Claiming a Bird in Hand: Economic Potential of Plantation in Nepal under Clean Development Mechanism

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Abstract: The paper explores the avenues for carbon trading from existing and potential afforestation and reforestation (A/R) activities in Nepal. As the proposal for A/R projects under Clean Development Mechanism (CDM) is a relatively new idea for Nepal, the paper revisits some preliminary concepts of CDM under this category. It reviews the relevant literature on CDM in the context of Nepal. Different categories of land viz. private land, leasehold forests, community forests, government-managed forests, and community wastelands have been identified potential while claiming carbon dollars for A/R projects under CDM. A preliminary estimation of plantation areas shows that A/R projects in Nepal have enormous potential in claiming for carbon dollars under CDM. Taking six metric tons per hectare as the average annual carbon sequestration and price of carbon as US $ 10-20 per ton into account, gross annual income ranging from $0.4 million to $0.8 million can be earned from plantation after 2000. Pursuant to huge economic potential of carbon sequestration projects, significant efforts are required to realize the potential benefits. The paper recommends establishing broker institutions to mediate carbon trading in Nepal at global markets in order to reduce transaction costs. Effective advocacy is needed for the inclusion of avoided deforestation projects such as protected area systems and community forests to maximize benefits from carbon trading under CDM.

Key words: clean development mechanism, afforestation and reforestation activities, carbon, plantation

INTRODUCTION

Since the fulfilment of two basic requirements, viz. ratification of Kyoto Protocol and the establishment of Designated National Authority (DNA) under the Ministry of Environment, Science and Technology, Nepal has been eligible for participating in the Clean Development Mechanism (CDM) (Pokharel 2006; Singh 2006). Biogas projects have been the only projects in Nepal to enter CDM so far and the design document of Micro Hydros as another potential CDM project has been submitted for approval (MEST 2007). A Clean Development Bank has also been set up in Kathmandu to provide financial and technical supports for clean energy activities, especially in non-forestry energy sector. There is no report whether any forestry projects have been designed for CDM yet. In this connection, various institutions and individuals are lobbying for new methodologies for CDM to include efforts that avoid deforestation, such as protected area management and community forestry, which conserve natural forests to sequester or conserve carbon (Karky and Banskota 2006; Karky 2005; Marasini *et al.* 2005; Skutsch 2003). However, the CDM Executive Board (CDM-EB) has decided to exclude the eligibility of such projects of natural forest conservation under the category of 'avoided deforestation'. As the community-based forests management are the mainstream forestry programs in the developing countries (Gilmour *el al.* 2004; Petheram *el al.* 2002), the decision to exclude such forests under carbon trading has a serious impact on their economies.

Nonetheless, it is our contention that Nepal can still benefit from already established criteria of afforestation and reforestation (A/R) projects because a substantial area of land has been afforested/reforested since 2000[1] and a significant area is still available for massive plantation. While expressing

[1] A reforested/afforested area to be considered for CDM projects should meet at least three criteria: a) an area of plantation equal or greater than 0.5 hectares, b) the crown cover should be minimum 10 percent and c) the plantation carried out in the year 2000 onwards in areas where there had been no forests since 1990 (detail in forthcoming sections).

solidarity with the countries struggling for the inclusion of natural forest conservation projects under CDM, Nepal can also claim for carbon trading derived from plantation projects. We argue that Nepal is missing what she could easily achieve from plantation forests at the cost of her claim for the carbon credits of already conserved forests, such as community forests. This is especially relevant when the inclusion of avoided deforestation activities seems almost impossible at least during the Protocol's first commitment period that ends in 2012. Approaching simultaneously to plantation forests along with community forests would not undermine the movement for including community forests into CDM. Instead, it would establish policy and institutional set up that would ultimately enhance the country's capacity to claim for community forests. Therefore, this article advances the debate by drawing attention to otherwise ignored area of Nepal's plantation forests, where we can approach with relatively less efforts but ensured outcomes. As the proposal for plantation projects under CDM is a relatively new idea for Nepal, some preliminary concepts of CDM under this category have been revisited in the paper.

