Ministry of Forests and Soil Conservation
REDD Implementation Centre

Develop National Database of Basic Attributes of all Forest Management Regimes and Develop National REDD+ Information System or Registry

Contract No: (FCPF/REDD/S/QCBS-24)

Technical Working Document n. 2 to Final Report

A quick analysis of Carbon Emissions Reference Level data produced by CAMCO Services in the framework of FCPF programme carried out by the REDD+ Implementation Center (MoFSC, Nepal)

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1. Foreword

The Final Report of the Project "Development of a REDD+ Forest Reference Level in Nepal - Methodological Steps and Presentation of the Forest Reference Level" developed by CAMCO Services was released by the REDD+ Forestry and Climate Change Cell (MoFSC, Nepal).

In view of the contiguity with past (MRV) and present (NFD-NFIS) forest related Projects carried out by Agriconsulting, Italy in Nepal, the author took the opportunity to carry out of a quick appraisal of the Carbon emissions scenarios presented by the RL Project, in order to contribute to the existing knowledge on REDD+ activities in Nepal.

The analyses presented here are very preliminary, being based only on the RL final report. More detailed analyses based on statistical and geo-referenced databases produced by RL Project can be prepared in future, as more data become available.

2. Executive Summary

The main findings extracted from RL Report are the following.

Forest state

The forest cover area of Nepal is estimated by RL Project at **5,786,452** hectares for the reference year 2010 and in substantial accordance (97%) with FRA Nepal data, which estimates the forest area of the country at **5,962,000** ha (source FRA Nepal web site, public) for the same reference year.

Forest change

Regarding the forest area change, the RL study measured an overall increase of the forest area of Nepal between years 2000 and 2010. According to RL data the forest cover of Nepal in year 2000 was 5,338,709 and increased to 5,786,452 hectares in 2010, with an increase of 444,743 hectares in 10 years, and an average annual growth of nearly 45,000 hectare per year equalling + 0.84% per year

However a closer look at the transition matrices for the whole country produced by the RL Project suggests that the area change above is not deriving from a stable increase of forest cover but rather from a combination of positive and negative processes related to forest dynamics in Nepal.

Negative changes

It was estimated that 84% of forest area of year 2000 remained stable in 2010, while 16% has been deforested, and the major land cover transition was from forest to crop land (11%) and to grassland (4%). The total negative change for the period was equal to -847,616 hectares (- 1.6 % per year).

Positive changes

However, during the same period also an increase of forest cover (afforestation / reforestation) was registered, totalling +1,295,359 ha.

The most important positive transitions to forest area were from cropland (17%) and from grassland to forests (6.5%). The total increase of forest area between 2000-2010 was of nearly 1.3 Million hectares or 130,000 hectares per year (+2.4%)

Net area changes

Combining the reported negative and positive forest are changes the results report an annual increase of around +45,000 hectares every year (+0.84%) for the whole country.

Summarizing, according to the RL Project findings, the dynamics of forest cover changes in Nepal are quite complex, including both deforestation and afforestation/reforestation, with the latter prevailing, and the net balance is positive, showing a net increase of forest cover between 2000-2010 of +44,774.3 hectares per year (+ 0.8% per year).

Carbon emissions and removals assessment

In spite of the increase of forest cover the overall CO2 emissions due to forests show a predominance of carbon emissions over carbon removals.

In particular CO2 emissions over the 2000-2010 period totalled 29.3.Million tons per year, while removals equalled 8.6 million ton per year, and the corresponding net emissions balance was estimated at 20.7 Million tons per year.

Regarding the emissions, the majority are related to forest degradation (92%), while only 8% was attributed to deforestation.

For Carbon removals, the majority was attributed to forest enhancement (91 %) and 9% to reforestation.

Such data, in particular the massive predominance of forest degradation vs. deforestation and the magnitude of the removals should be crosschecked and validated to the extent possible.

Suggestions for Data validation

As anticipated the analyses presented here are based on partial RL data currently available.

Further data for consistency checking and validation should include before deriving conclusions from the RL Report:

1. More detailed transition matrices, using RL data, at Region/District level.
2. Spatial (GIS) land cover change maps at Region/District level.
3. Crosschecking and comparison with spatial and statistical data produced by FRA Nepal (currently not available to NFD/NFIS Project at the moment). In particular FRA Nepal produced an independent assessment of forest cover change of Nepal between 1995-2010, which can be very useful for validating the RL Project data.

4. Crosschecking and comparision with spatial and statistical data produced for Terai by Terai Arc Landscape Project.

Linkages with NFD/NFIS and forest management regimes

Approximately there is a 23% of CO2 sequestration from forests due to reforestation and forest enhancement.

