

Development of Reference Level for REDD+ Result Based Implementation in Vietnam

Vu Tan Phuong

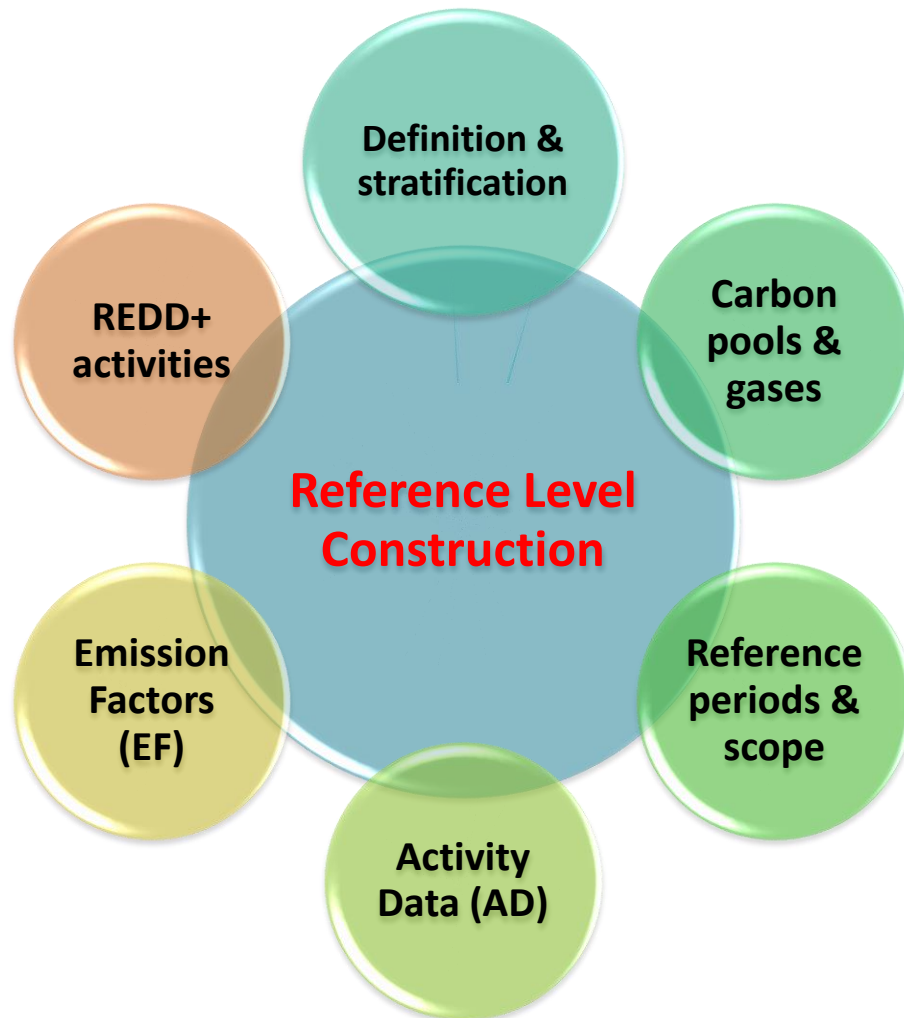
Vietnam Academy of Forest Sciences

Why Reference Level (RL)?

- is a **“benchmark”** to quantify mitigation actions performed...;
- Vietnam is eligible for REDD+
- required by UNFCCC Decision 12/CP.17 as the basic for **result based payment** for REDD+ performance



Requirements for Reference Level



1. Comprehensive & transparent:

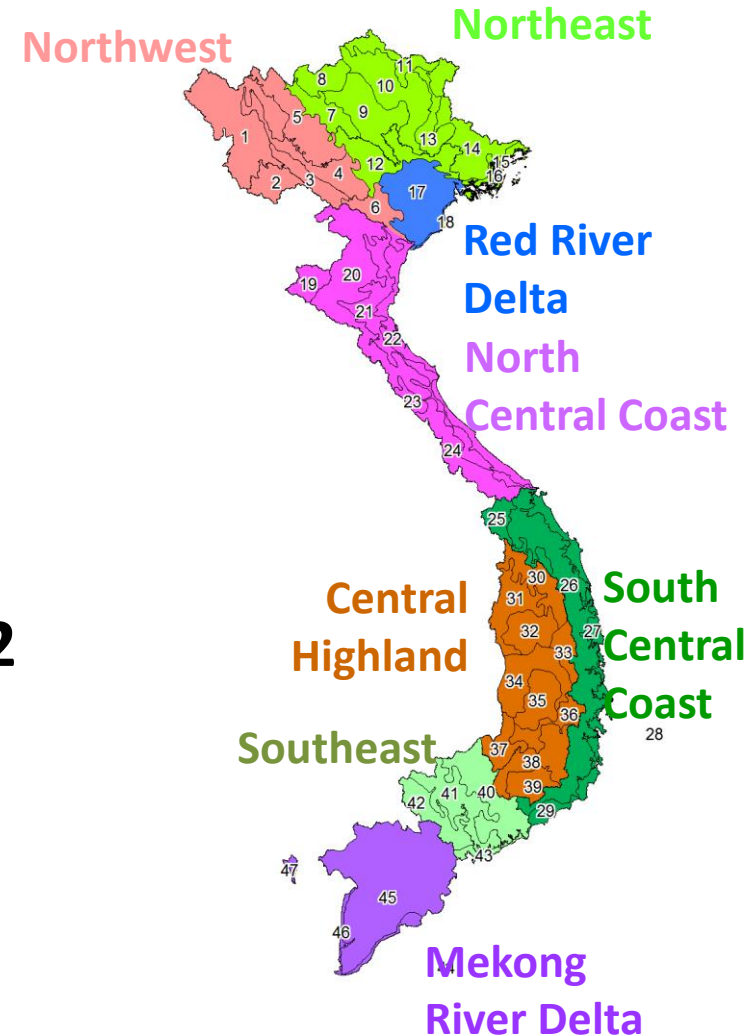
- Historical data
- Methods & models used
- Data accuracy