While claiming carbon dollars for A/R projects under CDM in Nepal, at least six areas can be considered. These include plantation in: 1) private lands, 2) pro-poor leasehold forests, 3) community wastelands, 4) Sagarnath Forest Development Project area, 5) previously degraded community forests, and 6) national forests with less than 10 per cent crown cover. Apart from the existing forest cover established as an outcome of plantation from the year 2000 onwards, the prospects for further plantation in these six categories of land are very high.

KYOTO PROTOCOL AND CLEAN DEVELOPMENT MECHANISM

The Third Convention of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) held in December 1997 in Kyoto of Japan adopted Kyoto Protocol to the Convention. Article 3 of the Protocol set quantified targets for the developed countries (Annex I Parties) to reduce their overall emissions of greenhouse gases (GHGs)[2] by at least 5 per cent below 1990 level in the first commitment period 2008-12 (UNFCCC 1997). The Protocol developed flexible mechanisms for the developed countries to achieve their emission reduction targets. Out of three such mechanisms, namely CDM, Joint Implementation (JI) and Emission Trading (ET), CDM is the one which can be executed in developing countries (Parties not included in Annex I). Article 12 of the Protocol explains CDM as "*the purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under article 3*" (UNFCCC 1997). CDM is a mechanism for channelling financial resources and improved technologies from developed countries to developing ones in lieu of carbon credits the developing countries save or sink. It has often been glorified as a win-win strategy for, in one hand, it reduces the emissions of GHGs at a global scale and, it contributes to reducing poverty in developing countries on the other (Satyanarayana 2003). Under CDM, the industrialized countries pay dollars to the poor nations in order to purchase carbon credits so that the buyer countries can continue industrializing while meeting their emission limitation and reduction commitments set by the Protocol.

A number of industrialized as well as some developing countries have already registered their A/R projects to enter into CDM under the Protocol. In the global market, the UK was the biggest buyer of carbon credits in the first two quarters of 2006 covering 43 per cent of the total volume of carbon purchase in the world (Capoor and Ambrosi 2006). On the supply side, China was the biggest seller of carbon credits in the same period sharing more than 60 per cent supply of the credits (Capoor and Ambrosi 2006). In South Asian context, India can be the harbinger to enter CDM with her accession

[2] Carbon dioxide (CO2), Methane (Ch4), Nitrous oxide (N2O), Hydroflurocarbons (HFC), Perflurocarbons (PF6) and Sulphur hexafluoride (SF6) are the greenhouse gases (GHGs) listed in Annex A of the Protocol and are responsible for global climate change. Carbon dioxide is the major component.

to the Protocol in 2002, much earlier than Nepal. More than 400 CDM projects have already been approved in India. However, the share of A/R projects is minimal, accounting only 1 per cent globally and 3 per cent regionally (in Asia) of the total volume of carbon trading (Capoor and Ambrosi 2006).

If the plantation in Nepal remained unpaid, given her insignificant amount of GHGs emissions (Pokharel 2006), a free riding at global level on her carbon credits will continue to occur (Karky and Banskota 2006; Karky 2005; Marasini *el al.* 2005). It will be an environmental injustice to her for she has no obligation to reduce GHG emissions under the Protocol. In this scenario, Nepal should either strongly claim for the payment to her carbon sequestered in the plantation forests, or stop investing in A/R activities (to reduce both resource and opportunity costs of forested areas) and divert the funds elsewhere. Definitely, the first option would be wise for the betterment of both Nepal and the global community because, in addition to the carbon sinking the forested areas have tangible benefits such as timber, fuel-wood and non-timber forest products (Koning *et al.* 2005).

