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Climate Change and Forestry Management for Sustainable Development in India

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Abstract—*Forests play a vital role in reducing greenhouse gas emissions. They offer an opportunity to balance the emissions generated from one region (source) with a carbon sink in another region. Driven by the Kyoto Protocol, governments in many developed nations are creating mechanisms to permit the trading of "carbon credits" and "carbon offsets" between regions. The sale of carbon dioxide (CO2) emissions reductions from avoided deforestation through the growing carbon market may represent a unique opportunity to reconcile natural resource conservation and poverty reduction in India. The funds generated from this market can be used to fund protected area creation and management to conserve biodiversity and safeguard critical ecosystem services important for human livelihoods.*

Keywords*: Forestry Management, Climate Change, REDD, GHG, Carbon Finance etc.*

1. INTRODUCTION

Although India is the second largest generator of environment-friendly projects, domestic firms, public and private, are shying away from maximising the monetary benefits derived from such carbon emission reductions.(Kala seetharam Sridhar, 2007)

The country, which is second only to China in terms of generating of carbon credits through the introduction of low polluting technologies, ranks very low when it comes to encashing of these credits through carbon trading. Over 90 per cent of such credits generated are being held back by Indian firms, amid growing uncertainties in the global carbon trade market(Ebeling & Yasué, 2008).

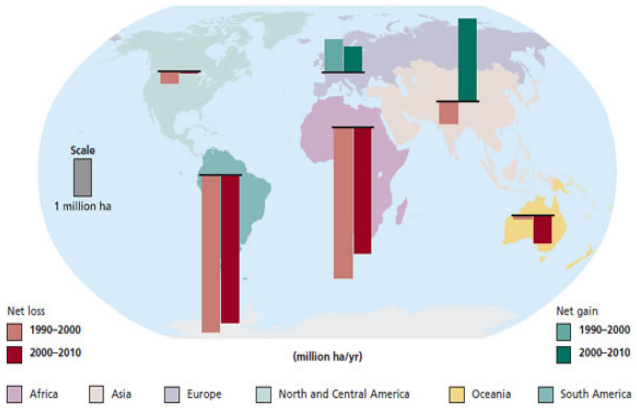
As a result, there is a great chance awaiting India in carbon credit trading which is estimated to go up to $100 billion by 2010. In the new regime, the country could come out as one of the largest beneficiaries accounting for 25 per cent of the total world carbon trade, says a recent World Bank report. (Seeberg-elverfeldt, Schwarze, & Zeller, 2009)

The country's authority in carbon trading is expected to be driven, not so much by the domestic industry, but more by its huge tracts of plantation land, estimated to be over 15 million hectares, much larger than Australia which aims to be a major player in emission trading by adding 2 million hectare plantation by 2020.(Kupfer & Karimanzira, 1991)

1.1 Climate Change & Forestry in the World

Forests and trees on farms are a direct cause of food and cash income for more than a billion of the world's poorest people," Food and Agriculture Organization (FAO) Assistant Director-General for Forestry Eduardo Rojas-Brails said."They provide both staple foods and supplemental foods. To enhance these benefits, governments and development partners should increase investments in support of sustainable forest management and rehabilitation of degraded forest lands," he added, noting that in India, more than 50 million people depend directly on forests for survival, while in Laos wild foods are consumed by 80 per cent of its 6.4 million people on a daily basis.

FIGURE 4
Annual change in forest area by region, 1990–2010



Sources: http://www.celsias.com/article/forestry-key-food-and-climate-change/

Fig. 1: Forest area by Region-Annual Changes

2. REVIEW OF LITERATURE

(Seeberg-elverfeldt et al., 2009)This study assesses which impact carbon sequestration payments for forest management

