A Study on Carbon Sequestration to Curb Climate Damage: An Impact of Planting Trees along Roadsides

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Publication Info

Article history :

Received : 20th May. 2016

Accepted : 15th June, 2016

DOI : 10.18090/samriddhi.v8i1.11415

Keywords :

Global warming, Climate change, Carbon sequestration, Environmental damage, Tree plantation

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Abstract

Global Warming is now becoming a challenge for survival of species on Earth and draws attention of many modern societies, power and energy engineers, academicians, researchers and stakeholders to go for deeper study. During 21st century, the environmental consequences of increased levels of atmospheric carbon dioxide lead to the considerable impacts upon Earth's weather and climate change. It is due to faster consumption of hydrocarbon fuel in the transport sector which is posing global threat of increase of green house gases through tail pipe emission. It is also a known fact that major greenhouse gas H2O substantially warms the Earth, minor greenhouse gases such as CO_2 have also considerable effect. To sequestrate the Carbon Di-oxide and Carbon Mono-oxide many methods were tried to reduce the impact of environmental issues. But it is noticed that plant and trees are the most effective source to absorb the carbon being released through green house gases. In this paper a study has been carried out to focus on planting trees, that forms a tunnel when matured, along roadside to sequestrate the carbon released from exit gases of transport, as vehicles are increasing every year in manifold especially in developing country like India. Authors have taken many readings at different places in Lucknow City and concluded that if trees are planted along roadsides, the carbon can be sequestrated optimally, if green coverage tunneling with sufficient matured trees is present along road sides. Thus planting trees according to the rate of release of carbon can be the most effective solution for curbing the impact of climate change. This can make Green and Clean Environment and need maximum coverage by media too so that people may start planting trees in residential areas also.

1. INTRODUCTION

Globally, faster consumption of hydrocarbon fuels in the transport sector is creating threat to the environmental and ecological imbalance and thereby depletion of hydrocarbon fuel is causing another challenge to oil reserves. In view of these issues, extensive researches are being carried out to explore the alternative energy sources and to find out appropriate energy conversion system. On the basis of the recent data, 80% of the population of the country still lives in rural and suburban areas where the means of transport is motorbike, jeeps and cars. This is releasing exit gases through its tail pipe and damaging environment. Light vehicles in India have gone to around 1.4 million as per data available in 2013 from Ministry of Transport, India. India has became 3rd highest polluted country realizing heavy carbon to the extent of 1560 million tonnes every year in

comparison with those of China and USA that are releasing 21,000 and 20,560 million tonnes respectively. This has major impact on climate change globally.

Global Warming and Climate Change refers to an increase in average global temperature. Natural events and Human activities are believed to be the main contributors to such increase in average global temperature. The climate change, caused by rising emission of Carbon Dioxide from vehicles, factories and power stations, will not only affect the atmosphere and the sea but also alter the geology of the Earth. Emission of Carbon Dioxide due to the use of fossil energy will change the climate and the temperature with an estimated increase by 2^{o} to 6^{o} C within year 2100, which is a tremendous increase from our current average temperature of 1.7^{o} C as predicted by IPCC. Forecasts indicate that major storms could devastate New York City in next decade whereas Gulf countries could get affected badly well before.

Predictions of catastrophic global warming are based on computer climate modeling, a branch of science still in its infancy. There are also no experimentally validated theoretical evidences of such amplification [1]. The CO_2 levels have increased substantially and are expected to continue doing so and humans have also been responsible for this increase in environment. There is, however, one very dangerous possibility. Our industrial and technological civilization depends upon abundant, low-cost energy. This civilization has already brought unprecedented prosperity to the people of more developed nations. Billions of people in the less developed nations are now lifting themselves from poverty by adopting this technology [2-5].

Industrial conversion of energy into forms that are useful for human activities is the most important aspect of technology. Abundant inexpensive energy is required for the prosperous maintenance of human life and continued advancement of life-enriching technologies. People who are prosperous have the wealth required to protect and enhance their natural environment **[6-8].** Currently, the United States is a net importer of energy. Americans spend about $300 billion per year for importing oil and gas – and an additional amount for military expenses related to those of imports.