Forestry projects can contribute to reducing atmospheric CO2 in three major ways. First, carbon is stored in standing forests where it is prevented from being released into the atmosphere. In this 'carbon conservation' approach, forests are prevented from being degraded due to various harmful activities, such as deforestation, forest fires, grazing and excessive logging. The process is usually called 'avoided deforestation' or 'averted deforestation'. Second is the 'carbon sequestration' scheme in which carbon stock from the atmosphere is actively absorbed augmenting the overall rate of photosynthesis. It can be achieved through plantations, soil improvement activities and the protection of land to regenerate naturally. The third way is the 'carbon substitution' where alternative sources of energy that release less carbon are used to replace fossil fuels. The overall forestry projects including carbon conservation, carbon sequestration and carbon substitution are covered in Land Use, Land Use Change and Forestry (LULUCF) context under CDM. CDM-EB under the Protocol has admitted the second and third approaches, i.e. carbon sequestration and carbon substitution mechanisms to be considered for the first commitment period (2008-12). Carbon conservation projects, which are based on already existing forests (usually old-growths), are excluded partly due to difficulty in assessing baseline carbon data and partly due to difficulty in emission certification in such forests under various uncertainties (Skutsch 2003). Some other underlying causes may include the fact that net carbon sequestration (carbon assimilation minus carbon release) in old-growth forests is low or even negative. The carbon conservation projects, such as community forestry (CF) and protected area systems may be included in the subsequent commitment period beyond the year 2012 depending on inter-governmental negotiations (Satyanarayana 2003; Smith and Scherr 2003). Within the broad scope of carbon sequestration, only A/R activities have been included for CDM in the first commitment period. Similarly, carbon substitution schemes include projects such as micro-hydros, biogas and solar energy.

Understanding of the terms such as 'forests', 'afforestation' and 'reforestation', which have been strictly defined for the CDM purposes, has crucial implications in possibilities of benefiting from CDM schemes. Forest is defined as *'a minimum area of land of 0.5 -1.0 hectares with tree crown cover (or equivalent level) of more than 10 - 30 per cent with trees with the potential to reach a minimum height of 2-5 metres at maturity in-situ'* (CDM-EB 2007). Each host country can choose the thresholds of area, crown cover and height within the given ranges complying with the same thresholds as she has been reporting to FAO or other international institutions (Marasini *et al.* 2005). According to CDM-EB, *'afforestation is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources*'. Likewise, reforestation is defined as *'the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land'*. The CDM-EB has limited carbon trading on reforestation activities

occurring on lands that did not contain forest on 31 December 1989. For A/R to be considered for CDM, the plantation activities have to be commenced since 2000 or onwards. The twenty-first meeting of the CDM-EB has clarified that A/R activities can also be validated and registered after 31 December 2005 (CDM-EB 2007). The CDM projects need to comply with a number of rules and conditions (Box 1).

Among the CDM rules and conditions, issues of leakage and the permanence of the project are two major concerns. Leakage means the changes in emissions and removals of GHGs outside the project boundaries, resulting in the overall reduction of sequestration benefits of the project. If carbon saved somewhere (in a project) is lost elsewhere (outside the project) due to the project activity, the leakage will occur, resulting in the imbalance of the net carbon offset calculations (Skutsch 2003). The leakage can occur due to the changes in activities, demands, supplies and crowding outside the accounting system of the project but eventually cause changes in the overall level of emissions at a national scale (Kant 2003). Smith and Sheer (2003) argue that leakage takes place when CDM projects prevent people from undertaking carbon emitting activity that provides income or products, without substituting it with carbon saving compensation. A pre-project assessment of potential leakage and mitigation measure is therefore mandatory. The permanence refers to securing carbon stocks generated by CDM projects over a long period of time.

Box 1: CDM rules and conditions

The following rules and conditions apply for CDM forestry projects under the Protocol:

- Only areas that were not forest on 31st December 1989 are likely to meet the CDM definitions of A/R.
- Projects must result in real, measurable and long term emission reductions as certified by the Operational Entities (OE).
- Sequestration must be additional to any that would occur without the project.
- The carbon stocks generated by the project need to be secured over the long term (permanence).
- Only projects starting from the year 2000 onwards would be eligible.
- Each CDM project management plan must address and account for potential leakage.
- Projects need to select a crediting period for activities, either a maximum of seven years that can be renewed at most two times, or a maximum of ten years with no renewable option.
- Some of the profits from carbon credit sales from all the CDM projects will be used to cover administrative costs of the CDM.
- Two per cent of the carbon credits awarded to a CDM project will be allocated to a fund to help cover the costs of adaptation in countries severely affected by climate change and would provide support for land use activities.

