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AN ANALYTICAL APPROACH ON CARBON CAPTURE & SEQUESTRATION POTENTIAL OF INDIAN FORESTS

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ABSTRACT:

The projections captured on climate change reveal rise in future global mean temperature, increment in sea levels and enlargement in the frequency of heat waves due to unlimited anthropogenic emissions of C02 mainly caused by forest degradation and fossil fuel combustion from many decades. The scale of the problem is very challenging and must not be underestimated. It is therefore necessary to seek for such alternative options which could possibly reduce the concentration of Carbon in the atmosphere without harming the need for developmental activities. To keep control on GHG emission, discussions often look upon transition to C02 free energy resources such as nuclear or renewable energy production in various applications but that incorporates a huge initial economic value. For carbon capture & sequestration (CCS) a range of other alternatives also exist with low-tech investments. The contribution of forests as a significant potential option for CCS must not be neglected. The results of many scientific studies have shown substantial carbon harvest from forests and carbon capture through the biological growth of forests. The present paper analyses ecological perspectives of enhanced carbon capture and sequestration (CCS) in forests and carbon stock changes as well as potential of carbon sequestration in Indian forests.

KEYWORDS:

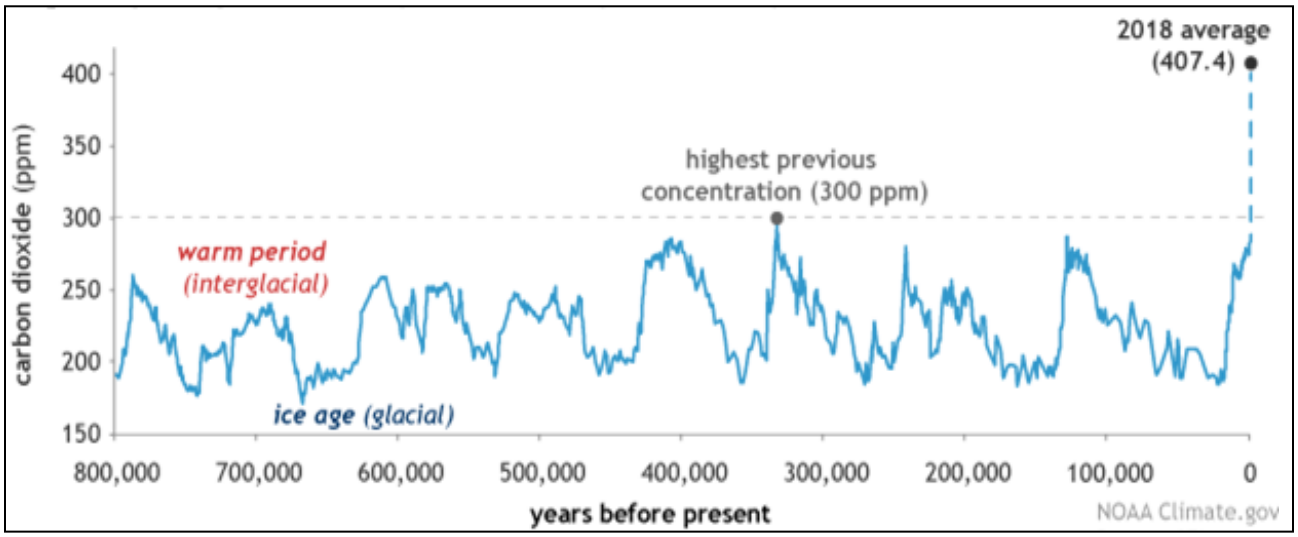
FORESTS, CARBON EMISSION, CLIMATE CHANGE, CARBON SEQUESTRATION, CARBON STOCK, SUSTAINABLE DEVELOPMENT.

INTRODUCTION

The concentration of CO_2 in the atmosphere which is one of the major components of heat-trapping greenhouse gas has increased so far since the beginning of the industrial revolution. Such rise is attributed by both the natural sources and human activities. The major factors of natural sources involve decomposition, terrestrial exchanges, ocean release & respiration and volcanic eruptions. Human sources of perturbations include activities like cement and electricity production, forest degradation as well as fossil fuel combustion such as burning of coal, oil and natural gas. These carbon emissions are estimated to be increased in the upcoming periods because of rising population at exponential rate with their increasing demand of food and energy. Major population in India is dependent on forests and agriculture. Observations by the IPCC (2014) state that agriculture, forestry and land use changes have become the world's most significant sources of CO_2 emission after heat and electricity production. Almost 85% of all human generated CO_2 is caused by burning of fossil fuels such as oil, coal and natural gas. The remainder comes from the removal of forests and other land use land cover changes (10%), as well as some industrial functions like cement manufacturing (4%). This high rate of CO_2 emission now has reached at dangerous levels not seen in the last 800.000 years (Fig.1) (Lindsey, 2020). Comparing the CO_2 emissions by natural sources and human sources, contribution by humans is less but they have caused an interruption in the natural balance system that existed for millions of years before the influences of humans.

