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Forests playing a critical role to slow down or to stop the climate change

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Abstract
Because of upset the balance of the world's carbon cycle the problem of global climate change has occurred by humans, together with other greenhouse gases like methane, exceed the earth's capacity to store carbon in forests, oceans, living and dead biomass are responsible for atmospheric carbon emissions. Forests also help in regulation of water ways to protect soil, cool cities and entire regions and more. Through forestry there is a very large potential for carbon storage. Renewable biomass plays a multiple role in which an energy source and fodder, grasses, food production, biodiversity conservation, yield and other services for the society and the mitigation of the impact of climate change both. Trees with row crops, perennial crops, minimal tillage, rotational grazing systems and other techniques these are the different forestry systems help in the reduction of storage of carbons in soils and also reduce the carbon emissions. Reduction in the use of fertilizer can help to cut the emission of nitrous oxide and management of manure and biogas systems can lower methane emissions.

Keywords: Carbon cycle, climate change, emission, greenhouse gases, forests

Introduction
As a whole climate change affects the forest and trees conditions in some areas allows the increasing of growth rates while endangering the species survival and communities of forest in others. Depend upon geographic area, climatic conditions, species variety and human interferences there are some limiting factors like temperature, availability of water and seasonality changes. These changes mostly affect the light intensity and fire frequency and insect pests attack, diseases as well as extreme weather and climatic conditions destroy such as rainfall, droughts and hurricane winds. Forest ecosystem provision of goods and services will be altered by these changes, serves many new challenges to forest managers. Climate change responses will affects the demands on products of forest in some areas for example increment in the demand of forest-based fuels in substitution of fossil fuels. Societies react on the basis of climate change perception of actual and potential impacts and develop legislation and policies as well as concerned changing requirements of forest production and trade.
Reviews by Lucier *et al*., 2009 [20] and Fishlin *et al*., 2009 on detected impacts, projected impacts and vulnerability of forests climate change found that across the continents impacts varies with some types of forest being more vulnerable in comparison to others. Impacts covers the increment in the frequency, intensity of fire, potential increase on the events of extreme weather severity, pests and diseases e.g. droughts, wind and rainstorms. Activities of a human being which includes conservation of forest, protection and practices of management shows interaction with climate change and most of the time makes it difficult to differentiate the difference between the causes of changes observed and projected. A vicious circle formed by the deforestation and fires in the Amazon region with climate change (Aragão *et al*., 2008; Nepstad *et al*., 2008) [1, 22] with the degradation potential up to 55% of the Amazon rain forests (Nepstad *et al*., 2008) [22].

Forest conditions and Area
Due to changing temperature and precipitation rate, the covered region of forests is likely to be

change while the expansion of area is expected in some regions e.g. temperate regions and contracts in other region's e.g. mountain forests, tropical and boreal. However, currently separation between the forest area change due to climate change and the area changes due to other factors is difficult (Lucier *et al*., 2009) [20]. In the future prospects, the combination interaction of climate change; conversion of land use and unutilized land use practices is expected. The change in water availability is considered as a key factor for the survival and growth of many forest species, although among species and also among the different varieties of the same species varies the responses (Lucier *et al*., 2009) [20]. Increase in the intensity of risk and frequency of fire due to climate change which is to be accompanied by longer dry spells as in the boreal or lower precipitation (Burton *et al*., 2010) [5], sub-tropical forests and Mediterranean (Fischlin *et al*., 2009) [13] and traditional land clearing practices as in the Amazon (Aragão *et al*., 2008; Nepstad *et al*., 2008) [1, 22].

Health and vitality

Profound impact due to climate change has been seen on the world's forests health and vitality. Vitality may increase in some cases because of CO2 fertilization and a more favorable climate for growth combination. However, mostly temperature increase favors the insect population's growth which is detrimental for the forest's health (Lucier *et al*., 2009) [20]. Few tree species which is dominated in Forests or where insect populations are control by specific temperatures or moisture levels are more susceptible to it.

