AATCC Review

Review Article

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Role of Ornamental Plants in the Improvement of Environment

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ABSTRACT

Now a day, pollution has become the biggest threat for the survival of the biological species. There are different types of pollution e.g. air, water, soil, noise and mental pollution. Ornamental plants instead of adding aesthetic values also improve environment by different ways like Temperature regulation, oxygen production, regulate rainfall and check spread of desert, carbon sequestration, control urban glare and reflection, control water and soil erosion, reduce impact of weather through windbreaks, air, water and noise pollution. Soil salinity is also a major environmental issue affecting livelihood of many due to the effects on agricultural productivity and environmental quality. In this review, I tried to compile the work of different authors from 1971 to 2022.

Keywords: Pollution, Ornamental plants, Environment.

Introduction

Environment is defined as the sum total of water, air, and land relationships among themselves and with human beings. It affects our health in many ways. The interaction between human health and the environment has been extensively studied and environmental risks have been proven to significantly impact human health either directly or indirectly. However, the present status of our environment is very alarming. A report by governmental Panel on Climate Change (IPCC), which was released in 2001, estimated the rise in global average surface temperatures between 1.8ºC and 4ºC from 1990-2100. By 2030, India's per capita CO_2 emission is projected to increase by 1.6 tons (Francis *et al*, 2005). This Environmental Degradation has been defined as any undesirable change in the physical, chemical or biological characteristics of air, water, and soil that creates a hazard or potential hazard to the health, safety or welfare of any living species. Environmental Degradation is one of the ten threats officially cautioned by the High-Level Threat Panel of the United Nations.

Environmental problems are manifestations of disharmony between human activities and the environment. Both natural and man-made factors have contributed to the environmental degradation. Deforestation, overuse of pesticides, chemical fertilizers and insecticides, congested housing and unmanaged urbanization, industrialization and production of litters, sewages and garages etc. are the major reasons which deteriorate the quality of the environment. The pressure of the population is awful in towns which results in air, water and sound pollution too. Deforestation provokes the wildlife and other organism to the verge of extinction. The forest areas have been cleared for agricultural land, settlements and to collect useful herbs. This results in environmental degradation**.**

Global warming is another result of environmental degradation. The temperature of the earth is rising and due to the rise in temperature, the polar icecaps are melting and the ice in the colder regions is not as thick as it was before. Many species are lost every day due to various activities of the human beings. Scientists have, for decades, been trying to bring to the attention of people and their governments the importance of maintaining the environment of planet Earth and of carrying out our daily lives in a fashion that ensures our offspring will inherit a cleaner, greener, more ecologically sustainable world. Earlier, the purpose of planting trees in urban areas was purely aesthetic [3]. The incessant increase of urban environmental pollution has necessitated reconsidering the whole approach of urban landscaping and its orientation in order to achieve a duel effect i.e. bio-aesthetics and mitigation of pollution. Ornamental plants have a wide spectrum of uses in environmental management; the most obvious are the direct effects on the ecological position of human being such as the control of erosion by wind and water. Over time, plants have modified themselves morphologically to absorb pollutants and provide us with a clean and healthy environment [23]. Trees, which form the principal group of ornamental plants, act as a sink of air pollutants and thus reduce the concentration of pollutants in the air.

The important roles of ornamental plants in the improvement of the environment are
1. Temperature Regulation
Collectively, trees can affect the local climate by reducing the effect of urban "heat islands" often found in built-up areas. The heat island phenomenon causes urban and suburban temperatures to be 1-6ºC hotter than nearby rural areas [22]. Heat islands form as vegetation is replaced by asphalt and concrete for roads, buildings, and other structures necessary to accommodate the growing population. These surfaces absorb, rather than reflect, the sun's heat, causing surface temperatures and overall ambient temperatures to rise [19]. Heat islands develop in pockets around single buildings and temperature differences of 4°C have been reported along a single street (Taha *et al,* 1990). The obvious solution for counteracting urban heat islands is to plant trees and shrubs in such areas.

