

PLANTING TREES IN LARGE NUMBERS WILL NOT MITIGATE CARBON EMISSION TO THE DESIRED LEVEL BUT CONSERVATION OF OLD FORESTS WILL DO

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ABSTRACT-The old forest ecosystem is more effective than new plantations in term of sequestering carbon; in an estimate this has been claimed that conservation of old forest is 40 times more effective than planted forest. Forests help mitigate climate change by sucking out carbon dioxide from the atmosphere, locking it away in their trunks and soil. But re-greening efforts in many countries rely on the expansion of plantations, where commercially important crops are grown, rather than forest restoration. Plantation is a very complex issue in India and requires many components to be integrated with each other and availability of land is one of them. Land has become a scarcer resource with each passing day as the world population is competing with the available land for many developmental activities and agricultural demands. For a mega-forest plantation like this, there is a strong need of huge investment in this sector and this has to be socially and ecologically viable from social audit point of view. This also needs very large areas and the size of the land required will vary with the objective of the plantation but the core issue is non-availability of suitable land in India. The legal infrastructure related to the forests and the forest departments across the states need radical reforms in order to meet the massive plantations, country is undertaking in the face of climate change mitigation after Bonn change summit in 2011. There has been a very strong pace of degradation in the Indian forests which is not visible to many but we are sitting on an explosive due to explode anytime. This has its implications on the carbon stock of the forest also. Growing plants may be one option to mitigate carbon dioxide emission in the atmosphere but this has to be so large that if it is carried out, this may engulf half of the agricultural land of the world and eliminating half of the natural agricultural ecosystem

KEY WORDS-Climate Change, Carbon Sequestration, Forest Cover, Old Forest Ecosystem, Natural Regeneration, Plantation, Food Security, Agricultural Land, Carbon Emission, Plantation Drive

INTRODUCTION

There has been a worldwide campaign to go in for a massive plantation after COP in Paris in the year 2015. Pakistan also launched a drive popularly called as 'Plant for Pakistan' drive in 2018 in which around 10 billion trees would be planted across the country in the next five years. The Government of UK also launched a massive plantation programme in which 50 million plants are supposed to be planted in a span of 25 years beginning from 2018 under the name "Northern Forest". This green belt that will stretch from Hull to Liverpool will reportedly cost British taxpayers £500m (USD690m) over 25 years, of which £5.7m (USD7.8m) have already been awarded. There has been a developing trend across the world that plantation forest will be capable of mitigating carbon faster than the old forest and that is how the natural forest is neglected and on decline. A recent report released by FAO in 2018⁽¹⁾ clearly states that the world's forest area decreased from 31.6 per cent of the global land area to 30.6 per cent between 1990 and 2015 but planted forest has increased from 167.5 to 277.9 million hectare or 4.06 % to 6.95 % of total forest area and incidentally 85% of the of the planted forest twenty countries⁽⁴⁾. China has been seen as country which added a little more than 1542 thousand hectare of plantation in between the year 2010 and 2015 followed by Australia, Chile, USA and others as shown in the figure 1. India occupies 8th position out of the top ten countries which went to add more areas under plantation forest.

ADDITION OF FOREST AREA GLOBALLY IN BETWEEN 2010 AND 2015

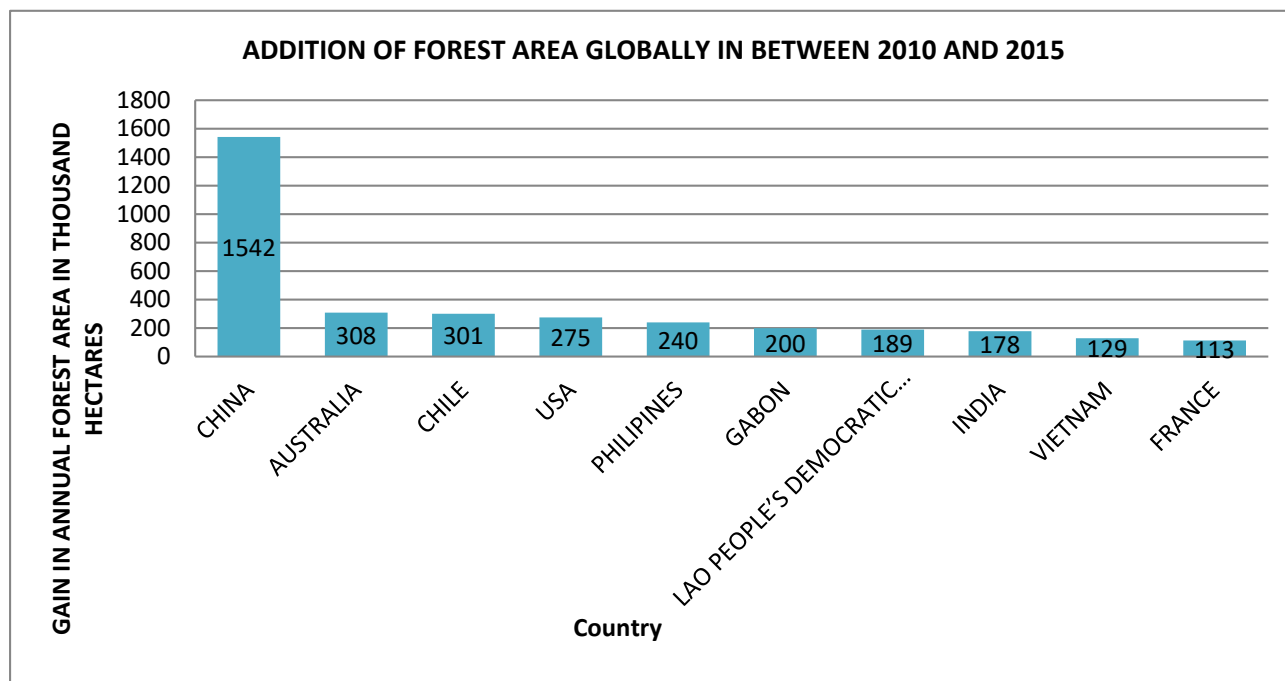


Figure no -1

SOURCE: FAO 2016,

The forest across the globe is under severe stress to meet the demand of growing population and that is why most of the countries are undertaking commercial plantations to meet the demand of those who depend on forest (3). If we look at the growth of plantation at global level then India marches ahead with reference to the global growth. Currently India is on plantation drive at the rate of 17% compared to 7% globally as shown in Table-1