It is very likely that this amount of carbon sequestration is linked to the on-going Government support of Community Based Forest Mangement Regimes (especially CFUGs).

At present the NFD-NFIS Project is developing a National database including all CBFM regimes. In will be then possible to correlate forest emissions (and removals) with CBFM regimes and to determine their contributions to avoided emissions and removals.

From the potential carbon credits point of view the estimated benefits, using the preliminary figures above of 8.6 Million tons of CO2 being fixed annually in Nepal as a result of reforestation and forest enhancement, and using a conservative estimate of 5 USD per ton of avoided CO2 emission, the amount of avoided emission would be worth 43 Million USD per year. Of course this a cumulative amount and should be carefully verified and more precisely correlated with incremental annual removals, but the magnitude of the phenomenon, if confirmed, could greatly contribute, through REDD+ mechanisms, to the economic, environmental and social benefits of the on-going forestry policies.

3. Summary of activity data 2000 – 2010 - Wall to wall change matrix 2000 to 2010.

Areas in hectares

Year 2010	Year 2000							Negative changes of forest land		
	Forest land	Crop land	Settlements	Grassland	Wetlands	Other land	Total 2000	Total	Annual	Perc.
Forest land	4,491,093	608,837	1,459	209,685	938	26,697	**5,338,709**	**- 847,616**	**-84,762**	**-1.6%**
Crop land	906,246	2,872,378	16,782	170,032	0	73,070	4,038,508			
Settlements	775	23,072	23,479	383	0	1,032	48,741			
Grassland	348,807	251,554	1,180	1,842,372	0	75,083	2,518,996			
Wetlands	16	1,176	21	66	70,938	124	72,341			
Other land	39,515	100,263	356	56,052	4,188	2,526,066	2,726,440			
Total 2010	**5,786,452**	3,857,280	43,277	2,278,590	76,064	2,702,072	14,743,735			

Positive changes (FL)	**+1,295,359**
Annual change	**+129,536**
Annual perc.	**+2.4%**
Net Total forest land change 2000-2010	**+447,743.0**
Net Total annual change	**+44,774.3**
Net Perc. annual change	**+0.8%**

From the transition matrix above, the following considerations can be made:

According to the data produced by the RL Project:

The forest cover area of Nepal is estimated by RL Project is **5,786,452** hectares for the reference year 2010 and in substantial accordance (97%) with FRA Nepal data, which estimates the forest area of the country at **5,962,000** ha (source FRA web site, public).

In spite of the use of two different satellite/sensors (Rapid Eye vs. Landsat) and methodologies, both Projects came to a similar conclusion of Nepal having a forest cover around 40% of the total country land, which is also in line with the objectives declared by the Government to maintain at least forest cover of 40% (see corresponding forest policy acts).

Regarding the forest area change, the RL study measured an overall increase of the forest area of Nepal between years 2000 and 2010. According to RL data the forest cover of Nepal in 2010 was 5,786,452 hectares and has increased by 444,743 hectares as compared to year 2000, with an average annual growth of nearly 45,000 hectare per year equalling + 0.84% per year

3.1 Gross forest area change and its dynamics

However a closer look at the transition matrices for the whole country produced by the RL Project suggests the following considerations:

The Gross Change above is not deriving from a stable increase of forest cover but rather from a combination of positive and negative processes regarding forest dynamics in Nepal.

3.2 Negative changes

In particular, the following negative land cover transitions, relative to forest cover 2000 were observed:

From forest area 2000	To:	Area transition (ha)	Percentage transition (percent of forest area 2000)
5,338,709	Stable Forest	4,491,093	84.12%
	Crop land	-608,837	11.40%
	Settlements	-1,459	0.03%
	Grassland	-209,685	3.93%
	Wetlands	-938	0.02%
	Other land	-26,697	0.50%
	Total	-847,616	15.88%

It is estimated that 84% of forest area of year 2000 remained stable in 2010, while 16% has been deforested, and the major land cover transition was to crop land (11%) and to grassland (4%). The total negative change for the period was equal to -847,616 hectares (- 1.6 % per year).

3.3 Positive changes

However, during the same period also an increase of forest cover (afforestation / reforestation) was registered, totalling +1,295,359 ha or around +130,000 (+2.4% per year).

