RESEARCH ARTICLE

Assessment of Roadside Plants as Barriers for Control Pollution of Some Districts of Uttar Pradesh: Green National Corridor

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DOI: 10.18811/ijpen.v7i04.7

Abstract

Several studies have investigated the use of roadside plants in reducing near-road air pollution concentrations since this method is often one of the few short-term options available to reduce near-road air pollution. In addition to air quality and general health benefits, roadside vegetation can improve aesthetics, increase property values, reduce heat, control surface water runoff, and reduce noise pollution (with dense, thick and tall stands). Since roadside vegetation has other potential benefits, the impact of this feature has been of particular interest. Roadside tree planting can make significant improvements to the quality of roads and the environment and can protect key natural resources. Road corridors can be a focus area for the restoration of vegetation cover, as vegetation supports many additional benefits, such as trapping dust and reducing run-off flows. Roadside vegetation may provide an opportunity to reduce near-road pollutant concentrations in urban areas. This roadside vegetation can include the preservation of existing trees and bushes, as well as planting vegetation, which may constitute some of the few near-term mitigation strategies available for urban developers and facilities already subjected to high pollution levels near roads. This paper describes the field survey of roadside vegetation of different districts of Uttar Pradesh and it was observed that some common species are barriers to control pollution on road side besides covering other the environmental aspects such as control noise pollution, air pollution and maintenance of the ecological balance. It was also observed that the vegetation of Uttar Pradesh consists mostly of shrubs. Forests are generally concentrated in the southern uplands.

Keywords: Assessment, Control pollution, Green National corridor, Roadside Plants.

International Journal of Plant and Environment (2021); **ISSN:** 2454-1117 (Print), 2455-202X (Online)

Introduction

As with growing time, government of every country wants the best and economic technique should be adopted in each part of the country and an attempt is made by the engineers to find the alternatives of each technique. The Roadside vegetation or bio engineering is a technique through which the life of road can be increased by controlling the moisture content of soil, by improving shear strength of soil, by improving infiltration capacity of soil andby controlling soil erosion. Through this technique we can also reduce the cost of construction, maintenance cost of roads. The roadside vegetation technique or bio engineering technique requires assessment of existing road condition determination of type of roadside environment desired according to increased public demand and customer expectations. There are various factors on which vegetation techniques depend: Such Soil conditions traffic composition; location of road, topography, adjacent land use, the priority of road, aesthetic appearance etc. Roadside air quality is aggravated due to high traffic density, old vehicles, poor fuel quality, poor road and inadequate inspection and maintenance programs (Wang *et al.*, 2010). The environmental performance index ranked air quality at the 178th position out of 180 in 2020 (Wendling *et al.*, 2020). As the examples of Kathmandu, the capital city of Nepal with dense settlement areas and below global average opens green space per capita (Pokhrel *et al.*, 2019), has been reported to be one of the highly polluted cities in Asia.

Roadside tree planting can make significant improvements to the quality of roads and the environment and can protect key natural resources, especially in ASAL regions where vegetation is essential in binding the soil with organic matter that aids in enhanced infiltration and water retention in the soil. Road corridors can be a focus area for the restoration of vegetation cover, as vegetation supports many additional benefits, such as trapping dust and reducing run-off flows. The benefits accumulated from roadside tree planting include better soil formation by shedding dead leaves, increased water quality by reducing sediment flow, reduced erosion, road beautification, flood control as the trees slow down and absorb road runoff, windbreaking, providing important pollinator habitats, improving peoples' health, and protecting crops (Steenbergen *et al.,* 2021)

Roads have both positive and negative impacts in the areas surrounding them. With the expansion of roads growing at an inexorable speed in Ethiopia and all Sub-Saharan Africa, these impacts need to be well understood. A questionnaire was used to gather information on road-related impacts on

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How to cite this article: Awasthi, K., & Srivastava, M.P. (2021). Assessment of Roadside Plants as Barriers for Control Pollution of Some Districts of Uttar Pradesh: Green National Corridor. International Journal of Plant and Environment. 7(4), 280-286.