The following graph (Fig.1) presents the global average atmospheric CO_2 in the year 2018 which was approximately 407.4 ppm (Parts per Million), the highest point in the past 800,000 years (Lindsey, 2020). With the passage of time, forests have been recognized as a stabilizing tool for GHG (greenhouse gas) concentration in the atmosphere. Several initiatives and efforts are being taken to keep the forests protected and under conservation. Many studies have shown that carbon capture & sequestration (CCS) in the forest biomass may provide a comparatively low cost net C emission reduction solution. They can not only sustain its own carbon but also possess potential sinks to store atmospheric carbon (Lal and Singh, 1998).

FIG.1: CO_2 DURING ICE AGES AND WARM PERIODS FOR THE PAST 800,000 YEARS



Source: NCEI/ NOAA Climate.gov

A. CURRENT STATUS OF FORESTS IN INDIA:

Forests are a renewable natural resource and help in maintaining the earth's temperature by balancing the concentration of GHG in the atmosphere, hence mitigate the global warming. They also act as a reservoir of terrestrial biodiversity and are critical to hydrological integrity of many ecosystems. The need of forests for a sustainable ecosystem is now widely identified as there are many initiatives and efforts are being taken for their enhancement and conservation. India occupies a 10th place amongst the most forested countries of the world and typically known for its sound forest ecosystems and megabiodiversity. The country has 21.67% (712,249 sq km) of total forest cover (TFC) and 2.89% (95,027 sq km) of tree cover (TC) of its total geographical area according to the biennial India state of forest report (2019).

In India, forests are distributed according to their nature, type of climate & soil, topography & elevation, into 5 major categories namely tropical evergreen forests, tropical deciduous forests, tropical thorn forests, montane forests and swamp forests. In terms of canopy density, forests are classified as very dense forests (99,279 sq km), moderately dense forests (3,08,472 sq km), and open forests (3,04,499 sq km) where the percentage of open forests (9.26%) is highest and very dense forests (3.02%) is lowest (Table 1).

TABLE 1: FOREST COVER CHANGE MATRIX FOR INDIA BETWEEN 2017 AND 2019 ASSESSMENT

Class	2019 Assessment					Total ISFR 2017
	VDF	MDF	OF	Scrub	NF	
Very Dense Forest	97,309	626	50	2	171	98,158
Moderately Dense Forest	1,755	3,03,781	699	109	1,974	308,318
Open Forest	127	2,244	2,89,358	1,069	8,999	301,797
Scrub	2	48	1,732	41,831	2,366	45,979
Non Forest	85	1,773	12,660	3,286	25,15,413	25,33,217
Total ISFR 2019	**99,278**	**3,08,472**	**3,04,499**	**46,297**	**25,28,923**	**32,87,469**
Net Change	1,120	154	2,702	318	-4,294	

Gain Loss (area in sq km)

Source: ISFR (2019)

India has set a target to bring its 1/3rd share of geographical area under forest cover by 2022 which requires nearly 2% increase in forest cover every year till 2022. The total forests and tree cover in India covers 80.73 million hectares (24.56%) of total geographical area of the country and has shown growth of about 1% (5,188 sq km) as compare to the estimate of ISFR 2017.

B. THE EARTH IS GETTING GREENER DUE TO THE MASSIVE HUMAN ACTIVITY IN CHINA AND INDIA: NASA STUDY[1]

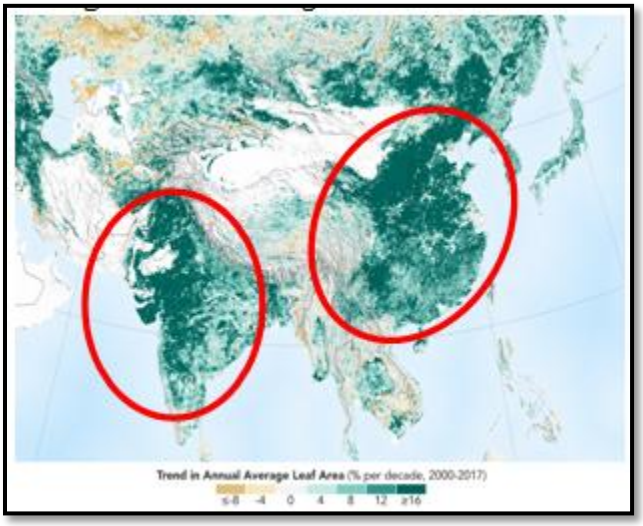
Earth's greening indicates more and more areas covered under green leaves, this milestone is attained by China and India since the mid 1990s. NASA released maps of the planet-wide changes and wrote, "The effect comes mostly from ambitious tree-planting in China and intensive agriculture in both countries." The study by Chi Chen

published on Feb. 11, 2019, in the journal '*Nature Sustainability'* says that most of India's greening is coming from croplands (82%) and a little contribution from forests (4.4%) while in China it came mostly from forests (42%) and then by croplands (32%).

[1] The information about the NASA study is provided by the author: Abby Tabor, NASA Ames Research Centre, with Mike Carlowicz, Earth Observatory, Silicon Valley.

