is polythene. We need to punch some holes in the base of this lining to allow the water to percolate through and ensure good drainage. For preparing a hanging basket, we first of all need to prepare compost by mixing a handful of slow-release fertilizer granules and some aerosols into peat-free multi-purpose compost. Next, we need to remove one of the hanging chains from a 35cm wire hanging basket and stand the basket on a pot to keep it steady. Covering the inside of the basket with a coconut fibre liner is good for retaining moisture for longer periods.

The traditional mesh hanging basket is made of plastic-coated wires although solid plastic hanging baskets are also available in market. Wire hanging baskets require a liner to hold in the compost and plants. The most inexpensive and versatile basket is sheet plastic, which can be cut to size and disguised by placing in a layer of straw. To prevent too much water from escaping, it is better to place a plastic bin liner on top of the fibre and cut around the edges where it overlaps the basket, making sure none of the black plastic is visible. We need to put a 2-3 cm layer of compost in the base of the basket for manuring. In order to prevent damage to roots and stems, we need to individually wrap each plant in a tube of paper. From the inside of the basket, push the tube through one of the holes until the rootball is fixed against the liner. We need to un-wrap the paper and add other plants one by one. The soil around the root-balls need to be made a little firm. Once planting is done we need to thoroughly water our hanging basket. A very simplified way to prepare small hanging basket hanger at home is shown in pictures below.



Containers : There are a variety of baskets available in the market. We need to consider what will fit with the colour of our wall, decoration in the room and garden theme if we need to place in our garden pole. We also need to select the size that suits best and the type of plant, including consideration for its likely future growth. Hanging baskets are typically available in such materials as:



Galvanized wire Solid plastic Ceramic pot, knotted hanger



Basket Ceramic pot with wire Glass pot with solid wire

Media : General ingredients of hanging basket media are regular peat moss, fine perlite, fine vermiculite, limestone, dolomite, starter charge. Since procurement of these materials can be difficult in Delhi and also because we need to choose a growing medium with a lower bulk density for hanging basket a peat-based growing medium with perlite or perlite/vermiculite can be used. Bark-based growing media allow better porosity and drainage, which contributes to a more toned, finished produce. This is an important attribute for shelf life. Bark-based mixes may cost more than peat-based mixes. A more porous, or a more moisture retentive mix are types of peat/bark-based mixes that perform well in hanging basket. Larger baskets hold more growing media and available water, requiring less frequent irrigation.

Care : Containers and hanging baskets can be placed outside when the weather is suitable. If we are growing our container or basket indoors then the plants will need to be hardened for a week before placing in their final positions outside. We need to keep hanging baskets in sunny position unless our plants are shade-loving. Placing hanging basket in windy and exposed sites is not suggested.

Frequent watering quickly flushes nutrients from the soil. Frequent fertilizing is needed to replenish the losses. Two different fertilizers can be used, liquid or slow-release. Liquid fertilizers are applied fortnightly throughout the growing season. Slow-release fertilizers are applied to the soil, and are released over time. They can last up to several months, depending on the fertilizer. Before we fertilize, it is important that the soil is moist. Fertilizer is utilized by plants much better when they are turgid and not wilting. We should follow all the instructions on fertilizer label and apply them accordingly to hanging baskets. To get the best performance from our containers and hanging baskets we should

spend some time dead-heading the plants occasionally. Removing the faded flowers stops the plant producing seed and wasting energy it could otherwise use on producing more beautiful flowers. With a little care our containers, flowers pouches and hanging baskets should give a colourful display from early summer right through until autumn.

For those plants which are not shade-loving, we should choose a sunny and warm location, preferably south-facing so our baskets and containers receive full sun all day. Try and avoid windy sites if possible. Due to the volume of plants in hanging baskets and containers, they dry out very quickly in hot weather so we need to keep an eye on the soil moisture, and water if the top half-inch of compost feels dry. If the surface is not dry, leave watering until needed.

Plants : We can grow all sorts of plants in containers from perennials to bedding, fruits, vegetables and even shrubs and small trees. If we're looking for climbing plants for containers then we can try climbing roses, jade plant, clematis or sweet peas. Growing strawberries in hanging baskets and containers will prevent slugs and snails from eating our delicious crop. Many other fruits and vegetables can be grown in containers such as herbs, lettuce, cherry tomatoes, dwarf beans, blueberries and bell pepper. Due to their invasive nature, Pudina, and Bamboo can be grown in containers and sunk into the ground to restrict their roots.

To decide how many plants we will need to fill a container, consider the types of plants we will be growing. Trees and shrubs will each need their own container whereas annual bedding plants are packed quite closely together to provide a full effect. For hanging baskets a general rule is to use one plant per inch of basket diameter – so 12 plants per 12 inch basket. We will only need 5 plants per 12 inch hanging basket for bigger plants such as Geraniums (Pelargoniums), Petunias, verbena, oregano and thyme.