Conflict of interest: None

Submitted: 15/10/2021 **Accepted:** 27/11/2021 **Published:** 31/12/2021

the rural population. A total of 529 sample households were selected in Tigray, Northern Ethiopia. The three most common consequences cited by respondents in order of importance were dust, flooding and erosion. Close to 44% of the respondents said that the occurrence of dust has increased after construction of the road. The reduction of yield estimated by farmers ranges from 10 to 50%. Close to 11% of the sample households faced decline in crop production and income due to dust lifted up from roads. The breakpoint for road dust occurred approximately at 200 to 280 meters from the road. Roadside plantations along rural roads have proven to mitigate road-related impacts and restore the ecological balance. When linked to rural development programs, roadside planting can create employment while generating a reliable source of income for rural communities (Agujetas, *et al.*, 2016).

Communities located in near-road environments face adverse health effects due to elevated exposures to traffic-related air pollution (TRAP). While the use of a combination of solid structures (i.e., sound walls) and vegetation barriers can be an effective TRAP mitigation tool, installing these barriers can also present challenges to local communities. Sound walls are costly, and building these structures often requires the involvement of federal, state, and local permitting agencies. In paper, that the use of low-cost, impermeable, solid structures (LISS), e.g., an impermeable thin wooden, plastic or metal fence, combined with vegetation can provide an effective option for local communities to improve near-road air quality due to lower costs and easier implementation. We conducted Large Eddy Simulations (LES) for different potential design scenarios of LISS and vegetation barriers tested under various conditions. Our results indicate that (i) combining LISS and vegetation is more effective than either alone, (ii) combining a less dense vegetation and LISS can be as effective as a dense vegetation barrier, (iii) In certain scenarios, depending on wind speed and particle size, vegetation barriers alone might lead to elevated pollutant concentrations; however, combining LISS with vegetation can mitigate those negative impacts, (iv) placing LISS closer to the freeway and in front of the vegetation barrier enhances vertical dispersion of pollutants, and (v) increasing LISS height promotes pollutant concentration reduction. (Hashad *et al.,* 2021).

The assessment of plants and design for roadside barriers recommendations can be discussed for urban planners, developers, and local community leaders to evaluate and implement green infrastructure.

Material and Methods

To examine the plants growing on roadside areas of Uttar Pradesh we have traveled through various outer roads to click the photos and to record some photograph by which we can easily identify the various plants and their families. Some of them are grasses, herbs, shrubs, trees and also pollution indicators.

Site Visit and Description

An intensive field survey was initiated from January 2020 onward to observe and collect the various plant species growing in the Varanasi, Lucknow, J.P Nagar, Jhansi district of the Uttar Pradesh state of India. During survey visits were made to each and every corner of the district to record and collect the plant species. The field observations and collection process was completed by the July 2020. The collected specimens were identified through various sources (Hooker, 1875-1897; Bor, 1960; Kirtikar and Basu, 1975). The APG III (2009) classification was followed for arranging the taxa to families.

Result and Discussion

Trees are considered as 'Lungs of Earth'. They are the biological entities with a perennial, tall, and conspicuous trunk. Evergreen, large trees serve as natural air conditioners especially in hot and dry climate, by lowering down temperatures of surroundings through transpiration. A careful planting of trees enhances the beauty of surroundings and brings the change in the skyline of a landscape.

Pollution is one of the serious problems in the world. There are different types of pollution. Pollution effects on Environment Degradation, Human Health, Global Warming, Ozone Layer Depletion, and Infertile Land. Vehicles are one of the main causes of air pollution on the road side. It is known fact that 60 % of air pollution in metro city is caused by automobiles only. Vehicles release:- Particular matter (PM), Hydrocarbons (HC), Nitrogen oxides (NOx), Carbon monoxide (CO), Sulphur dioxide (SO_2), Toxicants, Greenhouse gases into the air. The effect of these pollutants is observed on plants which are considered for investigation of effect of auto exhaust pollutants on roadside trees. Plants are one of the natural solutions to reduce air pollution (Manisalidis *et al.,* 2020).