TABLE 1 -- COMPARATIVE GROWTH IN PLANTATION TILL 2015

PLANTATION	GROWTH IN PERCENTAGE
GLOBAL AVERAGE PLANTATION	7%
INDIAN AVERAGE PLANTATION	17%

SOURCE: FAO 2016,

PLANTATION DRIVE IN INDIA

India is way ahead in plantation campaign and going at a rocket speed without understanding the consequences in long run. The Indian National Forest Policy aims and emphasizes at maintaining 33% of the country's geographical area under forest and green cover. In view of this and Bonn challenge signed by India in 2011 many state governments decided to launch massive tree plantation. Maharashtra Forest Department as a part of this programme and has decided to plant 50 crore seedlings across the state beginning from 2017 till the last seedling planted in the year 2019. Year wise targets have also been fixed as 4 crore, 13 crore and 33 crore in the three consecutive years of 2017, 2018 and 2019 respectively. Uttar Pradesh is unique in the sense that it is a seasoned campaigner in massive plantation since 2007 and has many world records to its credit till to this day without understanding that what has been its mortality rate over the years and how much money has been wasted in this process wasteful design of work. In an effort to increase the forest cover and to get into the Guinness World records for the most number of trees planted in 24 hours, people from all walks of life came together to plant trees at designated spots along roads, rail tracks and forest lands in the different cities of UP. In the year 2016 the forest department planted 5 crore of seedlings followed by

4.53 crore saplings during 2017-18. In the rains of 2018 it planted 9 crore seedlings while proposing to plant 22 crores and 25 crores in the year 2019 and 2020 respectively. India's central state of Madhya Pradesh undertook a massive plantation drive aimed at planting 60 million saplings on a single day in 2017 and has been rated as a farce and the most corrupt exercise in the recent history of plantation in the state. The plantation drive was initiated by local government to protect the environment and save river Narmada flowing in the state.

THIS IS TECHNICALLY NOT POSSIBLE TO SUSTAIN MASSIVE PLANTATION IN ONE DAY

Many states such as Andhra Pradesh, Telangana, Odisha, and UP achieved the target of more than 40 crore trees planted even though they do not have the same number of seedlings in their nurseries. This is against the principle of natural justice. It reflects a blind race to carry out tree plantations for political hype, not for improving the environment and the income of farmers. Regarding UP's ambitious plan to plant 22 crore seedlings in July 2019, seven crore out of the 22 crore are to be planted by the UP Forest Department and 15 crore by farmers. This has been decided by the government of UP that in order to meet the deficit of land available in the state for plantation farmers must be roped in to meet the target of 22 crore plantation in this rainy season of 2019 but with this comes the gigantic problems of land holdings in this state. The country where 67% of India's farmland is held by the marginal farmers with holdings below one hectare, against less than 1% in large holdings of 10 hectares⁽²⁾ then how could this be possible for farmers to undertake huge plantations target and compromising with their food security and annual income. The third party validation is yet another issue to be taken care with such a huge target. The maintenance of plantation for another ten years is an extremely important issue (if the stated plantation is to be converted into a forest) but unfortunately this has never been made a part of the structured planning of the UP Forest Department. The farmer will also not like to be associated with this plantation project because there is not any defined and structured market for their produce nor any minimum support price (MSP) defined by the state government.

(A) A CASE STUDY OF UTTAR PRADESH

There is a very huge target of plantation in UP and it is certain that if a fiercely independent third party monitoring is done the mortality rate of any plantation be reduced to 5% therefore, there seems to be a huge trust deficit in actual doing and the result on the ground. Normally, any third party verification involves any NGO or any institute which in turn hires retired forest officers (ACF or RFO) to count the living seedlings after three years and most of them are compromised therefore, the reality check is never done. There is a monitoring cell in the UPFD which is lying moribund and a sanctuary of rejected officers of the department. There have been multiple reasons as stated below and this explains to us that why the forest department of UP is not structured to carry out massive plantation for the sake of political appeasement.

1. There has been a shortage of trained and skilled staff in UPFD at the implementation or executive level.
2. Land is not available in the department for afforestation and this has been found that department carries out plantations on the failed area of last year without following the proper procedure. This has also been seen that the same land has been planted over and over again in the last five years.
3. There is complete disconnect in departmental nursery back up and plantation area therefore, this leaves a huge area of corruption. Most of the seedlings are bought from outside the department which is invariably found to be incompatible with the land quality besides the seedlings being very weak and from a genetically poor stock.

4. There is a huge shortage of front line staff in each district therefore; the virtual plantation is carried out by laborers only without having any supervision at the “actionable or technically skilled level”.
5. Maintenance and protection of plantations are extremely poor and it will be proper to say that it is not structured at all in the plan. Safety net of most of the plantation areas is kept wide open hence; incidences of grazing, illegal cutting of saplings and fire have been found to be rampant but go unnoticed by officers of actionable level. This is understood to be true to almost all the states across the country.
6. The top forest bureaucracy has been found wanting in initiative and most of them are disabled before bureaucrats and political bosses. They cannot say no to a wrong move provided it is coming from above.

MAGNITUDE OF PLANTATION IN UP

India has registered an increase in the forest cover of 8,021 sq km in overall forest cover and tree outside forest⁽¹⁰⁾. Based on satellite data analysis, the biennial assessment the Ministry of Environment, Forest and Climate Change (MoEFCC) has put the total forest and tree cover at 802,088 square km, which constitutes to 24.39% of the total geographical area⁽¹⁰⁾. The percentage of forest cover to the total geographical area was 21.34% in 2015. It increased by 0.11 percentage points as compared to 2013⁽⁹⁾. The government of India has also decided to back all the state governments to increase forest cover as a tool to mitigate carbon emission and commitments made at climate change summit in Paris without understanding the technical part involved in it. The Central Government has not allocated sufficient money at the right time for the purpose across the state of UP, in keeping with its pledge to push India's forest cover to 95 million hectares (235 million acres) by 2030. However, it is pertinent to mention that the long-term survival of trees planted in such mass campaigns remains a matter of concern. The following table -2 gives us fairly good idea about the massiveness in plantation over the years in UP. If the numbers of seedlings planted till July 2018 in UP are being taken into consideration and the number of seedlings proposed to be planted in 2019 and 2020 are also translated into the area covered for the plantation then it comes to 3235042 hectare. I have tried to work out some of the statistics which may be very conservative in nature and an approximation but it is extremely interesting and revealing. I could not be able to find some of the data like the total area under constructed houses despite very serious efforts therefore, I had no option but to calculate the area under constructed category by multiplying 1500 square feet with the households in Uttar Pradesh. This calculation has been done on the presumption that every household may have a minimum level of average area of 1500 square feet under this category. This presumption may be corrected with the availability of better data base.