Annual plants for hanging baskets		Perennial plants for hanging baskets	
Full Sun	Partial Sun	Full Sun	Partial Sun
Aclypha	Begonia	Zebrinapendula	Syngonium
Pudina	Jade plant	Tradescantia	Ophiopogon grass
Oregano	Fuchsia	Dianthus (Pinks)	Single Dahlia
Thyme	Geranium	Gaillardia	Aloevera
Marigold	Syngonium	Petunia	Phlox
Nasturtium	Sweet Alyssum	Lavender	Jade plant
Sweet William	Pansy	Lilies	Sedum
Petunia	Viola	Rose	Asparagus
Sweet Pea	Ivy	Chlorophytum	Pothos
Verbena		Ferns	Bryophyllum

We can try growing our own vegetables and herbs in a hanging basket or container. These can be both attractive and productive and we can try growing all sorts of edible plants. Many herbs and vegetables have decorative features such as coloured leaves, seed pods or fruit. The best plants for hanging baskets and containers include bush cucumbers, chilli peppers, cut-and-come-again lettuce such as 'Salad Bowl', tomatoes, spinach, strawberries, peas, and dwarf beans.

When growing strawberries in hanging baskets, we need to incorporate a slow-release fertilizer like neem coated urea into the compost for the best crops. Herbs suitable for hanging baskets include mint, methi, parsley, bejal, sage, stevia and thyme.

It is essential that vegetable baskets do not dry out. Also, vegetables and herbs need less space than bedding plants, for example we would only need 3 trailing tomato plants per 35cm basket or container. Bush cucumbers become quite large so 1 plant per basket or container would be sufficient. Position our basket or container in a sheltered, sunnysite, although herbs and cucumbers do better in some shade.

Conclusion : Hanging baskets add a whole new dimension to gardening and help in utilizing the available space smartly. With hanging baskets we can brighten up a sunny wall, or with the right choice of plants, even add colour to dull shady areas and grow salads, veggies n fruits as well. We can even grow fresh herbs throughout the winter with an indoor basket next to a sunny window.

POPULAR TREES FOR LANDSCAPING

Aakanksha Mahindrakar, Section Officer (Hort.), CPWD, Mumbai

The city of Mumbai, commercial capital of our country in present times is facing the problem of rampant immigration leading to over population. With this ever increasing population movement of vehicles (automobiles) has also increased in intensity. Trees with their huge canopy minimize pollution by filtering dust and by absorbing gaseous pollutants. Efficiency of green covers for minimizing urban pollution has been scientifically proven and well established.

Here are some of the tree species which are widely seen in Mumbai

1. *Neolamarckiacadamba*

Common Name : Kadamba, badminton ball tree

Origin : India, China, Australia, Indonesia, Malaysia, Papua New Guinea, Philippines,

Flowering Season : October to July

Kadamba is one of the most frequently planted trees. Kadamba are suitable for reforestation programs



2. *Bauhinia purpurea*

Common Name : Purple Orchid Tree

Origin : India

Flowering Season : February-April & June-October

The narrow purple, pink, and lavender petals arranged to closely resemble an orchid, hence the name



3. *Brassiaactinophylla*

Common Name : Umbrella Tree or Octopus Tree

Origin : Australia

Flowering Season : February-March

The name 'Umbrella Tree' is due to the leaf formation while the name 'Octopus Tree' can be attributed to the inflorescence.



4. *Cassia fistula*

Common Name : Indian Laburnum or Golden Shower

Origin : India, Burma and Sri Lanka

Flowering Season : February-March

The inflorescence of golden yellow flowers borne on green stalks resembles a chandelier. This moderately sized tree is truly spectacular when in bloom.



5. *Cassia spectabilis*

Common Name : Golden Cassia

Origin : Central America and the Northern regions of South America

Flowering Season : September – November

The combination of green and yellow is quite spectacular when the tree is in bloom. All these features make it well suited for landscaping.



6. *Cordia sebestena*

Common Name : Scarlet Sebesten

Origin : Caribbean

Flowering Season : Throughout the year; peak between January and March

It needs full sunlight. This tree has a small stature and has a long flowering season. All these features not only make the tree look attractive throughout the year but also make it well suited for large home gardens and parks



7. *Delonix regia*

Common Name : Gulmohar

Origin : Madagascar

Flowering Season : March to July

It is a fast growing species. These trees add colour to the city when they start blooming.



8. *Jacaranda mimosaeifolia*

Common Name : Jacaranda

Origin : Brazil

Flowering Season : February-March

The flowers are mauve coloured and tubular. The seeds are enclosed in a round, woody capsule. They hang from the tree for a long time before dropping off.



9. *Lagerstroemia indica*

Common Name : Pride of India

Origin : India (W Ghats). Distributed in Ceylon, Burma, Malay Peninsula, Australia and China.