Green Roofs Or Roof Gardens

These are constructed on flat rooftop having a slope of less than 10'' and covers balconies & terraces which help with energy savings via climate control both inside the building and for the city as a whole, assist in water management by cleaning and retaining water, and can reduce the noise levels around the city [8], reduce greenhouse gases by 2.18 MT based on 6.5km^2 of green roof coverage. It has been reported that 30 MT of pollutants were removed from the air and summer temperatures were reduced by 1-2°C [7]. Green roofs can significantly reduce the roof surface temperature by 7.3°C and can also lower the ambient air temperature by 0.5°C [10]. Ideal plants for green roofs should have fibrous root systems, should be hardy to survive in extreme climatic conditions, and should preferably be self-sown. Since the airflow on roofs is high, the plants for green roofs should not be more than 0.5-0.6 m in height. The benefits of green roofs may be categorized under a range of scales. Some of the benefits are appreciable only when a large number of green roofs are implemented at the larger neighborhood or urban scale, while others may be availed at the individual building level. Even when the advantages at the building level are not that substantial, green roofs add value to the structure. Vegetated roofs provide an outdoor healthy space for the user, and add aesthetic value to the building, benefits that are not tangible. The following table compares the positive aspects of a green roof installation with a conventional roofs (Peck, 2008).

Benefits	Green Roofss	Conventional Roofs
Storm water volume retention	10-35% during wet season, 65-100% during dry season	None
Temperature mitigation	In hot season	Achieved with insulation
Urban heat island mitigation	Prevents temperature increases	With light colored roof ,e.g. White roofs
Improved water quality	Retains atmospheric deposition and retards roof material degradation. Reduce pollutant loadings	None
Air quality	Filters air and increases Evapotranspiration	None
Energy conservation	Insulate building roof	Through addition of insulation, Light colored roof and shading Reduction in energy consumption may be achieved.
Vegetation	Allows Seasonal Evapotranspiration; Photosynthesis	None
Green space	Replaces green spaces lost to due to the building footprint	None
Habitat	For birds and insects	None
Other advantages	Buffers noise, alternative aesthetic, offers passive recreation	None

Ornamentals suitable for green roofs include flowering shrubs (*Hamelia petens, Ervatamia divaricata* dwarf, Bougainvillea, Lantana sp.), foliage plants (*Ficus panda, Ficus benjamina*, Duranta sp., Iresine, Tradescantia), pot plants (Sansivieria, *Euphorbia splendens*, Yucca, Cacti, Bryophyllum), shade loving plants (Salvia, Cineraria, Scindapsus sp.), climbers (*Vernonia elaegnifolia, Pyrostegia venusta*, Jasminum sp., *Ficus repens*).

1. Oxygen Production

The fundamental benefit provided by plants is their production of oxygen; thus providing the atmosphere with the element that allows humans to breathe and live on this planet. Oxygen is produced by the plant during the process of photosynthesis. Photosynthesis is how plants produce their food (energy). It requires carbon dioxide, water, and sunlight. The outputs of photosynthesis are sugars and oxygen. A mature tree produces as much oxygen in a season as 10 people inhale in a year. On average, a tree can produce 260 pounds of oxygen per year and two mature trees can produce sufficient oxygen for a family of four [7]. It has been found that two mature trees can produce sufficient oxygen required for a family of four persons. Similarly, a natural turf area just 50 feet by 50 feet releases enough oxygen for a family of four (Virginia State University, 2004).

2. Regulate Rainfall and Check Spread of Desert

Punjab experienced drought due to inadequate rain in Monsoon. The State was experienced drought in 1978, 1979, 1985, 1987, 2002, and 2004, both in rural and urban areas. In 1987, a major drought was experienced in the State but in 2002, the intensity of the drought has made the situation much more acute and has broken the back of the farming community. The State Government has declared 17 districts in the State as drought-affected. The primary causes of drought include low rainfall or inadequate snow pack the preceding winter. However, other factors may also contribute to drought conditions including land degradation and an increase in water demand. A United Nations Development Programme (UNDP) report states that about 12% of Punjab state suffers from the threat of desertification. Land has been intensively cultivated under the Green Revolution at the expense of grazing and traditional fallow periods. The desertification of Punjab is proceeding (and will increase with climate change) due to the excessive use of fertilizers and improper irrigation techniques without a proper long-term soil conservation strategy. In one day, one tree can lift up to 100 gallons of water out of the ground and discharge it into the air. Ornamentals suitable for arid regions of Punjab include-