Increase of forests between 2000-2010	Area transition (ha)	Percentage transition (percent of forest area 2000)
Crop land to forest	906,246	17.0%
Settlement to forest	775	0.0%
Grassland to forest	348,807	6.5%
Wetlands to forest	16	0.0%
Other land to forest	39,515	0.7%
Total increase of forests	1,295,359	24.3%

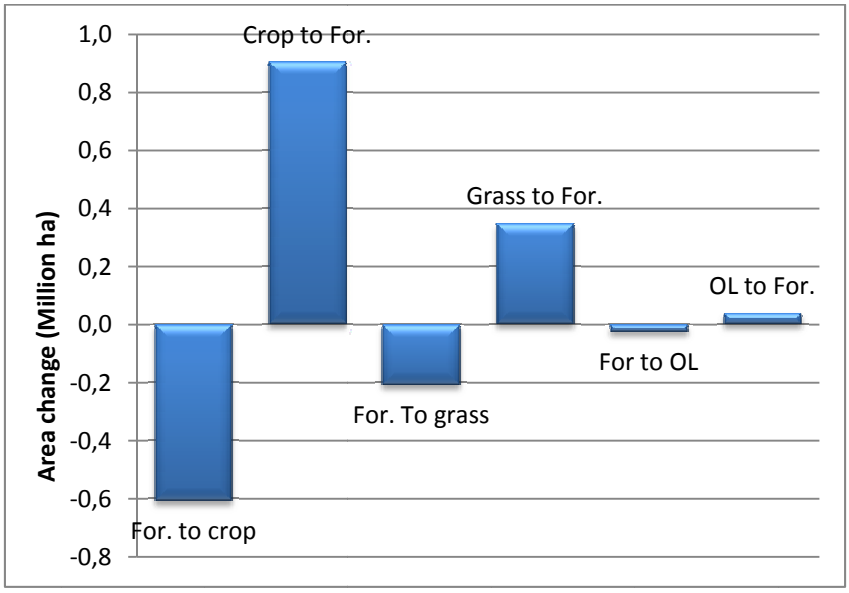
The most important positive transitions to forest area were from cropland (17%) and from grassland to forests (6.5%). The total increase of forest area between 2000-2010 was of nearly 1.3 Million hectares or 130,000 hectares per year (+2.4%)