2. Consistent with national GHG inventory estimates

- Data
- Methods

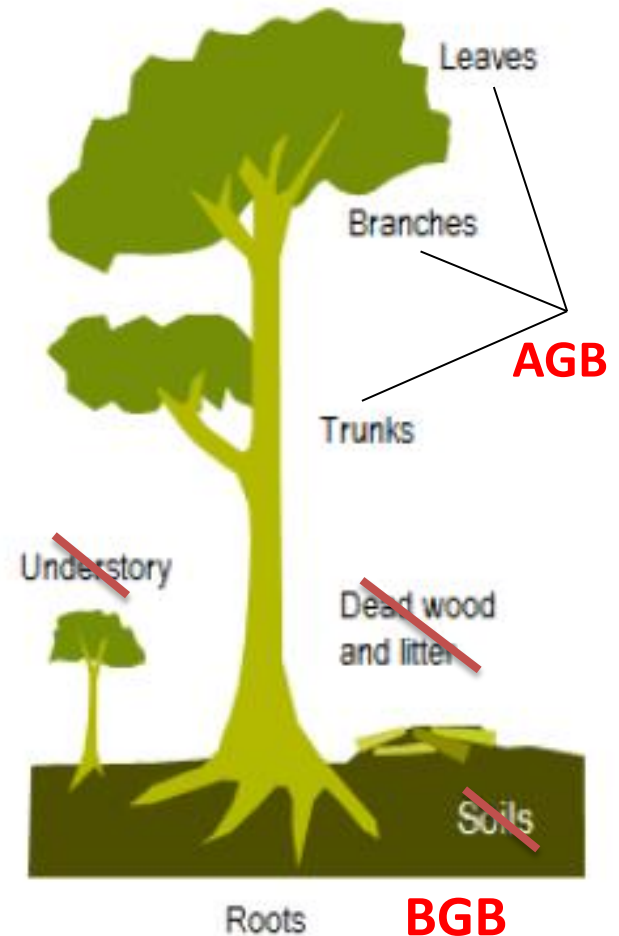
Definitions & Stratification

- **Forests:** is an area meeting all 3 following criteria:
 - **minimum tree height of 5 m;**
 - **minimum tree cover of 10%;**
 - **minimum plot area of 0.5ha;**
- **17 land use categories, of that 12 are forests; 5 are non-forest**
- **8 agro-ecological zones**



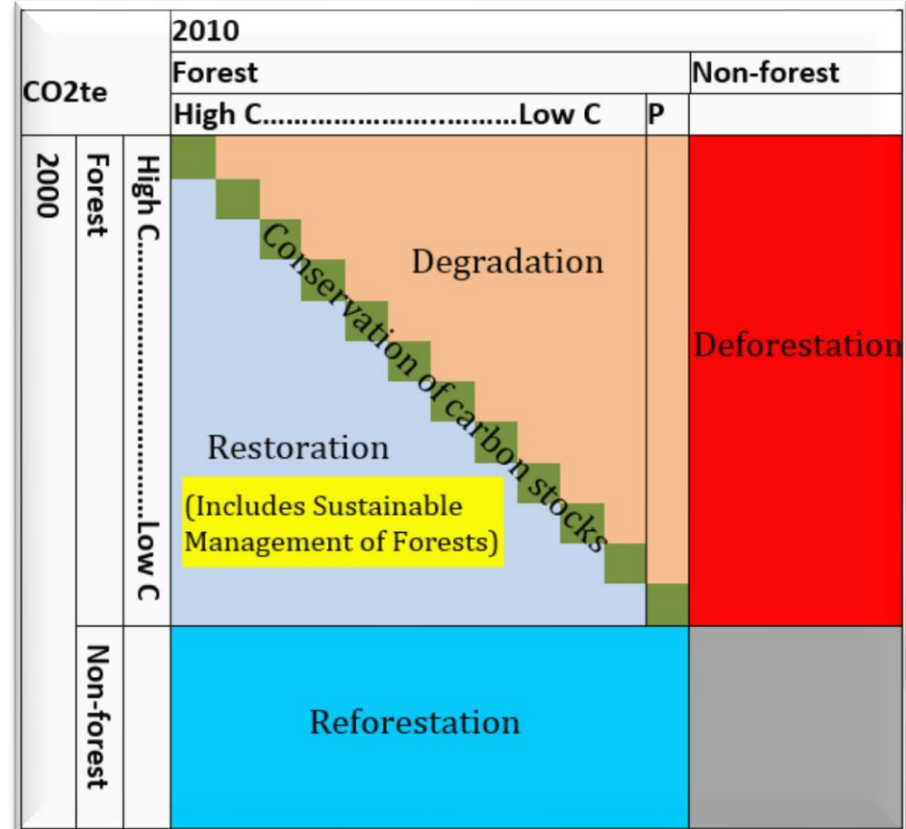
Carbon Pools & Gases

- Carbon pools:
 - Above Ground Biomass - **AGB**
 - Below Ground Biomass - **BGB**
- Gases:
 - Only **CO₂**
 - None-CO₂ not included
- Why not other pools & gases:
 - **AGB & BGB** are significant & changeable by human activities
 - No data available for other pools