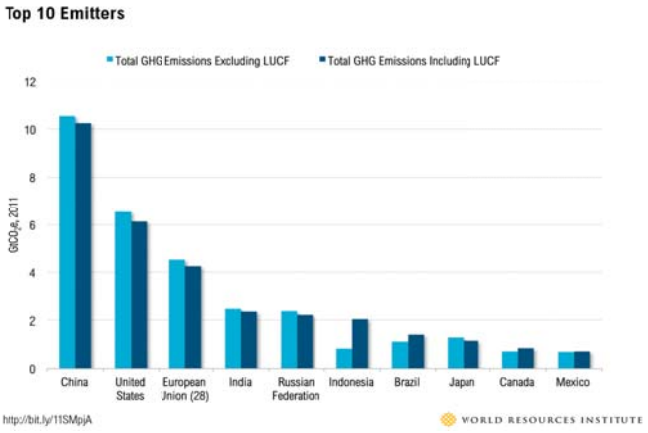
systems have on the prevailing land-use systems. The level of incentives is determined which stimulate farmers to desist from further deforestation and land use intensification actions.(FCPF, 2011)Permanence can never be entirely guaranteed in the context of land-use change and forestry activities, including REDD+. Some measures may assist to mitigate this risk. The Carbon Fund will seek to obtain ERs from programs for which there is a high level of buy-in from people on the ground, including native peoples and local communities, and where there is good governance, including verification of a sound relevant legal framework and good capacity and assurance to enforcement of law. These factors would raise the likelihood that the program is sustained in the long term and the title to the ERs is stable. The use of reserves where a number of portions of the ERs generated by an ER Program could be set aside and maintained as a buffer for probable losses to the carbon asset can cut the non-permanence risk if the reserve is set at the proper level. The buffer could either be managed by the REDD Country Participant, or be managed at the program level. ("Report Information from ProQuest," 2013)(Staddon, 2009)A major inhibiting cause to the growth of the CDM in Africa is the limitation on types of activities currently eligible for the CDM. The land use region holds the greatest prospective for carbon finance in most African countries. Under the present rules, Project activities implemented in agricultural, forestry and other land use sectors (AFOLU) are inadequate to narrowly defined afforestation / reforestation activities. The lack of AFOLU projects under the Kyoto Protocol owes principally to the fact that rules and methodologies for crediting these activities are very complex, and A/R credits are not at present an eligible asset class in the European Union (EU) Emissions Trading Scheme (ETS), the major market of carbon credit buyers.(Fisher, 2009)As we have seen in India, the World Bank and ADB have used carbon trading to rationalize and fund projects that are risky to local communities and lock India into a GHG- intensive growth model.(Policy, Luttrell, Schreckenberg, & Peskett, 2007)The chance which REDD offers for increasing the pro-poor outcomes from community forestry is that it signify a extremely different funding and governance structure from existing carbon financing mechanisms. The degree of central coordination which is likely in REDD offers some return: the manner in which community forestry has developed in most countries is through projects that are intended to join together into national programmes. In many cases it is only at this point of coalescence that critical matter such as benefit redistribution, alignment with government structures and replicability are addressed. A high level of inner coordination from the outset should permit for such issues to be taken on board at a prior stage. REDD has the potential to act as a pro-poor influence in the funding, regulation and distribution of benefits associated with community forestry. current experience would yet warn of the need for a pro-active approach if equity goals are not to be marginalized.(Karcher, Faulwetter, & Forth, 2013) CDM Executive Board revised some project methodologies and suspended others. With the voting actions of some Board members driven in part by national prejudice (Chinese and Indian delegates, for example, opposed revisions that affected lucrative HFC-23 projects and efficient coal-fired power stations), several revisions fell short of what was required.(Seeberg-Elverfeldt, 2010) The definition of a small-scale farmer differs between and within countries. In most cases it is a farmer who cultivates less than one hectare of land and has diverse sources of livelihood. The guide is structured into five sections: first, the background of climate change is explained (1); second, an introduction is given to how the carbon market works (2); this is followed by an explanation of carbon project development and the timeline and project size to take into account for planning (3); four, costs to be expected during the development of carbon projects are summarized, as well as benefits (4); finally, different funds and grants are presented (5).(Weidmann, 2008) (Murdiyarso & Herawati, 2005)The carbon footprint includes direct as well as indirect emissions of carbon dioxide, methane and nitrous oxide. The Ecological Footprint consist of direct and indirect impacts for the land types fossil fuel energy land, nuclear energy land, cropland, pasture, forest, built-up area and sea area. (Meizlish, Spethmann, & Barbara, 2007) The result is that small changes in discount rate have huge effects on the net present value and, thus, the relative competitiveness of carbon finance versus oil palm development. (Caddie & Nelson, 2008)(Lavalle et al., 2009)(Sathaye et al., 2001) It providing information on forests interact with the other components of the physical and natural world with the human society, and how we could manage forests globally to make the most of their contribution to mitigation of climate change along with the established purpose of sustainable management to maximize the full range of financial and non-market benefits which forests provide. It impacts of climate change on forests; current and future policy of national and international frameworks; and implications for future forestry and related environmental and development policy. (Guariguata, Cornelius, Locatelli, Forner, & Sánchez-Azofeifa, 2008) (Boscolo, van Dijk, & Savenije, 2010)The relationship between tropical forests and global climate change has alert on mitigation, while much less importance has been placed on how management activities may help forest ecosystems adapt to this change. In the case of planted forests, the usually higher intensity of management offers additional opportunities for implementing adaptation actions, at both industrial and smallholder levels. Although the integration in forest management of measures aimed at enhancing adaptation to climate change may not engage substantial extra effort with respect to current practice, modest action appears to have been taken to date. Tropical foresters and forest-dependent communities emerge not to value the risks posed by climate change and, for those who are aware of them; practical guidance on how to respond is largely non-existent. The extent to which forestry research and national policies will promote and adopt management practices in order to assist production forests adapt to climate change is currently uncertain.

