

SEQUESTERED STANDING CARBON STOCK BY TREES CLEARED FOR HIGHWAY EXPANSION (PART OF NH-144A THE JAMMU-AKHNOOR) & IMPACTS OF ROAD WIDENING

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ABSTRACT

Road widening can cause significant carbon loss through tree removal and ecological disturbance. This study assessed the carbon stock of trees affected by NH-144A widening in Jammu. Among 377 trees representing 10 species, the total volume, biomass, and carbon stock were estimated at 341.322 m³, 0.192 t, and 0.091 t, respectively. *Eucalyptus citriodora* was the most abundant species, while *Ficus religiosa* showed the highest carbon stock. The study highlights tree loss, soil disturbance, pollution, and erosion as major impacts and emphasizes compensatory plantation and ecological management during highway development.

KEYWORDS: Carbon Sequestration, Roads, Stocks, Jammu

INTRODUCTION

Carbon sequestration or carbon dioxide removal (CDR) is the long-term removal, capture or sequestration of carbon dioxide from the atmosphere to slow or reverse atmospheric CO₂ pollution and to mitigate or reverse global warming (Brent et al. 2012). The phenomenon of CO₂ removal from the atmosphere and its storage in plant tissue or biomass is known as carbon sequestration. Selection of ideal species for revegetation of mined out areas is very important step for restoration of reduced ecosystem. The significance of role of biomass of tree species in carbon sequestration has long been recognized, but very little attempts have been made to estimate the biomass accumulation and their contribution for sequestration of carbon, especially in mined out areas.

Carbon sequestration rates vary by tree species, soil type, regional climate, and topography and management

practice. Beckett et al., (2000) found that roadside trees capture more large-size particulate matter than trees not near the road. These effects have implications for air quality standards. Urban trees perform important ecological function in cities by sequestering carbon and reducing automobile pollution. The net save in carbon emissions that can be achieved by urban planting can be up to 18 kg CO₂/year per tree and this benefit corresponds to that provided by 3 to 5 forest trees of similar size and health (Francesco Ferrini et al., 2011). Tree canopies provide a cooling effect on microclimate directly by shading the ground surface and indirectly through transpiration (Scott et. al., 1999). Carbon stock of trees along the roadside are a result of both carbon capture by biomass growth and duration of carbon in biomass. Study is carried to calculate the carbon Sequestered by trees to be cut for the widening of roads and to study the impacts of road widening.



Fig. 1 Linear clearing of trees along the Jammu- Akhnoor highway (Source: Daily Excelsior)

G Sandhya Kiran (2011) demonstrated by this research paper that urban trees planted on roadsides can help in sequestering CO₂ and mitigate the effects of carbon emitted from the automobiles. The selection of tree species in such cases if done precisely i.e. specifically looking at their development of girth size and capacity to resist pollution, additional environmental and economic benefits can be accrued. Karlson et.al (2013) discussed about wide array of effects transport infrastructure has on terrestrial and aquatic ecosystems. Road and railway networks are increasingly being associated with a loss of biodiversity worldwide. A review of environmental impact statements and environmental reports (EIS/ER) produced between 2005 and 2013 in Sweden and the UK was then conducted using the list of problems as a checklist. The results show that the treatment of ecological impacts has improved substantially over the years, but that some impacts remain problematic. Chavan et.al (2010) calculated the carbon sequestered in trees in the campus Dr. B. A.M. University, Aurangabad and the biomass and total organic carbon of standing trees is estimated by non-destructive method and compared with Allometric model. The present study has calculated total organic carbon stock in 20 trees species. The average standing stock of organic carbon in 20 well grown trees in Dr. B. A. M. University campus is about 1.65 t/tree. Laurance et.al (2009) examines linear clearings on tropical rainforest from various perspectives, demonstrating that its impacts are often qualitatively and quantitatively different in rainforests than in other ecosystem types with the help of existing research. Roads and other linear infrastructure are rapidly expanding in

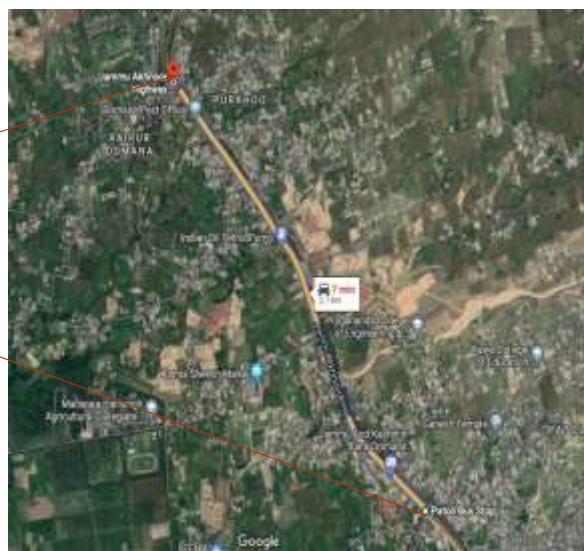
many developing countries and have a key role in opening up forests to hunting, illegal mining, land speculation and destructive exploitation, a problem exacerbated by often weak enforcement of environmental laws in frontier areas. The proliferation of unplanned, illegal roads is a serious problem in many tropical nations.