STUDIES ON CARBON TRADING IN NEPAL

Limited literature is found in the field of carbon trading in Nepal. FAO (2006) has estimated that altogether 1,123 million tons of carbon stock is found in the biomass of forests and shrub-lands of Nepal at present. Skutsch (2003) recommended that carbon be included as a non-timber forest product in community-based forest management under CDM in developing countries including Nepal. She noted that a significant amount of costs (both investment and transaction) is required for carbon certification in community managed forests, implying that it is beyond the reach of impoverished local people. However, she believed that the monitoring of and reporting on carbon sequestered can be carried out by the local communities to a certain extent. She argued that training to local communities to assess and monitor increased carbon sink of their forests could reduce high costs of carbon assessment.

Upadhyay *et al.* (2005) reviewed a plethora of literature on the relation of land-use change and forest/soil degradation with carbon sequestration dynamics in the Himalayan region. They found an estimate of

only 1.47×10^6 Mg/year of carbon emission for the year 1994 in Nepal in contrast to previous claims with significant overestimation. According to them, improved management of degraded lands in the hills could contribute to enhancing carbon sequestration [both in vegetation and soil]. Since analyzing carbon sequestration in the Nepalese hills is complex due to the diverse bio-physical and socio-economic factors, they suggested a system approach tool for a comprehensive analysis. Upadhyay *et al.* (2006), with their further refinement in their earlier analysis, recommended a number of models to analyze carbon sequestration as a function of land-use changes and forest/soil degradation in the Hindu Kush Himalayan region. Karky (2005) studied carbon sequestered in community forests in the hills (Ilam), mid-hills (Lalitpur) and high hills (Manang) and found considerable volume of carbon sequestered in the form of both above ground biomass and soil organic carbon. In line with the findings coupled with his assumption of community forest regeneration over degraded lands, he argued that under carbon trading with a minimum price of US$ 5 per ton of carbon, community forests of Nepal could earn at least US$ 8.25 million per year excluding the customary benefits of timber and non-timber forest products. Pokharel (2006) analyzed energy consumption of Nepal in terms of GHGs emissions and observed that annual per capita release of GHGs in Nepal through energy consumption was 0.155 tons in 2003, which he termed insignificant in comparison with that in US, China or India. Plantation for increased biomass, wide distribution of biogas plants, further development of hydropower, spreading out improved cook-stoves, use of briquettes in industry and promotion of clean transportation are some likely major projects Pokharel (2006) has proposed for CDM in Nepal. He concluded that there is a dire need of formulating enabling policies for the promotion of CDM-based energy projects given the favorable potential of carbon trading in Nepal.

Whether a project works as a sink or source of carbon in totality is important under CDM. In carbon trading, the net result should be the sequestration, not the emission. Analyzing the difference of carbon stock in Nepal's standing forests between 1978 and 1994, Marasini *et al.* (2005) estimated that a net sequestration of 25.9 megaton of carbon occurred, for which they attributed to community forests. They compared some developing countries' net carbon sequestration from forests and concluded that it is positive in Nepal, while negative in India, Indonesia and Brazil. Mandal and van Laake (2005) argued that community forests have not yet been claimed under the CDM due to difficulties in assessing the biomass and carbon storage. They have developed relations between Leaf Area Index (LAI) and forest biomass which could be helpful in estimating carbon storage in the community forests.