Flowering Season : March - May

Never is the tree leafless. The leaves are shed, few at a time and turn red or yellow prior to dropping off, on a scale never equaling the grandeur of temperate trees in autumn.



10. *Peltophorumpterocarpum*

Common Name : Copper pod, Haldigulmohar

Origin : Ceylon, Andamans, Malaya and North Australia

Flowering Season : March - September

The name `Copper Pod' comes from the coppery-red seed cases that are seen in profusion (they turn black with age). A carpet of the yellow petals and is sight to behold.



11. *Plumeriasps.*

Common Name : Temple tree

Origin : Mexico, Central America, Colombia and Venezuela

Flowering Season : Summer and autumn

Both are of small stature; the former being deciduous and the latter evergreen. Both, bear fragrant flowers in clusters at the tips of their branches.



12. *Samaneasaman*

Common Name : Rain Tree

Origin : South America

Flowering Season : March-September

The flowers are white and pink resembling an open brush contrasting against the green crown. An ideal species to be planted along broad roads, it also provides for roosting and nesting of many birds.



13. *Saracaasoca*

Common Name : Ashoka Tree

Origin : India, Sri Lanka, Myanmar and Malayasia

Flowering Season : Throughout the year; mainly November – March

The flowers are borne on dry branches in dense clusters that are orange-red that deepens as they age. The tree looks particularly attractive when in bloom.



14. *Spathodeacampanulata*

Common Name : African Tulip Tree

Origin : Africa

Flowering Season : August to December

It is a grand sight particularly where they have been planted at the boundary of parks. A handsome tree bears dark green leaves most of the year. It is in bloom for a long duration providing many birds with nectar from its cup shaped deep-orange flowers.



15. *Tabebuiaargentea*

Common Name : The Tree of Gold

Origin : Tropical Americas

Flowering Season : January – March

This tree when in bloom has spectacular yellow blossoms that stand out. The tree bears large clusters of bright yellow tubular flowers. The tree is not entirely leafless when in bloom.



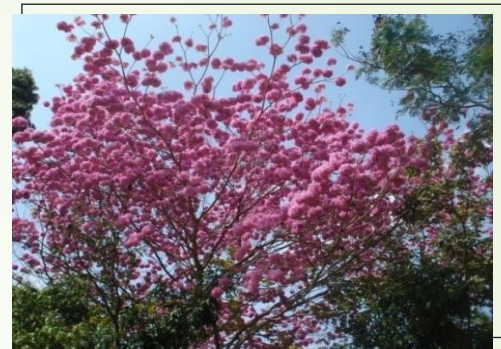
16. *Tabebuiaavellanedae*

Common Name : Pink Tabebuia

Origin : Paraguay & Argentina

Flowering Season : January – February

During most of the year the trees bear very characteristic broad leaflets (five in number) that are pointed at the tip and curved inwards. Prior to bursting into bloom the tree sheds all its leaves.



17. *Thespesiapopulnea*

Common Name : Bhendi tree

Origin : India and Burma

Flowering Season : Almost throughout the year peaking during winter

Leaves are heart shaped with prominent veins. The tree, being a relative of the Hibiscus, has flowers similar to it too. They are large crumpled looking flowers with an exterior yellow colour and a deep reddish centre.



18. *Buteafrondosa*

Common Name : Flame of the Forest

Origin : India and Burma

Flowering Season : January – March

The Flame of the Forest too, like many other trees that share the habitat sheds most of its leaves before putting forth the bright, yet pleasing, orange flowers arranged that are placed in clusters on its branches.



BIO-AESTHETIC PLANNING IN URBAN LANDSCAPING

Meenu Kumari, Section Officer (Hort.), CPWD, New Delhi

Bio-aesthetic planning is the proper utilization of flora and fauna for beautification of surroundings or a piece of land. The term "Bio-aesthetic planning" given by Prof. Lanceolet Hogben referred to conscious planning of use of flora and fauna. In India, this concept was first propagated by Dr M.S. Randhawa who gave a practical shape to the first planned city Chandigarh along with the famous French architect Le Corbusier. The term bio-aesthetic planning embraces both the science of animals and plants and is recognized as the planned ecology of living organisms from the artistic and aesthetic point of view. The aim behind this concept is to plant ornamental flowering trees along with roads, in parks, house compounds, public places etc. It creates improved ambiance for living, working and recreation. The bio-aesthetic planning has immense significance in present scenario of industrialization, where the open land area is decreasing day by day and concrete structures are coming up indiscriminately. The continuous increase in population, over-industrialization and craze for development has resulted into unlimited exploitation of natural resources. Since the green cover is declining rapidly to establish industries, malls, residential colonies, public offices etc., hence a thorough long term bioaesthetic planning is desired.