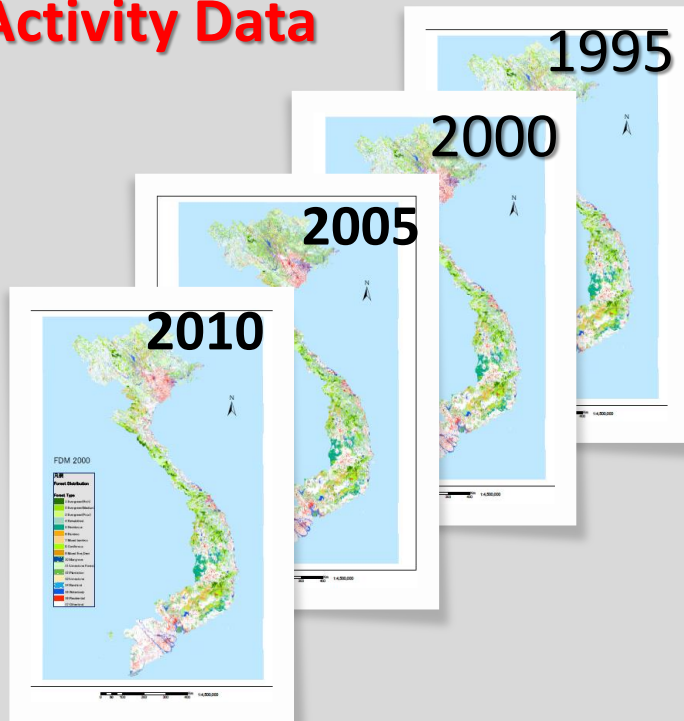
Reference Period & Scope

- 1995-2010
- National level
- All 5 REDD+ activities are included, but reported separately into 2 reference levels:
 - **Forest reference emission level (FREL):** including deforestation & degradation
 - **Forest reference level (FRL):** including reforestation & restoration (ie SMF, Enhancement of forest carbon stock)