Thus, we have to think how to sequestrate carbon being released while using huge quantity of Hydrocarbons every year and burning it for producing energy to cater current needs. The paper describes the detail about carbon absorption process through plant and how it can reduce the carbon being emitted in the atmosphere especially by transport sector alone. It is found that if we plan and develop proper scheme of road construction and planting trees along road sides to form tunneling by green coverage. It can have major impact to sequestrate it without damaging environment and making our future generations also happy.

2. METHODOLOGY OF CO_2 TRANSFORMATION INTO OXYGEN

2.1 Process of Carbon Absorption Rates by Trees

White oak trees live about 100 years, reaching heights of 100 feet or so, with trunks about 9 feet in diameter and canopies about 60 feet around [9]. A tree of a given height has a volume roughly equivalent to a cylinder whose diameter is that of the trunk at the base, if assumed. So, a 100-foot tree with a 9' trunk has a volume:

$$v = \pi r^2 h = \pi * (4.5^2) * 100 = 6362 \text{ cubic feet} \quad (1)$$

One cubic foot of white oak weighs 47 lbs. (assuming living weight). So, the tree at maturity will weigh 299,000 pounds. If the tree grows at a

S-JPSET : Vol. 8, Issue 1, ISSN : 2229-7111 (Print) & ISSN : 2454-5767 (Online)

uniform rate, it will be 2990 pounds per year over its 100-year lifespan. About 60% of a living tree is cellulose; the rest is mostly water; only the cellulose contains carbon. So that is 2990 * 0.6 = 1794 pounds of cellulose per year.

From polyglot, Cellulose, $C_6H_{10}O_5$, is produced from CO, as:

$$6CO_2 + 5H_2O \rightarrow C_6H_{10}O_5 + 6O_2 \quad (2)$$

The sequence of reactions that results in cellulose is much more complicated, but it doesn't matter for this analysis:

Atomic weights are (very round numbers): C=12, H=1, O=16. To produce 1 mol of cellulose (162 g) requires 6 mol of CO_2, (264 g) and 5 mol of water (90 g) and releases 6 mol (192 g) of oxygen. Therefore, it can be figured out the quantity of CO_2, absorbed from the mass of the tree. 1000 kg of tree soaked up 1630 kg of CO_2, ... So:

$$1794 \text{ lbs} * 1.63 = 2924 \text{ lbs of } CO_2, \quad (3)$$

In a year's time, a single white oak gains 2990 lbs, trapping 2924 lbs of CO_2. It releases 2130 lbs of O_2, . It takes 0.68 white oaks / year to convert a ton of CO_2, .

Therefore, you can figure out the quantity of CO_2 absorbed from the mass of the tree. 1000kg of tree soaked up 1630kg of CO_2... all that remains is to figure out how fast your trees grow and how dense they are. Different trees have very different growth rates and densities of their wood. But, we knew that, the study of density of various species and their growth rates can also be done separately in terms of height and girth. It is also learnt that three trees can offset 1 ton over the next ten years. The Green fleet project suggests that 17 native Australian trees will absorb the CO_2 of a "typical" car that will produce 4.3 tonnes- CO_2 in a year. The trees turn CO_2 and H_2O into cellulose ($C_6H_{10}O_5$) and oxygen. For finding better data one has to go far a research project on the development of sustainable timber farms.

2.2 Fertilization of Plants by CO_2

Plant life provides a large sink for CO_2. Using current knowledge about the increased growth rates of plants and assuming increased CO_2 release as compared to current emissions, it has been estimated that atmospheric CO_2 levels may rise to about 600 ppm before leveling off. At that level, CO_2 absorption by increased Earth biomass is able to absorb about 10 Gt C per year. At present, this absorption is estimated to be about 3 Gt C per year [10].

As atmospheric CO_2 increases, plant growth rates increase. Also, leaves transpire less and lose less water as CO_2 increases, so that plants are able to grow under drier conditions. Animal life, which depends upon plant life for food, increases proportionally.

Fig.1: Plantation of Trees along Road side forming Tunnel

It is also learnt that plant response to CO_2 fertilization is nearly linear with respect to CO_2 concentration over the range from 300 to 600 ppm. Wheat growth is accelerated by increased atmospheric CO_2, especially under dry conditions. Orange and young Pine tree growth enhancement with two atmospheric CO_2 increase – that which has already occurred since 1885 and that projected for the next two centuries. The relative growth enhancement of trees by CO_2 diminishes with age.

