Forest Policy and Economics 12 (2010) 277–286

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Assessing the mitigation potential of forestry activities in a changing climate: A case study for Karnataka

Kaysara Khatun [a,*], Paul J. Valdes [a], Wolfgang Knorr [b], Rajiv Kumar Chaturvedi [c]

[a] School of Geographical Sciences, Bristol University, University Road, BS8 1SS, Bristol, UK
[b] Earth Sciences, Bristol University, University Road BS8 1SS, Bristol, UK
[c] Centre for Ecological Sciences, Indian Institute of Science, Bangalore, India

ARTICLE INFO

Article history:
Received 20 February 2009
Received in revised form 5 November 2009
Accepted 17 December 2009

Keywords:
Afforestation
Carbon price
Clean development mechanism
Reforestation
Land use
Sustainable development

ABSTRACT

The Clean Development Mechanism (CDM), Article 12 of the Kyoto Protocol allows Afforestation and Reforestation (A/R) projects as mitigation activities to offset the CO_2 in the atmosphere whilst simultaneously seeking to ensure sustainable development for the host country. The Kyoto Protocol was ratified by the Government of India in August 2002 and one of India's objectives in acceding to the Protocol was to fulfil the prerequisites for implementation of projects under the CDM in accordance with national sustainable priorities. The objective of this paper is to assess the effectiveness of using large-scale forestry projects under the CDM in achieving its twin goals using Karnataka State as a case study. The Generalized Comprehensive Mitigation Assessment Process (GCOMAP) Model is used to observe the effect of varying carbon prices on the land available for A/R projects. The model is coupled with outputs from the Lund–Potsdam–Jena (LPJ) Dynamic Global Vegetation Model to incorporate the impacts of temperature rise due to climate change under the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) A2, A1B and B1. With rising temperatures and CO_2, vegetation productivity is increased under A2 and A1B scenarios and reduced under B1. Results indicate that higher carbon price paths produce higher gains in carbon credits and accelerate the rate at which available land hits maximum capacity thus acting as either an incentive or disincentive for landowners to commit their lands to forestry mitigation projects.
© 2009 Elsevier B.V. All rights reserved.

1. Introduction

Under Article 12 of the Kyoto Protocol, namely the Clean Development Mechanism (CDM) developed countries are able to implement greenhouse gas (GHG) reduction activities in developing countries, where the costs of such projects are usually much lower. These projects are to be carried out with the purpose of assisting developing country Parties in moving forward with their sustainable development goals, whilst simultaneously allowing developed country Parties in achieving compliance with their quantified emissions limitation and reduction commitments. The CDM has no specific reference to sinks, but it has been decided that afforestation and reforestation (A/R) will be allowed. The Kyoto Protocol stands to be revised in Copenhagen 2009, and afforestation, reforestation and deforestation (ARD) activities are expected to feature prominently as continuing mitigation strategies for subsequent commitment periods.

The carbon sequestration by sinks approach as a mitigation strategy is appealing to policymakers because it can be equated directly with carbon emissions and is considered a relatively inexpensive strategy (Kolshus et al., 2001). The forestry sector is fairly unique in that not only does it contribute significantly to global CO_2 emissions through deforestation, pests and fire, but can also provide opportunities to lessen the levels of CO_2 in the atmosphere by sequestering it in soils and vegetation as well as in wood products. In this way the forestry sector can play a critical role in stabilizing global CO_2 concentrations (IPCC, 2007).

Global studies (Sohngen and Sedjo, 2004; Sathaye et al., 2005) have analyzed the sensitivity of the forest sector's mitigation potential to carbon price variation using ARD activities and by region. Regional studies in India deal with methodologies (Ravindranath et al., 2007b; Sudha et al., 2007) and only one by Ravindranath et al. (2007a) examines the impact on available land from on carbon price for A/R sequestration activities. The study uses the Generalized Comprehensive Mitigation Assessment Process (GCOMAP) Model (Sathaye et al., 2005) for the whole of India based on two carbon prices $50 and $100 respectively and aims at estimating India's forestry mitigation potential at a regional level based on two systems of land classification. The authors conclude that investment capital barriers pose the main limitation for A/R projects in India.

GCOMAP is a dynamic partial equilibrium economic model built to simulate the response of forestry land users to changes in prices in forest land and products and prices emerging in the carbon market

* Corresponding author. Tel.: +34 944 014 690.
E-mail address: kaysara1@googlemail.com (K. Khatun).

1389-9341/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.forpol.2009.12.001

(Sathaye et al., 2005). Partial equilibrium models have been used to examine the effects of carbon prices on afforestation and forest management options in an integrated framework of global demand and supply of timber (Sohngen and Sedjo, 2004) as well as to assess the demand for agricultural products over time, by region, and competition between agricultural production of crops and biofuels and forestlands for tree planting. The GCOMAP model has been employed as a tool to make policy recommendations using forestry projects by a number of authors, avoided deforestation by Kindermann and Obersteiner (2008), all forestry mitigation options by Sathaye et al. (2005) and A/R activities under the CDM by Ravindranath et al. (2007a). Our study complements the latter work by focussing on plantation projects in the four agro-ecological zones corresponding to Karnataka based on changing the carbon price and adds to it by factoring climate variability under a number of mitigation scenarios by coupling GCOMAP with data from the Lund–Potsdam–Jena (LPJ) dynamic global vegetation model (Sitch et al., 2003).