Methodology for RL Construction

Activity Data



- 17 categories of LU/LC (12 forest stratum)
- Landsat TM+ , SPOT 4&5



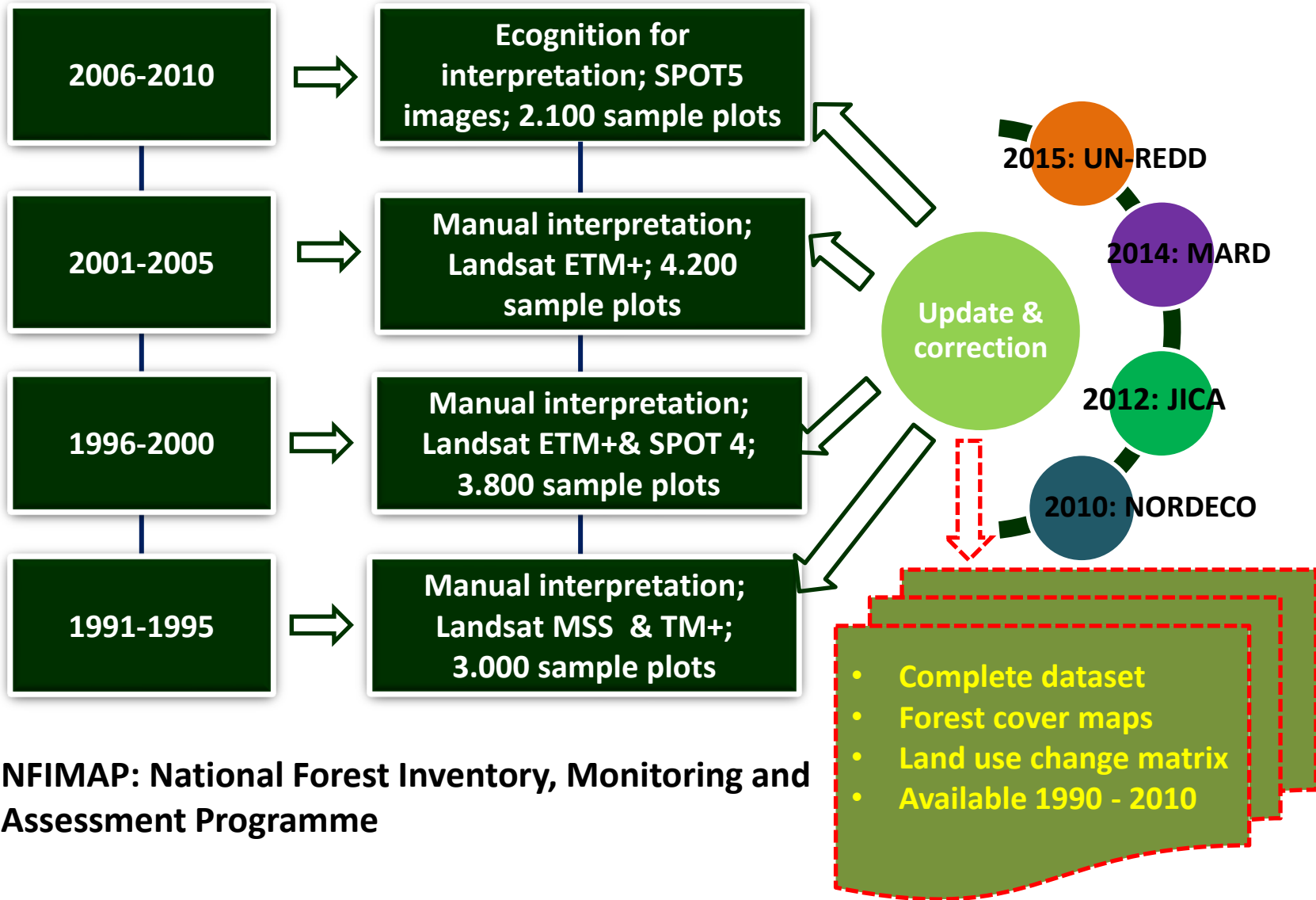
Emission Factor

Forest types	Northwest	Northeast	Northcentral	North highlands	South highlands	Highlands	Southwest	Mekong river delta
Rich Evergreen broad-leaved forest	343.44			306.15	230.44	219.40	295.45	
Medium Evergreen broad-leaved forest	85.15	89.79		136.33	149.99	149.50	180.96	
Poor Evergreen broad-leaved forest	37.25	34.24		81.92	74.18	85.72	75.95	79.34
Restored forest	33.51	20.81		32.85	70.35	86.67	83.04	67.43
Coniferous forest		30.60		65.50	94.04	95.74	180.90	
Broad-leaved and coniferous mixed forest						106.73	179.86	
Rich Dry open forest of Dipterocarps					149.07		226.64	
Medium Dry open forest of Dipterocarps					134.97		175.62	
Poor Dry open forest of Dipterocarps					70.47		77.83	
Restored Poor Dry open forest of Dipterocarps					70.60		39.62	
Bamboo forest	35.97	30.36		83.41	52.60	60.14	63.03	
Primary forest and natural forest								
Mangrove								
Forest on rocky mountains								
Man-made forest	20.79	20.66		11.15	10.46	19.33	4.56	

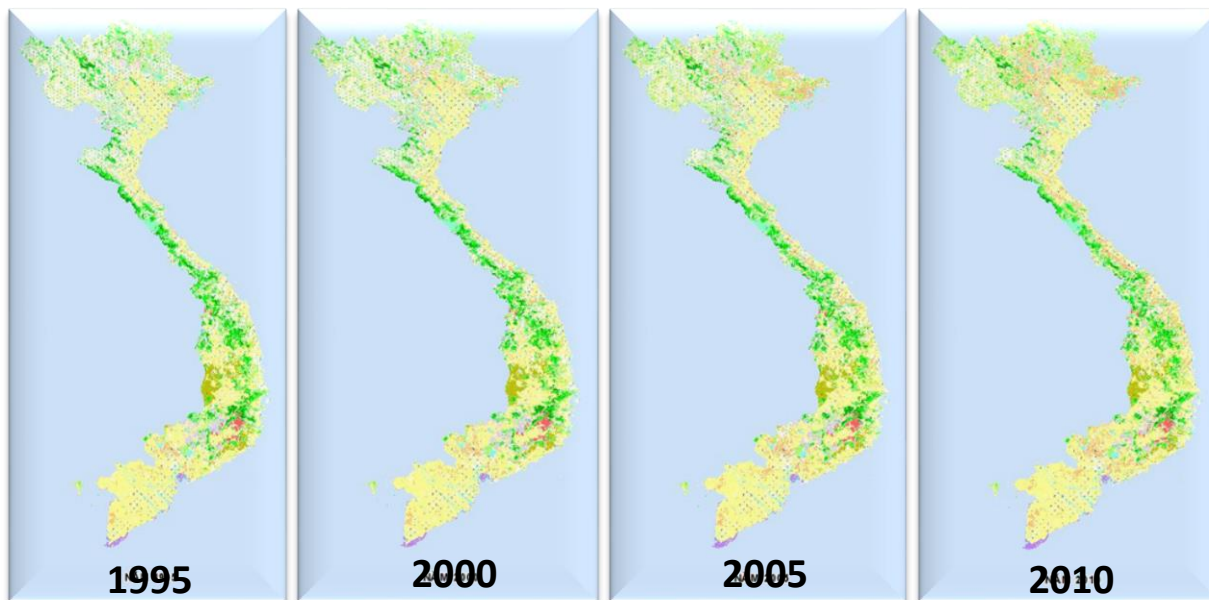
- National AEs
- Sample plots data
- 5 years Interval
- 8km Systematic