Roads are the integral part of transportation system. It plays a significant role in achieving national development and with the help of roadside vegetation and by selecting right species of plant at right area. We can reduce the maintenance needs and cost of road, provides safety for vehicles, improves the overall driving experience of roads, reduce soil erosion. Enhance the drainage aspect of roads as vegetation increase the water infiltration capacity of soil, improves the shear strength of embankments by controlling the moisture content and increase the life of shoulder. Beside all these factors vegetation also covers the environmental aspect such as control noise pollution, air pollution and maintains the ecological balance and aesthetic view (Steenbergen *et al.,* 2021).

Roadside planting is a row of trees along the road which provides shades for people in urban areas. Proper management practices among the local authorities will improve the quality of life and human well-being. Unhealthy trees may cause problems to the road users that result from the lack of monitoring by local governing bodies. 200 respondents from the public from Selayang Municipal Council and Shah Alam City Council have participated in this study. The data analysis showed that fallen trees were the main reason for the public to lodge complaints, followed by brittle branches, thick branches and leaning tree trunk (Hashad, *et al.,* 2021, Hasan *et al.,* 2018). Invasive alien plants of Indian Himalayan Region with background information on family, habit and nativity also study also included in the study. A total of 190 invasive alien species under 112 genera, belonging to 47 families have been recorded. Among these, the dicotyledons represented by 40 families, 95 genera and 170 species monocotyledons represented by 7 families, 17 genera and 20 species. The analysis of invasive species reveals that 18

species have been introduced intentionally, while the remaining species established unintentionally through trade. In terms of nativity, amongst 13 geographic regions, the majority of invasive plants reported from American continent (73%). While in life form analysis, the herbs (148 species) are dominant, followed by shrubs (19 species), Grasses (11 species), Trees (4 species), sedges and climber (3 species each). Most of the invasive species (63%) are annual in habitat (Gaur *et al*., 2001).

Several studies have investigated the use of roadside features in reducing near-road air pollution concentrations since this method is often one of the few short-term options available to reduce near-road air pollution. Since roadside vegetation has other potential benefits, the impact of this feature has been of particular interest. The literature has been mixed on whether roadside vegetation reduces nearby pollutant concentrations or whether this feature has no effect or even potentially increases downwind pollutant concentrations. However, these differences in study results highlight key characteristics of the vegetative barrier that can result in pollutant reductions or increase local pollutant levels. According to Baldauf *et al.,* (2017) the characteristics of roadside vegetation that previous research shows can result in improved local air quality, as well as identify characteristics that should be avoided to protect from unintended increases in nearby concentrations. These design conditions include height, thickness, coverage, porosity/ density, and species characteristics that promote improved air quality. These design considerations can inform highway authorities, urban and transportation planners, and developers in understanding how best to preserve existing roadside vegetation or plant vegetative barriers to reduce air pollution impacts near transportation facilities (Baldauf *et al*., 2017)

Roadside vegetation studies have investigated the impact of many different types and conditions of vegetation barriers and urban forests, including preserved, existing vegetation stands usually consisting of mixtures of trees and shrubs or plantings of individual trees. A study was conducted along a highway with differing vegetation characteristics to identify if and how the changing characteristics affected downwind air quality. The results indicated that roadside vegetation needed to be of sufficient height, thickness, and coverage to achieve downwind air pollutant reductions. A vegetation stand, which was highly porous and contained large gaps within the stand structure had increased downwind pollutant concentrations. These field study results were consistent with other studies that the roadside vegetation could lead to reductions in average, downwind pollutant concentrations by as much as 50% when this vegetation was thick with no gaps or openings. However, the presence of highly porous vegetation with gaps resulted in similar or sometimes higher concentrations than measured in a clearing with no vegetation. The combination of air quality and meteorological measurements indicated that the vegetation affects downwind pollutant concentrations through attenuation of meteorological and vehicle-induced turbulence as air passes through the vegetation, enhanced mixing as portions of the traffic pollution plume are blocked and forced over the vegetation, and through particulate deposition onto leaf and branch surfaces (Deshmukh *et al.,* 2019)