TABLE 2- AREA STATEMENT OF UTTAR PRADESH

TOTAL AREA OF UTTAR PRADESH(UP)	2,40,928 Sq.km.
TOTAL AREA UNDER CULTIVATION	168200 Sq.km.
AREA UNDER VERY DENSE FOREST	2,617 Sq.km
AREA UNDER MODERATELY DENSE FOREST	4,069 Sq.km
AREA UNDER RIVERS INCLUDING TANKS,RIVERS,PONDS etc.	8000Sq.km
AREA UNDER RAILWAY TRACKS	90.77 Sq.km
AREA UNDER HOUSE CONSTRUCTION	4542.269156 Sq.km
AREA UNDER WASTELAND	16984.16 sq.km
AREA UNDER PLANTATION(UNTILL 2020)	32,350 Sq.km
GRAND TOTAL(LEAVING TOTAL GEOGRAPHICAL AREA OF UP)	236,853.199

Plantation is not possible nor should it be tried in the areas having very dense forest and moderately dense forest because these areas need protection more than anything else to restock itself in natural course of time. Plantations in the waste land is a very difficult proposition and a very cost intensive job for a long and sustained period, if UPFD wants to succeed in raising a successful plantation. Plantation can neither be done in already constructed area nor is it possible in the rivers or ponds. After having subtracted all the areas as stated above from the total geographical area of 2,40,928 Sq.km. then we are left with a very meager area of 4,075 Sq.km. in the state of Uttar Pradesh and this area may further come down because we have no data available on the area used for schools, colleges, bus stands, railway stations, offices, areas under mining, pasture land, community land etc. Therefore, this can be very safely inferred that the Uttar Pradesh Forest Department (UPFD) is planting and re-planting the same year over and over again without taking the right procedural recourse as laid down in the rule book and this is also reflective of a very high area of corruption in UPFD, yet remained without any investigation for the reasons best known to them.

The forest cover of UP is stated to be 6.09% of the total geographical area ⁽¹⁰⁾ and if the total plantation done till 2016 is added and presumed to have converted into an established plantation that total forest cover should have been 11.20% that means, there is a survival deficit of 5.20% and conversion rate from seedlings to sapling is very poor. The following figure- 2

PLANTATION SINCE EARLY YEARS IN UP (AREA IN HECTARE)

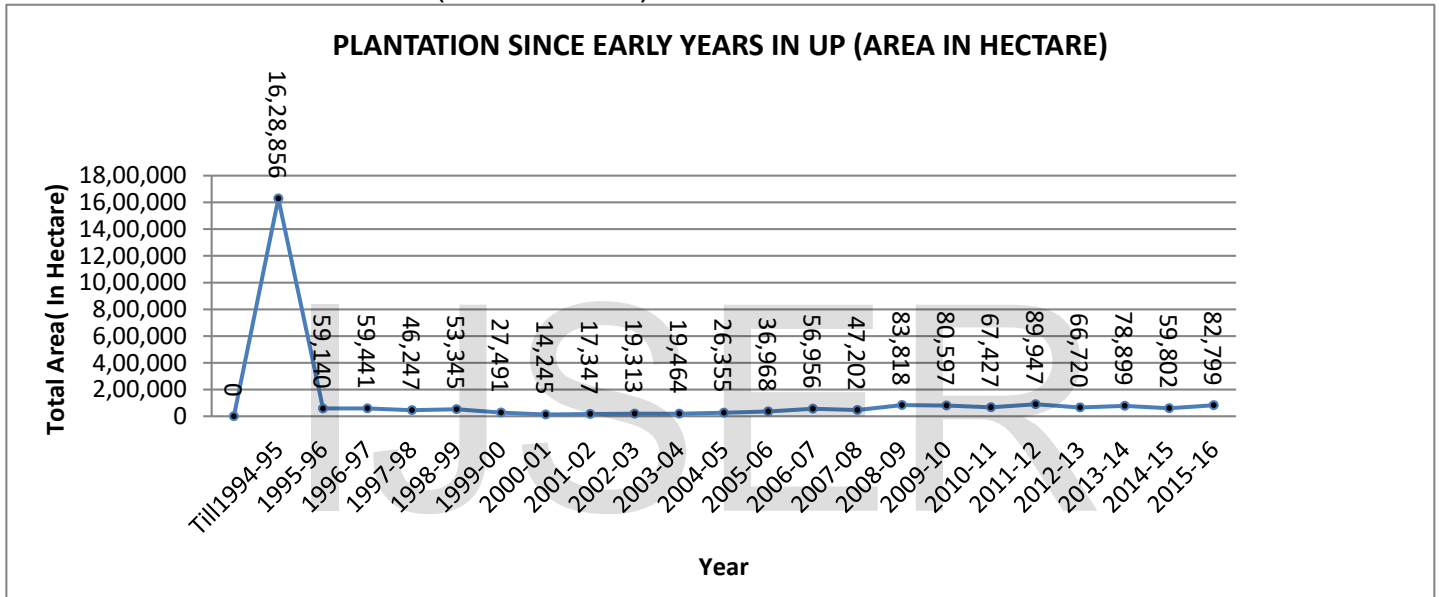


Figure no -2

SOURCE: UP FOREST AND WILDLIFE STATISTICS, 2015-16

SURVIVAL RATE OF PLANTATION DONE IN UTTAR PRADESH OVER THE LAST YEARS- AN INDICATOR

Government of UP regularly conducts monitoring and evaluation of plantations done over the last three years and publishes it every year in a report card called progress report ⁽¹¹⁾.

TABLE 3- DETAILS OF SURVEY PLANTING YEAR – 2007-08

UTTAR PRADESH-	TOTAL PLANTATION AREA	SURVEYED AREA	PERCENTAGE OF SURVEYED AREA	SURVIVAL OF PLANTS IN PERCENTAGE							
				0-20%		20-33%		MORE THAN 33% BUT LESS THAN NORMS SET BY GOVERNMENT		SURVIVAL PERCENTAGE MORE THAN NORMS SET BY GOVERNMENT	
				AREA	PERCENTAGE OF SURVEYED AREA	AREA	PERCENTAGE OF SURVEYED AREA	AREA	PERCENTAGE OF SURVEYED AREA	AREA	PERCENTAGE OF SURVEYED AREA
2007-08	47186.10	17485.01	37.06	294	1.68	114	0.67	6995	40.02	10075.02	57.62
2006-07	58321.03	20518.74	35.18	107.0	0.52	37.00	0.18	7049.8	34.36	13324.9	64.94
				0				1		3	

SOURCE: UP FOREST DEPARTMENT MONITORING AND EVALUATION DIVISION REPORT, 2006-10

SURVEY YEAR -2010-11 PLANTING YEAR – 2006-07 SURVEY YEAR – 2009-10 (AREA IN HECTARE)

A summary of the survival report has been shown in the above table in order to explain the survival percentage of the plantations undertaken in the years 2006-07 and 2007-08 for whole of the state of Uttar Pradesh. This has been found that nearly 35.06 % and 40.37% of seedlings did not survive in the years 2006-07 and 2007-08 respectively. This report can never be relied upon because the monitoring and evaluation division of UPFD is highly compromised on many reasons best known to the department. The mortality of seedlings is very high as the plantation progresses with time and if an independent evaluation is carried out with a third party the findings may be worse than expected.

