

Review Article

ROAD DEVELOPMENT AND MANAGEMENT WITH REFERENCE TO POLLUTION

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ABSTRACT

Rapid industrialization and random urbanisation posed a major threat to environment. Roadside vegetation essentially plays a vital role to curb environmental pollution. Here we review the pros and cons of roadside vegetation and the role of plants in mitigating air pollution along the roads. We also highlighted the importance of vegetation management along roadsides, road dividers and traffic islands.

Key Words: *Roadsides, Road Dividers, Traffic Islands*

INTRODUCTION

Earth, a beautiful landscape, has been ruthlessly exploited. Rapid industrialisation and random urbanisation leading to environmental pollution have become a serious problem. Over exploitation of open spaces, ever increasing number of automobiles and demographic pressure has further aggravated the problem (Sharma and Roy, 1999).

Impact of Development

The present set and pace of development has positive and negative impacts on the environment. Development has led to rapid increase in vehicular traffic. The number of vehicles on the road has increased to an enormous number posing a threat to human survival not due to accidents but more because of polluted air (Jasrai, 2005). Such increase has negatively affected the environment in [i] degradation of air quality, [ii] impairment of water quality, [iii] increased green house gas emissions and global climate change, [iv] increased noise levels, [v] upstream impacts from activities associated with vehicle use such as oil spills, [vi] loss of vegetation or trees due to road widening, etc.

Vehicular emissions are of particular concern. As these are ground level sources, so they have maximum impact on general population. Also vehicles contribute significantly to the total air pollution load in many urban areas.

Road Construction Project and Development through Road Connectivity

Road connectivity plays an important role in development of any country. Among the diverse impacts, road connectivity influences the diversification of activities and income source. Generally development of transport infrastructure can open new employment opportunities (Jacobs and Greaves, 2003) more in rural areas with traditional agriculture farming sector. Indeed road facilitate access to larger and farther markets. However, with the rapid development and increase in vehicular traffic there are major environmental impacts.

Road connectivity enhances development through diffusion of goods/technology/ideas, efficient, implementation, reduced transactions cost (lowering the price and increasing the variety and availability of consumer goods and the potential markets). Enhance mobility of labour and capital (reducing the inequalities) and strengthen the capacity of governance.

Road Management

Roadside is the area along the motorable stretch. Roadside development encompasses sustainable design and installation of landscape elements to integrate the transportation facility into the surrounding

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environment. The resource management include assessment protection of mitigation strategies for highways projects with reference to cultural and natural resources.

Road pavements, road dividers, traffic islands are the important components of the road management Landscaping enhances both the visibility and the visual quality of the road dividers. The two major concerns with landscaping are sight distance and its maintenance. Sight distance concerns are crucial in terms of signalised and unsignalised intersections. The maintenance concern includes the labour safety accessibility and cost.

The following measures must be taken in designing and maintenance of road side, road dividers and traffic island.

Roadside Management

1. Roadway shade
 - i. If removing tree is imperative for road development/ widening, revegetate the affected areas with suitable tree vegetation.
 - ii. Plant evergreens for shade [round the year]. Trees must be sturdy, hardy with little maintenance.
2. Sunlight and headlight glare
 - i. Block glare with good vegetation, as thick glare screens in terms of wall with negligible maintenance.
3. Clear Zone: The clear zone is the road side boarder at the edges of the travelled way, available for the emergency use.
 - i. Select trees that can grow and cover the ground in clear zone.
 - ii. Incorporate shrubs as appropriate vegetation.
4. Sight distance
 - i. Allow for adequate sight distance along the vertical and horizontal curves when designing intersection or roundabout or traffic Island for vegetation and other road side objects.
 - ii. Within sight distance on the inside of horizontal curves or at intersection approaches, select dwarf/low growing vegetation that will not obstruct signs and turning vehicles from drivers view to avoid accident hazards.

Road Dividers and Traffic Islands

The following measures can be taken for maintenance of road dividers and traffic island:

- i. Extend vegetation or mounding of earth, blocks, or bricks eight (08) inches above the top of curb height.
- ii. Limit vegetation or mounding to a maximum height of 24 inches above the pavement surface within the functional area of intersection to ensure sight distance lines are preserved.
- iii. Design slide slopes within the road dividers no steeper than 1:3 and preferably flatter.
- iv. Select and trim trees to provide a clear height of 10 feet above the pavement surface and 16 feet above the travel way.
- v. Consider planter boxes/pots rather than continuous vegetation to reduce maintenance.
- vi. Narrow road dividers tend to be a problem for maintenance personnel and irrigation
- vii. Consider paving, stone or other bare surface material in gore (a triangular piece of land, where roads merge or split) areas less than 10 feet wide.
- viii. Design planter strips to provide structural support for mowing maintenance.

