Challenges of Carbon-di-Oxide (CO_2) Mitigation through Present Technology: A Review

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ABSTRACT

Forest management, combined with global environmental changes, helps in increasing the capacity of carbon offsetting ofunorganized forests. The major focus of forest plantations is to short-rotation afforestry system,which have greater potentialof soil carbon accumulation, especially in agricultural farms and lands. The major aim of this complete review is to provide a clear image of the present development of various carbon capture technologies and existing technology options. In addition, this article tries to examine current advances in research and developments for CO_2 captures and storage. Finally, this article also focuses at opportunities and challenges based on cost and engineering economics of CO_2 capture and sequestration.Different types of organizations start to investigate their environmental impact are likely to similarly find that CO_2 sequestration in trees can only provide limited mitigation opportunities.

Keywords: Tree plantations, Biomass, Mitigation, CO_2 sequestration, capturing technologies.

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1. Introduction

Forests are a major critical component of the universal carbon cycle, storing over 80% of global terrestrial aboveground carbon. Forests play a significant role in stabilizing the carbon cycle through dynamic and vigorous exchange of CO_2 with the atmosphere. This type of management helps maintaining such terrestrial forest carbon stocks which deliver a significant component to

International climate change abatement strategies. Forest ecosystems play a vital role in global terrestrial carbon cycle owing to their enormous carbon pool and high productivity.

Earth's environment has been undergoing changes due to increasing human population and its activities; the most significant changes being the increase in concentration ofCO_2 and other greenhouse gases (GHGs) in the atmosphere. There is a clear evidence for the changes that have occurred in the composition and concentration of GHGs in the troposphere during the last century and over the long period of time scales of glacial and interglacial periods.CO_2 is one of the major GHG, whose level is continuously increasing in the atmosphere since preindustrial times. Human induced increase in atmospheric CO_2 over the past 140 years is thought to have contributed to average global temperature increase as well as other changes in climate and is attributable generally to fossil fuel combustion and deforestation worldwide. Fossil fuels combustion being the major principle cause of increase in CO_2, releases about 21 billion tons of CO_2 in the atmosphere per year, whereas deforestation is expected to account for 15-30% of CO_2 emission per year. Anthropogenic deforestation is converting the forest from being sinks of Carbon dioxide to its sources.