GAIN OF FOREST COVER IS MAINLY BECAUSE OF PLANTATION

The forest cover has been on the rise ever since the satellite data is available with us and it is mostly on account of plantations done by the state forest departments of the country and conserving them. Since 2001 till the date the latest report was published in 2018, the forest cover has been growing with an annual average of 1.79 %⁽¹⁰⁾ (figure-3)

GROWTH IN FOREST COVER

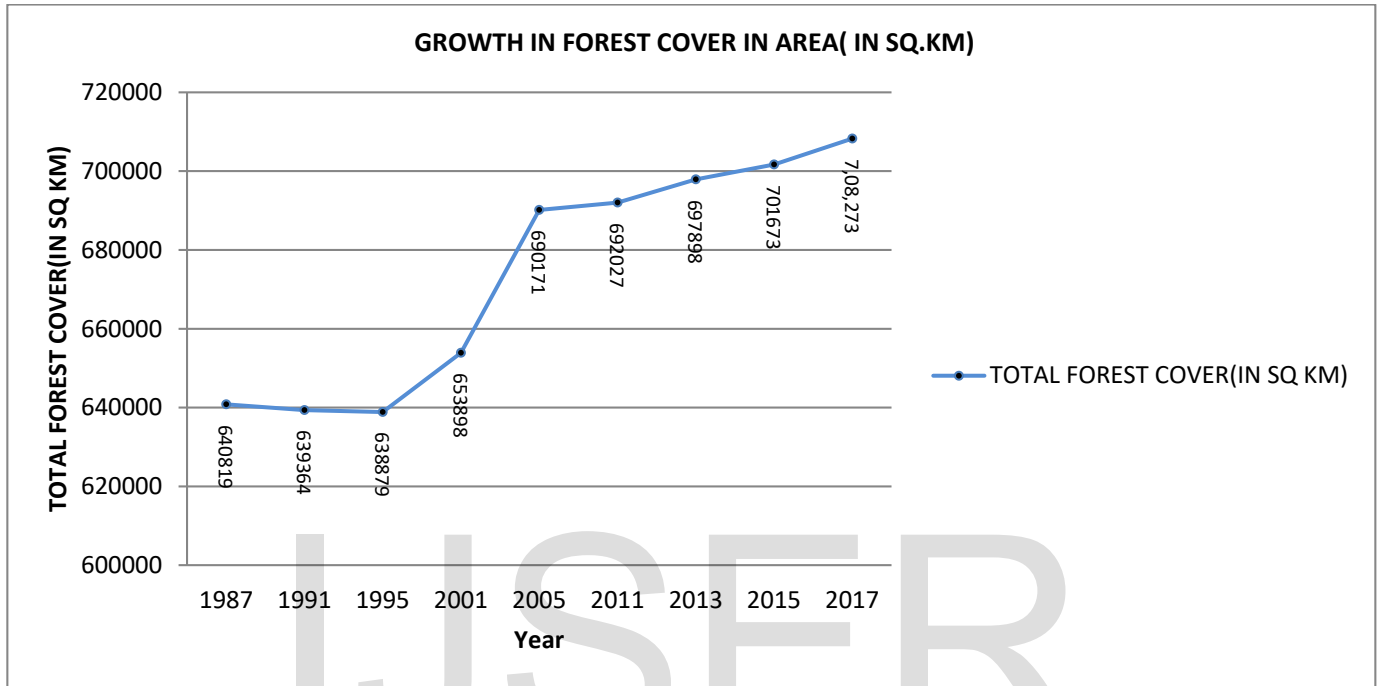


Figure no -3

SOURCE: ISFR 2016

GROWTH IN FOREST COVER

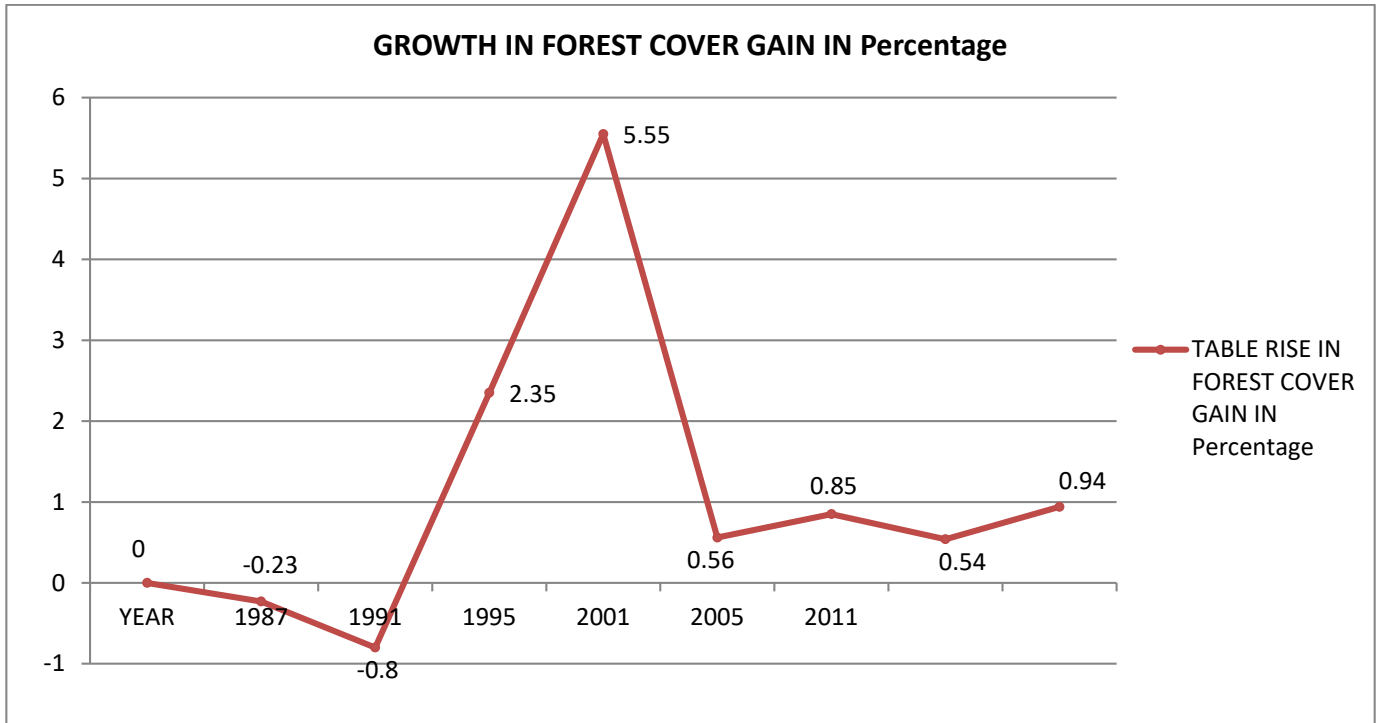


Figure no -4

SOURCE: ISFR 2016

GROWTH OF FOREST COVER IN INDIA

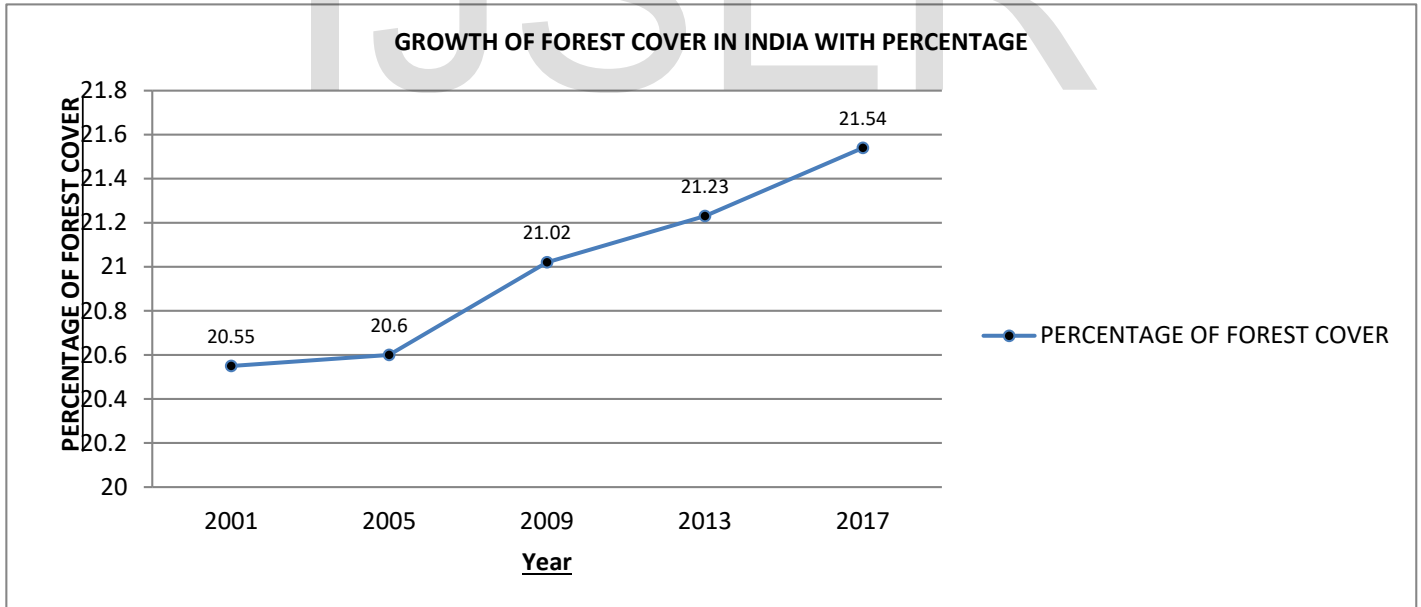


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SOURCE: STATE OF FOREST REPORT 2017.

WHAT DOES STATE OF FOREST REPORT 2017 SAY?

Very dense forest (VDF) has shot up by 1.36 percent as compared to the last assessment. Since VDF absorb maximum carbon dioxide from the atmosphere, the ministry sees the spike as an “encouraging” sign. Open forest (OF) has also seen a rise. On the flip side, the moderately dense forest (MDF) component has shown a downward trend.

LOSS OF OLD ECOSYSTEMS IN INDIA

India has lost over 1.6 million hectare of tree cover between 2001 and 2018, about four times the geographical area of Goa, according to a new study released by the World Resources Institute (WRI) in 2019. In India, five north-eastern states namely, Nagaland, Tripura, Meghalaya, Mizoram and Manipur were responsible for over 50% of all tree cover loss in the same period ⁽⁶⁾. The loss of tree cover contributed to 172 MT of carbon emissions in India during this period. The main reason for loss of tree cover in the north-eastern states is diversion of forest land; climate change is also impacting the quality of forests.

DECLINE IN FOREST COVER IN NORTH-EAST AREA