Mainstreaming adaptation into national development and planning programs may represent an initial step towards the incorporation of climate change considerations into tropical forestry.(Lindner et al., 2002) (Hemant, 2009)Forests and the forest sector are sensitive to climate change at really varying scales. The complexity of the interactions among the physical environment, forest growth, the management and utilization of forest resources, and market responses has stimulated efforts to model the impact of global changes on the forest sector by linking impact models developed from different disciplines. To date the most common method is a "one-way" linking, where results from one model are used as input to a different model. When different impact models are coupled, feedbacks can be analyzed, e.g. between ecological and economic systems. Integrated modeling is described as a third step, where different sub-models are embedded into a common model framework. The concept of balance is introduced as a key to successful integration of different disciplines in integrated assessment (IA) studies. The assessment of existing experiences emphasizes the problem of complexity and the need to simplify corrective approaches. It also illustrates how methodologies applied to forest sector IA studies have evolved over the last few years. Several scaling issues that are particularly significant for IA modeling in forestry are discussed, including the consequences of heterogeneity in site circumstances, the variable influence of severe events on ecosystems and on the economic sector, and the differences in temporal and spatial scales over which key forest growth and renewal processes operate. Climate impact assessments include doubts. (Schoene & Bernier, 2012)(Prasad et al., 2012) (Hooda et al., 2007)Carbon in forest biomass has in the past been the fulcrum for main changes in forestry and forests. Planned adaptation of forestry and forests under climate change as a new paradigm change, precipitated once more by forest carbon. To be sustainable, forest management and conservation must clinch planned adaptation to and mitigation of mitigation of and adaptation to climate change. The current initiative of Reducing Emissions from Deforestation in Developing Countries (REDD) represents, beyond its unique mitigation goal, a major facet of planned adaptation of forests and adjoining sectors in developing countries. The initiative is gaining a powerful momentum for enhancing sustainable forest management in developing countries. REDD may also adapt relations between developing and developed countries in another paradigm change. Worldwide observations of climate change impacts on forests and IPCC forecasts project an image of forests and forestry entering a new era. Dealing with this future by relying on autonomous adaptation is unlikely to suffice. Climate change will alter site and ecological conditions, increase risk in many forests, create new gaps in knowledge, increase the value of forest carbon and wood energy, and expand the international and human dimensions of forestry. Ending the proverbial seed dormancy of new developments in forestry, change is underway and appears expedient. (Anderson et al., 2011)(Singh, Varalakshmi, & Ahluwalia, 2000) Forestry–including afforestation, reforestation, avoided deforestation, and forest management–can show the way to enlarged sequestration of atmospheric carbon dioxide and has therefore been proposed as a strategy to mitigate climate change. However, forestry also influences land-surface properties, including albedo (the fraction of incident sunlight reflected back to space), surface roughness, and evapotranspiration, all of which affect the amount and forms of energy transfer to the atmosphere. In some circumstances, these biophysical feedbacks can result in local climate warming, thereby counteracting the effects of carbon sequestration on global mean temperature and reducing the net value of climate-change mitigation projects.(Kolström et al., 2011) (Khatun, 2013)Developing adaptation measures in forestry is an urgent task because the forests regenerated today will have to cope with climate conditions that may drastically change during the life of the trees in the stand. The COST Action ECHOES (Expected Climate Change and Options for European Silviculture). The adaptation measures include responses to both risks and opportunities created by climate change and address all stages of forestry operations. Measures targeted to reduce vulnerability to climate change may either aim to reduce forest sensitivity to difficult climate change impact adaptive competence to cope with the varying environmental circumstances. Adaptation measures mitigating drought and fire risk such as selection of more drought resistant species and genotypes are crucial. For adaptation to be successful it is of the utmost significance to circulate the knowledge of suitable adaptation measures to all decision makers from the practice to the policy level. The analysis of the ECHOES database demonstrates that this challenge is well recognized in many European countries.(Tavoni, Sohngen, & Bosetti, 2007)(Kadekodi & Ravindranath, 1997) This paper studies the potential contribution of forestry management in meeting a CO2 stabilization policy of 550 ppmv by 2100. An energy-economy-climate model for the study of climate policies is linked with a detailed forestry model through an iterative method to provide the optimal abatement approach. Forestry is a determinant abatement alternative and could lead to appreciably lower policy costs if included. Linking forestry management to the carbon market has the probable to ease the policy burden of 50 ppmv or equivalently of frac(1, 4) {ring operator} C, and to significantly decrease the price of carbon. Biological sequestration will mostly come from avoided deforestation in tropical-forest-rich countries. The inclusion of this mitigation option is demonstrated to crowd out some of the traditional abatement in the energy sector and to lessen induced technological change in clean technologies. (Vine, Sathaye, & Makundi, 2001)(Mohapatra, 2008) Monitoring and evaluation of forestry projects is needed to accurately determine their impact on greenhouse gas emissions and other attributes, and to ensure that the global climate is protected and that country obligations are met(Kupfer & Karimanzira, 1991) (Chaturvedi, Tiwari, & Ravindranath, 2008)The exchange of carbon between the atmosphere and biosphere is an significant factor in controlling global warming and climate change. Consequently, it is vital to inspect how carbon flows