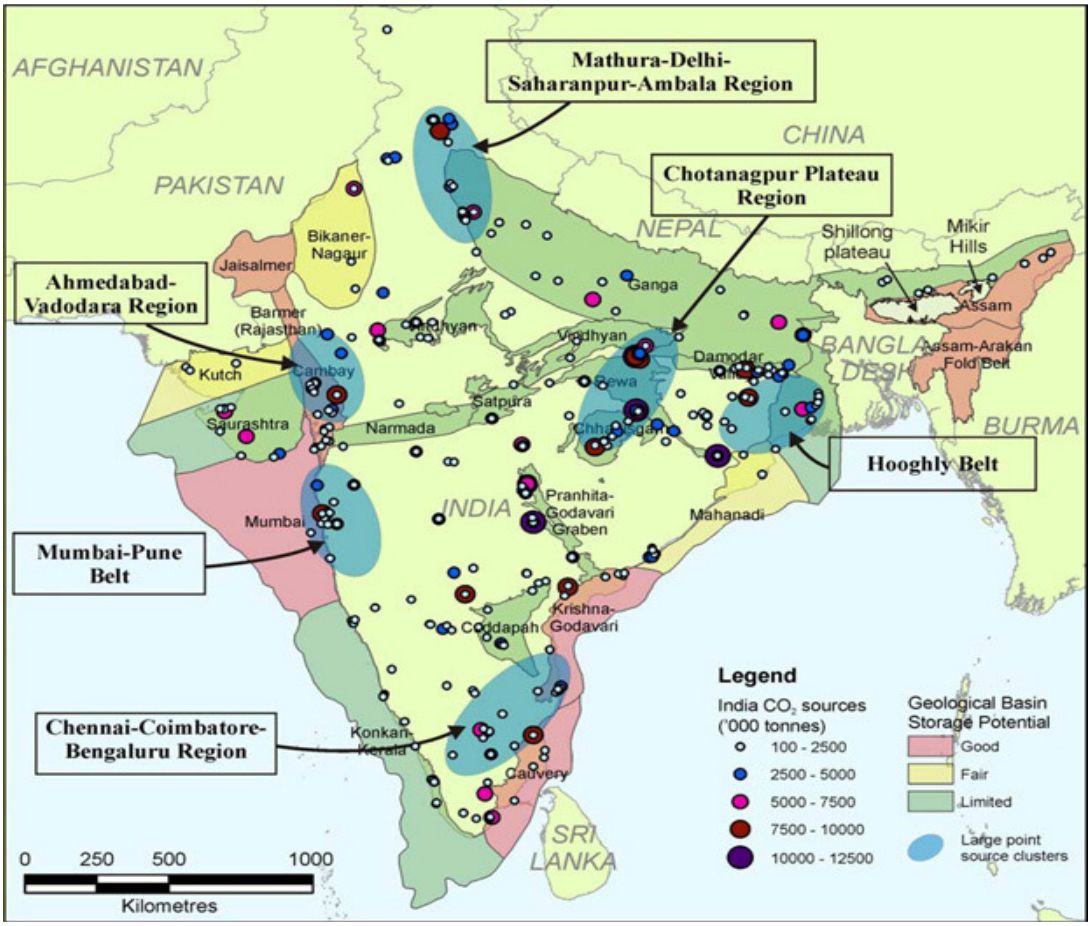

Figure 1: Major region of CO_2 emitter in India

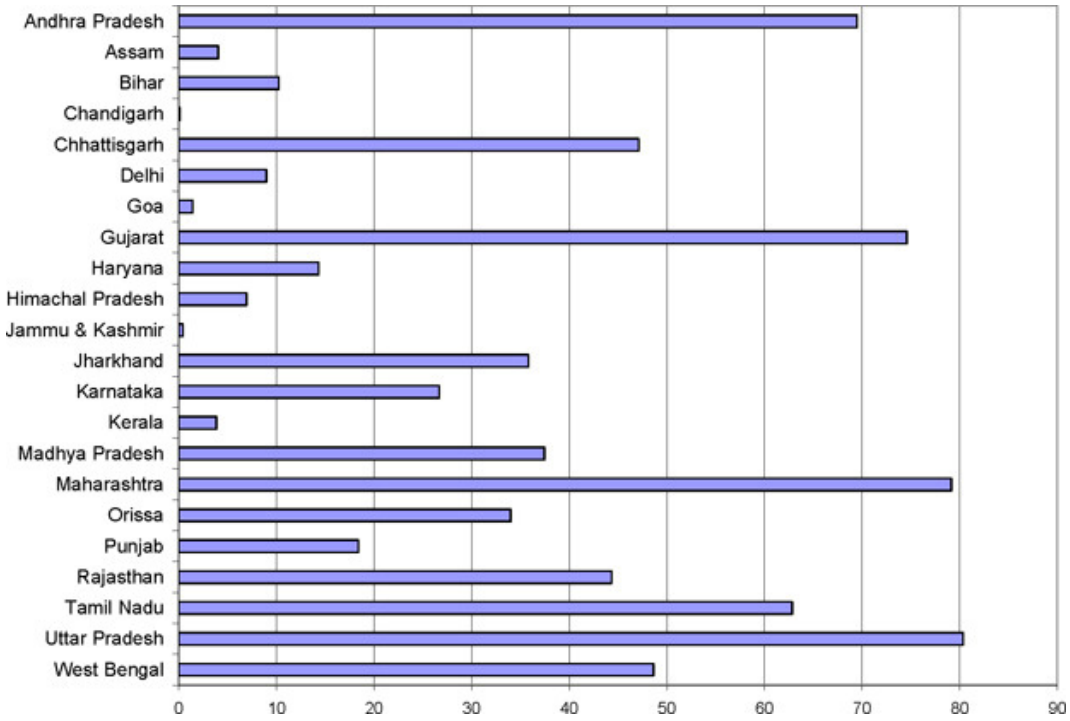

Figure 2. Total CO_2 Emissions by State (sources emitting >0.1 Mt per year)

2. Literature Survey

A review of earlier works is very significant for any type of research which is related to the theme. It helps to decide the objectives of the study and selecting the methodology and to analyze data with proofs. Here, some previous works already done by others in last few decades have been reviewed by me, which have distinct relation to the present biological research.