Historical Approach
Stock Difference Method

Generating Activity Data



Forest cover maps



Data on forests and land uses

No	Forest and land use category	1995	2000	2005	2010
	Natural area	33,014,931	33,014,983	33,016.827	33,016.827
I	Forest land	11,357,483	11,937,502	12,741.124	13,661.080
1	EGBL - rich	855,650	803,894	692.802	680.968
2	EGBL - medium	2,004,486	1,888,565	1,783.193	1,674.100
3	EGBL - poor	1,918,127	1,785,122	1,621.104	1,581.286
4	EGBL - regrowth	2,398,799	2,699,070	3,282.841	3,653.656
5	Deciduous	751,451	721,690	664.818	645.592
6	Bamboo	526,429	546,702	490.421	440.682
7	Mixed woody - bamboo	733,989	750,661	751.415	748.141
8	Coniferous	171,646	176,502	164.188	162.427
9	Mixed broadleaf - coniferous	63,846	55,981	54.011	52.723
10	Mangroves	198,822	178,223	133.989	141.941
11	Limestone forest	739,917	749,096	758.861	757.312
12	Plantations	994,320	1,581,996	2,343.481	3,122.254
II	Bared land	7,979,314	7,263,586	6,248.637	4,892.711
13	Limestone without forest	231,658	224,148	206.902	204.599
14	Other bared land	7,747,657	7,039,438	6,041.735	4,688.112
III	Agriculture and others	13,678,133	13,813,895	14,027.066	14,463.036
15	Water bodies	823,781	846,082	851.020	869.873
16	Residence	1,498,236	1,568,851	1,668.871	1,797.651
17	Other land	11,356,116	11,398,962	11,507.175	11,795.512

Land use change matrices

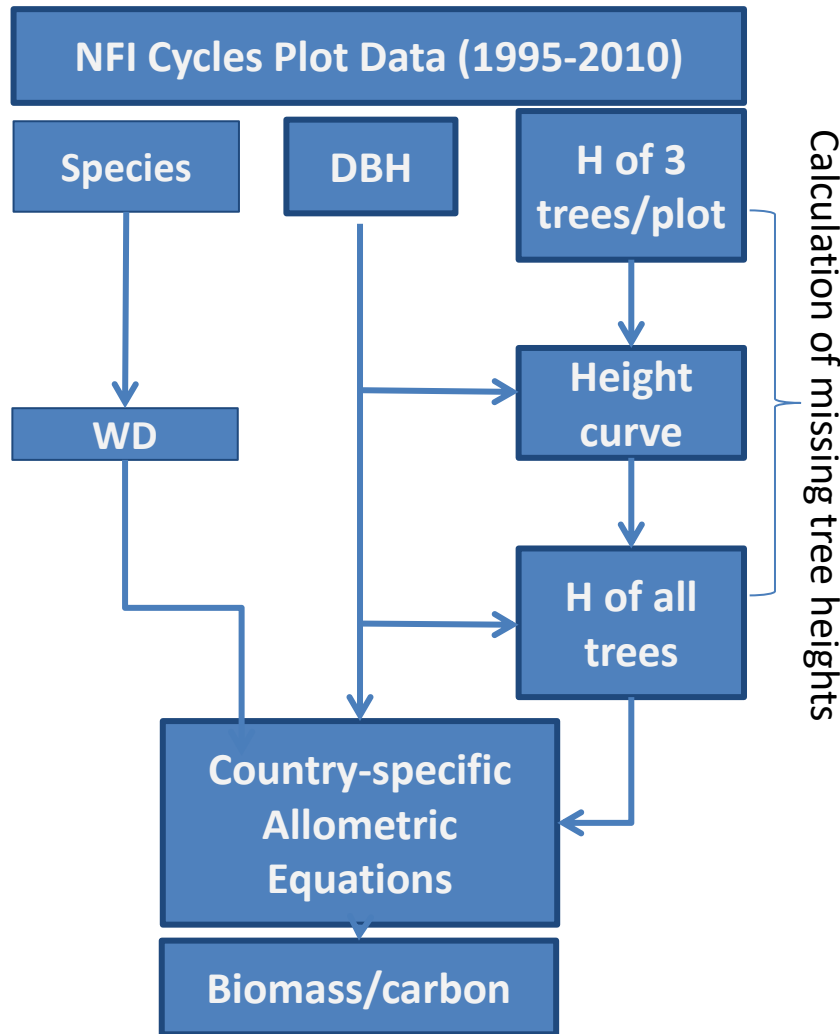
		Year 2000																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total	
Year 1995	1	713	104	17	11	0	2	2	0	0	0	0	0	0	0	0	0	0	6	855
	2	83	1,619	143	86	0	5	10	0	0	0	0	0	1	0	49	0	0	7	2,004
	3	3	131	1,421	174	0	8	19	0	0	0	0	0	7	0	133	0	0	21	1,918
	4	2	17	168	1,814	0	16	19	0	0	0	0	0	31	0	272	1	0	58	2,399
	5	0	0	0	0	709	0	0	0	0	0	0	0	0	0	24	3	0	15	751
	6	1	2	2	13	0	391	41	0	0	0	0	0	2	0	37	1	0	36	526
	7	1	4	11	29	0	19	619	0	0	0	0	0	2	0	21	0	0	28	734
	8	0	0	0	0	0	0	0	168	1	0	0	0	0	0	1	0	0	1	172
	9	0	0	0	2	0	0	0	6	83	0	0	0	1	0	1	0	0	1	64
	10	0	0	0	0	0	0	0	0	0	164	0	2	0	0	0	0	0	33	199
	11	0	0	0	0	0	0	0	0	0	0	736	0	2	1	0	0	0	0	740
	12	0	0	0	2	0	0	0	0	0	0	0	0	877	0	28	0	1	85	994
	13	0	0	0	0	0	0	0	0	0	0	11	0	219	0	0	0	0	1	232
	14	1	10	19	520	8	91	29	2	1	1	1	534	2	6,084	11	17	416	7,748	
	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	813	1	0	8	824
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1,491	3,149
	17	0	2	3	48	3	15	9	0	0	13	0	125	0	378	16	58	10,688	11,256	
Total		804	1,889	1,785	2,699	721	546	750	177	56	178	749	1,582	224	7,039	846	1,569	11,400	33,015	