Trees
- ✓ *Albizia lebbeck*
- ✓ *Butea frondosa*
- ✓ *Cassia fistula*
- ✓ *Eucalyptus citridora*
- ✓ *Casuarina equisetifolia*
- ✓ *Melia azadirach*

Shrubs
- ✓ *Daedlacanthus*
- ✓ *Tabernaemontana*

3. Carbon Sequestration

Plants take in carbon dioxide and convert it to carbohydrates (sugars). These sugars provide the plant with energy to grow. As the plant or parts of the plant die, the decomposition of the plant material returns the carbon to both the soil and the atmosphere. Carbon within soils can be released via agricultural tillage or soil disturbance [15]. This cycle of removing carbon from the air and capturing it in plants and soil is called carbon sequestration. A tree in a forest removes 4.5-11 kg of carbon per year [1] by simply growing and using carbon dioxide to do so. Plants' ability to sequester carbon is an important process that can be used to mitigate the increases in carbon dioxide concentrations in the atmosphere that has been occurring since the Industrial Revolution [2]. Carbon dioxide is a "greenhouse gas" and as such is contributing to the increase in the average global temperature. These changes are very likely to cause significant changes in climates around the world [2]. To counter this trend, green spaces (or large trees) are planted in public rights of way, parks, and open spaces to build the global availability of "carbon sinks" [16]. Programs are emerging around the world where people are paying to plant trees in order to mitigate the emissions they contribute to the atmosphere via airline travel [6]. By planting trees, travelers are creating a "carbon sink" and reducing their individual "carbon footprints". The trees absorb carbon as they grow and offset some of the carbon that is emitted by the burning of fossil fuels during travel. A number of entrepreneurial companies are providing tree planting services for people who wish to assist in reducing their impact on the increasing carbon dioxide levels [6], including the impact people have due to everyday living and working (Carbon Footprint, 2007).

4. Control Urban Glare and Reflection

Trees reduce the "urban glare" effect by absorbing heat and light. This improves overall quality of life and is beneficial to the environment. Urban glare is the excessive reflection of sunlight off of reflective surfaces such as windows and buildings. Green spaces reduce urban glare in cities by absorbing light. By installing urban green spaces, city planners can reduce the urban glare effect with strategically placed landscaping. Landscaping is an effective way to capture the light and deflect it so that the light in the city is not so harsh and unpleasant for residents, improving the quality of life in the community. Dense foliage absorbs about 70 percent of the sun's rays, reflects 17 percent, and transmits about 13 percent. Trees and shrubs help control light scattering, and light intensity and modify predominant wavelengths on a site. Trees block and reflect sunlight and artificial lights to minimize eyestrain.

Plants suitable along the road sides
- *Acacia auriculiformis*
- *Ailanthus excelsa*
- *Albizzia lebbeck*
- *AlstoniaMacrophylla*
- *Azadirachta indica*

- *Bauhinia acuminate*
- *Bauhinia purpurea*
- *Butea monosperma*
- *Cassia fistula*
- *Cassia marginata*
- *Cassia siamea*
- *Ceibapentandra*
- *Dalbergia latifolia*
- *Dalbergiasissoo*
- *Emblicaofficinalis*
- *Eucalyptus globulus*
- *Ficus benghalensis*
- *Ficus religiosa*
- *Lagerstroemia duperreana*

Plants for Road Dividers
- *Acalyphawilkinsiana*
- *Bougainvillea spectabilis*
- *Callistemon lanceolatus*
- *Durantaplumeri*
- *Hemilia patens*
- *Hibiscus rosa – sinensis*
- *Ixora coccinea*
- *Jatrophapanduraefolia*
- *Lantana camara*
- *Lantana depressa*
- *Neruim oleander*
- *Vincarosea*
- Adapted from [21,13]