3. FIELD DATA COLLECTION AND STUDY

A study was conducted during May 2016 in Lucknow city at different locations where major transport vehicles ply.

Considering all other factor constant, the data of (%) percentage of Green Coverage vs Temperature was taken at different locations of the city.

Table-1: Green Coverage and Temperature taken on *Date: May 07, 2016 at 12:00 Noon to 12:30 pm at different location of City, Lucknow

S. No.	Location at Which Reading is taken	Green Coverage in Percentage	Temperature (in Deg Centigrade)
1	Doordarshan, Ashok Marg	65	41.8
2	Gomti Nagar	40	42.7
3	Chak Gajaria	2	47.8
4	Khurdahi	25	42.4
*Source: * Prof. Bharat Raj Singh, School of Management Sciences, Lucknow*			

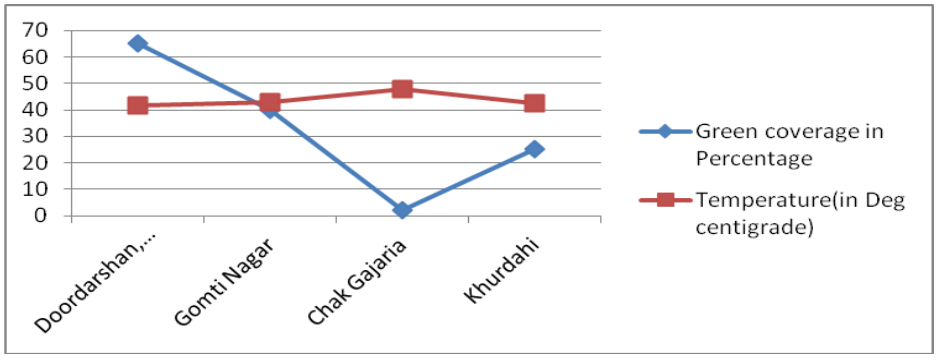

Fig.2: Green Coverage vs Temperature at Different Locations in Lucknow

Table-2: Green Coverage and Temperature taken on *Date: May 17, 2016 at 3:15 pm to 4:30 pm at different locations in Lucknow City.

S. No.	Location at Which Reading is taken	Green Coverage in Percentage	Temperature (in Deg Centigrade)
1	Ambedkar Park	5	50
2	Lohiya park	60	41.4
3	Gomti Nagar Vistar	30	45.4
4	Cantonment	75	41.1
*Source:** Prof. Dhruvsen Singh, Lucknow University, Lucknow*			

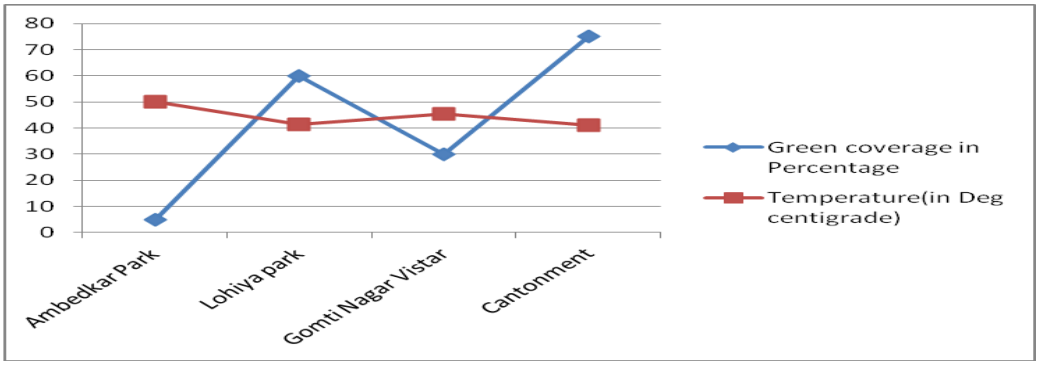

Fig.3: Green Coverage vs Temperature at Different Locations in Lucknow

S-JPSET : Vol. 8, Issue 1, ISSN : 2229-7111 (Print) & ISSN : 2454-5767 (Online)

3. RESULTS AND DISCUSSION

According to the data taken on two days, atmosphere was clear and sunny. The vehicles moving on roads were considered average, same excepting Chak Gajaria.