		Year 2005																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total	
Year 2000	1	626	112	23	12	0	1	2	0	0	0	0	0	0	10	0	0	17	804	
	2	54	1,526	155	88	0	4	17	0	0	0	0	1	0	36	0	0	7	1,889	
	3	6	114	1,267	209	0	6	35	0	0	0	0	13	0	112	0	0	25	1,785	
	4	4	16	136	1,995	0	9	29	0	0	0	0	59	0	377	0	1	73	2,699	
	5	0	0	0	0	657	0	0	0	0	0	0	4	0	28	1	0	30	722	
	6	0	1	2	23	0	373	39	0	0	0	0	12	0	52	0	0	44	547	
	7	0	4	12	41	0	29	584	0	0	0	0	6	0	37	0	0	37	751	
	8	0	0	0	0	0	0	160	0	0	0	0	3	0	11	0	0	1	177	
	9	0	0	0	1	0	0	1	53	0	0	0	0	0	1	0	0	0	56	
	10	0	0	0	0	0	0	0	0	116	0	0	20	0	0	0	0	0	41	178
	11	0	0	0	0	0	0	0	0	0	741	1	2	2	0	0	0	0	2	749
	12	0	0	0	12	0	1	2	0	0	0	0	1,268	0	88	1	5	203	1,582	
	13	0	0	0	0	0	0	0	0	0	0	16	1	203	2	0	0	2	224	
	14	2	10	20	839	4	54	31	2	0	0	1	620	1	4,942	2	20	492	7,039	
	15	0	0	0	0	0	0	0	0	0	1	0	0	0	1	836	2	6	846	
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1,569	8,169
	17	0	2	4	59	2	13	12	0	0	17	0	333	0	343	12	82	10,519	11,399	
Total		693	1,793	1,621	3,282	665	490	792	164	54	134	799	2,343	207	6,042	851	1,669	11,507	33,015	

		Year 2010																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
Year 2005	1	601	48	18	15	0	1	4	0	0	0	0	1	0	4	0	0	0	693
	2	70	1,464	117	70	0	3	19	0	0	0	0	3	0	31	0	0	5	1,783
	3	4	125	1,192	155	0	9	25	0	0	0	0	18	0	69	0	0	22	1,621
	4	4	26	194	2,459	1	12	34	0	1	0	0	62	0	394	0	1	94	3,283
	5	0	0	0	0	640	0	0	0	0	0	0	0	0	16	1	0	6	665
	6	0	1	2	24	0	318	48	0	0	0	0	12	0	40	0	0	44	490
	7	0	2	16	45	0	19	564	0	0	0	0	15	0	39	0	0	50	751
	8	0	0	0	0	0	0	0	163	2	0	0	1	0	1	0	0	5	164
	9	0	0	0	1	0	0	0	3	48	0	0	0	0	1	0	0	1	54
	10	0	0	0	0	0	0	0	0	0	104	0	12	0	0	0	0	18	134
	11	0	0	0	0	0	0	0	0	0	0	755	0	1	1	0	0	0	1,759
	12	0	0	1	4	0	3	1	0	0	2	0	2,076	0	57	1	6	193	2,343
	13	0	0	0	0	0	0	0	0	0	0	1	0	202	1	0	0	2	207
	14	1	6	34	814	3	60	42	3	1	1	1	724	1	3,808	6	29	512	6,042
	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	843	1	6	851
	16	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1,649	15	1,669	
	17	0	1	5	66	2	15	11	2	1	35	0	195	0	224	17	111	10,821	11,507
Total		681	1,674	1,581	3,654	646	441	748	162	53	142	757	3,122	205	4,688	870	1,798	11,796	33,017

- Deforestation
- Forest degradation
- Reforestation
- Restoration

Calculating Emission Factors



AGB: Country-specific data & AEs:

1. Evergreen broadleaf forest:

$$AGB = 0.757 \times (DBH^2 \times H_{mt} \times WD/10)^{0.930}$$

2. Deciduous forests

$$AGB = 310.3 \times (DBH^2 \times H_{mt}/10000)$$

3. Bamboo forests:

$$AGB = 0.0612 \times DBH^{2.0848} \times H^{0.2778}$$

$$AGB = 0.1012 \times DBH^{1.9667} \times H^{0.2778}$$

$$AGB = 0.3558 \times DBH^{1.2154} \times H^{0.2778}$$

$$AGB = 0.2829 \times DBH^{1.4306} \times H^{0.2778}$$

4. Mangrove forest: research data (VAFS)

BGB: Default RS, IPCC 2006

Carbon Fraction: IPCC default (0.47)

