FRELs/FRLs support by JICA

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JICA Support on FRELs/FRLs

- **National FRELs/FRLs** (through the REDD+ Study Project)*
- **Provincial FRELs/FRLs** (through the Dien Bien REDD+ Pilot Project)

* Study on Potential Forests and Land Related to Climate Change and Forests

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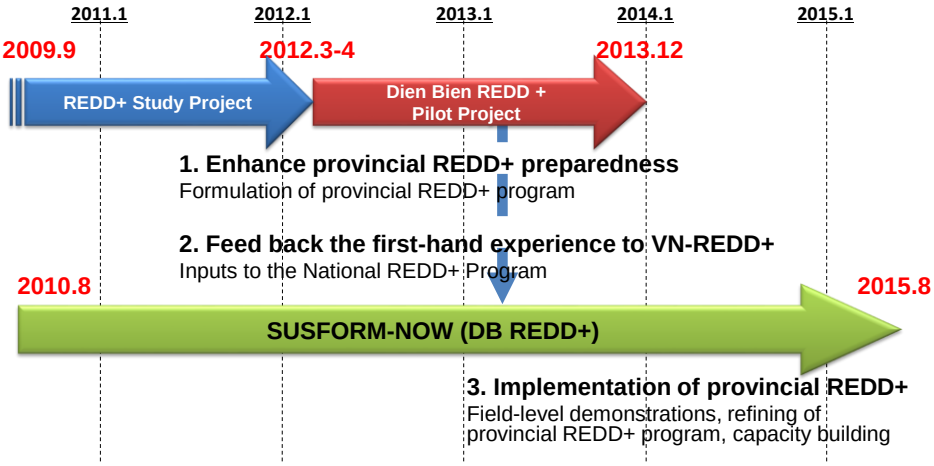
History of Support by JICA



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Definition of RELs/RLs in NRAP

- **The reference emission levels (RELs)** are the amount of greenhouse gases emitted into the atmosphere from deforestation and forest degradation at a certain time period or the baseline reflecting the change of greenhouse gas emission levels at different time periods in the past and predicting the future trends of emission.
- **The forest reference levels (FRLs)** are the amount of emissions from deforestation and forest degradation and the forest sequestration of greenhouse gases as the results of forest conservation, forest management before and during implementation of REDD+ activities.

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National FRELs/FRLs

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National FRELs/FRLs

- by the REDD+ Study Project (9/2009-3/2012)
- Preparation of:
  - Activity data (national scale)
  - Emission factor (by bio-eco-region and forest type)
  - Carbon stock estimation
- Development of national FRELs/FRLs

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Activity Data (National Scale)

The following were prepared:

- **Forest status maps**: 5 time points
  (1990, 1995, 2000, 2005, 2010)
  Based on FIPI maps corrected with Landsat, SPOT, ALOS, and ASTER data
- **Forest change data (forest change matrix)**:
  4 time periods
  (1990-1995, 1995-2000, 2000-2005, 2005-2010)

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Activity Data (National Scale)

Data standardization was required for:

- Data formats = Digitization (for 1990)
- Map projections (VN2000 vs. UTM)
- Base satellite images (different resolutions)
- Forest definitions (Dec.84 vs. Cir.34)
- Forest classifications
- Missing data (for certain geographical areas)

→ Internal and external verifications

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Activity Data (National Scale)

Uncertainty:

- Verification method different for 2010 data and others
- For 2010, ground truth was undertaken:
  - Forest vs. Non-forest: 94.5%
  - Forest types: 80%
  - Forest types (among evergreen types): 74%
- For others, third party verification was undertaken:
  - Forest vs. Non-forest (w/ Landsat): 90%
  - Forest vs. Non-forest (w/ SPOT): 95%

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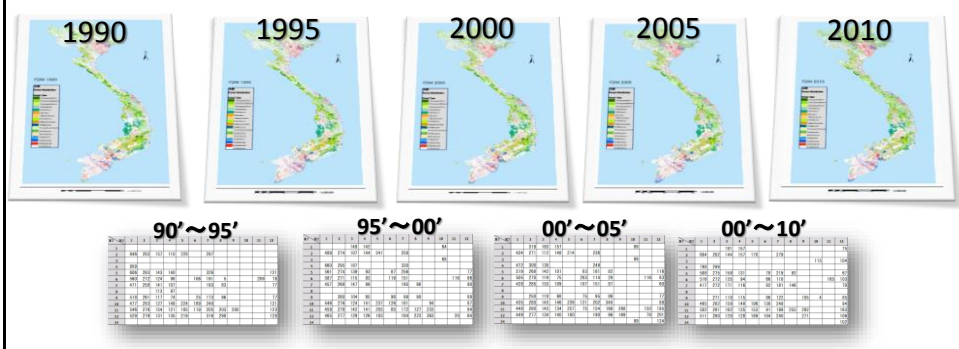
Activity Data (National Scale)