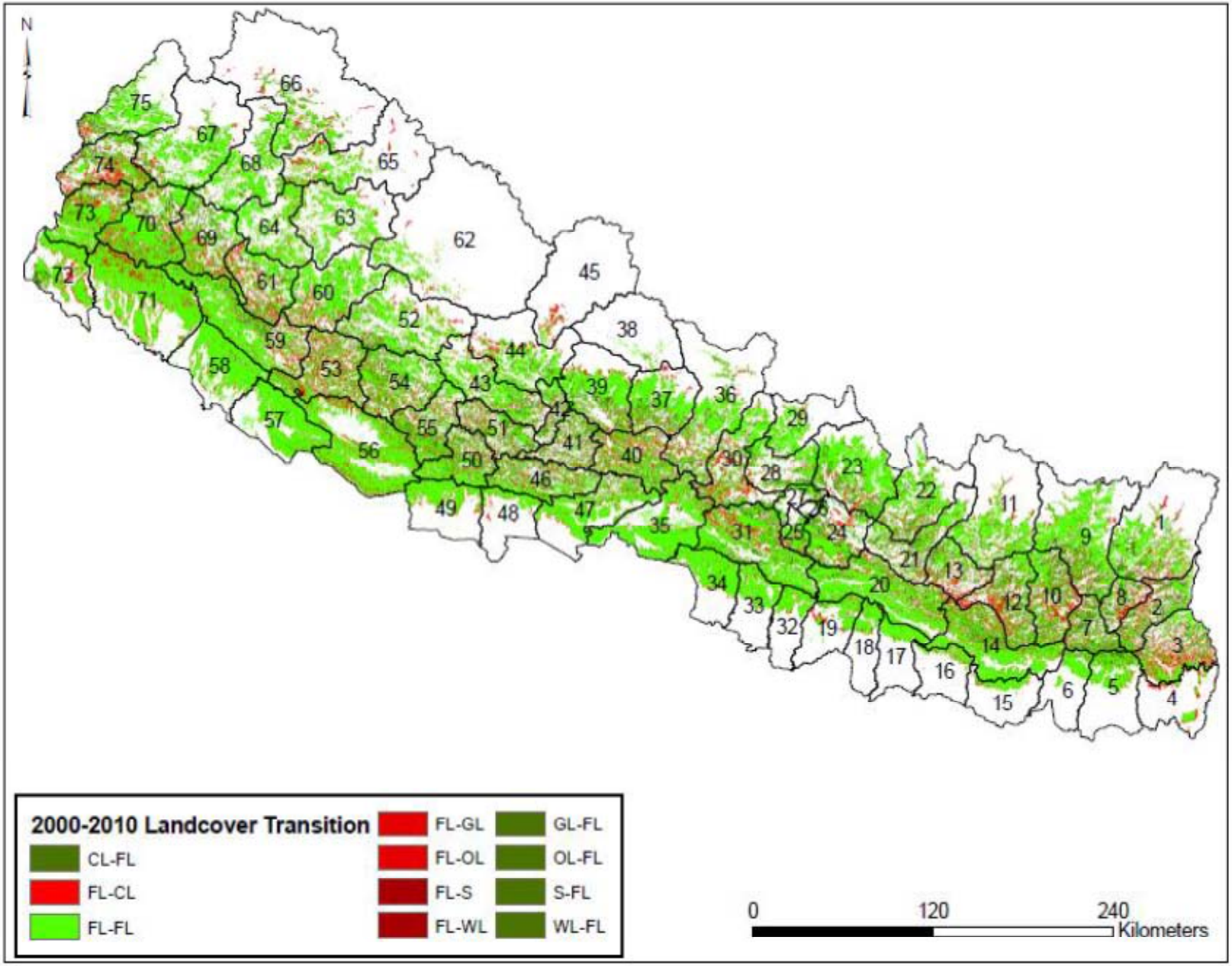
3.4 Net forest area changes

Combining the reported negative and positive forest are changes the results report an annual increase of around +45,000 hectares every year (+0.84%) for the whole country.

Forest area (ha)	2000	2010	Total change (ha)	Annual change (ha)	Annual % change
Nepal	5,338,709	5,786,452	447,743	44,774	0.84%

Summarizing, according to the RL Project findings, the dynamics of forest cover changes in Nepal are quite complex, including both deforestation and afforestation/reforestation, with the latter prevailing, and the net balance is positive, showing a net increase of forest cover between 2000-2010 of , as shown in the next graphic.




N
2000-2010 Landcover Transition
CL-FL
FL-CL
FL-FL
FL-GL
FL-OL
FL-S
FL-WL
GL-FL
OL-FL
S-FL
WL-FL
0
120
240
Kilometers

4. Carbon emissions and removals assessment

The RL Reports also provides Reference CO2 emissions scenarios including the area transitions described above namely

1. Deforestation
2. Afforestation

Complemented by

3. Forest enhancement, and
4. Forest degradation

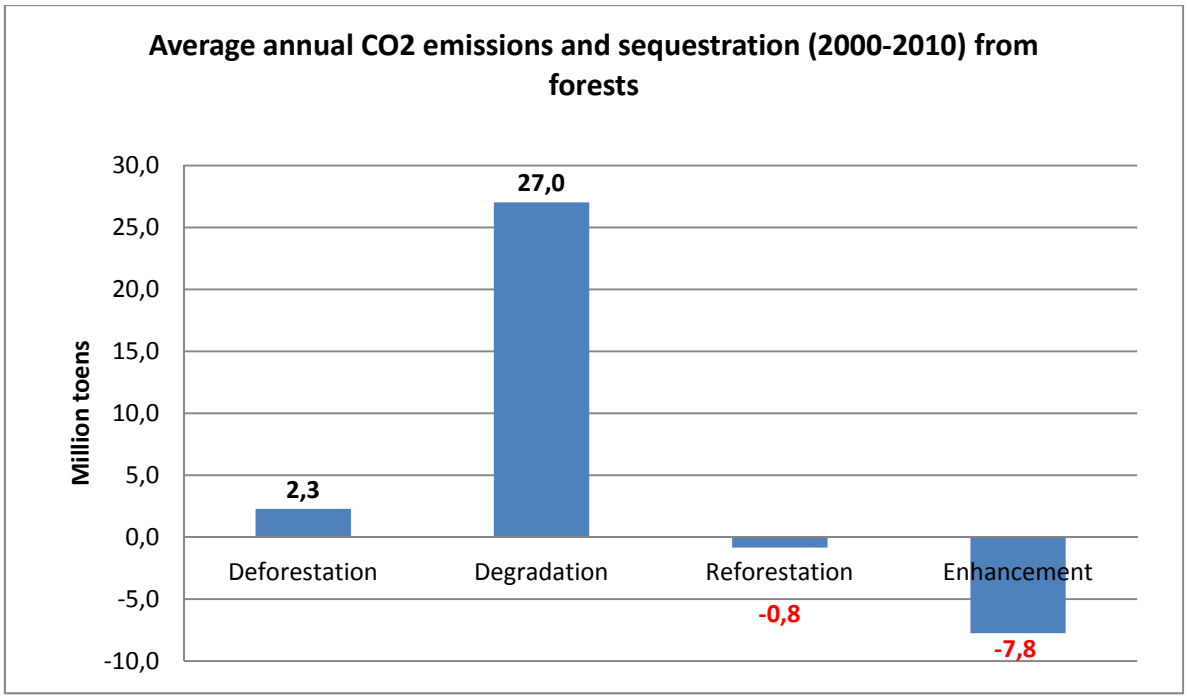
In our preliminary understanding of RL Project data forest enhancement included both the transition from non-forest to forest land as well as the increase in the tree canopy cover. For this purpose three canopy threshold were defined namely 10-40%, 40-70% and 70-100%.