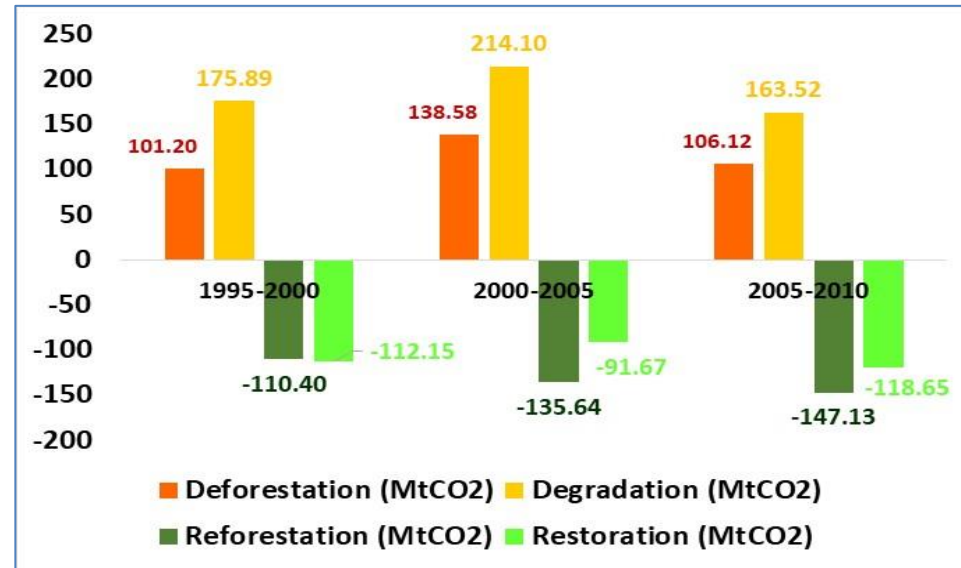
Average Carbon Stock by Forest Types (ton C/ha)

Forest types	1995	2000	2005	2010
1. Evergreen broadleaf – rich	150 ± 4%	152 ± 3%	146 ± 5%	140 ± 3%
2. Evergreen broadleaf – medium	73 ± 1%	73 ± 1%	75 ± 1%	75 ± 1%
3. Evergreen broadleaf – poor	32 ± 3%	32 ± 2%	32 ± 3%	32 ± 3%
4. Evergreen broadleaf – regrowth	32 ± 6%	30 ± 5%	26 ± 5%	26 ± 6%
5. Deciduous	40 ± 14%	36 ± 5%	32 ± 5%	31 ± 8%
6. Bamboos	14 ± 10%	13 ± 9%	13 ± 7%	15 ± 11%
7. Mixed timber – bamboos	50 ± 9%	47 ± 8%	43 ± 8%	42 ± 7%
8. Coniferous	87 ± 18%	72 ± 13%	83 ± 13%	95 ± 11%
9. Mixed broadleaf - coniferous	85 ± 24%	78 ± 16%	84 ± 25%	67 ± 45%
10. Mangrove	58 (*)	58 (*)	58 (*)	58 (*)
11. Limestone forest	36 ± 25%	26 ± 100%	23 ± 27%	19 ± 83%
12. Plantation	20 ± 22%	19 ± 20%	17 ± 11%	16 ± 13%

Estimated Emissions & Removals

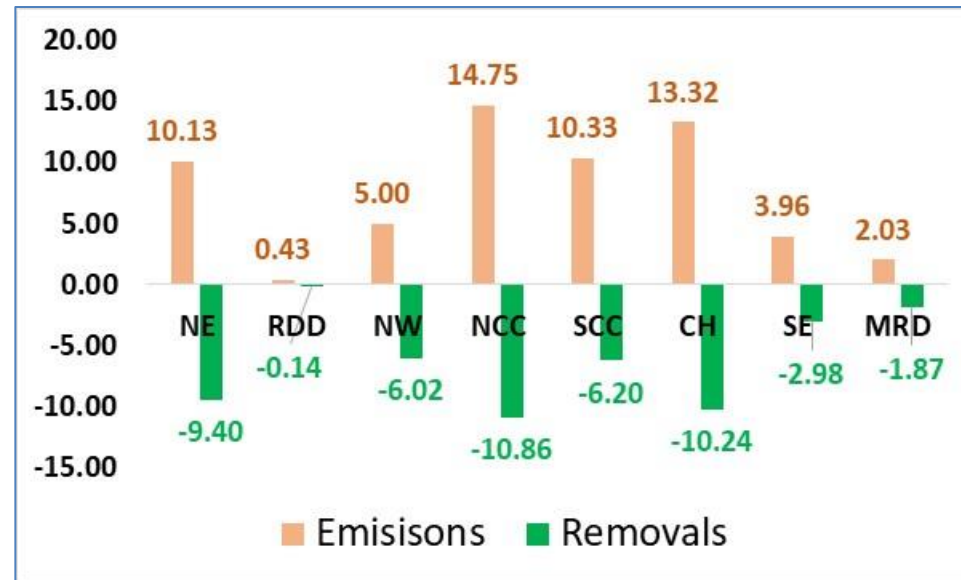
In 1995-2010:

- Total emissions: 899 MtCO₂
- Total removal: -715 MtCO₂
- Net emissions: 184 MtCO₂



National Average:

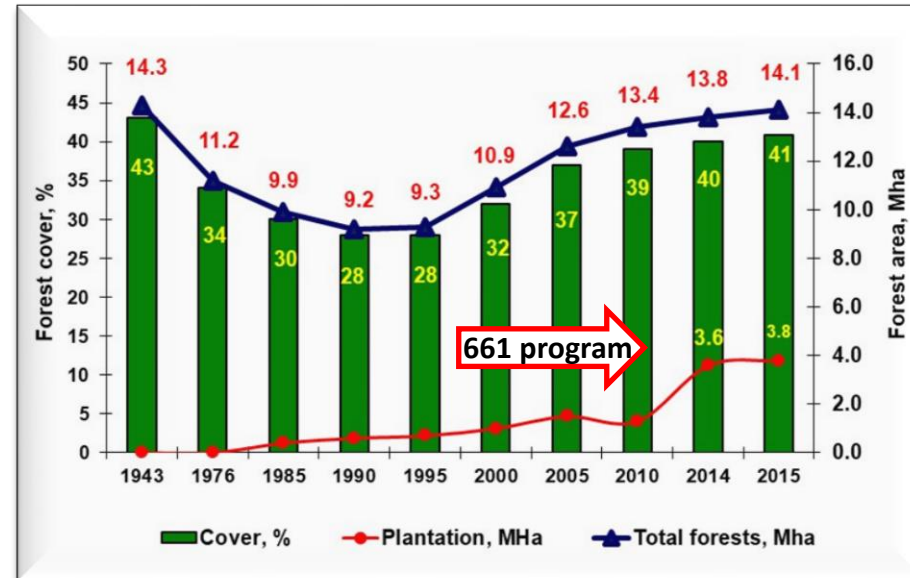
- Emissions/year: 59.9 MtCO₂
- Removals: -47.7 MtCO₂
- Net emissions: 12.2 MtCO₂