Uttar Pradesh is a state in northern India with roughly 200 million inhabitants; it is the most-populous state in India as well as the most-populous country subdivision in the world.

We recorded total 41 species from the study area which fall under six subfamilies and 14 tribes. Subfamily Panicoideae represented by 24 species followed by Chloridoideae with 9 species, Pooideae by 5 species whereas Bambusoideae, Ehrhartoideae and Arundinoideae with one species each. Subfamily Centothecoideae, Aristidoideae, Anomochlooideae, Danthonioideae, Pharoideae, and Puelioideae are not represented in this area. Out of 41 taxa, 18 are used for the treatment of fungal infection fungal infection, fever, haematuria, urinary diseases, intestinal worm, asthma, jaundice, cough, wounds, snakebite, rheumatism etc.

Based on the flora of difference sites, if could be concluded that the not so much variations were observed in the plants which are found quite similar to the all places where we have traveled. Forty six species of 38 genera belonging to 6 subfamilies and 11 tribes were recorded under family Poaceae. Subfamily Panicoideae (25 species) was the dominant followed by Chloridoideae (9 species), Pooideae (6 species), Ehrhartoideae (2 species), Bambusoideae (2 species) and Arundinoideae (1 species). Some species were used economically as medicinal, fodder and for other purposes.Uttar Pradesh is a state rich in flora. It has an amazing variety of some 1,000 woody plants, including 3,000 trees, 400 shrubs, and 100 woody climbers More than 200 species of grasses have been identified in the Gangetic plains along with a rich supply of herbs and valuable medicinal plants. Several woody species observed in the district like *Butea monosperma, Holarrhena pubescens, Madhuca longifolia, Holoptelea integrifolia, Melia azedarach, Nyctanthes arbor-tristis, Phyllanthus emblica, Terminalia arjuna, Terminalia bellerica, Woodfordia fruticosa, Ziziphus nummularia* and *Dendrocalamus strictus* are the chief component species of the tropical dry deciduous forest of the locality. Several plant species recorded from thesedistrict belongs to the threatened category of flora. These include *Alocasia sanderiana, Aloe vera, Celastrus paniculatus, Catharanthus roseus, Cephalocereus quadricentralis, Mammillaria bombycila, Rhipsalis prismatica, Urticadioica Euphorbia antiquorum, Euphorbia caducifolia, Euphorbia cattimandoo, Euphorbia lactea, Euphorbia milii, Euphorbia neriifolia* and *Euphorbia nivulia.*

Flora of Lucknow

Lucknow has a total of only 5.66 percent of forest cover, which is much less than the state average of around 7 percent. Some plants as Shisham, Dhak, Mahuamm, Babul, Neem, Peepal, Ashok, Khajur, Mango, Gular, Gorakhmundi (Fig. 1), Bittersweet (Fig.2), Dandelions (Fig. 3), Kadamba (Fig. 4), Arjun (Fig. 5), Lantana (Fig. 6), Nettle Leaf (Fig. 7) trees are all grown here. Different varieties of mangoes, especially Dasheri, are grown in the Malihabad adjacent to the city and a block of the Lucknow district for export. The main crops are wheat, paddy, sugarcane, mustard, potatoes, and vegetables such as cauliflower, cabbage, tomato and brinjals. Similarly, sunflowers, roses, and marigolds are cultivated over a fairly extensive area. Many medicinal and herbal plants are also grown here. The city also has a botanical garden, which is a zone of wide botanical diversity. It also houses the Uttar Pradesh State Museum.