Biological diversity

On a large part of climate variables, survival and species growth depend. Mostly species having a specific climatic range within which their growth is better are more comparative and also capable to adopt some environmental changes also become insect attack respondent, diseases and other adverse effects on environmental and human influences. Tree and other plant and many animal species to live together require many ecological processes which are influenced by conditions of climate. Importance of climate in relation to ecosystems of forests and its composition and diversity is exemplified by the various regional and global classifications of vegetation. The Holdridge ecological life zones (Holdridge, 1967) [16] are bounded by humidity, precipitation and temperature. In general many of the species having a tendency to move upto higher latitudes or higher altitudes (Rosenzweig *et al*., 2007; Breshears *et al*., 2008) [27, 4]. Lucier *et al*., (2009) [20] in their revision of impacts of change in climate on forests found reports that there is more phonological change in many number of species with more and higher changes noticed in higher latitudes. Common changes include time of flowering and bud breaking time change, productivity affects and potential of carbon sequestration. In oak phenological changes observed (Bauer *et al*., 2010) [2], pears and apple (Blanke and Kunz 2009) [3] and a range of 29 Mediterranean species (Gordo and Sanz 2010) [15] does not affect processes of ecosystem other than bringing them a few days forward however, prediction of such behavior was easier in insect pollinated species than in wind pollinated species. The changes in the phenological cycles affect the ecological processes such as fruit setting in the tropical systems, flowering and pollination due to the complexity of species interactions and involve more than one species while in parallel seasonality is not as clearly marked. Mostly natural disturbance causes forest area reduction through the standing trees damage and may also slows down the productivity (Chakraborty *et al*., 2008; Jepsen *et al*., 2008; Kurz *et al*., 2008 and Nepstad *et al*., 2008) [7, 18, 19, 22].

Carbon storage and sequestration

Carbon storage and sequestration of carbon with the help of forests and changes in temperature and precipitation shows an important part of interaction. On the one side, maximum carbon is stored in forests less will be in the atmosphere. Increase in the storage of carbon contributes in decrease of the rate at which the global temperature is increased. In the climate change discussion, this relation has become extremely important and many countries putting their efforts to reduce the emissions and increase in the carbon stock of forest in order to capture part of the pledged funding for reduction in GHG emissions. On the other side increase in temperature, long duration of dry seasons and increase in CO2 concentrations in the atmosphere in long-term are expected in reduction of the capacity to storage of forest and possibly carbon sequester converting forests from sink of carbon to source of carbon (Nepstad *et al*., 2008; Ollinger *et al*., 2008; Saigusa *et al*.. 2008 and Clark *et al*., 2003) [22, 23, 28, 9]. Since sequestration of carbon depends upon all the factors of productivity that will also affect carbon sequestration. In addition to the short term increase in temperature can also cause a reduction in capacity of storage of carbon although the effect may very depend on the temperate regions season. Increase in carbon sequestration of terrestrial ecosystems caused by early spring warming while earliness in autumn warming increased respiration process more than sequestration.

Multiple socioeconomic benefits

Climate change in few areas increases the growth while in other areas it is expected to decreases. While the expected increase in global wood production may lower prices, gives advantage to consumers, the combination of lower prices and regionally differentiated effects on productivity will lead to differentiated effects on harvest of timber relevant income and employment (Osman-Elasha *et al*., 2009) [24]. The three most important functions of the harvests of non wood forest products (NWFP) provision of part of the daily necessities of the people who is dependent on forest, a safety net in times of adverse situations for production of agriculture and off-farm income. Osman Elasha *et al*., (2009) [24] advised that climate change of climate will have productivity impacts on the NWFPs and that users of NWFP will mainly be impacted through increased pressure on products of forest from people that look for urgent supplies or alternative income ways. The latter is likely to happen in poverty areas; highly NWFP dependent area and increased frequency and extreme intense climate events and other naturally occurs disturbances such as pests, fires and diseases. Climate change impact on these products provision and the subsequent socioeconomic consequences however, requires core studies.