Adjustment of Reference Level

National context:

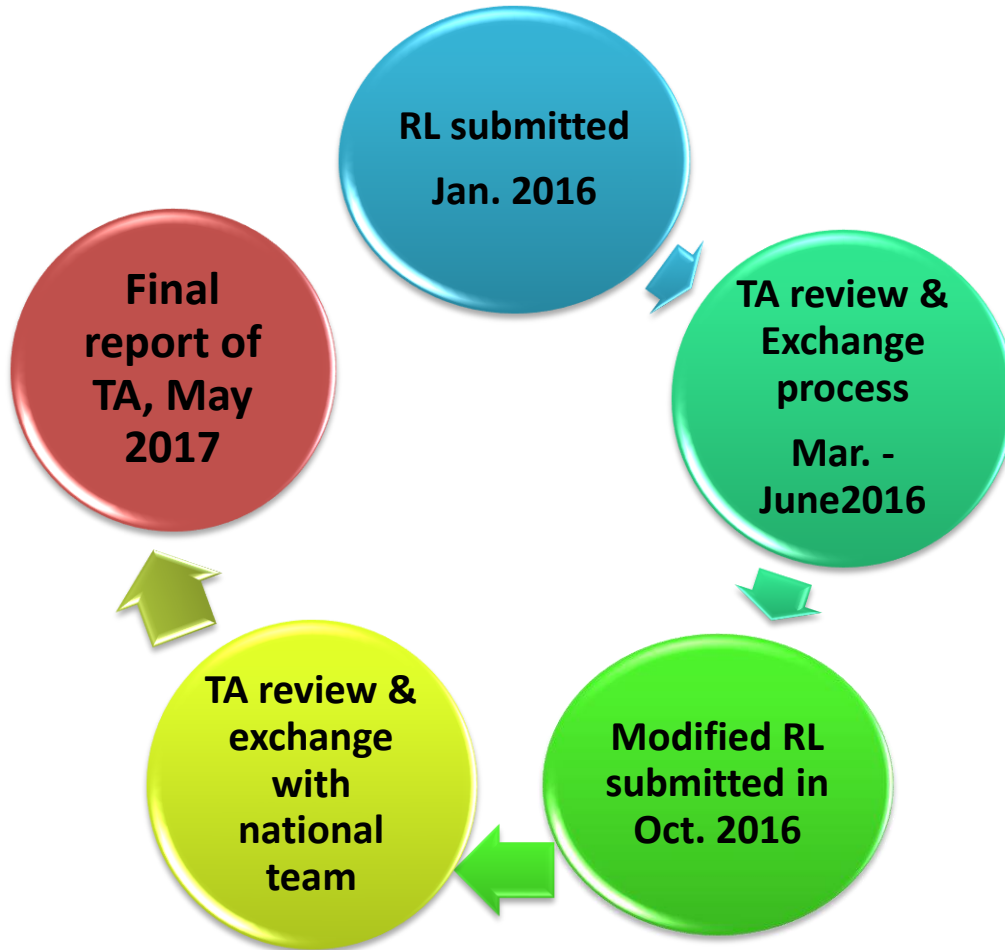
- GoV invested in a national reforestation program (661 program), 1998 -2010
- Increased forest cover from 29% to 39%;
- Therefore removals generated by 661 program should be rewarded and excluded from RL (-122 MtCO₂)



Final Reference Level 1995-2010:

- Average Emissions: 59,960,827 tCO₂/year
- Average Removal with Adj. -39,602,735 tCO₂/year
- Average Removal without Adj.: -47,786,072 tCO₂/year

Technical Assessment by UNFCCC



- **Constructive approach**
- **Exchange & discuss technical issues**
- **By written and video call between National Team and UNFCCC Team**
- **More than 40 questions made to National Team**
- **Require transparency of data used for RL construction**

Future Improvement

1. Improve **consistency** between RL and national GHG Inventory for LULUCF:

- Activity Data (Spatial explicit vs statistics)
- Emission Factors (national vs default)
- Forest Classification & ecological stratification
- Methods for emission accounting (SDM vs GLM)

2. Improve Reference Level:

- Biomass & carbon stock estimation for plantation
- Estimation of removal generated from forest restoration & reforestation (it is overestimated now)
- Consideration of inclusion of other carbon pools (soil, deadwood, litter etc)
- Assess uncertainty of emissions and removal estimation



The Philippines ?
No, it's Halong Bay,
Vietnam 😊

Thank you for your attention

Vu Tan Phuong
Vietnam Academy of Forest Sciences
phuong.vt@vafs.gov.vn



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