In order to meet GHG emissions reduction target, a complimentary range of technological approaches, including improving energy efficiency and conservation, adopting clean fuels and clean coal technologies, developing renewable energy, and implementing CCS, has been considered by various countries according to their own circumstances. It is noted that CCS comprises a portfolio of technologies that can massively reduce CO2 emissions, but CCS is yet to be widely deployed. This paper has reviewed various technologies and issues related to CO_2 capture, separation, transport, storage and monitoring. The selection of specific CO_2 capture technology heavily depends on the type of the plant and fuel used, where for gas-fired power plants, post-combustion capture technology was found generally to be the technology due to its lower cost. Absorption is the most mature CO_2 separation process, due to its high efficiency and lower cost; although issues related to environmental impact have to be fully understood.

Biomass analysis in *Annonasquamosal* and*Annonaretiaculata*tree species is estimated by destructive methods followed by the ash content method. Plants separated into stem, leaves, bark and sub branches and oven dried at 800C for 24 hours and after then placed in a muffle furnace

for carbon ignition process. Carbon content in *Annonaretiaculata*and*Annonasquamosa*was 83.1 Kg Cha-1 and 73.5 Kg Cha-1 estimated respectively. Carbon is estimated by following equation.

Carbon = Biomass x Carbon%

Biomass estimation of 4099 trees of *Eucalyptus spp. w*as calculated by non-destructive approach. Above ground biomass (AGB) are calculated by multiplying the volume to wood density. The BGB have been evaluated by multiplying AGB taking 0.26 as the root to shoot ratio. Total standing biomass and total carbon sequestered of *Eucalyptus spp.* was estimated 641.35tha-1 and 320.67tha-1 respectively.

$$\textbf{AGB (g)} = V\ (cm^3) \times \text{wood density}\ (g/cm^3)$$

$$\textbf{BGB (t ha}^{-1}\textbf{)} = 0.26 \times \textbf{AGB (t ha}^{-1}\textbf{)}$$

3. Mitigation measures for sinking carbon emissions

The need for reducing the CO_2 equivalent emissions will affect many sectors of theenergy creation, transport, buildings, industry, agriculture, human settlements, etc.

Energy Creation - Availability of adequate energy supply is fundamental to modern living. Currently, a major portion of the energy is generated using fossil fuels—coal, oil, and natural gas (in decreasing order of CO_2 emissions). These will need to be replaced by low- or zero-carbon fuels, such as wind, solar, and nuclear.

Transportation - Advancements will need to take place in areas of energy efficiency, improved vehicle performance, use of electrical vehicles, integrated urban planning, development of highspeed rail systems, improvement in public transportation systems, etc.

Buildings - Efforts will have to be made for adoption of low-energy building codes, use of energyefficient appliances, reduced usage of non-renewable electricity, etc.

Industry - Industry is a heavy user of energy. It will be necessary to undertake a wide-scale upgrading, replacement and deployment of new technologies, efficiency of material use, and recycling and re-using of materials and products.

Agriculture-Using compost instead of chemical fertilizer play an important role to reduced the CO_2 emission. Modern technology improves the total production and also helps in to minimize the carbon emission.

4. Challenges in implementing the mitigation measures

The increase in the concentration of GHGs (such as CO_2 or methane) due to increased emissions does not remain localized for very long; it gets uniformly distributed throughout the world in about 30 days. The world is getting smaller, interconnected, and interdependent. This means that no country can afford to remain isolated in the worldwide efforts to contain GHG emissions. Without full international cooperation from all countries, it will be very difficult to make any meaningful progress. There are a number of challenges in being able to achieve the objective of a low- or zero-carbon world.