Forests and Climate Change

The occurrence of world climate change is due to the equilibrium of the world's carbon cycle has been disturb. Atmospheric carbon emissions due to human activities along with other greenhouse gases such as methane amount is pick up and surpass the earth's capacity to stock up carbon in oceans, forests and living and dead biomass. Most climate

policy mainly focussed on dropping industrial emissions and with good reason industrial emissions account for about 70% of total greenhouse gases (GHG) and the absorption and storage of this much excess carbon are virtually impossible to imagine. But it is also fact that non industrial areas together with land use, forestry and agriculture report about 30% of emissions. Forestry embrace important potential for the storage of surplus carbon and other destructive gases; this is not enough to resolve the trouble but certainly sufficient to be a significant input to any regular policy solution. For this cause, interest has started to focus on the issues of land use, forestry and agriculture from time to time referred to as REDD (reduction of emissions from deforestation and degradation) or more generally as LULUCF (Land Use, Land Use Change and Forestry). Forests all over the globe store more than 650 billion tons of carbon- 44 percent in biomass, 11 percent in dead wood and litter and 45 percent in the soil. As per the Intergovernmental Panel on Climate Change (IPCC) 2007 found that deforestation accounts for about 17%-18% of global anthropogenic GHG emissions, the biggest supplier after energy supply power and fossil fuel which accounts for about 26 percent of emissions (IPCC, 2007).

Percent of Total Greenhouse Gas Emissions through Forestry (UNFCCC, 2007) [29]

Forestry	Total Green House Gas Emissions
Through Power supply	21%
Through Industry	19%
Through Forestry	17%
Through Agriculture	14%
Through Transport	13%
Through Building	8%
Through Fossil fuel supply	5%
Through Waste	3%
Total	100%

Deforestation and timber harvest both add 20.8% of GHG emissions, offset by 2% carbon absorption from afforestation (increase in forest area) and reforestation (re-growth in harvested areas). Mostly deforestation emissions are in the form of CO2 while emissions from agriculture, primarily methane (CH4) and nitrous oxide (NO2), amount to 13.5% of global GHG emissions. This table point out that decrease of emissions from deforestation and agriculture can be a significant part of worldwide efforts to battle climate change and reduce GHG emissions. The opportunity of mitigating climate change by reducing carbon emissions caused by deforestation and forest degradation and by rising carbon uptake through afforestation and sustainable forest management has turn into a noteworthy feature of worldwide discussions on responses to climate change. Increasingly, forest being managed and conserved for multiple values and use often in combination. The designated multiple uses of all forests are around 949 million hectares or 24 percent of all forests i.e. manage for a amalgamation of the production of goods, biodiversity conservation, soil and water conservation and social services provision. The primary use of agricultural land is for making of food and other agricultural products and can also give out functions of soil and water protection and storage of carbon depending upon the techniques of agricultural.

Table 1: Designated functions of forests 2010 (FAO, 2010)

S. No.	Functions of Forests	Percent
1	Production	29%
2	Soil and water conservation	8%
3	Biodiversity conservation	12%
4	Provide the social services	4%
5	Multiple use of forest	24%
6	Other function	7%
7	Unknown function	16%

Significance of forests in the carbon cycle

Consider a closer connection between climate change and forestry and clear some relevant definitions in order to enhance the knowledge of the role of forests in climate change combating. In two different ways, forests can affect the world carbon cycle

- Forests as stock of carbon – like any other ecosystem a forest can collect carbon from the atmosphere by breaking down carbon dioxide into carbon and oxygen. The escaped carbon is accumulating in branches, tree trunks, leaves and other plants as well as in soils as living and non living biomass. The dry biomass of a tree is approx 2 tons which can hold around 1 ton of carbon. A tropical wet forest can stock up to 430 tons of carbon per hectare in above ground biomass (CIFOR, 2009) [8].
- Forests as carbon fluxes - The second way by which forests can influence the carbon cycle is carbon fluxes they create. By photosynthesis process and using sunlight, from atmosphere, leaves absorb CO2 inbound flux. This stored carbon will be disseminated to the plant and transferred to soil when leaves and branches fall down and decay and also by the process of respiration a fraction of this CO2 will be go back to the atmosphere through respiration and soil mineralization outbound flux. The net absorption flux is the difference between the inbound and outbound (CIFOR, 2009) [8].
- As a forest grows the net flux is an inbound flux meaning that CO2 is separated from the atmosphere. This process is known as carbon fixation, absorption or removal and the ecosystem is known as a carbon sink. On the other hand if stock decreases in decomposing or burning of the forest then an outbound flux will advance the atmospheric greenhouse gas emissions concentrations and increase climate change. The process is called as carbon emission and the ecosystem is known as a carbon source (CIFOR, 2009) [8].