The following image (Fig.2) is acquired by NASA after a continued two-decade-long study. The data is recorded from the MODIS instruments by two excellent satellites of NASA- Terra and Aqua. MODIS laid out intensive coverage in space and time by providing high resolution data with very accurate information. The sensors of the satellites provided four shots of almost every place on earth, everyday, for the past two decades. It is very satisfying to note

FIG.2: SATELLITE IMAGE OF INDIA AND CHINA



Source: NASA Earth Observatory image by Joshua Stevens

that in spite of a heavy biotic pressure on the populated country like India, forests and tree cover are continuously showing an increasing pattern over the years. This consequence has been received from sustained protection and conservation programs to expand the forests with the objective of lowering land degradation and climate change.

C. KEY CHALLENGES BEFORE INDIA TO CONTINUE THE POSITIVE CHANGE IN GREEN COVER

Despite achieving 1% growth of forest and tree cover, India still need to worry about its green cover because inadequate regeneration of forests, ground water depletion, soil erosion and multiple crop injuries causing land degradation and distortion of forest health in the country. In India, a substantial portion of the population is dependent on forest resources to fulfill their necessities. Moreover about 275 million people rely solely on forests for extracting direct benefit such as habitat, food, fuel wood and fodder (FSI, 2011).

India accounts for 18% of the world's total population with only 2.4% of world's geographical area. Land degradation is a critical issue for a country like India which is very sensitive to climate change and extreme weathers. The rising demand of huge population is imposing high pressure on land through habitat fragmentation, agricultural practices, collection of timber for fuel and NTFPs (non-timber forest products). Globally, India has recorded highest annual wood extraction of 434,766 thousand cubic meters (86.6%) as a fuel wood (FAO, 2015). Grazing disturbs 81% of country's forest area, intensive grazing and lopping for fodder harms vegetation. 6.15% of forest is prone to injuries (FSI, 2015a).

India has pledged to regenerate 26 million hectare of degraded land by 2030 at COP 14 of the United Nations Convention to Combat Desertification (UNCCD). The Desertification and Land Degradation Atlas of India issued by the Indian Space Research Organization (ISRO) reveals that 30% of the land out of total country's geographical area is degraded and the target set at COP 14 covers only 1.5% of total country's degraded land. 28.5% degraded land is again left for the restoration.

In the last 30 years, India has diverted large forests land to 23,716 industrial projects (Ghosh, 2016). According to the data provided by CAMPA, 14,000 sq km of forests have been cleared over three decades by giving it over to mining (4,947 sq km) followed by defense projects (1,549 sq km) and hydro electric projects (1,351 sq km). Such rapid loss of natural forests due to massive CO_2 emissions are causing low growing stock, loss of future potential biomass and forests capacity to sequester more carbon (Joshi and Singh, 2003).

D. KEY MEASURES ADOPTED FOR ACHIEVING THE SUSTAINABILITY OF FORESTS IN INDIA

India has a long tradition for protecting and managing forests on the basis of biological, functional and scientific prescription. Although there have been some practices which couldn't achieve its targets due to inadequate capacity, finance and technology. But there are others successful forest management implications which have been stabilizing the environmental sustainability and ecological balance without compromising the rising demand of population and rapid economic growth. Some of those are discussed below:

- ***Draft National Forest Policy, 2018:*** The aim and objective of this study is to improve the ecological and livelihood security of people on the basis of sustainable management of forests for both the present and future generations. It also aims to bring minimum one-third of the total land area of the country under forest and tree cover in order to reduce soil erosion and land degradation.
- ***Green India Mission, 2010:*** GIM, as one of the eight missions under the National Action Plan on Climate Change (NAPCC) identifies the environmental phenomenon that could seriously harm the type and quality of forests or natural

resources of the country and livelihoods of the people. In this way this mission recognizes the potential influences on forestry sector through adaptation and climate mitigation, protection and conservation of biodiversity and livelihood security of forest dependent people.

- ***Green High ways Mission, 2015:*** The Green Highways (Plantation, Transplantation, Beautification and Maintenance) policy aims to promote greening of highway corridors with the active participation of public and private sector, local communities, NGOs and farmers.
- ***National REDD+ Strategy India, 2018:*** REDD+ stands for Reducing Emissions from Deforestation and Forest Degradation which aims at attaining climate change mitigation by promoting forest conservation in developing countries. National REDD+ strategy is prepared by ICFRE (Indian Council of Forest Research & Education). This strategy will push India to accomplish its Nationally Determined Contribution (NDC) commitments of capturing 2.5 to 3 billion tones of CO_2 by adding rehabilitated forests till 2030.
- ***Forest (Conservation) Act, 1980:*** The Forest (Conservation) Act, 1980 is an effective legislation with a view to combat deforestation and forest degradation. Its main objective is to put a limitation on the de-reservation of forests and to restrict the diversion of forest-land to non-forest purposes.
- ***Environment (Protection) Act, 1986:*** This act motivates central government to protect and modify the environment and the matters connected with it. It ensures prevention of all kind of pollution which is specific to environmental problems.
- ***Biological Diversity Act, 2002:*** The present act specifically brought up for the safety of bio-diversity and to make the sustainable fair and equitable use of all its components. The benefits coming out of the use of biological resources must be shared equally among the local communities who have fair knowledge about the forest biodiversity uses.
- ***National Environment policy, 2006:*** The objective of this policy is to insure and integrate environmental concerns into the plans and policies of government with the applicability of the principles of good governance (transparency, accountability, rationality, low time and cost). It also ensures provision of resources and finance, technology and management skills, social capital through multi-stakeholder partnerships, investors and multilateral development partners.
- ***The National Green Tribunal Act, 2010:*** This act establishes a special tribunal to provide a specialized forum which will handle the expeditious disposal of the cases pertaining to environmental protection.
- ***National Agro forestry Policy, 2014:*** The policy highlights the contribution of agro-forestry in improving the environmental condition by halting deforestation, conserving biodiversity and hence enhancing carbon sequestration capacity.