The primary function of road dividers and traffic islands is to regulate traffic as well as safety. They separate traffic streams and guide turning movement at intersection. It is important that road dividers and traffic islands be delineated with sufficient visibility to distinguish them from adjacent travelled ways. In order to accomplish this task the road dividers and traffic island must be visually contrasted with the

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driving lanes, particularly at night. Visual contrast may be achieved by manipulating colour and materials. To enhance the visibility of road dividers the following measures have to be taken:

- i. Select materials that have strong colour contrast with the pavement. Select more intense colour than might be selected for interior use.
- ii. Limit planting in road dividers to grasses and low growing ground covers or shrubs rather than trees unless there is sufficient width to meet clear zone requirements.
- iii. At regular intervals modular materials can be well suited to road dividers as they can be removed and replaced when necessary.
- iv. Take advantage of the impact of the road dividers and traffic island on driver perception by adding architectural details that will enhance overall appearance.
- v. Woody and hardy plants can be planned so that the drainage in the road dividers will not be obstructed.
- vi. Consider using special surface finishes in turning lanes, tapered ends and gores that will be observed at low speeds.
- vii. Do not use inappropriate vegetation for reasons of maintenance and the potential to reduce visibility.
- viii. Plan a vegetation programme utilising native species.

Role of Plants in Mitigating Air Pollution along the Roads

In recent times there has been significant increase in vehicular traffic. This has resulted in increased concentration of air pollutants like NO₂, SO₂, CO, CO₂ and suspended particles. Planting of trees and shrubs for abatement of pollution and improvement of environment is an effective way. Some plants can be planted as avenue trees to impart scenic beauty to the spots.

Researchers have identified potential roadside vegetative barriers for moderating concentrations of air borne pollutants emitted by vehicular traffic. Studies have found wide range of health effects including respiratory illness, cardiac effects, adverse birth and development outcomes, cancer and premature mortality.

In addition to their potential to improve air quality and manage wind flows, vegetative barriers can modulate flooding and droughts, reduce sediments and toxins through groundwater filtration, and moderate temperature thereby reducing global warming and urban heat island effects.

Roadside plantation (trees/shrubs/herbs) can contribute significantly in mitigating pollution but there are certain issues which should be taken into account while developing green patches along roadsides, road dividers, and traffic islands. The criteria for selection of plants on road dividers, roadsides, traffic islands in context to the Indian subcontinent include

- i. Because of the tropical conditions the plant should be hardy; they should be able to withstand severe climatic conditions.
- ii. The plant should be such type that they may not need much of irrigation.
- iii. The plants grown on road dividers, along road sides and traffic islands should have slow growth rate. They should not need frequent trimming.
- iv. The grasses as groundcover on the road dividers/pavement should not be uprooted and removed. They can be trimmed and allowed to grow as they hold the top soil and control the erosion through wind/water and particulate matter.

It has been observed that trees and shrubs which are drought resistant are generally tolerant to pollution (Sharma and Roy, 1999). Selection of plants species is another important task. For plant selection, it is necessary to consider following factors

- i. Agro-climatic suitability, height and canopy architecture, growth rate and habit, aesthetic effect (foliage, conspicuous and attractive flower colour) and pollution tolerance.
- ii. Dust scavenging capacity:

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Some of the ornamental plant species which have aesthetic value and pollution tolerance have been recommended for planting along the roads (Table 1). Emphasis should be given to native plant species which are stress and pollution tolerant and comparatively well acclimatised. Since the plants grown along roadsides, road dividers traffic islands are more close to automobile exhaust their capacity for pollution tolerance should be considered before selection.

Table 1: Plants for roadside and road divider plantation.