The scope of bio-aesthetic planning has increased further with better realization of environmental and socio-economic benefits of plants. Trees and other life forms supported by them have a positive value in scenic quality. Trees change skyline, add variety of forms, colour and texture to otherwise dull looking monotonous cities of concrete jungles. They soften the harshness of concrete structures, complement architectural lines, enframe views and provide background settings to different buildings. Plants help in controlling air pollution by acting as biological and physical nets. They cleanse the air by intercepting and slowing dust and other particulate materials causing them to fall out, and also by absorbing pollutant gases. Noise pollution from traffic, construction and public works, industries etc. affects human system. Plants can be successfully used for noise reduction. Vegetation along the highways can screen vehicular noise and vibrations from reaching the adjoining habitations. Hence, plants having thick and fleshy leaves with petioles are best suited for used as screens.

The bio-esthetic planning involves use of ornamental flowering plants along city roads, in parks, public place and compounds of houses in urban areas. Bio-esthetic planning improves micro-climate, mitigates pollution, creates habitat for several animal species, adds variety of form, colour and texture to the environment and brings positive changes in human behavior.

Benefits of Bio-aesthetic Planning

Environmental benefits

Temperature and energy use : Global surface temperatures have increased by about 0.3-0.6°C since late 19th century. Urban areas in particular behave as heat islands because of concrete structures, decreased wind, increased high-density surfaces and heat generated from human associated activities. Plants can be successfully used to mitigate heat. Their leaves intercept, reflect, absorb and transmit solar radiation. Thus, trees can reduce building energy use and cooling costs. A single large tree can produce the cooling effect of 10 room size air-conditioners operating 24 hours per

day. Furthermore, dew and frost are less common under trees.

Air quality : Sulphur dioxide, oxides of nitrogen, suspended particulate matter, lead, ammonia and carbon monoxide are the major air pollutants, which cause respiratory and other health problems. Plants help in controlling air pollution by acting as biological and physical nets. They cleanse the air by intercepting and slowing dust and other particulate materials causing them to fall out, and by absorbing pollutant gases. Plants increase humidity and thus help in settlement of particles. Interiorscape plants can remove organic pollutants from indoor air.

Precipitation and humidity : Plants intercept precipitation and slow its descent to soil surface thus increasing infiltration and reducing runoff and soil erosion. Pubescence on leaves help in water entrapment. Plants with horizontal branching and rough bark are most effective. Humidity is increased in hot and dry season by means of transpiration.

Noise abatement : Vegetation barriers partially minimize the sound from traffic, factories and construction sites. These screens should be dense, tall and wide, planted close to the source of noise. Urban residential areas can be protected by a row of dense shrubs backed by row of tall trees, which can grow about 20 feet wide. Vegetation along the highways can screen vehicular noise from reaching the adjoining habitations.

Carbon sequestration : Increase in CO₂ accounts for about 65% of the current direct positive radiative forcing due to greenhouse gases produced as a result of human activities. Plants remove CO₂ from the atmosphere during photosynthesis to form carbohydrates and return oxygen back as a by-product. Plants therefore act as carbon sink and remain one of the cheapest, most effective means of drawing excess CO₂ from the atmosphere. One hectare of trees absorbs about 3.7 t of CO₂ from the air generating 2.5 t of life sustaining oxygen.

Water erosion : Plants prevent harmful pollutants from soil from flowing into waterways, reducing topsoil erosion, slowing down water run-off, and loss of nutrients and sediments, while increasing ground water recharge. Reducing the flow of storm water reduces the extent of pollution that is washed into a drainage area, and also prevents severe clogging. Vegetation along rivers, lakes and other water bodies decrease their siltation and reduces cutting of bank during floods.

Wind protection and air movement : Trees perpendicular to wind direction may reduce its speed up to distance of 2-5 times the height of the tallest tree on windward side and 30-40 times on the leeward side. Trees can be planted to funnel or baffle wind away from areas – both vertical and horizontal concentration of foliage can modify air movement patterns.

Aesthetic benefits of Bio-aesthetic Planning

Trees and other life forms supported by them have a positive value in scenic quality. Trees change skyline, add variety of form, colour and texture to otherwise dull and monotonous cities. They soften the harshness of concrete structures, complement architectural lines, enframe views and provide background settings to buildings. Dynamic behaviour of vegetation makes the surroundings interesting. Plants can be very effectively used to screen undesirable and disturbing sight line.

Integrating Aesthetics and Nature Conservation

India is one of the 12 mega-biodiversity countries of the world with about 46,000 plant and 81,000 animal species described so far from 70% of the total geographical area surveyed. To conserve flora and fauna from extinction many botanical gardens, national parks and wild life sanctuaries have been created for conservation purposes.