METHODOLOGY FOR THE ASSESSMENT OF CARBON CAPTURE & SEQUESTRATION (CCS):

The increasing concentration of CO_2 in the atmosphere has risen up to 407.4 parts per million (ppm) in 2018 at global level (Lindsey, 2020). This rapid increase in the atmospheric C is almost 100 times faster over the last 60 years than previous natural increase. To tackle such acceleration in climate change, an immediate action is required that could somehow mitigate the changes and also decreases amount of CO_2 in the air. CCS is a process or practice that contributes to the removal of C from the atmosphere and stores it in the ecological sinks (aquatic and terrestrial) for a certain period of time. A positive balance of CCS is known to be occurred when C stored in the forests by photosynthesis (14.1 Pg C yr^{-1}) is higher than the C released by respiration and forest fires (11.6 Pg C yr^{-1}) (Nunes et-al, 2020). This whole process is called C cycle in which C travels from the air into the soil and its organism and then again travels back into the air. In this way, forests prove to be a potential solution as they have capacity to contribute in CCS over the different time periods. The process of photosynthesis in trees and plants is represented below by the chemical equation in which they "sequester" C from the atmosphere in the form of carbon dioxide and use it as food.

$6CO_2$ (Carbon absorbed) + $6H_2O$ (Water) + Sunlight = $C_6H_{12}O_6$ (Glucose) + $6O_2$ (Released oxygen)

The CO_2 absorbed by the plants is used for the growth of leaves, stems and branches of trees. Eventually, when the trees get dry, they release all the stored C back into the atmosphere with the process of decomposition. Plants also release C through respiration to produce energy for their growth. However, there are other numerous ways by which C can come back to the atmosphere. The process of cellular respiration is expressed by the following chemical equation-

$C_6H_{12}O_6$ (Glucose from the plant) + $6O_2$ (oxygen we breath) = $6CO_2$ (Carbon released) + $6H_2O$ (Water vapor) + ATP (Heat energy)

Here, the question arises that how plants can be considered as a carbon sink while they eventually contribute to carbon emission? So, it is true that forests are always not a carbon sink; they sometimes can be a carbon source- when they release more carbon than they absorb such as during forest fire or forest degradation. But most of the time, forests act as a carbon sink rather than a carbon source (Friedel, 2017).

In the ecosystem, carbon is stored in five major carbon

pools defined by Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF), 2003a. These carbon pools are consisting of live and dead, above and below ground biomass as well as of wood products. As per their categorization the five carbon pools are known as Above Ground Biomass (AGB), Below Ground Biomass (BGB), Deadwood, Litter and Soil Organic Compound (SOC). According to the ISFR (2019) (Table 2), the estimated carbon stock is 7,124.6 million tones. The forest carbon stock in India has increased (42.6 million tons) as compared to the previous estimates with the annual rate of change 21.3 million tones. Carbon stock is highest in the SOC carbon pool (56.19%) followed by AGB (31.67%), BGB (9.84%), Litter (1.80%) and dead wood (0.50%).

TABLE 2: CHANGE IN FOREST CARBON STOCK OF INDIA BETWEEN 2017 TO 2019 (MILLION TONS)