In terms of reduction in forest cover at the national level, the biodiversity-rich northeast region (NER), which accounts for one-fourth of India's forest cover, has taken a major blow. The total forest cover in the NER is 171,306 square km which is 65.34 percent of its geographical area in comparison to the national forest cover of 21.54 percent. The ISFR report 2017 shows an actual decrease of forest cover to the extent of 630 square km in the region. This decline is consistent with the 2015 assessment, which reported a contraction of 628 square km (from 2013 to 2015) in this region. Out of the eight NER states, Assam and Manipur have registered an increase in forest cover. While Assam registered an increase of 567 square km, for Manipur it was 263 square km. However, the NER is also the location where forest cover has shrunk in some states, thereby the net decline of forest cover. The top five Indian states where forest cover has shrunk belong to the NER. They are Mizoram (531 sq km), Nagaland (450 sq km), Arunachal Pradesh (190 sq km), Tripura (164 sq km) and Meghalaya (116 sq km). In Mizoram, Nagaland, Tripura and Arunachal Pradesh, the loss is linked to "shifting cultivation and development activities". Increase in forest cover in certain pockets is due to "regeneration of bamboo and other plantations". Northern Western Ghats has experienced decline of 2 percent, central Western Ghats 4.5 to 5 percent and southern Western Ghats about 6 percent in recent years. A study was carried out in 2016 which explained the level of deforestation in Western Ghats. Western Ghat is an extremely fragile ecosystem and has been under severe stress since long ⁽⁷⁾. This has been one of the biodiversity spots in India but despite our sincere efforts we have not been able stop deforestation till recently. A very interesting study was carried out by VK Dhadwal and others and the rate of deforestation in between 1920-75, 1975-85, 1985-95 and 1995-2005 have been found to be 0.75%, 0.13%, 0.12% and 0.01% respectively ⁽⁷⁾.