5. Control Water And Soil Erosion

About 3,000 hectares of cultivated land is lost to erosion in Punjab province annually. Intensive cultivation, deforestation, and destruction of the natural vegetation by grazing or other means have increased soil erosion to a large extent. Studies in the area have indicated that runoff during the monsoon period varies between 24 and 36 percent, whereas annual loss of rainwater varies between 26 and 42 percent. The runoff carries along with it upper fertile soil rich in applied nutrients, thereby decreasing the productivity of the soil. As per the Central Water Commission [9], around 9,140 sq. km area in the state is prone to water erosion. There are significant benefits that can be gained from plants concerning water management. Plants can assist in flood control by retaining water. For example, wetlands and green spaces both purify and retain water that would otherwise drain away putting overloads on storm sewers. This retention allows for aquifers to be recharged. Plants can be used in conjunction with stormwater management ponds to manage water run-off from urban areas [11]. Plants around the pond provide structure for the soil reduce water erosion and, in doing so, reduce sedimentation in the waterways. The water flow is slowed by the presence of plants allowing the water time to infiltrate the soil [4]. Additionally, stormwater ponds provide green and open space for a community's year-round enjoyment and provide unique habitat for wildlife [11] that is rapidly being lost to urban development. Using plants to reduce run-off can occur in many situations.

6. Reduce The Impact of Weather Through Windbreaks

The planting of hardy trees to build shelterbelts protects the soils from wind erosion, and encourages the protection of a natural resource. The added benefits of the shelterbelts are that they make working in a farm more pleasant because the cold winter wind is blocked in winter, and in summer, birds inhabit the stands of trees. Protection obtained from winds varies in relation to the height (H) of trees.

Windbreaks planted at the same distance as the height of trees (H) reduce the impact of wind by 90%, at a distance double the height (2H), by 75%. At a distance of 5 times the height of trees, the impact of winds is reduced by about 50%. Therefore, it is better to have several windbreaks 5H to 6H apart rather than large forest stands with wide open spaces in between. Ornamental plants which have been found suitable as windbreaks are-

For arid regions
- *Acacia auriculiformis*
- *Ailanthus excelsa*
- *Albizia lebbeck*
- *Azadirachta indica*
- *Casuarina equisetifolia*
- *Grevillea robusta*
- *Pongamia glabra*

For coastal areas
Ailanthus malabarica
Casuarina equisetifolia
Pongamia glabra
Sesbaniaaculeata
Thevetia Peruviana
Thespesia populnea
Vitex negundo

7. Pollution Amelioration
Air Pollution
Ambient air pollution in several large cities in India is amongst the highest in the world. The major air pollutants are carbon dioxide, methane, oxides of nitrogen and Sulphur, dust and particulate matter, and ozone. Industry and automobiles are the primary and secondary contributors to air pollution worldwide. Air pollution is a major environmental risk to health and is estimated to cause approximately two million premature deaths worldwide per year. A reduction in air pollution is expected to reduce the global burden of disease from respiratory infections, heart disease, and lung cancer. For every gallon of gasoline manufactured, distributed, and then burned in a vehicle, 25 pounds of carbon dioxide is produced, along with carbon monoxides, sulfur dioxide, nitrogen dioxide, and particulate matter; these emissions contribute to increased global warming. The global auto population is expected to double in the next 25–50 years. In 1997, the Environmental Protection Agency (EPA) proposed new rules that would require diesel manufacturers to build cleaner engines and the oil industry to produce much cleaner fuel. The main conclusion from the literature review is that some forms of air pollution, notably inhalable particulate matter and ambient lead, are serious matters of concern in the developing world since they are associated with severe health damages in monetary terms.

Plant species for pollution control
Urban trees can help to improve air quality for many different air pollutants in the cities, and consequently can help improve human health [18]. While selecting the species for pollution control the following are the important characteristics that could be considered. Plants should be evergreen, large-leaved, rough bark, indigenous, ecologically compatible, low water requirement, minimum care, high absorption of pollutants, resistant pollutants, agro-climatic suitability, height and spread, Canopy architecture, Growth rate and habit (straight undivided trunk),
Aesthetic effect (foliage, conspicuous and attractive flower color), Pollution tolerance, and dust scavenging capacity.

Different types of leaves tend to have differences in several aspects of their surfaces. Some types of leaves have greater surface rigidity or roughness than other leaves, which may affect their stickiness or particle solubility. Stickier leaves are better for collecting particles because more particles would stick to their surface. Therefore, certain plant leaves may be more useful for efficient dust capturing than other plants. The various morphological features are also major factors for dust capturing by leaves.