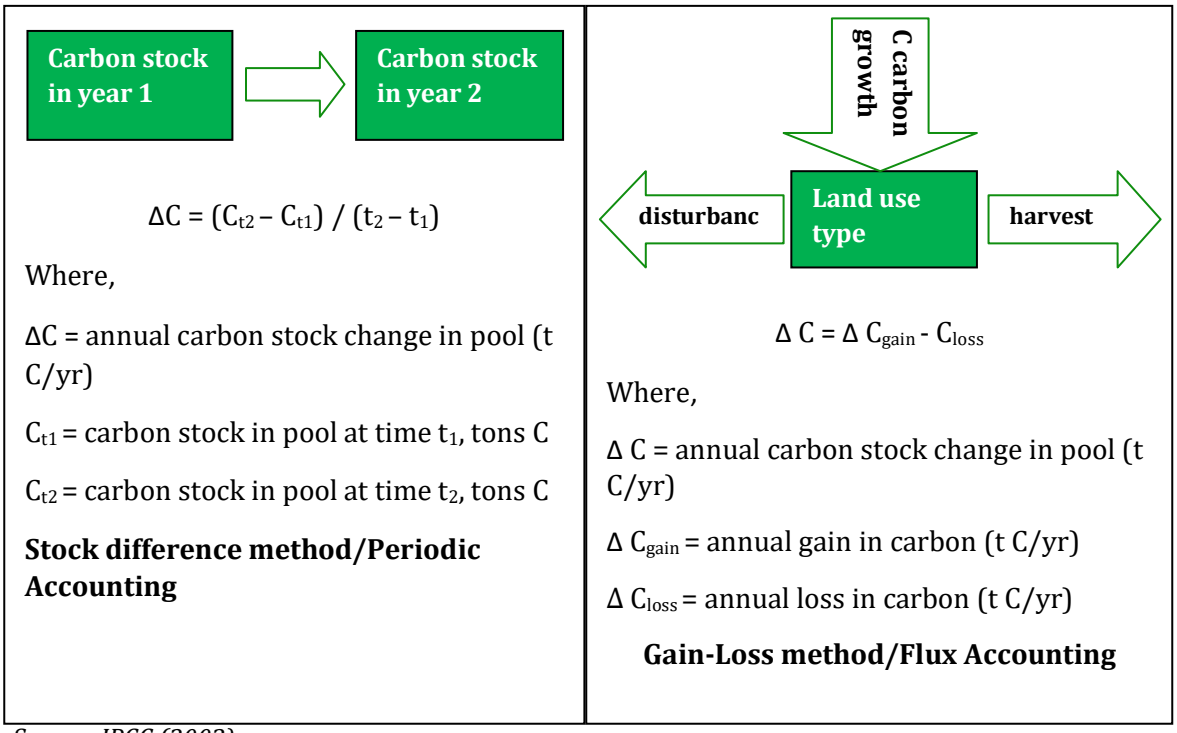
Component	**Carbon Stock in forest in 2017**	**Carbon stock in forest in 2019**	**Net change in Carbon stock**	**Annual change in Carbon stock**
Above Ground Biomass	2,237.5	2,256.5	19.0	9.5
Below Ground Biomass	698.7	700.8	2.1	1.0
Dead wood	30.1	35.8	5.7	2.9
Litter	136.2	127.9	-8.3	-4.1
Soil	3,979.5	4,003.6	24.1	12.1
Total	**7,082.0**	**7,124.6**	**42.6**	**21.3**

Source: ISFR (2019)

The high rate of plant growth indicates a great probability of CO_2 removal from the air because now the C uptake capacity of forest ecosystem has risen. On the other side, CO_2 emissions are caused by forest loss (especially harvest, LULC change and mortality). The net C emission or removal of CO_2 is calculated as the result of these two opposite activity which is commonly known as Carbon Stock Changes (Röhling et al, 2016). Estimation of C stock changes is very essential in forest ecosystem to acknowledge the actual carbon removal from the atmosphere and to identify whether the forests are working as a carbon sink or source.

At a national level, carbon stock differences can be calculated by NFI (National Forest Inventory) data. There are two broad approaches used to estimate the annual changes in C stock viz. Stock-difference method (SDM) and Gain Loss method (GLM). IPCC (2003a) has made the distinction between these two methods for calculating the emissions and removals of CO_2 associated with annual rates of changes in all carbon pools. Forest carbon accounting through Stock-difference method (SDM) calculates the annual uptake of CO_2 or emission of CO_2 as the difference between carbon stock of given forest area estimated at two points of time (Ct_2-Ct_1) divided by the number of intervening years (t_2-t_1) (Fig.3).

FIG.3: TWO APPROACHES FOR DETERMINING CARBON STOCK CHANGES



Source: IPCC (2003)

Estimation of C stock is generally calculated from repeated field measurements of forest variables as part of a National Forest Inventory (time series of NFIs) (Mcroberts et al, 2018). Remote sensing (RS) data can also be used for modifying the efficiency of sampling in a NFI. On the other hand, calculation of net annual change in C stock through