RATE OF DEFORESTATION IN WESTERN GHATS

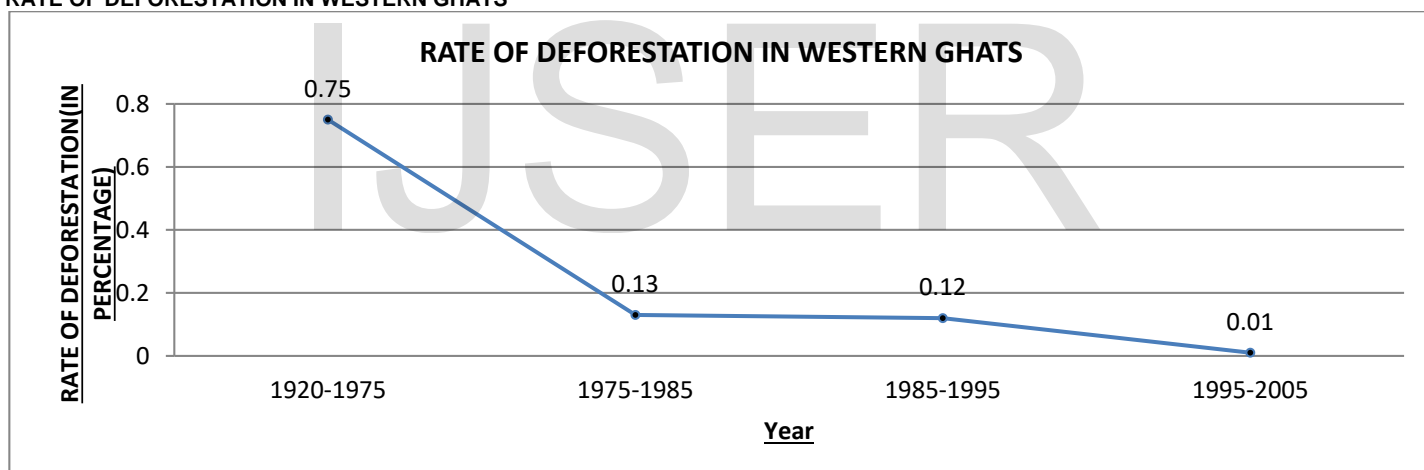


Figure no -6

Similarly, in yet another study on the rate of deforestation in India this was found that in between 1930 and 2013 annual deforestation rate was going unabated at 0.77% which declined to the level of 0.29% and 0.14% in the years of 1975-1985 and 1985-1995 respectively ⁽¹⁶⁾. The government of India classifies forests on the basis of density into the following categories

- (i) **Very Dense Forest (VDF):** When the density of forest is more than 70 %, it is known as very dense forest.
- (ii) **Moderately Dense Forest (MDF):** When the density of forest is between 40 to 70 %, it is known as moderately dense forest.
- (iii) **Open Forest (OF):** When the density of forest is between 10 to 40 %, it is known as open forest.
- (iv) **Scrub:** When the density of forest is less than 10 %, it is known as scrub.

Indian state of Forest Report conducts a biennial survey of Indian forest cover and in its latest survey done till 2017 and published in 2018, it has been found that 261.22 square kilometer, 6,885.7 Sq.km and 940 Sq. Km has been lost in VDF, MDF and OF respectively in the last two years with reference to its last survey done in the year 2015(Table-4). The maximum loss of VDF has been found in Himachal Pradesh followed by Arunachal Pradesh and MP but loss in MDF is widespread and except the two states namely, HP and Meghalaya. Mizoram and Nagaland have also seen widening in OF to

the tune of 588 and 342 Sq.km respectively.

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TABLE 4- LOSS OF VERY DENSE FOREST AND MODERATELY DENSE FORESTS (AREA IN SQ.Km)

STATES	2017 ASSESSMENT DONE BY ISFR				CHANGE WITH RESPECT TO 2015 ISFR ASSESSMENT			
	VDF	MD F	OF	Total	VDF	MDF	OF	Total Change
Andhra Pradesh	1,957	14,051	12,139	28,147	1,536	-301	906	2,141
Arunachal pradesh	20,721	30,955	15,288	66,964	-85	-226	121	-190
Assam	2,797	10,192	15,116	28,105	1,372	-1,064	259	567
Bihar	332	3,260	3,707	7,299	84	-102	63	45
Chhatisga rh	7,064	32,215	16,268	55,547	63	-90	15	-12
Delhi	6.72	56.24	129.45	192.41	-0.22	-0.91	4.77	3.64
Goa	538	576	1,115	2,229	2	-4	21	19
Himachal pradesh	3,110	6,705	5,285	15,100	-115	318	190	393
Jammu Kashmir	4,075	8,579	10,587	23,241	14	-236	475	253
Jharkhand	2,598	9,686	11,269	23,553	-3	-6	38	29
Madhya Pradesh	6,536	34,571	36,280	77,414	-23	-266	277	-12
Maharashtra	8,736	20,652	21,294	50,682	51	-140	72	-17

Meghalaya	453	9,386	7,307	17,146	36	-169	17	-116
Mizoram	131	5,861	12,194	18,186	-4	61	-588	-531
Nagaland	1,279	4,587	6,623	12,489	-5	-103	-342	-450
Odisha	6,967	21,370	23,008	51,345	-18	-100	1,003	885
Rajasthan	78	4,340	12,154	16,572	1	-74	539	466
Sikkim	1,081	1,575	688	3,344	582	-582	-9	-9
Telangana	1,596	8,738	10,085	20,419	1,131	-2,602	2,036	565
Uttarakhand	4,969	12,884	6,442	24,295	165	-778	636	23
West Bengal	2,994	4,147	9,706	16,847	51	-29	-1	21
A&N Island	5,678	684	380	6,742	-8	-1	0	-9
Chandigarh	1.36	13.82	6.38	21.56	0	-0.1	0	-0.1
Lakshadweep	0	17.04	10.06	27.1	0	-0.18	0.22	0.04
Puducherry	0	17.6	36.07	53.67	0	-11.18	7.9	-3.28
GRAND TOTAL	83,698	2,45,119	2,37,081	5,65,961	4,826.78	6,506.37	5,740.89	4,061

