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ENHANCING CARBON RETENTION THROUGH IMPROVED FOREST MANAGEMENT

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ABSTRACT

Most of the discussions of Reduced Emissions due to Deforestation and Degradation (REDD) focus on tropical deforestation, however, the potential carbon saving from reduced forest degradation is mostly disregarded. This cost-effective approach to mitigation needs be included in the new climate change agreement. The potential global contribution of improved tropical forest management to carbon retention is substantial. To assess the effect of silvicultural management on the yield and carbon sequestration, a study was conducted in two teak sample plots (thinned and un-thinned) established in Koppa Forest division of Karnataka in India. Both the plots were nearby and of similar age. The volume yield and above-ground stored carbon was found to be about three times more in silviculturally managed (thinned) forest stand compared to un-managed (un-thinned) stand. In this paper, the role of improved forest management for carbon retention is highlighted. The silviculturally managed forest stands sequester significantly more carbon compared to un-managed forest stand. Incentives to retain more forest carbon through improved management would represent a big step toward sustainability in the vast area of tropical forests outside protected sites.

Key words: Forest management, Reduced emission, Carbon retention, Teak stands, Tropical region.

Introduction

Worldwide, a total area of 350 million ha of tropical moist forests is designated as production forest (ITTO, 2006), about one-fourth of which is managed by rural communities and indigenous people (White and Martin, 2002). These forests are mainly exploited for timber.

Consideration of Reduced Emissions due to Deforestation and Degradation (REDD) was an integral part of negotiations for an international climate change agreement to replace the Kyoto Protocol in 2012. This alternative figured notably in the "road map" toward such an agreement which was agreed upon during the 13th Conference of Parties (COP) meeting of the United Nations Framework Convention on Climate Change (UNFCCC) held in Bali during December 2007. The discussions of REDD mainly focus on tropical deforestation, while the potential carbon saving from reduced forest degradation is mostly overlooked (Gullison *et al*., 2007; da Fonseca *et al*., 2007). Given that carbon losses due to degradation could be of the same magnitude as those from deforestation, this neglect is worrisome (Nepstad *et al*., 1999; Asner *et al*., 2005) and requires utmost importance.

Improved forest management for carbon retention

Putz *et al*. (2008) have shown that substantial reductions of global CO_2 emissions can be achieved by improving forest management in the tropics, and argue that this cost-effective approach to mitigation should be included in the new climate change agreement. Pinard and Putz (1996) have highlighted the carbon benefits of improved forest management with a large-scale, long-term study in Malaysia. Shifting from Conventional logging (CL) to Reduced-impact logging (RIL) is one example of improved forest management. RIL has been very effective in reducing collateral damage to trees during timber harvesting and selective logging since trained workers follow directional felling.

In forests subjected to conventional logging in Malaysia, carbon emissions were over 100 t ha^{-1} (Putz *et al*., 2008). In contrast, where improved harvesting practices were used, these initial losses were much lower, mainly due to reduced collateral damage. After 30 years, the typical period after which loggers are allowed to return to an area for the next harvest, carbon stocks in forests with improved management was predicted to be at least 30 t ha^{-1} higher than those in conventionally logged forests (Pinard and Cropper, 2000), and probably much higher in practice. In a similar study in Amazonian Brazil, where forests are logged much less intensively, the benefit of improved timber harvesting practices was estimated to be 7 t C ha^{-1} (Keller *et al*., 2004). In both cases, improved management reduced carbon emissions by approximately

The volume yield and above ground stored carbon was about three times more in silviculturally managed forests as compared to unmanaged forest.

Table 1: Summary statistics of the data from thinned and un-thinned teak sample plots.5

Plots	Age (yrs)	Density (stems/ha)	BA/ha (m^2)	Av. Height (m)	Av. dbh (cm)	Dominant height (m)	Volume/ha (m^3)	MAI (m^3)
Thinned	35	527	23.60	17.53	23.87	22.96	223.81	6.39
Unthinned	31	498	10.28	12.48	16.21	18.37	73.69	2.38

30%, relative to conventional logging. Using information on intensities and intervals of logging, area of production forest (ITTO, 2006) and the above figures on carbon loss, Putz *et al*. (2008) estimated the global consequences of improved tropical forest management. Use of improved timber harvesting practices in the tropical forests designated for logging would retain at least 0.16 gigatons of carbon per year (Gt C y^{-1}). Most of the emission reductions from improved forestry are expected to be from the more intensively logged forests in Asia, where emissions are largest. This reduced annual rate of carbon emissions is substantial. The total amount of carbon emitted due to tropical deforestation is estimated to be 1.5 gigatons per year or 20% of global anthropogenic emissions (Gullison *et al*., 2007). Thus, the potential for emission reductions through improved forest management is at least 10% of that obtainable by curbing tropical deforestation.