During tree plantation in an urban environment, little or no attention has been paid to evaluating the effect of trees on filtering the particulate matter. New housing developments offer an opportunity to control atmospheric particulate pollution through tree plantations. Trees such as Tamarind (*Tamarindus indicus*) having smaller compound leaves are generally more efficient particle collectors than larger leaves. Particle deposition is heaviest at the leaf tip and along the leaf margin. In the preliminary survey of dust fall on common roadside trees in Mumbai, carried out by Shetye and Chapheka [20] rreported that the shape of leaves of Mango (*Mangifera indica*), Ashoka (*Polyalthea longifolia*), Pongamia (*Derris indica*) and Umbrella (*Thespepsia populnea*) trees captured higher amounts of dust as compared to other neighboring plants. Dochinger [5], a plant pathologist of USDA Forest Service, Ohio, reported that the filtering effects of evergreen trees are better than the deciduous trees. In Singapore; it has been noted that a single row of trees planted with or without shrubs can reduce particulate matter by 25% and each hectare (2.471 acres) of plantation can produce enough oxygen to keep about 45 persons alive [3]. The value of trees in urban environments is now generally recognized not only aesthetically but also functionally in helping to make cities and towns agreeable places to live and work in. The first choice should be, therefore, to select easily propagated and readily available, medium-growing, ecologically much suitable, pest and disease-resistant tree species and also require less maintenance should be given top priority. Columnar and medium-sized trees are preferred. Ingold [12] reported that the leaves with complex shapes and large circumference area reported to be collected particles more efficiently. Many trees like Neem (*Azadirchta indica*), Silk cotton (*Bombax ceiba*), Indian laburnum (*Cassia fistula* and *C. siamea*), Gulmohar (*Delonix regia*), Pipal (*Ficus religiosa*), Jacaranda (*Jacaranda mimosifolia*), Indian lilac (*Lagerstroemia indica*), Temple or Pagoda tree (*Plumeria rubra*and *P. alba*), Java plum (*Syzygium cumini*) and several other roadside and street trees have foundmore suitable in urban environment. Chakra has suggested that insect-pollinated trees with short flowering periods and also with less pollen productivity should be selected. It is also recommended that wind-pollinated tree species those, flowering during the rainy season can also be planted, as rains will wash out extra pollens. A tree should be relatively free of insects and diseases and there should not be dropping of messy fruits (*Muntingiacalabura*, *Cerberaodolam*), seed pods (*Acacia auriculaeformis*), twigs and leaves (*Dyeracostulata*). Trees with a tendency to drop large and heavy fruits (*Durio*spp.) and emit a bad smell (*Sterculia foetida*) must be considered a serious drawback.

Sulphur Dioxide
Sources of Sulphur dioxide pollution are the refining of Sulphur containing Cu, Pb, Zn and Ni ores, use of high Sulphur petroleum and natural gas, and use of low-quality and high Sulphur containing coal.

As all gaseous exchanges take place through stomata, because of air pollutants, the regulation of opening and closing of stomata is disturbed. SO_2 once enters into cells, reacts with proteins of the plasma membrane and gets converted into sulphites and bisulphite ions. The most sensitive plants are affected by Sulphur dioxide even at a lower concentration of 0.05ppm. Moderately sensitive plants withstand 0.3 ppm level. But the immune plants are quite unaffected at 3 ppm level for a few hours.

Plants with high amounts of ascorbic acid content should be selected against SO_2 pollution. Ascorbic acid detoxifies SO_2 and the plant system is not much disturbed. The presence of enzyme such as sulfite oxidase helps in SO_2 tolerance. Trees resistant to SO_2 pollution include

- *Albizia lebbeck*
- *Alstonia scholaris*
- *Ficus religiosa*
- *Terminalia arjuna*
- *Polyalthia longifolia*

Ozone

Under the high level of ozone, stomata remain closed which leads to the accumulation of harmful chemicals. Like SO_2-tolerant plants, plants having high ascorbic acid content are tolerant to ozone pollution. The presence of enzymes such as cationic peroxidases is responsible for ozone tolerance. Plants resistant to ozone pollution are

- *Acer campestra*
- *Acer negundo*
- *Acer plantanoides*
- *Euonymus japonica*
- *Quercus rubra*

Hydrogen Fluoride

Sources of this pollutant are fertilizers, cryolith baths, phosphate fertilizer plant, refining of aluminum ore, brick plants etc. resistant plants are-

- *Acer campestra*
- *Euonymus europaeus*
- *Juniperus sp.*
- *Quercus sp.*

Oxides Of Nitrogen

Oxides of nitrogen appear in atmosphere from fertilizers, fossils, fuel combustions and biomass burning. Resistant trees are-