SOURCE: ISFR 2017,

Forest degradation means any negative changes taking place in a forest that damage/degrade the quality, density and productivity of forest. The forest showing degradation is known as degraded forest. Forest degradation is different from deforestation as in deforestation the forest (or patch of forest) gets converted totally into new land cover/land use class such as urban area, agriculture etc, while in case of degradation the quality and density of forest decreases. There has been a very strong pace of degradation in the Indian forests which is not visible to many but we are sitting on the explosive due to explode anytime. This has its implications on the carbon stock of the forest also. Plantations can never be a viable option to mitigate carbon emission entirely and if this is desired so then the area of plantation will be so huge that this will engulf half of the agricultural land across the world. Plants suck CO₂ out of the atmosphere to build their woody roots, stems and leaves. The biomass plantation has been considered across the world as not a very high tech process and this low tech terrestrial carbon sequestration should be always combined with carbon capture and store technology to effect the maximum gain. The plantation required to mitigate the available carbon dioxide in the atmosphere will necessarily have to be huge in area and may be done either on the productive land or on the degraded land but in both the options the economic and social losses will be irreparable. We will not be able to feed nine billion people if plantation is done on the productive land and if done on the degraded land the financial implication will be gigantic in magnitude. The trees which are grown to sequester carbon dioxide can retain carbon in itself unless it is burnt or allowed to degrade therefore preventing carbon dioxide from returning to atmosphere. For the carbon dioxide to be locked in the trees, the trees would have to be stored deep below the ground, to prevent the carbon returning to the atmosphere to accelerate global warming rather than limit it. Let us examine three scenarios if plantation is carried out in order to mitigate carbon emission

1. BUSINESS AS USUAL

We have three assumptions and they are all based on plantations as the central instruments to capture carbon in their woods and all the plantations would need huge areas of biomass plantations if the temperature is to be kept below 2 degree Celsius as was decided in Paris climate change conference of parties (COP). This has also been estimated in most of the studies that if plantations alone is the criterion for mitigation of carbon emission then possibly this may replace the entire natural ecosystems of the world be it forest or agricultural ecosystem and this may cause a devastating environmental consequences for sure.

2. PARIS PLEDGES

Conference of Parties in Paris was very important in the sense that it talked about each one of us as a country to fix nationally determined pledges to reduce their carbon emission which was also called the nationally determined contributions (NDCs). The NDCs were finalized by all the member countries after long internal deliberations. If carbon dioxide reductions are carried out by biomass plantations in line with the current national pledges (NDCs) under Paris Climate Change agreement then this has to be huge. A study was carried out which spelt out that in order to mitigate carbon dioxide as per the national pledges under Paris climate change agreement, it requires 6.9 billion hectare of plantation, fed by 570 million tons of N₂ as fertilizer every year, if it is translated in term of dimension of land then this would be equal to the six times of Canada in term of area for plantation.

3. AMBITIOUS CARBON DIOXIDE REDUCTION

There are some options which may be important along with the biomass plantations if we want to contain the temperature rise below the 2 degree Celsius by 2100 in accordance with the guidelines laid down by the COP at Paris. The following options should be followed as below

(a) Carbon capture and storage should be combined with the plantation, if temperature is to be retained below 2 degree Celsius. To this end, technologies minimizing carbon emissions from cultivation, harvest, transport and conversion of biomass and, especially, long-term Carbon Capture and Storage (CCS) would need to improve worldwide.

(b) Conservation of native forest will stock more carbon than plantation

ALL OPTIONS SHOULD BE OPEN

As scientists we are looking at all possible futures, not just the positive ones. What happens in the worst case, a widespread disruption and failure of mitigation policies? Would plants allow us to still stabilize climate in emergency mode? The answer is: no. There is no alternative for successful mitigation. In that scenario plants can potentially play a limited, but important role, if managed well." The scientists investigated the feasibility of biomass plantations and CO₂ removal from a biosphere point of view. To this end, they used global dynamic vegetation computer simulations. The plantation has been understood to be the comparatively less technical and cost effective method to sequester carbon dioxide but this has to be preceded by many other factors instead of going for biomass plantations straightaway. The usage of fossil fuel has to be cut drastically and help the world switch over to clean technology so as to minimize or stop the level of carbon emission. This action should be ably supported by a range of options from reforestation on degraded land to low tilling agricultural system.

PLANTATION ALONE IS NOT THE ANSWER TO COMBAT CLIMATE CHANGE

There are many gains of Paris Agreement but the major constraint is that it is not binding therefore, enforcement of the agreement clauses are very difficult to implement to the different stakeholders despite to the fact that Paris Agreement has set the target to keep the target of global temperature below 2 degree Celsius above pre-industrial levels and try to pursue various ways and means vigorously to limit the temperature increase maximum to the level of 1.5 degree Celsius above pre-industrial level. Therefore, there is a strong need to cut drastically the global emission of green house gases and even keeping the target of 2 degree Celsius would need a transformational change in the economic growth of each country but unfortunately global carbon emission has shown a rise in 2018 and set to hit an all-time high of 37.1bn tonnes. Almost all major countries have been contributing to the rise of carbon emission, for example, China, USA and India have stepped up its global emission to the tune of 4.7%, 2.5% and 6.3% respectively. The EU's emissions are near flat, but this follows a decade of strong falls. The role of the biomass plantation was discussed at length in the 5th IPCC Assessment Report more reliance was shown upon bio-fuel energy with carbon capture and storage (BECCS) along with reforestation and afforestation to remove carbon dioxide from atmosphere.