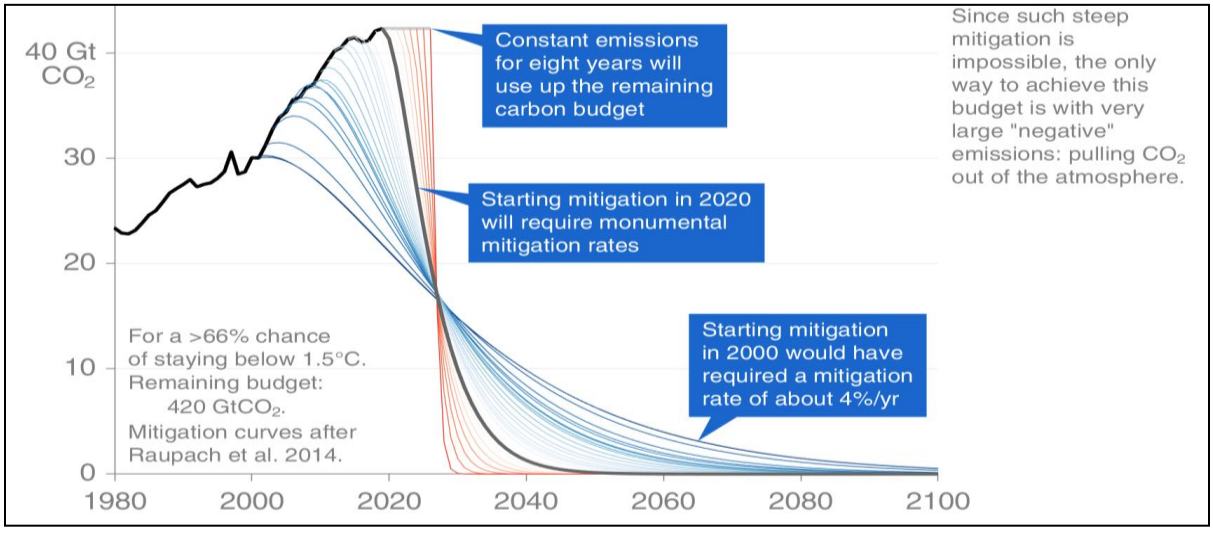
Gain-Loss method (GLM) is estimated as the difference between Carbon gains (through increase in forests and tree cover) and carbon loss (by losing forests) in carbon pools (Mcroberts et al, 2018) where the changes in carbon pools are often evaluated as a factor carbon removal or emission which defines the rate of gain or loss in each carbon pools per unit of land area. NFI is not required in this method. For such calculation of emissions and removals 'activity data' is required. Here remote sensing (RS) is likely to provide the main source of such area data. When applying these two methods and the net change occurring in biomass carbon stock is positive then it reflects growth in the forest ecosystem. Meaning by that forest growth has exceeded the degradation of forests and land.

RESULTS AND DISCUSSIONS:

Over the period of time it is very essential to track the actual gain out of plant and vegetation in the form of CO_2 reduction and emission. In other words, there must be an update about the real potential of carbon sequestration in the forests so that the policy measures can be implemented accordingly in a more efficient way. In 2015, according to the World Meteorological Organization (WMO), global average temperature was risen up to 0.76^0C as compare to the 1961-1990 average temperature. This evidence was an awakening call for the world leaders to find a way for fighting against this global challenge as a climate change. On this path, the 'Paris Agreement' under United Nations Framework Convention on Climate Change (UNFCCC), a legally binding global climate change agreement, being adopted at 'COP 21' (21th Conference of Parties) in Dec. 2015, reflects a strong international commitment to reduce the adverse effect of climate change by limiting the global temperature well below 2^0C above pre industrial levels as well as make efforts to limit it to 1.5^0C. This pact also indicates the developed nations to assist the developing countries in their efforts to climate mitigation and adaptation.

In the present era, observing the steep rise in CO_2 emissions, many scientific studies have presented their results saying that it is becoming harder and harder to achieve the goal of Paris Agreement or to limit the temperature under 2^0C (Fig.5). It is only theoretically possible to keep global temperature under 1.5^0C above pre industrial level (Andrew, 2020). In the fig.4, the dark black line is representing the mitigation curve for limiting the global temperature under 1.5^0C. The rate of mitigation for keeping the warming below 1.5^0C is different for every year. As, if we start mitigating the global cumulative CO_2 emission in the year 2020 then the required rate of mitigation will be very high because the cure is very steep means an immediate, intensive and highly effective effort is needed. Likewise, if we continue emitting the CO_2 as per present level continuously for eight years then we will reach on the extant of finishing the entire remaining carbon budget (IPCC special report on 1.5^0C provides global carbon budget). Starting the mitigation back in 2000, would have required a lower rate of mitigation nearly 4%/year.