POLICY REVIEW

Following a treatise of hill deforestation concerns instigated by Eckholm (1976) and later popularized as a 'Theory of Himalayan Environmental Degradation' by Ives and Messerli (1989), Nepal adopted some seminal forms of environmental policies from the late seventies. The initial attempts targeted at greening the hills through massive plantation under various bilateral and multilateral assistance (Gilmour and Fisher 1991; Guthman 1997). National Conservation Strategy 1988 has been the pioneer policy document to herald guidelines for environmental conservation. The Constitution of Nepal 1990 also recognized environmental conservation as one of the directive principles of the state. Nepal Environmental Policy and Action Plan 1993 has been the first comprehensive policy instrument in the environment sector. Environmental Protection Act 1996 and Environmental Protection Regulations 1997 have been landmarks in advancing environmental protection to mitigate negative externalities of development activities. Further, Nepal has expressed her commitments to environmental conservation and emission regulation by ratifying international conventions including Convention on Biological Diversity (1992), United Nations Convention to Combat Desertification (UNCCD) and UNFCCC. Designing policies to coordinate environmental activities and establishment

of a central level mechanism under the Ministry of Environment, Science and Technology (then the Ministry of Population and Environment) has been envisaged to implement environment-related international treaties (NPC 2003). The Tenth Plan (2002-07) of the government has given due importance to environment-related issues including implementation of Sustainable Development Agendas for the country. The recently promulgated Interim Constitution of Nepal 2007 has also guaranteed the fundamental rights of citizens to live in an unpolluted environment (GON 2007).

Despite the plethora of environmental policies and initiatives, little attention has been paid to benefit from carbon trading. Nepal submitted the first comprehensive document, explaining her status of GHGs emissions and mitigation measures in her Initial National Communication to the Conference of the Parties of the United Nations Framework Convention on Climate Change in July 2004 (MOPE 2004). She still lacks substantive policies to establish CDM projects, especially in A/R activities, though the government has ratified the Protocol on September 16, 2005 and has established Designated National Authority to deal with CDM issues.

ECONOMIC POTENTIAL OF CARBON TRADING IN PLANTATION FORESTS

The economic potential of A/R projects in Nepal under CDM is very high due to large scale of plantation. For example, the total area of plantation from the year 2000 to 2005 is 7,046 ha in different categories of land (Table 1). As there is no data available on plantation area in leasehold forests, seedling distribution number was taken as the basis for estimating area of plantation. For this purpose, a total of 2500 seedling at a spacing of 2m x 2m was assumed to be planted in a hectare.

Although major plantation activities in Nepal were carried out in the late seventies or during eighties, FAO (2006) notes an increasing trend of A/R after 1990 as well. It has documented 49,000 ha, 52,000 ha and 53,000 ha of plantations in the year 1990, 2000 and 2005 respectively. The total plantation area in Nepal comes to 1.3 per cent of total forest area in the country. Considering the plantation areas worldwide, which account for 3.8 per cent of global forest area (FAO 2006), Nepal's plantation area can be considered remarkable [given her 39% land covered by forests].

Empirical evidences from Madhya Pradesh and Andhra Pradesh (India) showed that dry deciduous forests under community production sequestered up to seven metric tons of carbon per hectare per year as a result of mean annual increment (Poffenburger *et al.* 2001 cited in Skutsch 2003). The average value was six metric tons per hectare per year in Andhra Pradesh. In the world market, the price of carbon has been valued at between US $3 and $57 per metric ton (Satyanarayana 2003). The prices would change over time upon the evolution of emissions trading and dissemination of knowledge regarding the CDM rules (Poffenburger *et al.* 2001 cited in Skutsch 2003).

Table 1: Area of plantation in hectare (ha) under different categories of forests in five fiscal years

Fiscal Year	Private	Community	Leasehold	Government	SDFP	Total
2000/01	23	958	440	990	76	2,487
2001/02	73	401	167	620	62	1,323
2002/03	14	329	320	184	25	872
2003/04	32	843	87	159	205	1,326
2004/05	35	416	80	164	343	1,038
Total	177	2,947	1,094	2,117	711	7,046

SFDP : Sagarnath Forest Development Project
Source: DOF, 2002; 2003; 2004; 2005; 2006.