On the contrary forest degradation occurs when a forest remain forest, but its canopy coverage decreases e.g. from 100% to 20%, for instance.

The RL Report provides the parameters and algorithms used for Carbon emissions, under different scenarios, which are not discussed in this simple working document. Only the main findings are presented in the next paragraphs.

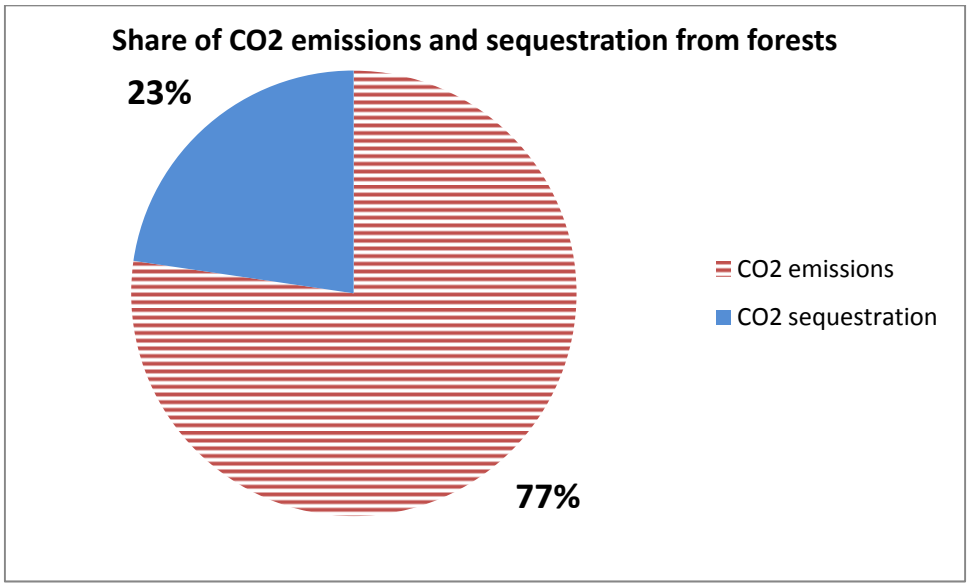
The CO2 emissions associated to forest-related processes according to RL Report are as follows:

CO2 Balance from forest changes	**Process**	**Annual CO2 emissions (million tons)**	**Percentage (%)**
CO2 emissions	Deforestation	2.3	7.9%
	Degradation	27.0	92.1%
Total gross CO2 emissions		**29.3**	**100%**
CO2 sequestration	Reforestation	-0.8	9.3%
	Enhancement	-7.8	90.7
Total gross CO2 removals		**-8.6**	**100%**
Total net emissions		**20.7**	



From the data above it seems that forest degradation play a major role in CO2 emissions with an impact of 92.1% of total gross CO2 emissions, while deforestation accounts for 7.9%. On the contrary reforestation accounts for 9.3% of emissions reduction and forest enhancement for 90.7%.

Simplifying, the loss and gain for CO2 emission from forest processes in a REDD+ perspective, can be summarized as follows:



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5. Suggestions for data validation