- *Pinus sp.*
- *Robinia pseudocacia*
- *Quercus rubra*
- *Sambucus nigra*
- *Ulnus montana*

Dust And Smoke

Trees having compact branching and closely arranged broad, elliptical leaves with cuticular hairs collect a lot of dust from the atmosphere. Leaves with shiny surfaces or waxy in nature will collect dust which will easily get washed away by winds. Compact branching and arrangement of leaves increase dust collecting ability of trees. Dustfall can be reduced 2-3 times by 8m wide green belt between roads and buildings. A reduction of overall dust fall up to 42% was noticed by planting conifers in temperate urbanized dwellings. Suitable tree species are-

- *Alstonia scholaris*
- *Bombax ceiba*
- *Butea monosperma*
- *Shorea robusta*
- *Terminalia arjuna*
- *Ficus benjamina*
- *Tectona grandis*

A study conducted by Kulshrestha [14] reported that Bougainvillea is a dust mitigator and it adsorbs and / or absorbs the pollutants from the environment in which it grows

Heavy Metals

Lead deposited on plants enters through stomata. Plant proteins are rich in amino acids such as cystein. Lead, Cadmium, and Zinc bind with these amino acids and the environment becomes free from these pollutants. Trees with hairy foliage are not suitable for lead pollution since such deposition of lead contaminates wood and surroundings. Protective planting and green belts diminish lead content in air. *Cassia siamea* is resistant to lead pollution. A fern, *Pteris vittata* has been found to accumulate about 14,500 mg/kg arsenic in fronds without showing any symptoms of toxicity.

Indoor Air Pollution

Plants also have the potential to significantly improve the quality of indoor air [24]. A report published by American Lung Association in 2001 has found that city dwellers often spend over 90% of their time indoors. Concentrations of Volatile Organic Compounds (VOC's) are higher indoors than outdoors causing Sick Building Syndrome. World Health Organization recently estimated the approximately 30% of all new or remodeled buildings have varying degrees of indoor air pollution. Energy efficient buildings that are filled with modern furnishings and high-tech equipment off-gas hundreds of volatile organics that possibly interact with each other. Man himself should be considered as another source of indoor air pollution, especially, when living in a closed, poorly ventilated area. Common indoor air pollutants are 1,1,1-trichloroethane, Benzene, toluene, Octane, Formaldehyde, Alipthatic hydrocarbons, Chloroform, Trichloroethylene, Xylene, Dichloromethane, tetrachloroethylene, Acetone, CO & CO_2.

Studies have shown that indoor plants are effective at removing VOCs. Orchids remove pollutants during the day and also remove CO_2 and xylene at night and release oxygen to the air. Researchers from NASA recommend at least 15-18 good-sized plants for a house or apartment of 1800 square feet. In 1980s, a two-year study by NASA scientists suggested that the most sophisticated pollution-absorbing device in your home is a potted plant. NASA deals with volatile organic compounds (VOCs) on the Space Station by using a dozen varieties of plants. When plants transpire water vapor from their leaves, they pull air down around their roots. This supplies their root microbes with oxygen. The root microbes also convert other substances in the air, such as toxic chemicals, into a source of food and energy. Microbes, such as bacteria, can rapidly adapt to a chemical contaminant by producing new colonies that are resistant to the chemical. As a result, they become more effective at converting toxic chemicals into food the longer they are exposed to the chemicals. It is also important to remember that the efficiency of plants as a filtering device increases as the concentration of chemicals in the air increases. For example, the removal rate of a chemical is much higher at 7 parts per million (ppm) exposure than at 2 ppm. The suitable plants for removing indoor air pollutants are-

Spider Lily- It is a great indoor plant for removing carbon monoxide (CO) and other toxins from the indoor environment. It is one of the best plants deemed by NASA for removing formaldehyde from the air.

- **Gerbera-** It removes benzene and trichloroethylene from air. Studies have shown that it also improves sleep by absorbing CO2 and giving off more O2 at night.

- **Bamboo-** It helps in removing formaldehyde and also acts as natural humidifier.

- **Peace Lily-** Studies have shown that it cleans best at 1 plant per 10 m sq. They are often placed in bathrooms and laundry rooms because they are known to remove mold spores in humid environment.