OUTPUTS



- 5 forest status maps
  - 17 land use categories (incl. 12 forest types)
  - 3 categories of evergreen forest (rich, medium, poor)
- Forest change matrixes

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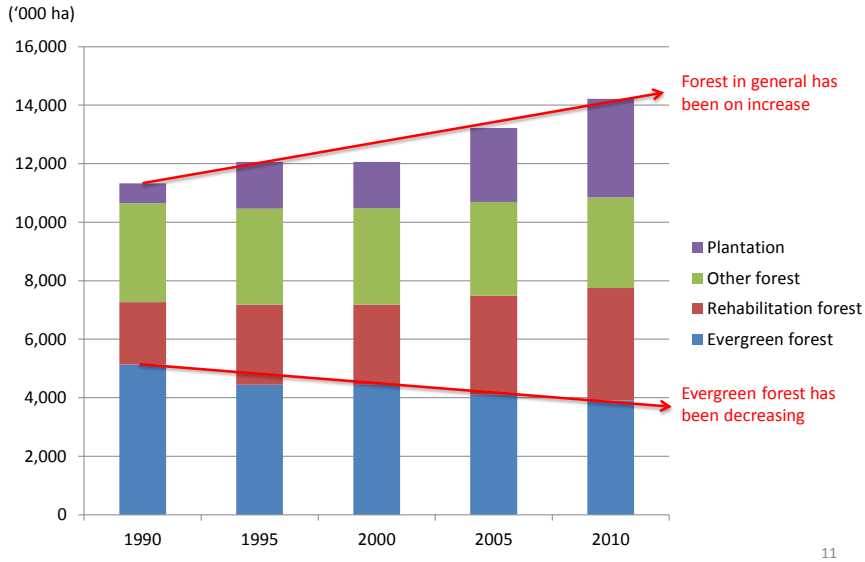
Forest Area Change in Viet Nam



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Forest Change Matrix

Forest Type (2000)

Forest Type (1990)

Year 1990	Evergreen broadleaf forest, rich forest	Evergreen broadleaf forest, medium forest	Evergreen broadleaf forest, poor forest	Evergreen broadleaf forest, rehabilitation forest	Deciduous forest	Bamboo forest	Mixed timber and bamboo forest	Coniferous forest	Mixed broadleaf and coniferous forest	Mangrove forest	Limestone forest	Plantation	Limestone area (no forest)	Bare land, shub land, fragmented trees	Water body	Residential area	Other land	Grand Total
Evergreen broadleaf forest, rich forest	33,891	8,241	6,470	1,874	100	897	1,640	0	222	0	0	2	0	2,108	5	17	2,565	48,033
Evergreen broadleaf forest, medium forest	8,415	23,456	1,803	2,673	158	1,135	3,193	0	0	0	0	131	0	4,272	19	1,183	31,171	77,316
Evergreen broadleaf forest, poor forest	1,184	22,034	59,310	11,500	1,054	1,003	7,417	0	8	0	0	1,466	0	11,774	223	652	28,435	140,375
Evergreen broadleaf forest, rehabilitation forest	348	2,734	13,117	3,893	69	886	9,182	0	229	0	0	2,555	0	5,539	20	255	17,148	55,971
Deciduous forest	74	324	718	959	33,140	0	0	0	0	0	0	0	0	5,316	45	701	14,463	69,744
Bamboo forest	6	253	477	2,812	1	4,772	9,865	0	0	0	0	0	0	2,413	5	11	1,495	23,623
Mixed timber and bamboo forest	357	7,373	8,990	7,321	7	3,558	37,204	0	1,939	0	0	0	0	0	0	0	4,903	71,722
Coniferous forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mixed broadleaf and coniferous forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mangrove forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limestone forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plantation	0	0	47	12	0	0	0	0	0	0	0	906	0	79	1	21	357	965
Limestone area (no forest)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bare land, shub land, fragmented trees	204	1,089	12,322	4,987	3,175	2,263	3,242	0	131	0	0	2,575	0	12,940	144	803	41,610	85,490
Water body	1	4	9	0	0	0	0	0	0	0	0	1	0	21	2,321	75	248	2,718
Residential area	0	0	8	0	0	0	0	0	0	0	0	72	0	113	9	122	466	791
Other land	10	626	1,778	3,561	233	940	1,182	0	25	0	0	1,427	0	9,866	484	7,798	47,116	75,098
Grand Total	34,470	65,833	99,371	39,600	51,943	15,411	66,527	0	2,554	0	0	10,655	0	60,535	3,320	11,651	189,974	651,844