Landscaping of Roads

India has made tremendous development in building roads and highways. At present the total road length of India is of 43.2 lakh kms. The environmental impact of the road construction activities

and the implications of air and noise pollution among others caused by the vehicular movement and the need to evolve an efficient approach to deal with such effect have received little attention. Plants should be selected with due regard to soil, rainfall, temperature and water level. The tree species should be either truly evergreen, nearly evergreen or should bear leaves during peak summer. They must not spread too wide to interfere with traffic flow and ideally grow to the height of 2.5-3.5 m from ground level. They should be fast growing and wind strong without thorny or droopy leaves. Trees should be deep rooted. Traditional roadside or avenue trees like *Jamun* and seedling mangoes should be preferred which have long life.

Highways

Bio-aesthetic planning for highways should begin at design stage so that it could be a part of the master plan. Design objectives of highways should be to fit the road into the existing terrain and harmonise it with general landscape of the region. Existing features along the road alignment, like natural wooded areas, streams, ponds, rock outcrops, scenic vistas, historical buildings, monuments, gardens etc. can contribute significantly to general landscape. In the construction stage removal of vegetation and cutting of trees should be done judiciously and limited to minimum possible extent so that least habitat loss occurs. Plantation of ornamental and economically important species should be carried out to a sufficient distance on either side of the road. Besides pollution abatement, planting blends the road into the surrounding countryside and enhances the overall beauty. Vegetation also provides habitat for many species of birds, rodents etc.

Roadside planting of trees may be in the form of avenues, groups or groves. At least 5-6 rows of trees should be planted so as to provide sufficient green cover. Location of trees and vertical clearance available across the roadway should be checked to ensure that motorists get clear vision of highway signs or signals at all times. Road dividers should be planted with hardy, short height shrubs to cut off headlight glare coming from vehicles from opposite lane.

Tree planting along highways can be done according to the following two schemes:

- i. *Front row of flowering trees and rear rows of utility trees:* Front row should be planted with flowering trees of different species, each for 3-5 km and the subsequent rows should be planted with species of economic importance such as timber, fruit and fuel wood.
- ii. *Mass effect of flowering trees:* Flowering trees should be planted as large groups for about 0.5 km after every five km of the plantation of economically important species. Such groups should be arranged alternately on both sides of the road. This will break the monotony of singly planted species.



Rural

concern shade and flowers, which would provide economic products such as fuel wood, timber, honey, fodder etc. Roads should be planted with small to medium sized trees.

Avenue Plantation

Urban Centres

Today the cities have expanded so much due to population pressure that nature, which used to be near at hand previously has receded far away to the countryside and citizens have little opportunity to be in contact with its various moods in different seasons. The few public gardens and tree-lined avenues are the only places where the beauty of nature can be appreciated in the towns. The creation of healthy natural areas increases biodiversity, while providing important habitat for urban wild life. It also contributes to a city stock of “green infrastructure,” which includes parks, avenues and green belts.



Proper town planning is a pre-requisite for bio-aesthetic treatment of our cities and towns. This can be seen only in new towns with wide roads and well laid out public parks, rather than in congested old towns with narrow crooked streets. Older parts of our towns have ugly, ill-ventilated houses joined together along narrow lanes. Deficient in open places, they offer little scope for bio-aesthetic planning. The few existing trees in such areas should be preserved as far as possible and wherever possible some open spaces should be created and converted into parks. Some open spaces are however available around religious places and historical buildings, which can be used to give a healing touch by planting flowering trees and shrubs. New townships have greatest potential for proper bio-aesthetic planning.

Bio-aesthetic Planning of Cities

Under ideal conditions, a garden should be near at hand, so as to be easily accessible by safe walkways from the dwelling places, so that the children can be taken there for playing. Such walkways can be fitted in, in the system of parks and gardens to enable children to reach their schools from home in complete safety and freedom from traffic hazards. Gardens near commercial hubs can be very useful for resting and spending time, while waiting for public transport. Theme parks like Bougainvillea garden, Cacti garden, Seasonal garden, fragrant garden, Rose garden *etc.* can be developed with an intention to create awareness among the citizens. Intended use and available space should be the main criteria for selection of plants from amongst those suitable for the agro-climate of the region. For planting at public places selection should be made from a variety of shade giving and flowering trees. In case of individual buildings large trees help architectural composition and provide the required background and in fact look like structural members of the scheme. Shrubs and climbers also serve their purpose by the creation of various decorative patterns.

Compounds of Hospitals : Flowering trees, shrubs with fragrant flowers blooming in different seasons, palms and shady trees should be planted in compounds of hospitals. Medicinal plants like neem should be preferred, which also provides good shade. This will improve microclimate of the hospital complex and the beauty of flowers will make the otherwise dull environment, little interesting.

Educational Institutions : Maximum possible ornamental and economic species should be planted in educational institutions so as to educate the students about importance of plants in everyday life. Students should be involved in maintenance of the plants.