The aim of this study is to look at the impact of the price of carbon credits for forestry on land availability and hence the policy implications should "wastelands" be offered up for mitigation purposes by the government of India. We also attempt to consider the implications and the usefulness of using the GCOMAP model as a policy tool for India and its usefulness in practical implementation. Two important aspects of forest plantation development will be looked at namely: the current and future status by exploring short (2020), medium (2050) and long term (2100) trends in forest plantation establishment and the economic and development issues associated with these forestry projects.

This will be achieved by:

- Quantification of biomass change by using LPJ outputs for the Karnataka Region as inputs to GCOMAP to offer insights into the effect on land availability and the significance to carbon stock and hence potential credits during a mitigation period for large-scale A/R projects.
- Examination of the economic controlling factors by changing the carbon price and observation of the subsequent effects on available land produced by the use of short rotation (SR) and long rotation (LR) species for the IPCC scenarios A1B, A2 and B1.
- Using both enhancements to observe:

-The difference from base case on land availability and carbon stock in the short, medium and long term for SR and LR

-The change in available land.

Economics play a significant role in social development whether they are made explicit or just perceived by stakeholders. Hence it is "good practice" to calculate the costs for more than one rate to provide guidance for policymakers on how sensitive the impacts are to a given carbon price path and thus provide a glimpse of the overall picture.

2. Study area

Karnataka has a geographic area of 19.18 million ha which constitutes 5.83% of the total area of the country with a range of climates varying from the very moist monsoon climate on the coastal and hilly areas to the semi-arid climate of the northern districts (Forest Survey of India, 2005). The state is endowed with diverse and dense forests in the county ranging from evergreen forests of the Western Ghats to the scrub jungles of the plains (Fig. 1).

Table 1
Area of available wasteland and amounts allocated for SR and LR plantations in Karnataka.
Source: Ravindranath et al. (2007a).

AEZ	Area (ha)	SR %	LR %	SR (ha)	LR (ha)
AEZ 3	260000	67	33	174656	85344
AEZ 6	408740	67	33	274572	134168
AEZ 8	472430	67	33	317356	155074
AEZ 19	212460	67	33	142721	69739
Total	1353630				

Table 2
Breakdown of wasteland area.
Source: Ravindranath et al. (2007a).

By use	Industrial roundwood	34%
	Fuelwood	21%
	Other purposes	45%
Area	SR	67%
	LR	33%

The Western Ghats of Karnataka is one of the 25 global priority hotspots for conservation and one of two on the Indian subcontinent (Ministry of Environment and Forests, MoEF, 2004). An increase in temperature due to climate change will potentially impact on the vegetation and subsequently land use and resources. Due to the vast forests, Karnataka has a large rural population who depend on the forests for their livelihoods and energy requirements.

The classification system of the zones used in the GCOMAP model for India have been categorized into 20 Agro-Ecological Regions on a 1:4 million scale. The mapping and classification of the various parts of the country for generation of agro-ecological regions involved the superimposition of four base maps, namely physiography, soils, bioclimate and length of growing period and have been used for resource planning at national level (Forest Survey of India, 2005). Zones 3, 6, 8 and 19 correspond to Karnataka as shown in Fig. 2. We have selected Karnataka to observe the impacts of the four somewhat different zones to rising carbon prices on land availability under the SRES scenarios should wastelands in the state be used for A/R projects under the CDM. The State has a variety of land uses (Tables 1 and 2).

The selection of lands available for CDM projects is a key driver of mitigation potential. This appraisal is confined to lands only under the control of state forest and land revenue departments as these may be able to directly benefit local communities as under national state laws, they have rights to the resources of that land. The appraisal is also concerned with land that does not jeopardize food and livelihood security and hence the analysis is limited to land classified as "wastelands" as reported by National Remote Sensing Agency (NRSA). Degraded lands in India called wasteland, have been assessed by Ravindranath and Hall (1995) to be technically suitable for growing trees and can be regarded as a promising land type to be used for A/R activities under the CDM. Approximately 23% (75 million ha) of Indian land area is classified as wasteland and according to Sathaye et al. (2001) about 40% of this amount is considered available for forestation. This value includes degraded forestland as well as pasture land, marginal cropland and other privately owned non-crop land categories. These are the lands that are most likely to meet the additionality criteria required for eligibility under the CDM and such an effort would also help to offset the increase in atmospheric CO_2.

3. Methodology

The GCOMAP model includes four of the five carbon pools defined by the UNFCCC (2001) Marrakech Accord: these are aboveground biomass, belowground biomass through an expansion factor, litter and soil organic carbon. Dead organic matter however, is not included in this study. To estimate the future investment necessary for plantation implementation and the effect of those investments on the plantation rate, the linear model establishes a baseline scenario with no financial revenues from carbon (Ravindranath et al., 2007a). From this baseline the areas under plantation activities for carbon mitigation and also the overall mitigation activity and potential for the

Download English Version:

https://daneshyari.com/en/article/91843

Download Persian Version:

https://daneshyari.com/article/91843

Daneshyari.com