Forest Degradation (quality)

Deforestation

Forest Recovery (quality)

Forest Regeneration

- Detection of different forest changes (DD and Plus).

Note: The above is just an example to show how forest change matrix would look like. For the REL/RL purpose, the matrix was prepared for each province for every five-year time period.

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Emission Factor

PSP data screening and verification were done in this process (28% average error).

Mean Timber Volume by Bio-Eco-Region and Forest Type (NFI Cycle 4 data) (m^3/ha)

		1	2	3	4	5	6	7	8	9	10	11	12
		Evergreen broadleaf forest, rich forest	Evergreen broadleaf forest, medium forest	Evergreen broadleaf forest, poor forest	Evergreen broadleaf forest, rehabilitation forest	Deciduous forest	Bamboo forest	Mixed timber and bamboo forest	Coniferous forest	Mixed broadleaf and coniferous forest	Mangrove forest	Limestone forest	Plantation
1	Cardamom Mountains rain forests			71	61								25
2	Central Indochina dry forests	404	146	56	61	83		145					
3	Indochina mangroves										45		19
4	Luang Prabang montane rain forests	534	155										
5	Northern Annamites rain forests	340	143	62	51		15	102	54				22
6	Northern Indochina subtropical forests	345	142	53	51		12	46				64	19
7	Northern Vietnam lowland rain forests	279	142	67	45		10	85	114				24
9	South China-Vietnam subtropical evergreen forests		141	43	38		10	47		41	0		28
10	Southeastern Indochina dry evergreen forests	311	146	62	58	92	54	129					31
11	Southern Annamites montane rain forests	335	151	63	52	60	11	93	197	152			64
12	Southern Vietnam lowland dry forests	341	146	47	50	89	19	112		141			41
14	Tonle Sap-Mekong peat swamp forests												34

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Emission Factor

Use of IPCC Tier-1 parameter to convert the timber volume data to mean carbon stock

Emission Factor (CO2t/ha) = (AGB+BGB)*CF*44/12

AGB = GS × BCEF

BGB = AGB × R

Where:

AGB = Above-ground biomass (tons)

BGB = Below-ground biomass (tons)

GS = Growing stock (Volume, m3 over bark)

BCEF = Biomass conversion and expansion factor (FAO-defined)
(Above ground biomass / growing stock, (tons/m3))

R = Root-shoot ratio (Below-ground biomass / Above-ground biomass)

CF = Carbon Fraction (0.47)

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Emission Factor

EF for each forest type by bio-eco region in NFI Cycle 4 (CO_2t/ha)

	1	2	3	4	5	6	7	8	9	10	11	12
1			181	157								75
2	604	282	144	157	178		279					
3										115		104
4	798	299										
5	508	275	158	131		78	219	92				67
6	516	272	135	94		66	118				165	103
7	417	272	171	116		82	181	146				70
9		271	110	115		86	122		105	4		85
10	465	282	158	148	196	138	249					94
11	502	291	162	135	153	91	199	253	292			163
12	511	280	120	128	189	104	240		271			106
14												102