Other Public Buildings

Courts, office buildings of the government and post offices should be planted with flowering & shady trees and shrubs so that visiting public may rest under the shade and enjoy their beauty. Railway stations, bus stand and airports, which are gateways to the cities, should be meticulously planted so as to accord welcome to the commuters and make the long waiting period, little interesting.



Industrial Areas

Bio-aesthetic planning is thus very important for industrial areas. Government of India has issued certain guidelines for industrial sitting according to which industries should be located at least 25 km from ecologically sensitive areas such as national parks, sanctuaries, lakes, biosphere reserves; archaeological & and historic places and from major settlements (>3 lakh). Green belts should extend 500 m from the boundary of such areas. Bio-aesthetic plan for industrial areas should include creation of buffer zones around the areas with mixed plantation of economically important species to serve the dual purpose of revenue generation and environmental amelioration. A green belt of suitable trees having a width of 50 to 100 m between residential and industrial zones decreases dust markedly. Some of the trees suitable for different purposes are as follows;

Air pollution : *Acacia auriculiformis*, *Albizia lebbek*, *Ailanthus excelsa*, *Azadirachta indica*, *Cassia fistula*, *Cassia marginata*, *Madhuca indica*, *Polyalthia longifolia*, *Putranjiva roxburghii*, *Terminalia arjuna*.

Noise pollution : *Azadirachta indica*, *Butea monosperma*, *Erythrina variegata*, *Grevillea robusta*, *Kigelia pinnata*, *Lagerstroemia speciosa*, *Madhuca indica*, *Mangifera indica*, *Morus alba*, *Pterospermum acerifolium*, and *Terminalia arjuna*.

Botanical Gardens : Many botanical gardens have been created for conservation of plant wealth of the country. These gardens serve as centres of collection, maintenance and evaluation of germplasm of important species apart from education in botany. Except the ones of national importance and those established by the British, majority have been planned for scientific purpose only and lack beauty.



Landscape at hospital



Ooty Botanical Garden



Moonlight garden: Moonlight garden also referred as Night-scented garden is an Educational Institution enriched with different range of fragrance or mixtures of scent emitted by plants. The key feature of this garden is the celestial scent from the fragrant plants, which is stronger in the early morning and evening hours, particularly on a still day.



Butterfly garden: This can be a part of bio-aesthetic planning that focuses on the preservation of different species of butterflies as well as landscaping too. Butterflies are the most attractive insects and they give added interest to gardens when they visit flowers to feed on nectar. Creating a butterfly garden not only attracts beautiful butterflies but also filled the garden with colorful flowers throughout spring, summer, and fall. It focuses on creating a landscape with different ornamental plants that will provide a suitable environment for butterflies to thrive and reproduce.

Conclusion

Bio-aesthetic planning aims at enhancing biodiversity along with beautification of environmental natural features in urban landscape like green belts, parks, roundabouts and backyard plantings serve as urban wildlife habitat, supplying food, water and cover for a variety of birds and animals. Garden and avenues plants change the skyline, add variety of feature and forms, colour and texture to different buildings and features, roads and roundabouts, building and houses in otherwise concrete jungles in the cities. Hence, bio-aesthetic planning can play an important role in amelioration in urban and semi-urban areas. The planners of today should be able to satisfy the urge of citizens to be in contact with nature without covering long distances. This is possible by developing green areas in the form of botanical gardens, parks and wild-life centuries. Therefore, concept of bio-aesthetic planning should always be kept in mind, while designing new cities, towns and other residential establishments.

LAND SCAPING OF ROADS IN URBAN AREAS

Shiv Shankar Singh, Sectional Officer (Hort.), PWD, Delhi

In India most of the old cities and towns are very much planned without any consideration given to landscaping with trees and plants and as a result they look nothing but like brick and concrete jungles. The great architect Corbusier once says that “**Unless the conditions of nature are reestablished in man's life, he cannot be healthy in body and spirit**”. The City dwellers lack the sunshine, space, verdure which defriend them with the essential joys of life.

Our towns and cities can be made more livable, healthy and beautiful by resorting to bio-aesthetic planning. This can be achieved by planting road side trees and establishing parks planted with green plants. In the old congested cities this can be achieved by planning garden shrubs. The cities can further be beautify byutilizing the surplus land for developing parks.

Previously the purpose of planting trees in urban areas was purely aesthetic. The incessant increase of urban environmental pollution has created a necessity for us to reconsider the whole approach of urban ecology and its orientation in order to achieve dual effect of bio-aesthetics and mitigation of pollution. Proper planning and planting scheme depending upon the magnitude and type of pollution, selection of pollution tolerant and dust scavenging trees and shrubs should be used for phytoremediation of environmental pollution. Pollution, the major problem in the cities which is compounded by the fact that there is no exhaust for the polluted air to escape. Landscape architects / horticulturists can solve the pollution problems related to urban landscape by creating a micro-climate. “Arboriculture” is the science for selection of the suitable plant species on the road side and dividers intended for giving relief to the pedestrians, motorcar and cycle drivers. The planting of road side avenues are not only important for beautification, but also from utility point of views. Trees provide cool shade which is so much needed in the long hot summer months. Trees also help bring down air pollution, act as wind break, and cut down noise. Parks are places of relaxation, entertainment, and fresh air in an otherwise congested city.