5. Policy background

5.1. The UNFCCC and the concept of Joint Implementation (JI)

In July 1992, United Nations Conference on Environment and Development (UNCED) organize a meeting of different delegates in Rio de Janeiro in which representatives from 155 nations gathered. Recognition that climate change was a reality led to the signature of the United Nations Framework Convention on Climate Change (UNFCCC), which resulted in a voluntary commitment by industrialised countries (Annex 1 countries) to reduce their emissions to the 1990 levels until the year 2000. Imbedded in the agreement was the concept of Joint Implementation (JI) with other countries to reduce and stabilized greenhouse gases. Investors country provides the technology, idea, communication and financial support to the under developing countries for developing the projects which helps for the carbon emission reduction or carbon sequestration and generating carbon credits. These carbon credits should be equivalent to the carbon sequestration derived from the investment, and host country would be allowed to use them to lower greenhouse gas related liabilities (e.g. carbon taxes, emission caps, etc.) in their own countries. JI provides the facilities of marginal costs of emission reduction or CO_2 sequestration in developing than developed countries.

5.2. The Kyoto Protocol

The Kyoto Protocol was conceived during Conference of Parties-03 of the UNFCCCin December 1997. The most important feature of the Kyoto Protocol is the compulsory commitment by 39 developed countries to reduce their GHGs emissions by an average of 5.2% of 1990 levels by the commitment period in 2008-2012. The Kyoto Protocol provides the ‘flexibility mechanisms’ for facilitating GHGsemission reduction targets. These are Joint Implementation (JI), carbon trading and the Clean Development Mechanism (CDM).

5.3 Mechanism of clean development mechanism (CDM)

Important features are includes on CDM is:

- ✓ Project activities must have additional benefits in a business-as-usual scenario.
- ✓ The CDM provides the facilities to open participation by either private or public entities, or combinations of the two.
- ✓ CDM projects must be certified independently.

The working model of the CDM is under development and is expected to be defined during the Sixth Conference of Parties (COP-6) to the UNFCCC.

6. Scientific concepts

Carbon sequestration through afforestation is basically based on two premises. First, CO_2 is an atmospheric gas that circulates continuously around the global and, efforts to remove GHGs from the atmosphere will be equally efficient whether they are based next door to the source or on the other side of the globe. Second, green plants takeCO_2 gas out of the atmosphere during the process of photosynthesis in the presence of sunlight and use it to make glucose, fructose and other organic compounds used for continuous growth and metabolism. Plants store carbon in wood and other tissues until they die and decompose at which time the carbon in their wood may be released to the atmosphere as CO_2, CO, or methane or it may be decomposed into the soil as organic matter.

New tree planting means the creation of new carbon sinks, i.e., carbon obsession during tree growth in afforestation,forest rehabilitation,reforestation, or agroforestry schemes. When considering carbon storage, not all forests are equal. Generally, longer-lived trees with high density wood store more carbon per volume than short-lived, low density, fast-growing trees.

7. CONCLUSION

There are many social, institutional, economic and ecological issues that plague CDMprojects in India. These projects are complex, inflexible and time consuming by design,which is frustrating for the stakeholders.Awareness about the CDM is very low in localpeople and field staff of the four surveyed projects; hence they cannot effectively participatein it.

There are issues related to long project duration, high project costs, and uncertain and lowcarbon revenues that affect the economic sustainability of these projects. Opportunity cost ofland and labor is much higher than the projected carbon revenues.

This research raises some critical questions for the large scale carbon forestry programmessuch as Green India Mission and REDD+ underway in the country. Some of thesequestions include- what is the rationale and significance of these programmes given thatsimilar schemes with significant public investment are already being implemented? Howwill these programmes affect forest governance in the country? Do the nature and design ofthese programmes promote monocultures of fast growing species? What will be its impact on biodiversity in and outside the forest areas? And finally, how carbon forestry programmeswill affect the rights and livelihoods of forest dependant people in the country? Furtherresearch is required to understand these issues better.

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