Between the wide-ranging prices, US$ 10 to $20 per metric ton of carbon is the common spread (Skutsch 2003), which can be considered realistic in the case of Nepal. The actual price depends on the prevailing market forces including the bargaining power of buyers and sellers. Since most of the communities who are managing community forests, leasehold forests or private forests have little access to global market for carbon trading, they have low bargaining power with possibilities of getting the lowest price. However, establishing broker institutions to mediate centralized carbon trading between the communities and international buyers could enhance communities' collective bargaining power for higher prices. In line with it, taking six metric tons per hectare as the average annual carbon sequestration for the prices between $10 and $20 into account, gross annual income ranging from $0.4 million to $0.8 million can be earned from the existing plantation area contingent upon the open bidding of the carbon trading. The carbon dollars are the extra income from the usual benefits of forests, such as fuelwood and timber. Given substantial area of degraded forests or barren land suitable for plantation, the economic potential of carbon trading will be much higher than this preliminary estimate.

AVENUES FOR FURTHER WORKS

Pursuant to above economic potential of carbon sequestration projects under CDM in Nepal, significant efforts are required to realize the potential. While both livelihood opportunities and environmental risks are likely from such projects, a number of pre-project studies and activities need to be undertaken.

First, the above plantation area is a gross estimation from carbon sequestration points of view. The data has been obtained from the official records of the Department of Forests. Field verification is extremely needed to find out where such plantation areas actually occur and whether such plantations meet the criteria of A/R activities defined for CDM. If the plantation areas did not meet the criteria, the data presented above would be an overestimate to be included under CDM. The data presented above could also be an underestimate given the plantation activities in community forests and private lands often take place without notice of the government records. Whether the seedlings have been established or not is also unknown. An accurate calculation of the plantation areas at field level is a further task to assess the baseline information to prepare CDM projects. The leakage from increased fuelwood consumption due to A/R projects is another area to be estimated.

Second, an *ex-ante* economic analysis of carbon projects is a pre-requisite to ascertain whether such projects exceed benefits over costs under various risks and uncertainties. Such benefit-cost analysis on case study bases representing eco-regions or various property rights regimes or both would be helpful. Smith and Scherr (2003) have noted a number of benefits and risks of carbon projects at varying degree for both local livelihoods and environment depending on various factors such as forest management modalities under different property rights regimes, enabling policies, collaboration of communities and intensity of plantations. Considering more than a three quarter of Nepalese people directly depending on forests for their livelihoods, developing CDM projects that would curtail their existing access to forest resources would be neither viable nor acceptable. Therefore, the detail accounts of benefits, costs, risks, uncertainties and sensitivities of proposed CDM projects under various market failure scenarios at social discount rates are to be pre-evaluated. In project design phase, an Annual Equivalent Value (AEV) can be obtained as profitability indicator on the basis of Net Present Value (NPV) of the project (Gutiérrez *et al.* 2006).

Third, developing local level regression equations to estimate carbon sequestration on per hectare basis in different conditions is another task to be accomplished to advance A/R projects under CDM. The valuation undertaken above is based on international models to quantify per hectare carbon sequestration in given forests. Internationally, a universal constant of 0.5 is used to estimate carbon content from biomass of trees which means the weight of carbon is approximately half of the biomass. The weight of CO2 is then obtained multiplying carbon content by 44/12

(Gutiérrez *et al.* 2006). The general formula does not provide a location-specific accuracy. Some studies in naturally regenerated community forests located in the hills have been carried out to estimate annual carbon sequestration on the basis of above ground biomass of tress (Karky and Banskota 2006). However, the volume of carbon sequestration in a forest greatly varies contingent upon a number of variables such as the species, age of the trees, densities of the trees per unit area, total biomass of the trees, site qualities and so forth. Therefore, location specific regression models have to be constructed to estimate carbon sequestration per hectare in a given locality to value carbon dollars. Once the biomass or carbon growth equations are developed, carbon dynamics can also be estimated using computer software such as Carbomáx to model maximum benefits from the combination of timber and carbon revenues (Gutiérrez *et al.* 2006).