India possibly has the largest number of flowering trees, both indigenous and exotic which can be used for landscaping town roads. Road of the urban areas remains busy with movement of vehicles resulting lot of pollution. There areas are to be landscaped with proper selection of trees which are tolerant to pollution as well produce flowers also. Trees may be planted in single or double rows considering space availability. The pattern of planting may be triangular so that trees act as a physical barrier against the horizontal and vertical movement of pollutants including sound. Close planting is recommended as overlapping branches and dense leaves offer more resistance and scope for setting pollutants or get absorbed. Trees recommended for this purpose are – *Anthocephaluscadamba*, *Cassia marginata*, *Lagerstroemiathroelii*, *Mimusopselengi*, *Polyalthialongifolia*, *Putranjivaroxburghii*, *Acaciaauriculaeformis*, *Ailanthus excels*, *Pongamiapinnata*, *Tamarindusindica*, *Terminaliaarjuna*, *Terminaliapaniculata*, *Grevillearobusta*, *Ficustsila*, *Meliaazadirachtaetc*.



A Beautiful view of roads

When planting is to take place in central verge which is quite wide (more than 2m) selection of dwarf trees may be made like *Cassia fistula*, *Cassia Javanica*, *Cassia marginata*, *Bauhinia purpurea*,

Bauhinia variegata, *Spathodeanilotica*, *Jacaranda mimosifolia*, *Lagerstroemia flosreginae*, *Pongamiaglabra*, *Saracaindica*, *Plumaria alba*, *Plumariarubra* etc. Where central verge is narrow (less than 2m.) shrubs are good choice as these covers whole ground area.

While selecting plant species one should keep in mind the automobile emission as well as dust load. Some of the recommended ornamental plants species are- *Bougainvillea* sps., *Nerium indicum*, *Calliandra* sps., *Thevetia peruviana*, *Lantana depressa*, *Sanseveria* sps., *Wadalia laciniata*, *Euphorbia milli*, *Cassia alata*, *Pongamia pinnata*, *Albizia lebbek*, *Polyalthia longifolia*, *Alstonia scholaris*, *Azadirachta indica*, *Cassia nodosa*, *Butea monosperma*, *Madhuca indica*, *Crossandra in fundibuliformis*, *Portulacaria afra*, *Setcreasea purpurea* etc.

At the sides of road where traffic is more planting trees will serve both of purposes aesthetics and improvement of environment. Proper planning and selection of right type of



trees and plants will certainly serve the purpose. In large traffic islands, trees should be planted along the periphery besides shrubs and flowers beds in suitable size and design. Some of the recommended plant species are- *Lantana depressa*, *Bougainvillea*'s, *Russelia equisetifolia*, *Russelia juncea*, *Portulacagranelia*, *Vincarosea* etc. Green belt is defined as the mass plantation of pollution tolerant trees and shrubs in an area for the purpose of minimizing air pollution by filtering intercepting and observing pollutants in an effective manner for improvement of the environment. The effectiveness of the greenbelt depends on the several factors viz. Climate conditions, design, selection of plant species, its characters and type of pollutants. The importance of the greenbelt can be ascertained from the estimate of cleaning capacity of 3.7 tons of CO₂ from atmosphere and supply of 2.5 tons of oxygen from one hectare of woodland area.

Designing greenbelt is a specialized task. It should be planned in such a way so that minimum time is taken to develop and remains effective for long period of time. Three tier system of planting keeping dwarf trees with round canopy close to the source of emission followed by medium and tall trees with cylindrical canopy is most effective design for the urban region because all trees are exposed to the pollutants. Selection of right type of trees is very critical for greenbelt and following characters are considered as ideal-fast growth, strong branches, large leaf size, dense foliage and long life span. Following trees and shrubs are recommended for planting in the greenbelt which have aesthetic effect as well as pollution tolerant capacity – *Albizia lebbek*, *Azadirachta indica*, *Bauhinia purpurea*, *Butea monosperma*, *Dalbergia sissoo*, *Ficus infectoria*, *Melia azedarach*, *Mellingtonia hortensis*, *Bougainvillea* sps., *Murraya paniculata*, *Nyctanthes arbor-tristis*, *Parkinsonia aculeate*, *Polyalthia longifolia*, *Putranjiva roxburghi*, *Terminalia arjuna*, *Thevetia nerifolia*, *Cassia siama*, *Acacia auriculiformis* etc.

