Chapter 6

Overall Conclusions and Implications

6.1 Conclusions

The role of forests in mitigating climate change has received much attention as have opportunities to avoid further tropical deforestation. Under the proposed REDD+ incentive mechanism of recent UNFCCC climate negotiations, participating countries have to determine and address the causes of deforestation and forest degradation to reduce CO_2e emissions. Identifying the drivers of deforestation and forest degradation, quantifying emissions reduction potential, and estimating the cost of emissions reduction are all pre-requisites to understand the viability of greenhouse gas emissions reduction before participating in the mechanism. In this context, several conclusions can be drawn from the essays reporting research conducted in a global biodiversity hotspot.

The circumstances and causes of tropical deforestation and forest degradation are diverse and vary from place to place. The study concluded that population growth; agricultural yield and property right variables appear to be the dominant underlying causes of deforestation in the Terai Arc Landscape. Other causes of tropical deforestation reported in earlier studies; e.g., the net effect of the road network, size of forest area, and political instability were found to be statistically insignificant. Increased agricultural yield, well defined property right as characterized in different management regimes and control in population growth are crucial to address deforestation in the landscape.

Despite the intertwined phenomena of deforestation and forest degradation, research on forest degradation is scanty mainly because detecting and quantifying it is more challenging than measuring deforestation. Permanent deterioration of forest biomass stock is one of several attributes of forest degradation. For the purpose of REDD+, the research considered negative change in forest biomass or C density as evidence of forest degradation. The study reveals that timber logging and fuel wood extraction are the proximate causes of forest degradation in the Terai Arc Landscape. Lack of econometric evidence of livestock population growth on forest biomass degradation, as shown in this study, might be due to grazing on annual herbs or grasses rather than browsing on tree species.

Another important conclusion of this study is that actual stocking of C in the forest of the TAL is less than those biome-average estimates. The result indicates the importance of forest type and site-specific studies to achieve precise and reliable estimates of C stock and emissions reduction potential. The study found that AGB, BGB and SOC are the important C pools. The findings of the research lead to a recommendation that litter and shrub pools should not be included in MRV framework to be designed for REDD+ program due to their negligible shares in total C stock.

One of the highlights of the research is evidence of strong association of C stock with management regime. Higher stocking of C was found in the protected areas where a strict restriction on exploitation of forest products is enforced. In contrast, unsustainable and illegal harvesting of timber and fuel wood due to poor enforcement of property rights as manifested in the government- managed forest may have contributed to the lesser stocking of C than in community-managed forest. This finding provides valuable information for policy makers to make informed choice of management regime for the landscape.

The results of the study demonstrated that forest of the Terai Arc Landscape has huge potential to reduce CO_2e emissions. Avoiding forest degradation, particularly of the government-managed forest can contribute significantly to reduce emissions as well as enhance C stock. Addressing this component of REDD+ is equally important as deforestation. Incorporating activities in the REDD+ design framework that ensure only sustainable harvesting of timber and fuel wood would be crucial for effective emissions reduction under the proposed REDD+ mechanism.

Estimation of opportunity cost of emissions reductions and amount of expected incentive determine the attractiveness of REDD+ for GHG emissions reductions. The bottom-up approach adopted in this study found that any REDD+ payment below US$ 8.95 per Mg of CO_2e emission reduction is unlikely to avoid deforestation in the Terai Arc landscape. However, emissions reduction through avoiding forest degradation is a cheaper option than is avoiding deforestation. Incentive payments based on most global opportunity cost estimates are likely to be insufficient for effective emissions reductions in the Terai Arc landscape. Therefore, policy makers need to be cautious when using global estimates and values while designing any national and sub-national REDD+.

Finally, the policy implications and contributions of research are discussed in section 6.2.1 and 6.2.2 respectively. The findings of the research are expected to be useful for REDD+ practitioners as well as researchers. The important results on C stocks, drivers of deforestation and forest degradation and opportunity cost of emissions reductions derived from the bottom up approach are particularly relevant to derive conclusions on role of forest on climate change mitigation. District-disaggregated time series data constraint of some of the important variables is the key impediment of the study. The limitations of the research and directions for future research are discussed in section 6.3.

6.1.1 Policy Implications

The scale of REDD+ to be introduced is still under discussions. Most parties in the UNFCCC recognize that REDD+ will need to be implemented at national scale. However, sub-national REDD+ is being discussed as an option because implementation at national scale will require significant capacity that the participating countries do not have at least in this initial stage. The national REDD+ may also include sub-national activities which is an option for engaging before implementation at national level. Therefore, this study which was conducted at sub-national scale is in line with ongoing discourse.