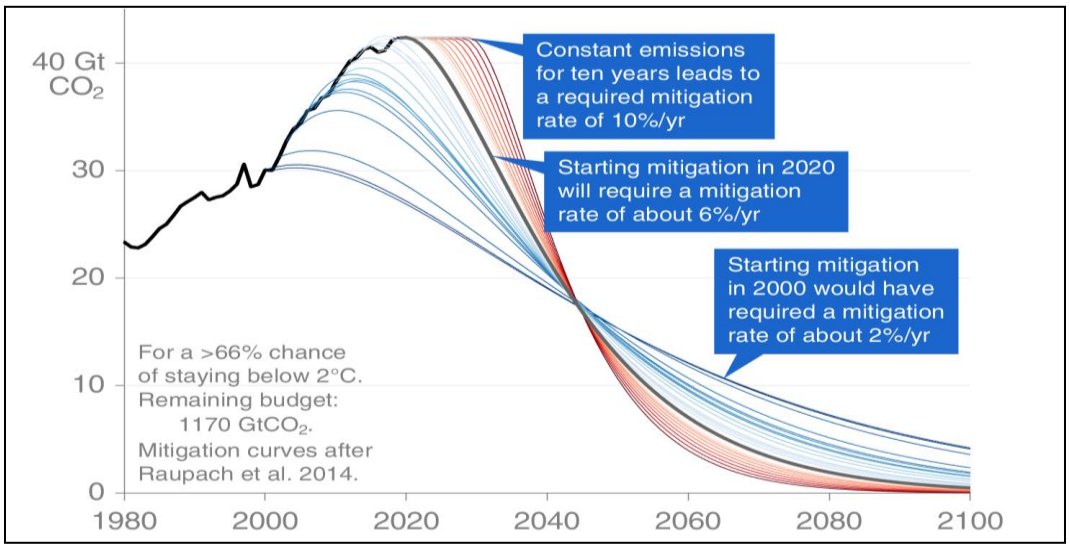
FIG.4: CO_2 MITIGATION CURVES: 1.5^0



Source: Robbie Andrew / Data GCP / Emissions budget from IPCC SR1.5

The following figure (Fig.5) presents the mitigation curves for keeping the temperature under 2^0C. It says mitigation started in 2020 for 2^0C will need a mitigation rate of approximately 6%/year. According to the IPCC special report on 1.5^0C (2014), the carbon budget left for a more than 66% (>66%) chance of staying below 1.5^0C is 420 Gt CO_2 (Gigatons of CO_2) and for a >66% chance of staying below 2^0C, left carbon budget is equal to 1170 Gt. CO_2, provided effective measures are adopted to slow down the temperature.

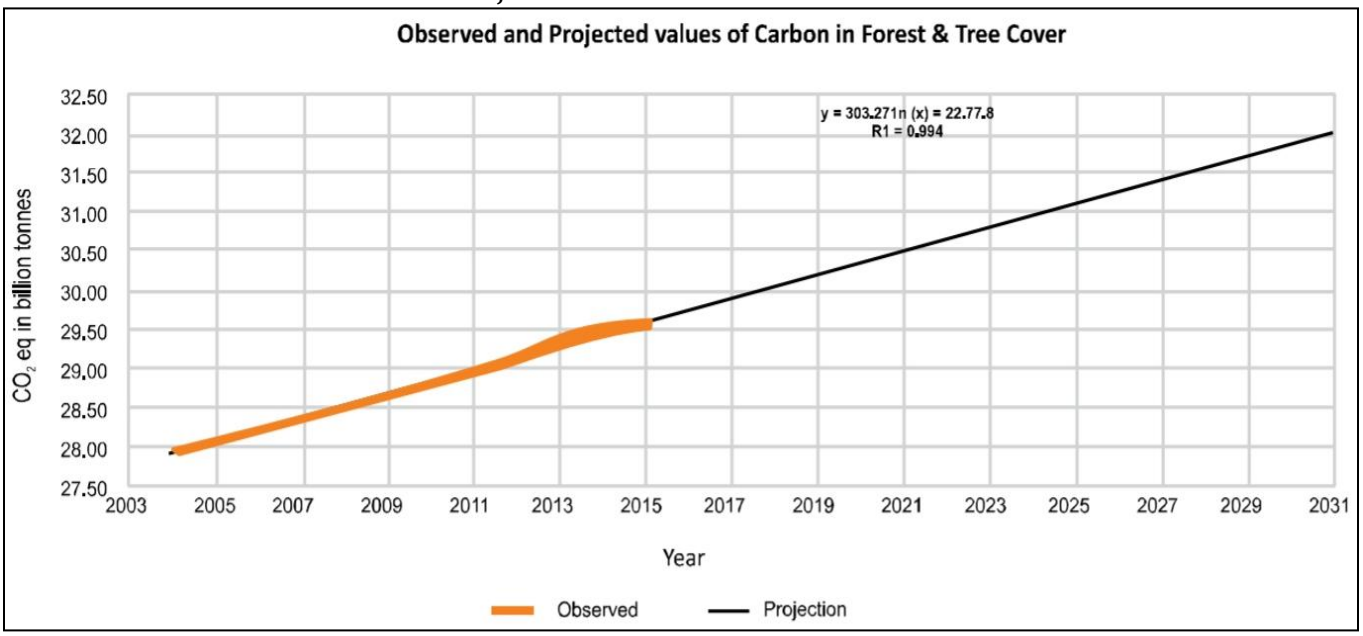
FIG.5: CO_2 MITIGATION CURVES: 2^0C



Source: Robbie Andrew / Data GCP / Emissions budget from IPCC SR1.5

India has shown its contribution towards achieving this global goal by submitting its Intended Nationally Determined Contribution (INDC) to the UNFCC in Oct. 2015 which focuses on the post 2020 climate initiatives that the country wants to implement under the global agreement. In the NDCs, one of India's most ambitious targets is to create an additional 'Carbon Sink' of 2.5 to 3 billion tones of CO_2 eq through additional forest and tree cover by 2030. It is also one of those targets in which India has not been performing well as compare to the other targets such as reducing the GHG emission intensity and creating non-fossil fuel based energy sources. To tackle this problem, FSI has carried out a study, in which it has projected a trend line using the time series data on forest cover so that it can have an understanding about the magnitude of possibilities and scale of actions necessary to attain the target. The projection shows (Fig. 6) a change matrix of carbon stock in forest and tree cover up to 2030 in BAU (Business as usual) (FSI Technical information Series Volume 1 No. 3, 2019b).