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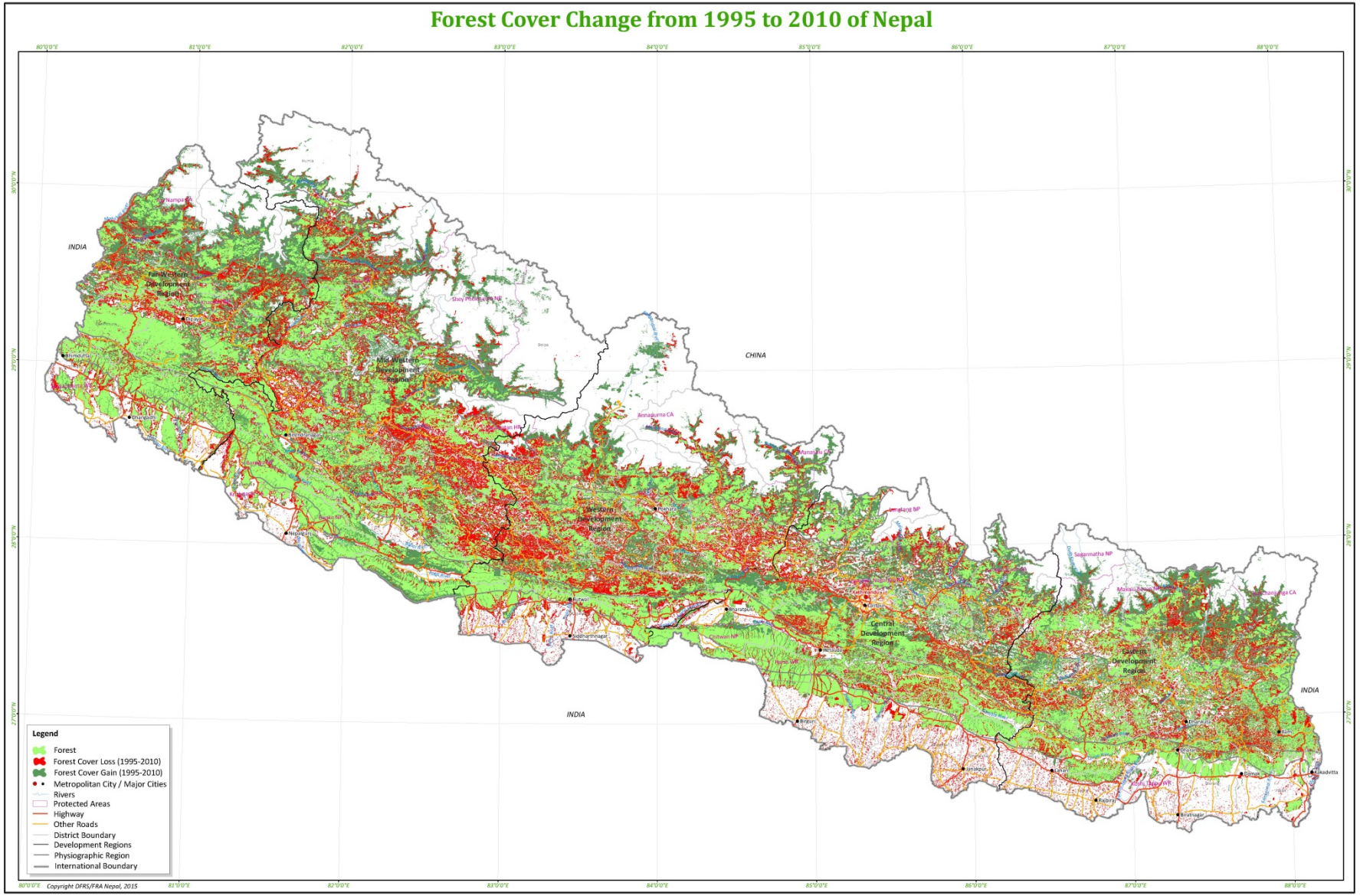
Forest Cover Change from 1995 to 2010 of Nepal
INDIA
CHINA
INDIA
Far Western Development Region
Mid Western Development Region
Western Development Region
Central Development Region
Eastern Development Region
Legend
Forest
Forest Cover Loss (1995-2010)
Forest Cover Gain (1995-2010)
Metropolitan City / Major Cities
Rivers
Protected Areas
Highway
Other Roads
District Boundary
Development Regions
Physiographic Region
International Boundary
Copyright DFRS/FRA Nepal, 2015
GoN/Ministry of Forests and Soil Conservation (MoFSC)
Dept. of Forest Research and Survey (DFRS)
Babarmahal, Kathmandu
Nepal
Ministry for Foreign Affairs of Finland
Forest Resource Assessment (FRA) Nepal Project
Babarmahal, Kathmandu
Nepal
50 25 0 50 100 km
Scale 1:10,00,000
Projection System: Modified UTM 84 Spheroid: Everest 1830 Adjustment 1937
Map Grid: WGS 1984
Note
This Forest Cover Change Map (1995-2010) was prepared by the DFRS/FRA Nepal Project with the support of Ministry for Foreign Affairs of Finland. This change map has been prepared by analysing Land Cover data of National Topographical Map prepared by Survey Department, 2001 and National Forest Cover Data (2010) prepared by FRA Nepal.