- The first data was taken on 07th May, 2016 shows that temperature at Doordarshan Kendra was lowest to 41.8° C, whereas at Chak Gajaria, it was highest to 47.8° C. Though the rate of vehicle movement was 15-20% compared to that of Doordarshan Kendra [Table 1]. There was about 5°C temperature difference which showed that carbon sequestration at Doordarshan was high where vehicle movement numbers and green coverage was high [Fig. 2].
- From the second reading taken on 17th May, 2016, it was observed that the temperature at Cantonment area was lowest to 41.1°C and Green Coverage was 75% and vehicle movement was also high [Table 2]. Whereas, at Ambedkar Park, the temperature was highest to 50°C, Green Coverage was hardly 5% and vehicle movement was high. There was a temperature difference of 10°C. This shows that at Cantonment Carbon Sequestration was very high being High Green Coverage and heavy vehicle movement [Fig. 3].

From above, it is noticed that in case vehicle movement is high and Green Coverage is low, practically, Carbon Sequestration is low and where the Green Coverage is high and vehicle movement is high, Carbon Sequestration is high. This leads to absorb carbon being emitted from tail pipe of vehicles. If proper project of tree plantation is executed along the road sides, that will have very positive impact to lower down the global warming effect due to increased transport uses by developed and developing countries.

4. CONCLUSION

From the above study, it is concluded that, there are no experimental data to support the hypothesis that:

- Increase in Human Hydrocarbon use or of atmospheric Carbon Dioxide and other Greenhouse Gases are causing or can be expected to cause unfavorable changes in global temperatures.
- As coal, oil, and natural gases are used to feed and lift vast numbers of people from poverty across the globe, more CO_2 will be released into the atmosphere. This will help to maintain and improve health, longevity, prosperity, and productivity of all people in the developed and developing countries.
- Human activities are producing rise in CO_2 in the atmosphere. Mankind is moving carbon in coal, oil, and natural gases from underground to the atmosphere, where it is available for conversion into living things. By planting more trees along roadsides, we will be living in an increasingly lush environment of plants and animals as a result of this.
- CO_2 increase that will be absorbed by trees planted around residential area in urban, semi-urban, rural area and roadsides where transport vehicles are extensively running will make our living healthier.

Our children will therefore enjoy living on Earth with far more plant and animal life with which we are blessed, provided, we have to plan and execute considerable projects to plant trees along road sides as per load and rate of vehicular movement. Trees along roadsides can make Green and Clean Environment and need maximum coverage by media so that people may start planting trees in residential areas also.

REFERENCES

[1] Landsea, C. W. (2007) EOS 88 No. 18, 197, 208.

[2] Landsea, C. W., Nicholls, N., Gray, W. M., and Avila, L. A. (1996) Geophysical Research Letters 23, 1697-1700.

[3] Goldenberg, S. B., Landsea, C. W., Mesta-Nuñez, A. M., and Gray, W. M. (2001) Science 293, 474-479.

[4] Jevrejeva, S., Grinsted, A., Moore, J. C., and Holgate, S. (2006) J. Geophysical Res. 111, 2005JC003229.http://www.pol.ac.uk/psmsl/author_archive/jevrejeva_etal_gsl/

[5] Leuliette, E. W., Nerem, R. S., and Mitchum, G. T. (2004) Marine Geodesy 27, No. 1-2, 79-94.http://sealevel.colorado.edu/

[6] 123. Gore, A., Pelosi, N., and Reid, H. (June 29, 2007) The Seven Point Live Earth Pledge. Speaker of the House Website, www. speaker.gov. and www. liveearth. org.

[7] 124. Beckmann, P. (1985) The Health Hazards of NOT Going Nuclear, Golem, Boulder, Colorado.

[8] 125. American Nuclear Society, Nuclear News (2007) March, 46-48.

[9] Kantt Tom, (2014), How many trees does it take to transform one ton of CO2 into oxygen, Scientific Software Designer, Botany, 8 May 2014.

[10] Houghton, R. A. (2007) Annual Review of Earth and Planetary Sciences 35, 313-347.