- **Areca Palm-** It is one of the best air purifying plants for general air cleanliness.

- **Snake Plant-** it has been found to absorb nitrogen oxides and formaldehyde from indoor environment.

Water Pollution

Water pollution is a serious problem in India as almost 70 per cent of its surface water resources and a growing percentage of its groundwater reserves are contaminated by biological, toxic, organic, and inorganic pollutants. In many cases, these sources have been rendered unsafe for human consumption as well as for other activities, such as irrigation and industrial needs. The high incidence of severe contamination near urban areas indicates that the industrial and domestic sectors' contribution to water pollution is much higher than their relative importance implied in the Indian economy. Agricultural activities also contribute in terms of overall impact on water quality. Besides a rapidly depleting groundwater table in different parts, the country faces another major problem on the waterfront—groundwater contamination—a problem that has affected as many as 19 states, including Delhi. Geogenic contaminants, including salinity, iron, fluoride, and arsenic have affected groundwater in over 200 districts spread across 19 states. According to one estimate, India lost about Rs. 366 billions, which accounts for about 3.95 percent of the GDP, due to ill effects of water pollution and poor sanitation facilities in 1995.

Noise Pollution

Grassy areas can decrease noise by eight to 10 decibels. This is especially important in an urban location. Trees and other vegetation can play an important role in attenuating noise through reflecting and absorbing sound energy. One estimate suggests that 7db noise reduction is achieved for every 33m of forest (Coder, 1996) whilst other reported field tests show apparent loudness reduced by 50% by wide belts of trees and soft ground Aquatic plants for removal of pollutants (Pb, Cu, Cd, Fe, Hg and chromium) from leather industries include-*Hydrillaverticillata;Spirodelapolyrrhiza; Bacopamonnierii; Phragmiteskarka; Scirpuslacustris;* Water hyacinth (*Eichhorniacrassipes*); Pennywarth (*Hydrocotyle umbellate;* Duck weed *(Lemna minor;* Water velvet *(Azollapinnata).*Plants having thick and fleshy leaves with flexible petioles are found to be more suitable. Studies have shown that grassed slopes beside lowered expressways can reduce noise by up to 8-10 decibels. Shrubs of 1.8-4.0m in height should be used next to the traffic lane followed by backup rows of trees of 4.5-9.0 m trees(Valasalakumari *et al*, 2008). Suitable trees for controlling noise pollution are-
- *Alstonia scholaris*
- *Azadirachta indica*
- *Butea monosperma*
- *Madhucaindica*
- *Terminalia arjuna*
- *Juniperuschinensis*
- *Kigeliapinnata*

Other Uses
Landfills
Landfill sites produce the greenhouse gases methane and carbon dioxide, as putrescible waste decays. Growing selected plants and trees on top of a landfill, a process known as 'phytocapping', could reduce the production and release of these gases. It is the most common practice in many countries that involve burying the waste. It is a comparatively inexpensive technique of waste disposal that avoids serious threat to community health represented by open dumping. A sanitary landfill methodically is more hygienic andbuilt. The sanitary landfills are lined with materials that are impermeable such as HDP liners. Waste deposited in sanitary landfills is normally compacted to increase its density and stability. In landfills, the organic waste undergoes natural decomposition and generates a fluid, which is known as leachate, and is very harmful to the ecosystem.

CONCLUSION
The unabated continuous environmental degradation could be attributed to population pressure, but lingering mainly on mismanagement of resources. The present environmental situation requires redefining strategies to bring about environmental management that are in conformity with national and international development efforts.
Ornamental plants have a wide spectrum of uses in management; the most obvious are the direct effects on the ecological position of human being. The objective of ornamental horticulture is the functional and aesthetic integration of people, buildings and site, using plants and space as its main tools. The necessity of it in landscape architecture is for positive control of the fast-changing landscape for the future.
Ornamental plants can also be used as cover mat on eroded areas, they help in eliminating dust, and they reduce glare, air pollution, heat buildup, and noise pollution. They provide convenient stadia for sport activities such as football, soccer, lawn tennis and other athletics. They provide good locations for adventure parks, children's playing ground rest areas and other social events. Ornamental plants also serve as complements, attractors, emphasizers, diverters, and indicators and provide aesthetic function by creating attractiveness for human activities.

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