Considering the present scenario of urban environmental pollution, there is a growing need for changing the approach of planting trees and other plant species. Inclusion of the ornamental plant having pollution mitigating ability in the landscape plan will serve the dual purpose in the long way for making the cities green and pollution free. Proper planting scheme will bring life and colour in the cement concrete jungle and healthy environment to the urbanites.

MAN AND ENVIRONMENT

Kuldeep Saddy, Director (Hort.) (Rtd.) CPWD

Earth is the only place in the universe known to sustain life. Yet the human activities are progressively reducing the planet's life supporting capacity at a time when increasing population and consumption are making increasing demands on it. It is necessary that a new economic order is achieved, human population stabilized and suitable mode of development is adhered to by the government.

Man's progress in science has increased his control over nature making him more powerful to exploit one natural balance. We ignore the signs of the resistance of nature in the belief that science will ultimately lead us through. We use the medium of science technology to win over nature to achieve what we call progress. At what cost can we achieve this so called progress. Can this progress be stable and long lasting with the steady deterioration of the environment around us?

The question we would ask "Is Development and Environment" contrary to each other. No – it needs to be made complimentary by co-operation rather than exploitation of nature. Development is modification of biosphere and application; of resources to improve the quality of human lives. Development needs to be made complimentary by proper management of human use of biosphere so that it may yield the greatest sustainable benefit to the present generation while maintaining its potential to meet the need and aspiration of future generations. The management involves conservation of living animals micro-organisms and plant life and non-living elements on which they depend. The delicately balanced order of nature is being disturbed by activities of men and we will have to exert to restore the balance and ensure survival.

Landscape gardening or Landscape Architecture as it is called now is an art as well as science. To know it one must have an aesthetic sense, an understanding of the scale and proportion of things and an appreciation of hues and various tones of which nature blends to create a pleasant picture. Planting of the right varieties of trees, shrubs climbers, annuals, bougainvillea etc. play an important role to create a pleasant change. However planting of trees /shrubs are the most important for improvement of the environment I will devote my talk only on trees while the art landscaping will be discussed by experts on the subject.

Trees bear fruit we eat, flowers we use for garlands etc. timber for furniture and housing material and myriads of other jobs. Trees afford shelter and shade in summer; they are weather conditioners by purifying and humidifying the air, screening the winds, checking radiation of heat and obstruction of glare. They are noise limiters in towns. Many trees are ornamental and beautiful while blooming or in outline and foliage. Some fill the air with fragrance or their flowers. Almost all of them delight and refresh the eyes with green foliage. They prevent evaporation from soil while mass scale plantation of trees in the form of forests influence local and regional climate.

Trees when planted judiciously add to the beauty of the surrounding. Both flowering and ornamental trees need to be planted on a large scale for enhancing the aesthetic quality of the environment. Trees can be planted to bring out the beauty of the buildings or to hide its deformities

Our ancestors loved indigenous trees. Kadamba, Ashok are associated with Lord Krishna and Sita. Trees had been sanctified in folklore and religion. It was under shade of pipal tree that Lord Buddha obtained inner light the Mughal kings were lovers of trees and reportedly introduced Chinar in Kashmir from China.

With all the knowledge about usefulness of trees, they suffer neglect from our countrymen. Excessive urbanisation created by industrialisation has torn away our population from the environment of trees. Most of the social conditions and tension which develop in towns are due to the fact that men are isolated from natural environment. Unless the conditions of nature are available in man's life, he cannot be healthy in body and spirit. It is necessary that people in towns are brought in touch with nature by planting and proper maintenance of trees.

New Delhi was developed by the famous Sir Edward Lutyens and his team. Trees native to India were planted on the well planned roads. The beautiful awareness is lined by Arjun, Imli, Neem, Jaman, Dilkhan, Pipal and other indigenous trees. The trees were planted decades ago and still they are growing strong changing the whole environment of the areas. The beauty of trees and shrubs can be further appreciated by comparing a properly landscaped surrounding of a house with barren surrounding of the other. We want our houses and surrounding to provide shelter from crowds and tension of modern world – a place to relax in privacy. Trees planted in the garden will help to absorb heat and suppress noise. They will capture pollutants from the air while freshening with oxygen.

With fast urbanisation, human population tend to be achieved to live in urban areas. Obviously it is important that future cities are made as hospitable / congenial as possible for human habitation. This demands conceptual shift from present day pattern of structure and growth of cities as concrete jungle to that of human centred habitats co-existing with greenery. Planning of urban-eco-system that incorporates vegetation as an important component of urban growth in the form of awareness, parks, orchards etc. is very important. Let us strive to scientifically maintain the trees in our urban landscape for making the trees more congenial to human habitation and better co-existence. Growing trees is living symbolic a progressive nation.

CPWD with its horticultural wing is leading organisation in the country involved in construction activities. It is necessary that this organisation sets an example to other organisations in providing proper landscape and environment for human habitation.

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