Fourth, identification of barren lands potential for A/R activities is another task to be carried out. A significant area (approximately 1.6 million ha) of barren lands or grasslands with scattered trees (less than 10 per cent crown cover) that are ideal for A/R activities, are available in the country. Proper identification and mapping of such lands applying Geographic Information System (GIS) would be crucial in this regards. Given the minimum opportunity costs, the net benefits of such barren lands in terms of carbon trading could be much higher than any other land-use alternative.

Fifth, potential areas for A/R activities can be explored in some other existing land-use modalities such as pro-poor leasehold forestry and agro-forestry in private lands. Since leasehold forests have been specially set aside in degraded forests (with less than 20 per cent crown cover), the area with below 10 per cent crown cover could be identified to be included for plantations under CDM. Since the programme is being implemented with a provision of exclusive use rights for the ultra-poor, extra income from carbon trading in addition to their existing forest products would contribute to poverty reduction. Likewise, the plantations in private lands often in a form of agro-forestry commensurate with the criteria of CDM are also remarkable. Kanel (1995) estimated higher net benefits of tree plantation than agricultural cultivation in private lands in Nepal's Terai. He accounted for customary benefits of trees, such as timber, fuel-wood and fodder. If carbon value were added to the tree resources, the net benefits of private tree plantations would be even substantially higher.

Sixth, development of carbon broker institutions particularly at non-government sector is a primary task to advance CDM projects. Such carbon brokers are needed to coordinate the scattered forest owners and mediate carbon trading at international level. We have argued that carbon trading is often beyond the capacity of local people in terms of the technical knowledge, bargaining power and political approach. The transaction cost of carbon trading per forest-owner, in case the owners are small or medium holders, is very high. Such barriers could be overcome if intermediary carbon brokers took responsibilities to purchase carbon credit from such small or medium holders and sell it to international markets. Alternatively, trust funds could be established to resolve the issue as Koning *et al.* (2005) recommend.

Finally, advocacy for the inclusion of avoided deforestation projects under CDM need to be continued. The global potential of LULUCF projects during the first commitment period is very limited at a rate of approximately 50Mtc annually at $10 per ton of carbon (Satyanarayana 2003). Carbon conservation under avoided deforestation projects has the biggest scope of carbon dollars in Nepal because only such projects can include protected area systems and majority of community forests across the country. Although the likelihood that such projects are included within the first commitment period of the Protocol (2008-12) is minimal, the voices for such projects could be stronger for the further commitment periods beyond 2012. A continued solidarity with other developing countries especially in the tropics for the inclusion of carbon conservation projects should be an important task of Nepal's government.

CONCLUSION

Nepal has immense prospects for carbon trading to generate extra revenue from A/R activities since substantial area has been found planted after the year 2000. The discrepancy of the plantation data between FAO estimation and Department of Forest records strongly demand field verification while designing project documents. The open public lands, especially in the Terai and degraded forest lands with less than 10 per cent crown cover are the two main areas where A/R activities can be established for the new CDM projects. Such A/R projects, both in existing plantation areas and to be planted in the open and barren lands, seem feasible in terms of environmental sustainability and economic viability. In order to achieve CDM benefits, broker institutions are required either to purchase the carbon credits or mediate buying and selling of such credits in the international market so that the excessive transaction costs for small and medium holders could be significantly minimized. Formulation of enabling policies and legislation are equally important to benefit from A/R projects under CDM in Nepal. The emphasis on lobbying for including community forests in CDM often at a cost of ignoring A/R projects during the first commitment period is futile especially due to the decision of CDM-EB to exclude 'avoided deforestation' projects. The campaign could be made more beneficial by capturing benefits from A/R projects vis-à-vis raising voices for the inclusion of community forests and protected areas. The two-forged strategy will bring about the financial benefits from A/R projects before 2012 and will equally buttress the international campaign of the developing nations to be benefited from natural forest conservation in the years beyond.

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