Plants along the Road Sides	Plants for Road Dividers
<i>Acacia auriculiformis</i>	<i>Acalypha wilkesiana</i>
<i>Acacia nilotica</i>	<i>Bougainvillea spectabilis</i>
<i>Ailanthus excelsa</i>	<i>Caesalpinia pulcherrima</i>
<i>Albizia lebbbeck</i>	<i>Callistemon lanceolatus</i>
<i>Alstonia Macrophylla</i>	<i>Callistemon polandii</i>
<i>Anogeissus sericea</i>	<i>Cassia surattensis</i>
<i>Azadirachta indica</i>	<i>Duranta plumeri</i>
<i>Bauhinia acuminata</i>	<i>Euphorbia milli</i>
<i>Bauhinia purpurea</i>	<i>Haemilia patens</i>
<i>Butea monosperma</i>	<i>Hibiscus rosa – sinensis</i>
<i>Cassia fistula</i>	<i>Ixora coccinea</i>
<i>Cassia marginata</i>	<i>Jatropha panduraefolia</i>
<i>Cassia siamea</i>	<i>Lantana camara</i>
<i>Ceiba pentandra</i>	<i>Lantana depressa</i>
<i>Dalbergia latifolia</i>	<i>Nerium oleander</i>
<i>Dalbergia sissoo</i>	<i>Vinca rosea</i>
<i>Emblica officinalis</i>	
<i>Eucalyptus globulus</i>	
<i>Ficus benghalensis</i>	
<i>Ficus religiosa</i>	
<i>Guazuma ulmifolia</i>	
<i>Lagerstroemia duperreana</i>	
<i>Lagerstroemia rosea</i>	
<i>Lagerstroemia flosreginae</i>	
<i>Tamarindus indica</i>	
<i>Polyalthia longifolia</i>	
<i>Pongamia pinnata</i>	
<i>Tectona grandis</i>	
<i>Terminalia arjuna</i>	
<i>Thespesia populnea</i>	

Adapted from (Sharma and Roy, 1999; Jasrai and Sisodia, 2005)

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Table 2: Plants for the Traffic Islands

Plants for Traffic Islands
<i>Bougainvillea cultivars</i>
<i>Nerium oleander</i>
<i>Cycas revoluta</i>
<i>Plumbago capensis</i>
<i>Hibiscus geranioides</i>
<i>Themeda triandra</i>
<i>Nandina domestica</i> "Nana"

Adapted from Table of Contents, Brisbane City Council

Benefit of Roadside, Road Divider and Traffic Island Development

Vegetation has many functions and adds significant value to our environment.

1. Positive Behavioural Influence

A variety of behavioural responses are attributed to the vegetation, or lack thereof, along our roadways.

- Memory, Impressions and sense of place: It is the roadside and the view from the road that the driver or visitor remembers long after having driven along the road.
- Reinforcing community character-Roadsides are more than a buffer for the roadway, they are often the transition into a community
- Scenic preservation: The presence of natural features and the perception of a clean, healthy, natural environment have often linked with positive visual preference. The public generally value visual features that fit the locality and contribute to a sense of place.
- Driver guidance and navigation: Roadside features can create patterns that provide the driver with the clues what lies ahead. Highway alignment, roadway geometrics landform configurations, vegetation , and structures all contribute to driver guidance
- Traffic Calming: By applying softening affects of pedestrian amenities and landscaping, the motorist natural speed is often slowed down to the perception of a changing road culture. When a lower speed appears reasonable to the motorist it is more readily accepted.
- Directed attention fatigue: There is increasing evidence to suggest that natural and naturalised roadside help to diminish or alleviate directed attention fatigue in the roadway user. Careful planning and design if corridor views for scenic vistas and aesthetically pleasing roadside treatment can be important for improving roadway safety.
- Stress: The Sight, sound and smell and touch of plants can reduce stress levels. Exposure to a natural roadside setting decreases stress levels and provides the driver with a greater ability to cope with introduced stressors.

2. Environmental Effects

- Glare Screening: Landscaping provides operational function s such as headlight screening, and sunlight glare mitigation
- Air Quality: Vegetation improves air by capturing pollution particles, reducing carbon dioxide and producing oxygen. Photosynthesis in green plant consumes carbon dioxide, plants help in counteracting the increase of this gas in the atmosphere. Studies show that planting urban trees could reduce heating and cooling demands enough to significantly cut fossil fuel consumption and electricity in the locality.

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- iii. **Energy Conservation:** Trees reduces solar heat gain and provide shade. Trees and other vegetation shield people from direct sunlight. Trees also shade soil, pavements, buildings and other surfaces that would absorb energy and radiate that heat back to surroundings.
- iv. **Soil Erosion:** Vegetation is a significant factor in preventing soil erosion.
- v. **Control noxious weeds:** Vegetation and revegetation of roadsides, road dividers, and traffic islands help to control weeds.
- vi. **Traffic Noise-**Plants absorb and scatter sound waves to a small degree. However the effectiveness of plants as noise reducers is limited because of considerable width height and density required.

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