FIG.6: OBSERVED AND PROJECTED VALUES OF CARBON IN FORESTS & TREE COVER



Source: ISFR (2019)

In the above figure the colored line shows observed and black line shows projected values of carbon stock in forests and tree cover. For plotting this projection, linear regression equation, logarithmic and exponential function were created. The Table 3 shows that C stock in India's forests and tree cover have reached to 31.87 billion tons CO_2 eq till 2030 from 28.12 billion tons CO_2 eq in 25 years in BAU.

TABLE 3: PROJECTION OF NDC TARGETS IN DIFFERENT (INDICATIVE) BASELINE YEARS

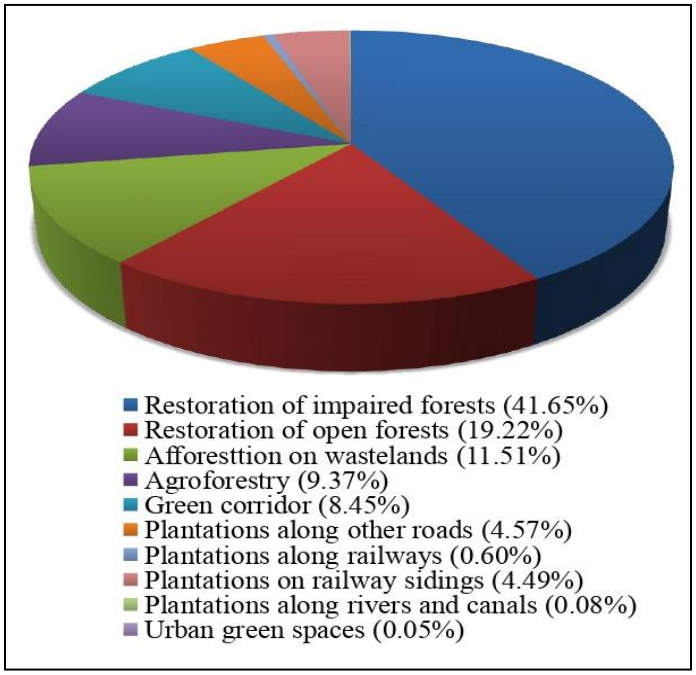
Year	Projection of Carbon in Forest & Tree Cover in BAU Scenario (billion tonnes CO_2 eq)	Plus 2.5 billion tonnes	Plus 3.0 billion tonnes	Difference from the Projected Value in 2030	
				2.5 billion tonnes	3.0 billion tonnes
2005	28.12	30.62	31.12	-1.25	-0.75
2015	29.62	32.12	32.62	0.25	0.75
2020	30.53	33.03	33.53	1.16	1.66
2030	31.87				

Source: ISFR (2019)

In the table, taking baseline year 2015 (Paris Agreement year), projection for 2030 demonstrates a short fall of 0.25 billion tons and 0.75 billion tons of CO_2 eq against the determined target of 2.5 to 3.0 billion tons respectively that may be achieved by various activities like restoration and afforestation programs, rehabilitation of degraded land, restoration of natural forests, agro-forestry etc.

Finally, the study concludes that if we can achieve the NDC targets by just following the projected trend line to increase the additional carbon sink by 2030 then the existing policies and programs of conservation and afforestation will be enough for it. For achieving the INDC goals and bringing the 33% of countries geographical land under forest and tree cover, the contribution of different activities have been presented in fig. 7.

FIG.7: CONTRIBUTION OF DIFFERENT ACTIVITIES FOR POTENTIALLY INCREASING THE CARBON SINK



Source: FSI Technical information Series Volume 1 No. 3 (2019)

It shows that reforestation of impaired forests and open forests hold more potential to create additional carbon sink (41.65% and 19.22% respectively). Though other activities have less contribution but they are equally important to achieve the NDC target and increasing the potential of Indian forests to sequester more carbon from the atmosphere.

CONCLUSION:

India is one of those countries which are very vulnerable to climate change because it is surrounded by Himalayan glaciers and depends largely on

monsoon patterns. Logging, harvesting and degradation of forests are reducing the country's carbon sequestration potential by losing enormous forest biomass. Paris Agreement intends to reduce GHG concentration and keep the temperature well below 2^0C. India took its initiative and submitted INDC report to the UNFCCC. In this way, it committed to bring the 33% of total geographical land under forest and tree cover by 2030. IPCC report (2014) has calculated the remaining carbon budget which is 420 Gt CO_2 for staying below 1.5^0C and 1170 Gt CO_2 for staying below 2^0C with the probability of more than 66% for both. If the immediate action were not taken and we continue emitting CO_2 at current level then we will exhaust our entire carbon budget within 8-10 years as per suggested by the scientific reports. This signifies the need to rapidly reduce the emitting C along with increasing the potential of forests biomass to sequester more carbon.

Forests and tree covers are an indicator to acknowledge the actual growing carbon stock and removal parameters. India need to manage its forests sustainably and be consistent with the Sustainable Development Goal (SDG)-2015 which aims to "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss." Therefore, keeping in mind the dynamic nature of forest ecosystem a regular monitoring is required to maintain the balance between conservation and development.

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