STUDY AREA

The project road starts between latitude 32°43'45.5"N to 74°50'52.8"E and ends at 32°89'17.17"N to 74°72'99.82"E. Start point of project road is a part NH144A. The total length of project road is 30 Km. The project road is located in District Jammu of UT of J&K. The project road consists of elevated road from Canal head (Km 0.800) to Ganesh Vihar (Km 6.000) of 5.2 Km, 24 km 4 lane road and a service road. Study was carried out in 3km starts from 32°46'18.41"N to & 72°47'51.665"E and ends at 32°47'39.689"N to 72°46'55.041"E (from Patoli Morh Bus Stop to Domana) with focus on calculation of loss of sequestered carbon by trees and road widening short term and long-term impacts on the environment. Part of NH-144A, the Jammu-Akhnoor Road is a vital defense road and among the busiest roads of the state, which connects Rajouri and Poonch to the rest of the country. Heavy traffic had made this road prone to accidents and therefore the locals demanded widening of the stretch. This has also been done to reduce the travel time. This is a lifeline for those living in border areas and for those who come to Jammu for medical emergencies.



**Jammu Akhnoor
Highway Project Road**



Source :- Google Map

Fig. 2 6800 trees were chopped from Jammu to Dummi area with most population of Eucalyptus and Poplar in a stretch of 30Km.

METHODS

Using the elastic meter scale the girth of tree at chest level is recorded of all the trees in the study area. The species of recorded trees are identified. Average Girth is calculated by adding the girth of all trees of particular species and dividing it by no. of trees of that species. Diameter is calculated from the average girth. Calculation of Diameter:

Average girth in meter = $2\pi r$

r = overall girth in meter / 2π

Therefore, Diameter = $2r$

Using the volume equation of respective species volume of trees is calculated.

VOLUME EQUATIONS (Developed by FSI 2006)

$$1. Dalbergia sisso : V = -0.013703 + 3.93499D^2$$

$$2. Melia azadiracta : V = -0.03510 + 5.32981D^2$$

$$3. Albizzia lebbbeck : V = 0.07389 + 4.47501D^2$$

$$4. Ficus sp. : \sqrt{V} = 0.03629 + 3.95389D$$

$$-0.84421 \sqrt{D}$$

$$5. Eucalyptus sp. : \sqrt{V} = -0.1545 + 0.3537D$$

$$6. \text{Miscellaneous formulae: } V = -0.03316 + 0.77262D - 0.50833D^2 + 11.50107D^3$$

Biomass of the species is calculated by multiplying the total volume of a species with the specific gravity of the respective species of tree.

Carbon is calculated by multiplying biomass with the Conversion factor (Singh and Chand, 2013, IPCC 2005) i.e. 0.475.



Fig. 3 Demolishing of Buildings on the Jammu-Akhnoor Highway



Fig. 4 Flyover Construction
Table 1. Calculation of Average Diameter

S.NO.	Name of species	Avg girth (m)	No.	avg. Diameter (m)
1	<i>Ficus religiosa</i>	2.193	24	0.697875
2	<i>Morus alba</i>	1.87	2	0.2975
3	<i>Melia azedarach</i>	0.7137	12	0.22716666
4	<i>Aegle marmelos</i>	0.94	3	0.2993
5	<i>Ficus benghalensis</i>	6.23333	3	1.98466
6	<i>Eucalyptus citriodora</i>	1.7	277	0.541
7	<i>Populus ciliata</i>	3.0766	6	0.9798
8	<i>Dalbergia sissoo</i>	1.2	21	0.382
9	<i>Albizia lebbek</i>	0.73	15	0.2463
10	<i>Alstonia scholaris</i>	1.1557	14	0.368
Total			377	