Fig 1: Gorakhmundi (*Sphaeranthus indicus*)

Fig 2: Bittersweet (*Celastrus*)

Flora of Varanasi

The great Hindu culture preaches and practices harmonious co-existence with nature. As a result, Varanasi, though having rich history of continuous urbanization, protects and preserves its floral and faunal diversity with religious zeal. This tradition of keeping human civilization in sync with the nature adds charms to Varanasi tourism.

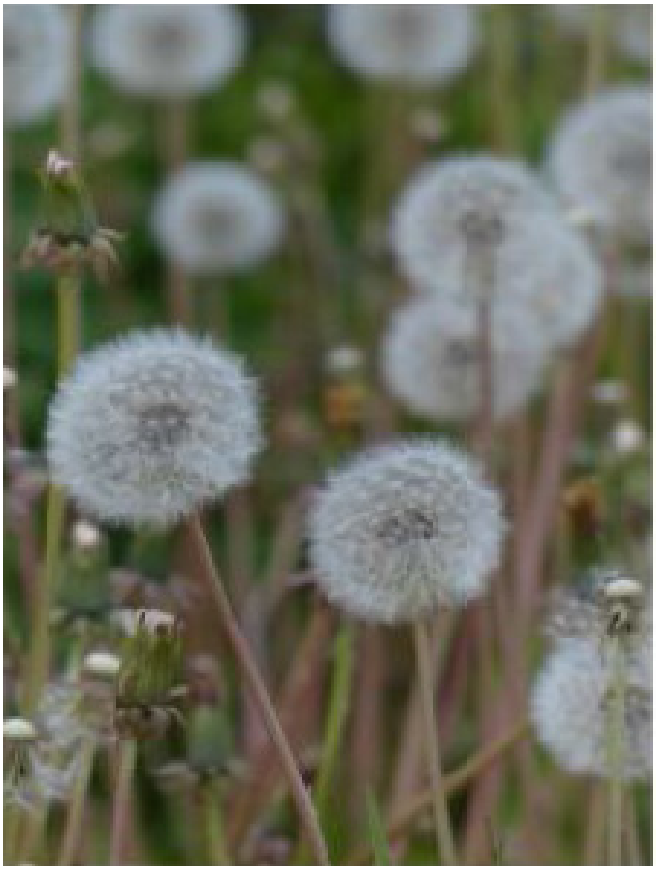

Fig 3: Dandelions (*Leontodon taraxacum*)

Fig 4: Kadamba (*Anthocephalus cadamba*)

Varanasi is picturesquely placed on both sides of Ganga. Its northern part is alluvial plain, while its southern part has hilly tracts of mountainous ranges of the Vindhyas. The district is made up of two natural divisions. The first part is the plain under the Ganges and its tributaries. The plateau area of Naugarh forms the second part. Naugarh development part has mountainous ridges overcast with dense forests and deep valleys drenched with rushing streams. Farmers in Varanasi grow different kinds of 'rabi' and 'kharif' crops. Their 'rabi' crops include crops such as wheat and other vegetables such as radish, cauliflower, gram,

Fig 5: Arjun (*Terminalia arjuna*)

Fig 7: Nettle Leaf (*Urtica dioica*)

Fig 6: Lantana (*Lantana camara*)

Fig 8: Clover Leaf (*Trifolium*)

peas, potato, onion, garlic and spinach. Their 'kharif' crops include Paddy, Maize, Jowar, Arharand Brinjaletc. *Syzigium, Seesham*, *Madhuca longifolia, Salmalia malabarica, Trifolium* (Fig. 8), *Ficus religiosa* (Fig. 9), *Ambrosia trifida* (Fig. 10) and Mango are the special charter of this dissect