Terai Arc Landscape is Nepal's largest conservation initiative and supports the worlds' most spectacular biodiversity. The largest commercially exploitable forest of Nepal situated in TAL is not only the habitat of endangered flagship species, but also the source of livelihood for many forest dependent communities. Rapidly decreasing and degrading forest of the landscape also has emissions reduction significance. Role of forest in climate change mitigation and recent climate talks focused on payment for emissions reduction through avoided deforestation and forest degradation opened new avenues to conserve these forests.

In this context, important policy implications can be drawn from these research findings. First, the study incorporates both deforestation and degradation components of proposed incentive mechanism called REDD+, which is under discussion in UNFCCC. The parameter estimates of the underlying and proximate causes of deforestation and forest degradation will be helpful to determine business as usual scenario or reference emission levels for the purpose of REDD+.

Secondly, the study area is the mosaic of different forest management regimes viz; community forests, government-managed forests, Buffer zone community managed and national parks. Evidence of strong association of C stock with management regime provided in this research is important for policy makers who need to make informed choice of management regime for the multiple benefits including C revenue among others.

Thirdly, the incentive payments based on most of the global opportunity cost estimates are likely to be insufficient for effective emissions reductions in the landscape. The resource managers are expected to switch alternative land use options that provide higher return than from REDD+ incentive. Policy makers, therefore, need to be cautious when using current global estimates and values to design any sub-national REDD+ framework and budget for the landscape.

6.1.2 Research Contributions

While deforestation and forest degradation are considered to be intertwined phenomenon, the latter is rarely integrated with deforestation research. Forest degradation is an important component of REDD+ and should be reported because it can contribute substantially to forest carbon emissions. We developed a synthesized econometric model of deforestation and forest degradation to understand the causes of both problems. For researchers, the study is expected to initiate fresh discussion on the under-researched topic of forest degradation with its intertwined relationship with deforestation. Practically, identification of important drivers of deforestation and forest degradation is the first key step to implement proposed incentive mechanism to mitigate climate change. The results highlighted the drivers of deforestation and forest degradation in the TAL which will provide an evidence-base for REDD+ policy formulation in the tropics in general and in the Terai Arc Landscape, Nepal in particular.

Prior to this study, limited evidence was provided about the impact of forest management regimes on C stock or density. The research found that stocking of the C was highly correlated with degree of enforcement of forest protection activities as observed in different forest management regimes of TAL. The effect of forest management regimes on forest degradation in terms of C stock demonstrated in this study is particularly an interest of forest policy makers in the milieu of designing REDD+. The research also suggested cautious use of biome average data of C stock to estimate opportunity cost of emission reduction

because those values may not represent the actual stocking of C. It enforced the importance of site-and-forest type specific studies to derive more realistic estimate of C stock and emissions from deforestation and forest degradation at local as well as global scale.

There is no single numerical value of opportunity cost of emissions reduction for the entire world, because costs vary substantially from place to place as the economic and agro-ecological circumstances differ. The study emphasized that a C price over US$ 8.95 per Mg of CO_2e will makes it worthwhile to participate in REDD+ for the TAL. Incentive payments based on most earlier global opportunity cost estimates are likely to be insufficient for effective emissions reductions in the landscape.

6.2 Limitations and directions for further research

Data constraints are very often a limiting factor especially in forest degradation research. This study also experienced limitations of time series, district disaggregated data for some variables. In this study, I could not include a GDP variable in the deforestation analysis and forest fire in the degradation analysis because of lack of historic data for the districts. Inclusion of these variables would provide a more comprehensive picture of drivers of deforestation and forest degradation on the Terai Arc landscape. The impact of other management activities (i.e.; prevention of forest fire, silvicultural activities, and other biotic factors) practiced within the management regimes on C stock should also not be overlooked and needs further research.

In this study, I used root: shoot ratio to calculate BGB C stock in BGB pool. I did not find any evidence of direct measurement of BGB carbon in similar forest types to compare our estimates. Considering the substantial percentage share of this pool in total carbon stock, BGB carbon warrants greater research attention. Finally, this study attempted to include the widely neglected component - forest degradation, but the "+" part of REDD+; '*role of conservation, enhancement of forest carbon stocks and sustainable management of forests*' is still excluded. Comprehensive assessment including all components of REDD+ is matter for future research.