Table 2. Calculation of Volume, Biomass and Carbon

S.NO.	NAME OF SPECIES	No. of trees	Average Volume(m ³)	Total Volume(m ³)	Specific Gravity	BIOMASS (Tones)	Carbon (C)
1	<i>Ficus religiosa</i>	24	4.3704	104.8896	0.652	0.068388019	0.032484309
2	<i>Morus alba</i>	2	0.45453424	0.9090685	0.746	0.000678165	0.000322128
3	<i>Melia azedarach</i>	12	0.239941602	2.8792992	0.51	0.001468443	0.00069751
4	<i>Aegle marmelos</i>	3	0.4609089	1.3827267	0.75	0.001037045	0.000492596
5	<i>Ficus benghalensis</i>	3	44.8111	134.4333	0.59	0.079315647	0.037674932
6	<i>Eucalyptus citriodora</i>	277	0.0001358	0.0376166	0.64	0.00002407	0.00001144
7	<i>Populus ciliata</i>	6	11.5394124	69.236474	0.37	0.025617496	0.01216831
8	<i>Dalbergia sissoo</i>	21	0.5617481	11.79671	0.76	0.0089655	0.004258612
9	<i>Albizia lebbek</i>	15	0.34536	5.1804	0.55	0.00284922	0.00135338
10	<i>Alstonia scholaris</i>	14	0.755491771	10.576885	0.36	0.003807679	0.001808647
Total		377		341.32208		0.192151287	0.091271861

Negative Impacts of Road Widening

- i. Filling in low-laying areas for embankments of the road
- ii. Cutting of large number of trees.
- iii. Loss of topsoil due to clearing and grubbing of new alignment, borrow area and quarry operation, construction of camps and material stacking yard.
- iv. Temporary impacts on flora and fauna due to the construction activities.
- v. Temporary impact on the drainage pattern due to embankment, culvert and bridge constructions
- vi. Impact on traffic management system.
- vii. Increased air pollution (including dust) due to the movement of vehicles and construction activities.
- viii. Increased noise levels due to the movement of vehicles and construction activities.
- ix. Increased soil erosion leading to loss of top soil and pollution of surface water bodies.
- x. Loss of Livelihood of road side dwellers.



Fig. 5 Linear cutting of trees



Fig. 6 Loss of livelihood of road side dwellers



Fig. 7 Markings by Govt. Officials to demolish the construction

Positive Impacts of Road widening

- i. Reduced noise and air pollution. With the proposed widening of the existing road and the construction of proposed bypasses, noise and air pollution levels are expected to go down in the urban areas where human exposure is more. Though there will be rise in pollutant levels in the proposed highway alignment, the overall human exposure to noise and air pollution will be minimal due to less congestion.
- ii. Reduced risk of accidents. The proposed alignment shall provide adequate safety measures and proper sight distances thereby resulting in reduced accidents. Moreover, with expected decrease in overall traffic density due to increased road carrying capacity, the chances of accidents will reduce considerably. Improved accessibility and connectivity.
- iii. The accessibility and connectivity increase for those living in border areas and connects Rajouri and Poonch to the rest of the country. Thus, the time of travel shall reduce significantly.
- iv. Reduced vehicle operating and maintenance cost. With advent of the four-lane highway, the vehicle operating and maintenance cost is expected to go down substantially. These benefits can be attributable to smooth and even roads and low congestion.
- v. Savings in fuel consumption. Savings in fuel consumption can be attributed to low congestion and relatively less travel time due to proposed improvements.
- vi. Improved quality of life. The proposed project is expected to improve the quality of life of the people residing in the project zone in terms of their economic, social and health

status. Land value in the nearby areas of the proposed alignment will increase substantially.

- Improved Aesthetics. The overall aesthetics of the area shall improve with proposed landscaping and avenue plantation in the project stretch.
- Generation of local employment. Both skilled and unskilled labours will be employed during the construction stage of the project.

RESULT AND DISCUSSIONS

6800 trees were chopped from Jammu to Dummi area with most population of *Eucalyptus* and *Poplar* in a stretch of 30Km. The tree species found along the road are shown in Table 1. The table 1 shows that 10 species of tree were found along the road from Patoli Morh Bus Stop to Domana and the total no. of trees were 377 with maximum population of *Eucalyptus*. The total volume is 341.3220803 m³ and total carbon stock is 0.091271861 tones. The total Biomass is 0.192151287 tones. The maximum volume a carbon stock was seen for the species *Ficus religiosa* followed by *Ficus benghalensis*. Roadside trees, because of their proximity to the generation of vehicle emissions, are important in reducing pollution. Vehicular emissions are a major source of carbon dioxide emissions. Trees planted on roadsides can help in sequestering CO₂ and mitigate the effects of carbon emitted from the automobiles. It is important to reduce fossil fuel emissions and planting large and healthy trees to maximize the amount of CO₂ sequestered by urban trees on roadsides.



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