Social and ecological functions of forests

Forests are beyond carbon storage, they provide essential ecosystem services and also more than just carbon they are local communities home. The livelihoods of 90% of the 1.2 billion people living in extreme poverty and are home to nearly 90% of the world's terrestrial biodiversity supported directly by forest resources. Indigenous people and also those people who are dependent on forest are stewards of their forests providing the rest of humanity with vital ecosystem services. Also provided some ecosystem services by forests like rainfall generation, watershed protection, nutrient recycling, water flow regulation and disease regulation this all are affected negatively by the deforestation and forest degradation trends (Parker *et al*., 2008) [26]. The total economic value covers of forest's all these services and other benefits like opportunities for recreation and simply knowing of the existence value that pristine forests are preserved. In order to measure the total economic value of intact forest ecosystems, some economists did attempts. While the conversion to monetary units of all the benefits are subject to both methodological and ethical concerns, to determine the optimal forest policies policy makers can potentially use this information. In particular, the comparison can be done between the economic value of preserving forests and to extractive uses such as timber or agricultural development. To suggests the result of several studies that exceed the benefits of extractive uses of preserving forests. For example, in some countries nonmarket benefits including carbon storage, watershed protection and recreation are greater than the combined economic values from timber, fuel wood and grazing found a study of Mediterranean forests. Forests provide about $5 trillion in total annual value to humanity with only about 20% of these benefits derived from extractive uses to estimate the economic value of the world's forest ecosystems. Forests provide some economic benefits which include some ecosystem services such as erosion control, nutrient cycling, climate regulation and waste treatment (Costanza *et al*., 1997) [11].

Scale of world forest coverage and forest loss

Among the total land area of the planet forest cover 31 percent. The largest forest areas are located in the Russian Federation and Brazil. Also have large forested areas are located in the Canada, the Eastern U.S., Central Africa and South-East Asia.

Table 2: Top countries with the largest forest area (FAO, 2010)

Countries	Forest area
Russian federation 1st position	809 million ha
Brazil 2nd position	520 million ha
Canada 3rd position	310 million ha
United State of America 4th position	304 million ha
China 5th position	207 million ha
Democratic Republic of the Congo 6th position	154 million ha
Australia 7th position	149 million ha
Indonesia 8th position	94 million ha
Sudan 9th position	70 million ha
India 10 position	68 million ha
Others countries	1347 million ha

Table 3: The world's forest coverage (FAO, 2010)

S. No.	Region	Total Forest area (million ha)
1	Africa	674
2	Asia	593
3	Europe	1005
4	North & South America	705
5	Oceania	191
6	South America	864
World		4033

Table 3: Causes of Forest Decline (Contreras Hermosilla, 2000)

S. No.	Causes
A	Direct
I	Natural causes
1	Hurricanes'
2	Natural fires
3	Pests
4	Flood
II	Resulting from human activity
1	Agricultural expansion
2	Cattle ranching
3	Logging
4	Mining and oil extraction
5	Construction of dams
6	Roads
B	Underlying
I	Market failure
1	Un-priced forest goods and services
2	Monopolies and monopsonistic forces
II	Mistaken policy Interventions
1	Wrong Incentives
2	Regulatory mechanisms
3	Government Investment
III	Governance weaknesses
1	Concentration of land ownership
2	Weak or non-existing land ownership and land tenure arrangements
3	Illegal activities and corruption
IV	Broader Socio-economic and political causes
1	Population growth and density
2	Economic growth
3	Distribution of economic and political power
4	Excessive consumption
5	Toxification
6	Global warming
7	War
V	Agents forest decline
1	Slash and burn farmers
2	Agribusiness
3	Cattle ranchers
4	Miners
5	Oil corporation
6	Loggers
7	Non-timber commercial corporations

Conclusion

Forests playing a critical role to slow down or to stop the climate change it also decreasing the current as well as future effects on people. Forest goods and agriculture acting more climatic resilient whenever disaster occurs or occurrence of crop failure happens forests play a role like a safety nets to protect the communities from losing all food resources and income also. The global warming mitigation requires the

renewable biomass which is having the tremendous potential to do it. There are different strategies for the mitigation of global warming in agriculture, agroforestry, forestry and grassland.

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