Silvicultural management: effect on yield and carbon sequestration

The silvicultural prescriptions (*e.g.* thinning and pruning) and intensive management systems are known to contribute in producing high quality timber, enhancing growth and yield, and improving wood quality (Perez, 2005). Pruning has been a common silvicultural technique used to obtain high quality timber (Hubert and Courrand, 1988).

To assess the effect of silvicultural management on the volume yield and carbon sequestration, we collected data from two teak sample plots located nearby in Balehonnur range of Koppa Forest division, Chickamagalur in Karnataka in Dec. 2012. One plot was thinned in the year 2000-2001 but no thinning was done in the other plot. There was a marked difference in the growth and yield of teak trees in these two plots (Table 1).

The reduction in the tree density in un-thinned plot was mainly because of mortality due to over-crowding which is another disadvantage of not following proper management schedules that leads to loosing precious wood resource. The age difference between the two plots was only 4 years and tree density was almost similar due to thinning and self-thinning (competition related mortality), respectively. However, there was a significant difference in tree height, diameter, per-ha volume and mean annual increment (MAI) in volume yield. The growing stock and MAI in the un-thinned plot was almost one-third compared to thinned plot. This clearly shows the positive effects of silvicultural management on stand growth and yield suggesting that the forests should not be left un-managed. The un-managed forest stands not only contribute in poor growth of the trees but also invite economic losses arising from density dependent mortality of the trees.

Considering the average basic wood density (ratio between oven-dry weight and green volume of wood) of teak as 0.6 tons per cubic meter (t m^{-3}) (Marklund and Schoene, 2006), the estimate of wood biomass available in the two plots worked out to be 134.29 tons and 44.21 tons, respectively. The carbon fraction values used by countries vary from 0.45 to 0.53 but, overwhelmingly, countries used the default value of 50%. The average weighted by forest area is 0.49 (Marklund and Schoene, 2006). Taking this carbon fraction value, the carbon stored in the above-ground biomass in the thinned and un-thinned plots were to the tune of 65.80 and 21.66 tons/ha. Thus, the managed stand has sequestered much more carbon (tree times) compared to un-managed stand.

Conclusion

The potential global contribution of improved tropical forest management to carbon retention is substantial. In addition to increased carbon retention, there are other important benefits from improving forest management. Minimizing canopy opening allows forest flammability to decrease and shade-requiring wildlife and plants to continue to thrive. Incentives to retain more forest carbon through improved management would represent a big step toward sustainability in the vast area of tropical forests outside protected sites. The silviculturally managed forest stands sequester significantly more carbon compared to un-managed forest stand.

उन्नत वन प्रबंधन द्वारा कार्बन धारण बढ़ाना

वी.पी. तिवारी

सारांश

निर्वनीकरण एवं निम्नीकरण के कारण न्यूनीकृत उत्सर्जन (आर.ई.डी.डी.) की अधिकांश चर्चा उष्णकटिबंधीय निर्वनीकरण पर केन्द्रित है। तथापि, न्यूनीकृत वन निम्नीकरण से सक्षम कार्बन बचत की अधिकतर उपेक्षा की गई है। न्यूनीकरण के लिए इस लागत-प्रभावी एप्रोच को नए जलवायु परिवर्तन समझौते में शामिल करने की जरूरत है। कार्बन धारण के लिए उन्नत उष्णकटिबंधीय वन प्रबंधन का सक्षम विश्व सहयोग पर्याप्त है। उपज एवं कार्बन पृथक्करण पर वन संवर्धनिक प्रबंधन के प्रभाव का मूल्यांकन करने के लिए भारत में कर्नाटक के कोप्पा वन प्रभाग में स्थापित दो सागौन नमूना भूखण्डों (विरलित और गैर विरलित) में एक अध्ययन किया गया। दोनों भूखण्ड पास-पास और समान आयु के थे। आयतन उत्पादन और भूम्यूपरिक भण्डारित कार्बन गैर प्रबंधित (गैर-विरलित) स्टैण्ड की तुलना में वन संवर्धिनिक रूप से प्रतिबन्धित (विरलित) वन स्टैण्ड में करीब तीन गुना ज्यादा पाया गया। इस शोध पत्र में कार्बन धारण हेतु उन्नत वन प्रबंधन की भूमिका की मुख्य-मुख्य बातों को बताया गया है। गैर-प्रबंधित वन स्टैण्ड की तुलना में वन संवर्धानिक रूप से प्रबंधित वन स्टैण्ड महत्वपूर्ण रूप से ज्यादा कार्बन पृथक्कृत करते हैं। उन्नत वन प्रबंधन के जरिए ज्यादा वन कार्बन बनाए रखने हेतु प्रोत्साहन संरक्षित स्थलों के बाहर उष्णकटिबंधीय वनों के विशाल क्षेत्र में पोषणीयता की दिशा में एक बड़े कदम का प्रतिनिधित्व करेंगे।

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