between different pools and how carbon stocks change in response to afforestation, reforestation, and deforestation, and other land-use activities. This IPCC Special Report is a comprehensive, state-of-the-art examination of the scientific and technical implications of carbon sequestration and the global carbon cycle. It also examines environmental and socioeconomic issues, conservation, sustainable resource management, and development issues in relation to carbon sequestration.

3. CLIMATE CHANGE & FORESTRY IN INDIA

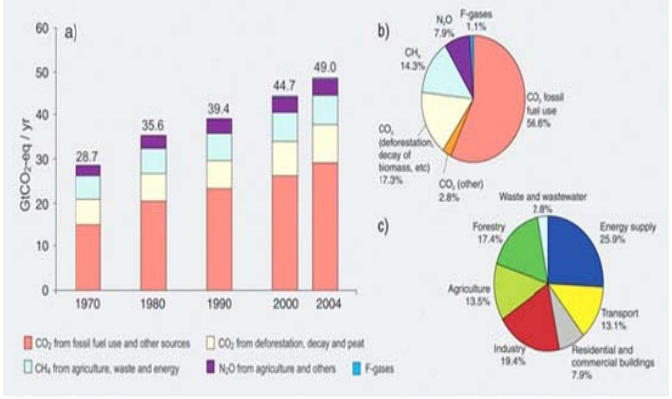
It is now recognized that global warming, part of the climate change phenomenon, is due to sharp increases in the concentration of greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxides (NO_2), chlorofluorocarbons (CFCs) beyond their natural levels. Climate change is an important driver affecting livelihoods, particularly in rainfed countries. Atmospheric concentrations of CO_2 (379 ppm) and CH_4 (1774 ppb) exceed by far the natural range over the last few thousands of years. Annual emissions of CO_2 alone grew by a staggering 80% between 1970 and 2004. In India, officials have taken the proposal to update information on Greenhouse Gas Emissions, and in this connection, the Indian Network of Climate Change Assessment (INCCA) brought out a report (INCCA, 2007) recording this valuable information.