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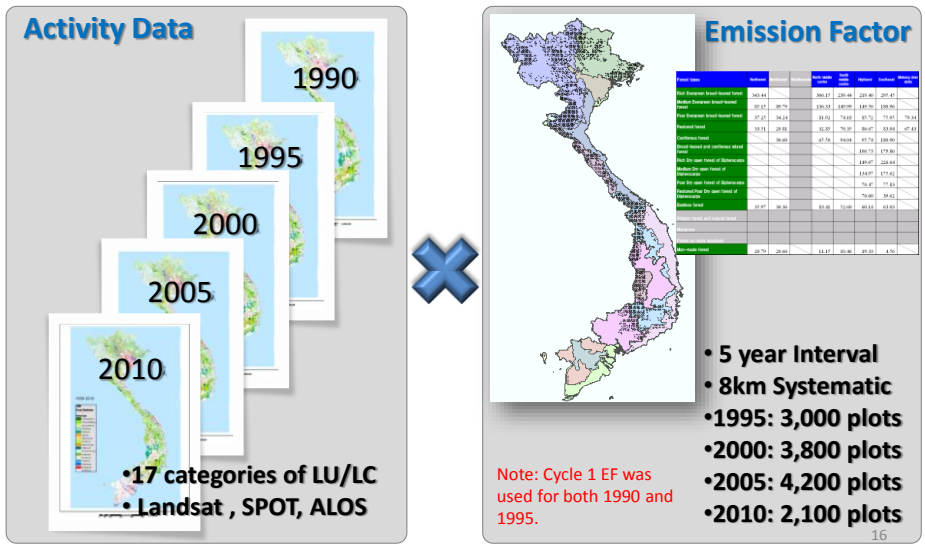
Carbon Stock Estimation



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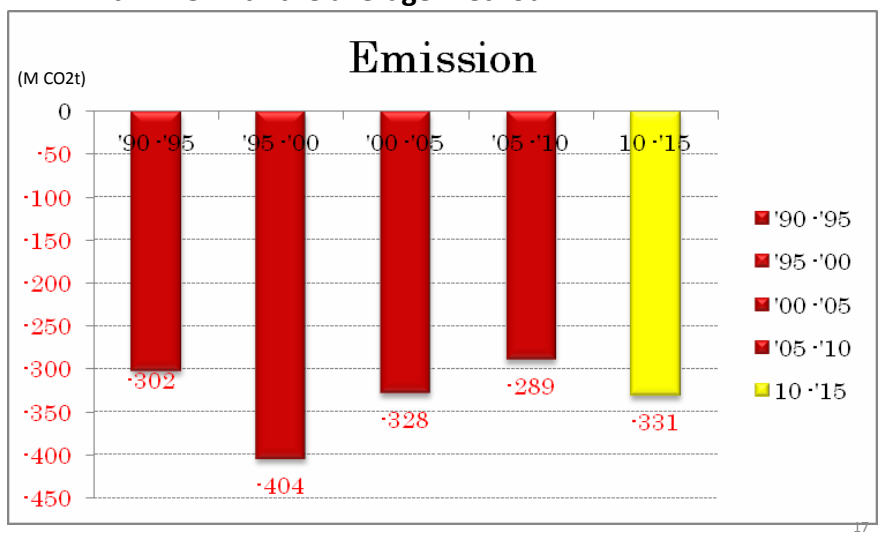
FRELs vs. FRLs

FREL with BAU with the average method



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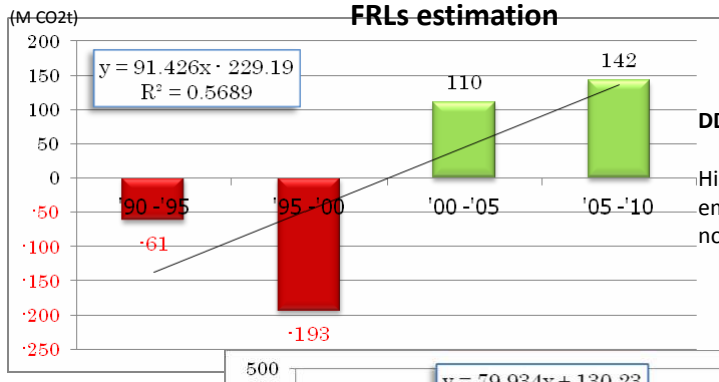
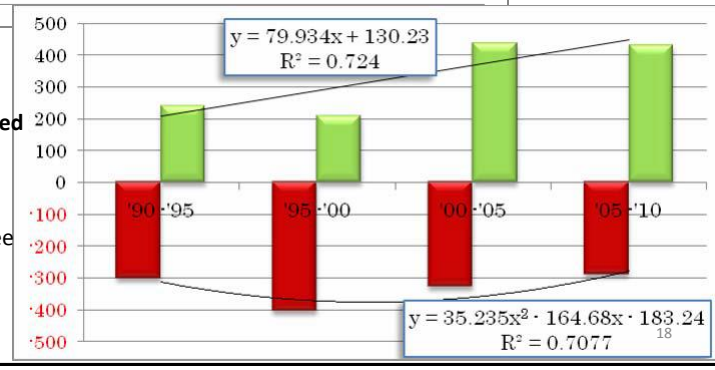
FRLs estimation



DD and Plus Combined

Historical trends of emissions/removals are not clear.