Flora of Jhansi

The flora of Jhansi is of the tropical dry deciduous type. In the Jhansi Plain sub-region areas of Banda, Hamirpur and Datia districts, along the banks of rivers like the Pahuj, Betwa and Yamuna, we see acacias like Babul (*Acacia Nilotica*) and Khair(*Acacia catechu*), Palas (*Butea monosperma*), Ber (*Zizyphus varieties*), Tendu (*Diospyros melanoxylon*), Mahua (*Mahuca indica*), Semal (*Salmalia malabarica*) and Kardhai (*Anogeissus pendula*).In the Jhansi Intermediate sub-region we also see Salai (*Boswellia serrata*), Seesham (*Dalbergia sissoo*), Stinging

Fig. 9: Pipal (*Ficus religiosa*)

Fig. 10: Giant Ragweed (*Ambrosia trifida*)

Nettle (*Urtica dioica*) (Fig.11), Japanese Knot Weed (*Polygonum cuspidatum*) (Fig.12), Siris (*Albizzia lebbek*) (Fig. 13), Asthma Weed (*Euphorbia hirta* (Fig. 14), Bhringaraj (*Euphorbia hirta*) (Fig.15),Balloon Vine (*Cardiospermum halicacabum*) (Fig. 16), Dhau (*Anogeissuslatifolia),* Jamun (*Syzizium*), karaundha (*Carissa spinarum*) Shrub and occasionally, teak.Teak is found in the southern Bundelkhand Upland sub-region (*Panna, Chhatarpur, Tikamgarh*), besides the above-mentioned species. In the Damoh and Sagar plateaus, we also see trees known locally as Dhawda (*Anogeissus latifolia*), and Bija (*Pterocarpus marsupium*). Tendu, which provides seasonal income to people living in and around forests, is found in abundance in Panna and Chhatarpur districts. Another very useful tree for people living around forests is mahua. There is little timber production in Jhansi. Good teak forests are found only in Sagar and Damoh districts

Fig. 11: Stinging Nettle (*Urtica dioica*)

Fig 12: Japanese Knot Weed (*Polygonum cuspidatum*)

Fig 13: Siris (*Albizzia lebbek*)

in small patches. Bamboo is found in small patches across the region. Forests and scrub lands are intensively used by to source firewood for consumption and sale. Researchers working on Ethno botany of Jhansi area, reported medicinal uses of wild trees and folklore therapy through herbs among poorer people and aboriginal tribes.

Fig 14: Asthma Weed (*Euphorbia hirta*)

Fig. 15: Bhringaraj (*Eclipta prostrate*)

Fig. 16: Balloon Vine (*Cardiospermum halicacabum*)

Flora of JP Nagar (Amroha)

A total of 46 species of 38 genera belonging to 6 subfamilies and 11 tribes were recorded under family Poaceae. Subfamily Panicoideae (25 species) was the dominant followed by Chloridoideae (9 species), Pooideae (6 species), Ehrhartoideae (2 species), Bambusoideae (2 species) and Arundinoideae (1 species). In the study area, the ratio of subfamily to genus was 1: 6.33, subfamily to species was 1: 7.66 and genus to species was 1: 1.21. Genus *Eragrostis*and *Saccharum* found dominant with 3 species followed by *Dactyloctenium, Setaria* and *Sorghum* with 2 species, while other genera have 1 species each. Some species were used economically as medicinal, fodder and for other purposes.

Conclusion

The finding of the present study might be useful for designing urban green belts and vegetation traffic barriers in any city. So these plants can absorb road side pollution and become toxic free and make green creditor as Improvement of the road geometrics will also attract more traffic to the region which in turn helps in the upliftment of the living standards of the people. It is also help in reduction of accidents. It insecure the safe and accident-free travel, up gradation of the present green corridor from the road side this will result in enhance ment of tourism spots like Araku, Lambhasinghi etc.

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