In one of the models called Integrated Assessment Model, this was proposed that in consistent with 2°C target a median of 3.3 GtC per year was likely to be removed through BECCS till 2100. The use of bio-fuel is extremely important tool to combat climate change as this is considered to be “Clean Energy” despite of the fact that it also emits carbon dioxide on combustion but the emission is minimal compared to gasoline. This has been found that one litre of ethanol minimizes the emission of carbon dioxide by 90.9% therefore, a net saving of 2.11 kg of carbon dioxide which otherwise would have been added to atmosphere in case of petrol or diesel being used in place of ethanol. If we work on an assumption that the removal of 3.3 GtC by the end of 2100 is to be carried out by plantations only then this may require a land size of 380-700 mha which is almost equivalent to 50% of the present day global cropland. There are two more models of hypothesis to explain the requirement of land if CO₂ is assumed to be removed by plantations only. If 1.1 GtC per year is presumed to be fixed by new plantation then the land needed to be around 320 mha of old forest to be cut for new plantations whereas in case of 0.6-2 GtC removal per year may be possible from afforestation, reforestation, conservation of old forest, forest fire management and proper management of native forests but the question arises as how can we anticipate that requisite amount of carbon may be stored to keep the temperature rise to the level of 1.5 °C if all the measures are taken and the second question also comes in mind that how can we afford to lose roughly half of the global crop area while the world is facing hunger⁽⁸⁾. The intention of IPCC is also to boost plantation across the world in woodlands, savannahs, mangroves and other vacant land with a hope to sequester one third of carbon dioxide limit global warming to 1.5 degree Celsius above pre-industrial level despite of the fact that carbon emission is growing alarmingly each year and was found to be peaking at 37.1 GtC at the end of 2018⁽⁹⁾. Policymakers are of the view that Plantation alone will save the planet from the climate change. In 2011 world leaders of 43 countries across the tropics and sub tropics met in Bonn and decided to restore 350 Mha of land till 2030 and if we take a closer look at their action plan then nearly 50 % of their plantation are going to be commercial plantation. This also means that once the rotation period of the commercially important species is over and it is felled it may emit carbon back in the atmosphere depending upon the usage of woods. If we are serious to stem climate change through forestry then we have to stop deforestation immediately and restore old ecosystem to its pristine state of health⁽⁹⁾.

BONN CHALLENGE AND INDIA

India has reiterated its commitment to achieving its Bonn Challenge⁽¹²⁾ pledge by launching the first ever country progress report. This includes datasets from the Government of India, NGOs and the private sector. Although not an exhaustive list, the data reveals patterns and provides a glimpse into the country's different initiatives towards restoration. The report is a joint publication of the government of India's Ministry of Environment, Forest and Climate Change (MoEFCC), and IUCN. At the UN Framework Convention on Climate Change (UNFCCC) Conference of Parties (CoP) 2015 in Paris, the government of India made a Bonn Challenge Pledge to bring 13 million hectares of degraded land into restoration by 2020 and an additional 8 million hectares by 2030. According to the report, India has brought an area of 9.8 million hectares under restoration since 2011, meaning that work to restore these landscapes is already underway. Of the 9.8 million hectares, 94.4% was contributed by government agencies, while the surveyed NGOs and private companies contributed 3.6% and 2% respectively⁽¹²⁾. This stark contrast between the three implementing agencies' contributions can be explained by the fact that private companies and NGOs generally carry out their restoration in small land holdings. However, they play a vital role in the planning and implementation of restoration programmes thanks to their technical expertise and knowledge of the local conditions.

THIS STRATEGY IS NOT WORKABLE

To combat climate change, the most effective place to plant trees is in the tropics and subtropics – this is where most forest restoration commitments have been found in the Bonn Challenge. Trees grow and take up carbon quickly near the Equator, and land is relatively cheap and available. Establishing forests has little effect on the albedo (reflectivity) of the land surface, unlike at high latitudes, where trees obscure snow that would otherwise reflect solar energy and help to cool the planet. Nations are following three main approaches.

1. Degraded and abandoned agricultural land will be left to return to natural forest on its own.
2. Marginal agricultural lands are to be converted into plantations of valuable trees, such as Eucalyptus for paper or Hevea brasiliensis for rubber.
3. Agro forestry, which involves growing crops and useful trees together.

Natural regeneration is the cheapest and technically easiest option. Just over one-third (34%) of the total area allocated is to be managed in this way. Protecting land from fire and other human disturbances allows trees to return and forests to flourish, building carbon stocks rapidly to reach the level of a mature forest in roughly 70 years. A study has been done to understand the carbon storage in the plantation and management of old forest in order to reach a conclusion⁽⁹⁾. Under the Bonn challenge process if all the 350 Mha land is subjected to following three models then what should be the carbon storage, let us understand the following models

1. If all the 350 Mha becomes a naturally grown forest then it stores 42 Petagrams of carbon
2. If all the natural forest is protected from fire, deforestation and degradation it will add up another 16 Petagrams of carbon.
3. If the natural forest is allowed to degrade and no protection is offered then storage of carbon is decreased to the level of 3 Petagrams.

4. If all 350 Mha is allowed to be planted afresh then it will sequester 1 petagram of carbon.

DISCUSSION

Old forests continue to accumulate carbon at a much greater rate than researchers had previously thought, making them more important as carbon sinks that must be factored into global climate models. Until recently, it was assumed that very old forests no longer absorbed carbon but this has been proven otherwise on many studies. CO₂ is the primary driver of climate change now more than 42% above historic levels. This increase is due to a few centuries of human activities that have released carbon stored by plants initially in the form of trees (deforestation), and more recently also in the form of fossil plants (fossil fuels). Forest destruction results in about more than 5 billion tons of CO₂ entering the atmosphere every year. This is what scientists call "net carbon emissions." In addition, about 10 billion tons

CO₂ are naturally absorbed by forests every year. The IPCC calls this a "residual" terrestrial sink. "Today, if we halt net deforestation and forest degradation activities all too common in the tropics would reduce human CO₂ emissions by about 12%. That's should be the single- barreled approach. Many scientists applauded the push for expanding forests, but some urge caution. They argue that forests have many more-complexes and uncertain climate impacts than policymakers, environmentalists and even some scientists acknowledge. Although trees cool the globe by taking up carbon through photosynthesis, they also emit a complex potpourri of chemicals, some of which warm the planet. Such concerns have prompted vigorous debate among scientists about how forests in different regions have warming or cooling effects. There was a controversial paper by atmospheric chemist Nadine Unger in 2013⁽¹³⁾, then at Yale University in New Haven, Connecticut, who conducted one of the first global studies examining one part of this exchange: the influence of volatile organic compounds, or VOCs, emitted by trees. These include isoprene⁽¹⁴⁾, a small hydrocarbon that can warm the globe in several ways. It can react with nitrogen oxides in the air to form ozone a potent climate- warming gas when it resides in the lower atmosphere. Isoprene can also lengthen the lifetime of atmospheric methane another greenhouse gas. Yet isoprene can have a cooling influence, too, by helping to produce aerosol particles that block incoming sunlight. As a corollary, Unger suggested that reforestation would also have uncertain climate effects. Trees in tropical and temperate zones emit huge quantities of isoprene that is not accounted for in most forestry schemes. Higher- latitude boreal forests emit mostly terpenes, which help to cool the climate by forming aerosols that can block sunlight and promote the formation of cloud particles although Unger didn't attempt to quantify this cloud- seeding effect. She acknowledged that her study was a first step, and called for increased monitoring of forest chemicals and their atmospheric interactions⁽¹⁵⁾.

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