6. Linkages with NFD/NFIS and forest management regimes

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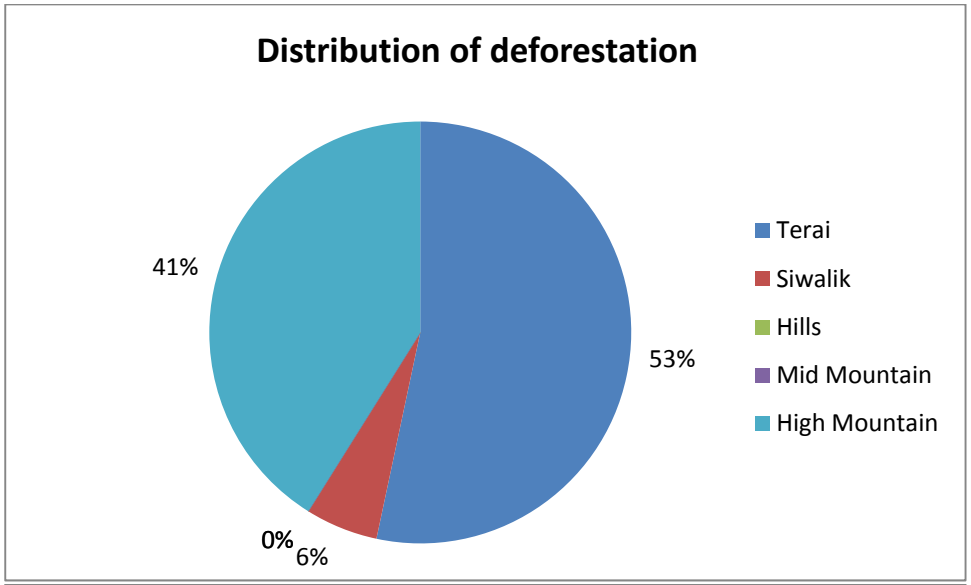
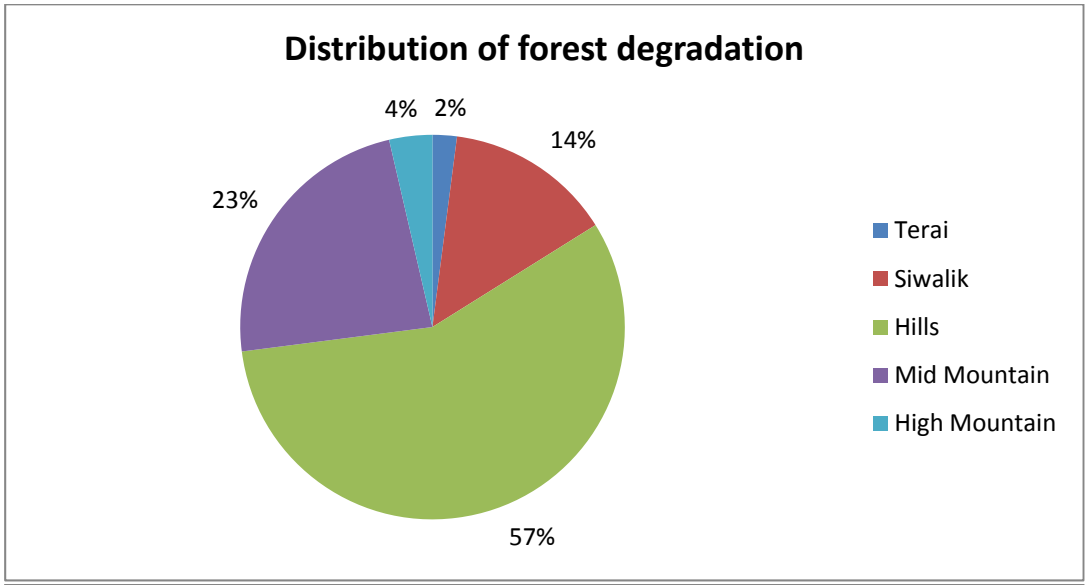
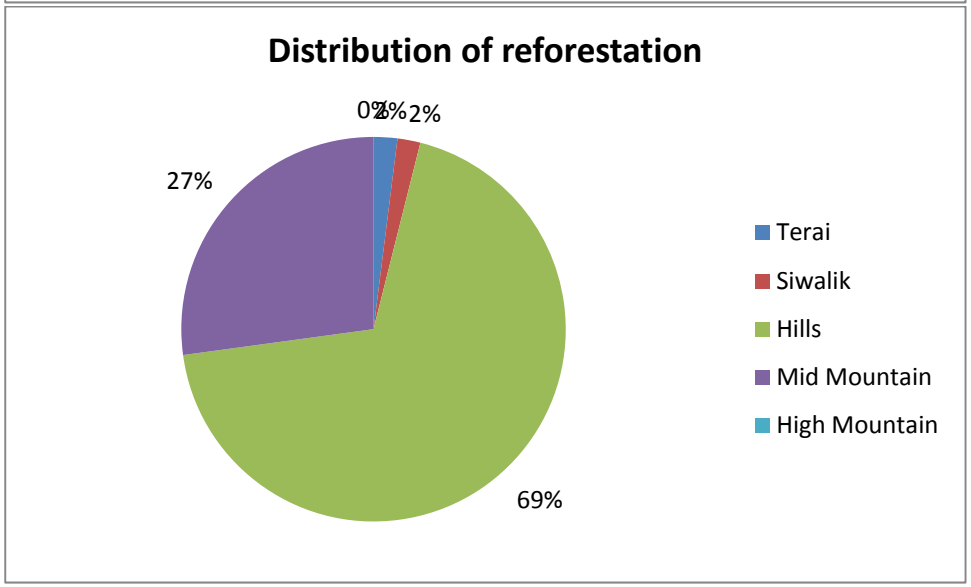
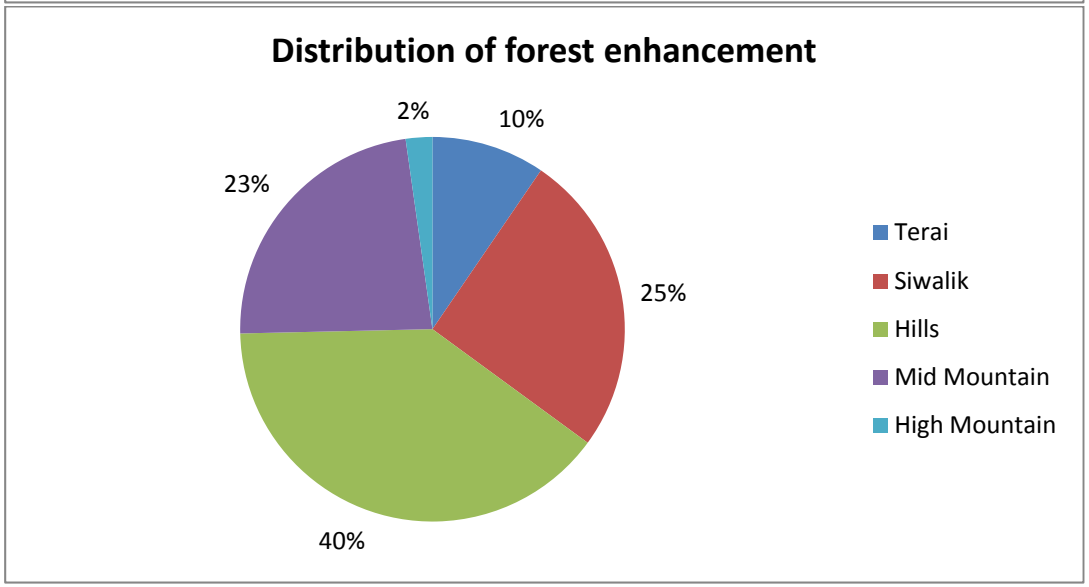
7. CO2 emissions and removals by Physiographic Regions

The RL Report also provides the following breakdown of carbon emissions by prcesses and Physiographic Regions


Distribution of deforestation
41%
53%
0%
6%
Terai
Siwalik
Hills
Mid Mountain
High Mountain


Distribution of forest degradation
4%
2%
14%
23%
57%
Terai
Siwalik
Hills
Mid Mountain
High Mountain


Distribution of reforestation
0%
2%
2%
27%
69%
Terai
Siwalik
Hills
Mid Mountain
High Mountain


Distribution of forest enhancement
2%
10%
23%
25%
40%
Terai
Siwalik
Hills
Mid Mountain
High Mountain

CO2 emissions and removals 2000-2010 (Million tons)

Region	Deforestation	Forest degradation	Reforestation	Enhancement	Net emissions
Terai	12.2	5.5	-0.2	-7.4	10.2
Siwalik	1.3	38.0	-0.2	-19.8	19.3
Hills	0.0	153.8	-5.8	-30.7	117.3
Mid Mountain	0.0	63.3	-2.3	-17.9	43.1
High Mountain	9.4	9.8	0.0	-1.7	17.4
National	**22.9**	**270.4**	**-8.4**	**-77.6**	**207.3**