Source:-http://www.wri.org/blog/2014/11/6-graphs-explain-world%E2%80%99s-top-10-emitters

Fig. 2: GHG Emission by country

With this publication, India became the first "non-Annex I" (ie, developing) country to publish such updated numbers. According to the results, India ranked 5th in aggregate GHG emissions in the world, behind USA, China, EU and Russia in 2007. Interestingly, the emissions of USA and China were almost 4 times that of India in 2007. It is also noteworthy that due to the efforts and policies that were proactively put in place, the emissions intensity of India's Gross Domestic Product (GDP) declined by more than 30% during the period 1994-2007.



Sources:-http://www.icrisat.org/what-we-do/SASA/sasa_august_2012.htm

Fig. 3: GHG Emission by Sources

India announced its plan to further decrease the emissions intensity of its GDP by 20-25% between 2005 and 2020, even as the country pursues the lane of inclusive growth.

Table 17.3: Change of Land Use in NCR, 1999-2012

Category	Area 1999		Area 2012		Change in Area	
	Hectare	%	Hectare	%	Hectare	%
Built-up	276566.40	8.10	372370.37	10.91	95803.97	2.81
Agriculture	2665622.08	78.07	2645022.12	77.46	-20599.96	-0.61
Green Areas	145453.44	4.26	112683.88	3.30	-32769.56	-0.96
Wastelands	291931.20	8.55	234613.90	6.87	-57317.30	-1.68
Water Bodies	24583.68	0.72	23119.19	0.68	-1464.49	-0.04
Others	10243.20	0.30	26590.55	0.78	16347.35	0.48
Total	3414400.00	100.00	3414400.00	100.00		

Source: Study Report on Creation and Updation of Landuse for Review of Regional Plan-2021 for National Capital Region, NRSC

Fig. 4 Land Use

Landuse change analysis point to that during the period 1999-2012, built-up area has increased by 2.81% (95803.97 ha.) from 8.1% to 10.91% of the total geographical area of NCR, while the area under agriculture use has reduced slightly from 78.07% to 77.46%, green areas have reduced marginally from 4.26% to 3.30%, wastelands have summary from 8.55% to 6.87%, water bodies have decreased from 0.72% to 0.68%, while area under others have increased considerably from 0.3% to 0.78%

4. CONCLUSION

The rural poor and landless need resilient, sustainable livelihood systems that is elastic in the short term due to dependence on various products. The Kyoto Protocol requires that Clean Development Mechanism projects result in long-term benefits related to the mitigation of climate change. This long-term requirement to keep carbon in storage may disagreement with the short-term needs of the poor. The objective of this paper is to examine the latent implications of

the Land use change and forestry projects to the rural livelihoods in India. Based on the analysis, the paper conclude that for CDM to be sustainable and result in sustainable progress of the local people, three important criteria should be satisfied: (1) Integrating the energy substitution possibilities in the objectives of carbon sequestration; (2) Management of the CPR lands by the rural poor through proper design of the rules for sustenance of user groups; and (3) Ensuring that the maximum revenue from carbon sequestration is channelled to the rural poor. Otherwise CDM would just result in either leakage of carbon benefits or have negative welfare implications for the poor. (Gundimeda, 2004) Seva Mandir, FES, and TIST all implement various kinds of forestry activities in India. The common aim of these activities is to strengthen rural livelihoods by improving the productivity of local resources.

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