DD and Plus Separated

Historical trends of emissions/removals are clear. Easier to see impacts of different policy interventions.

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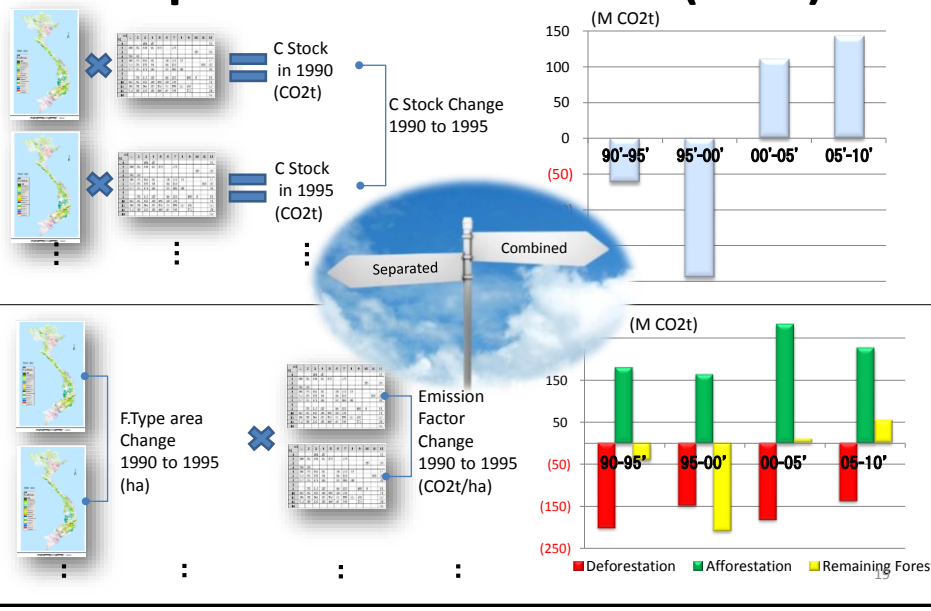
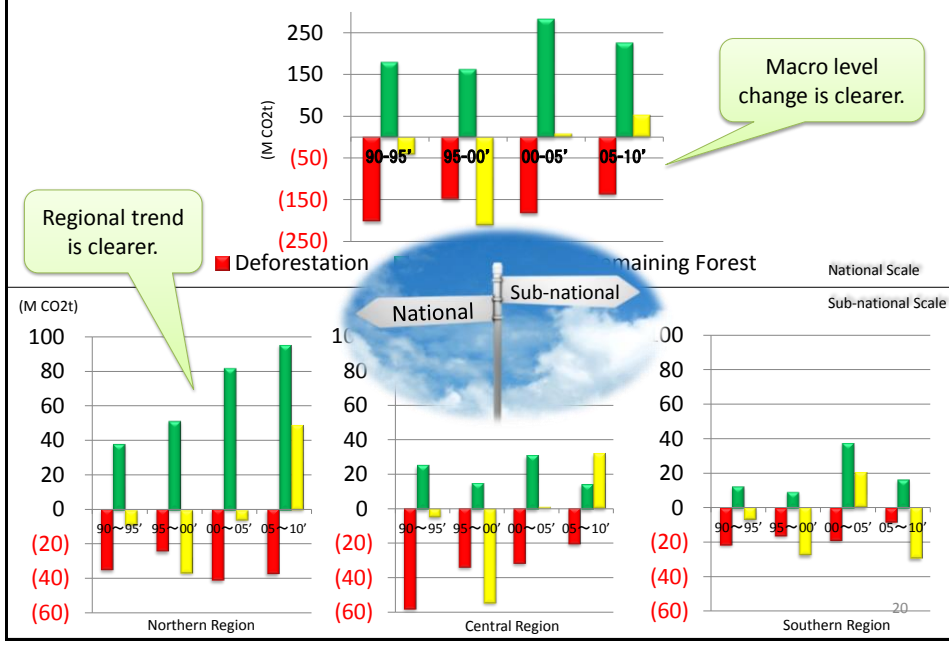
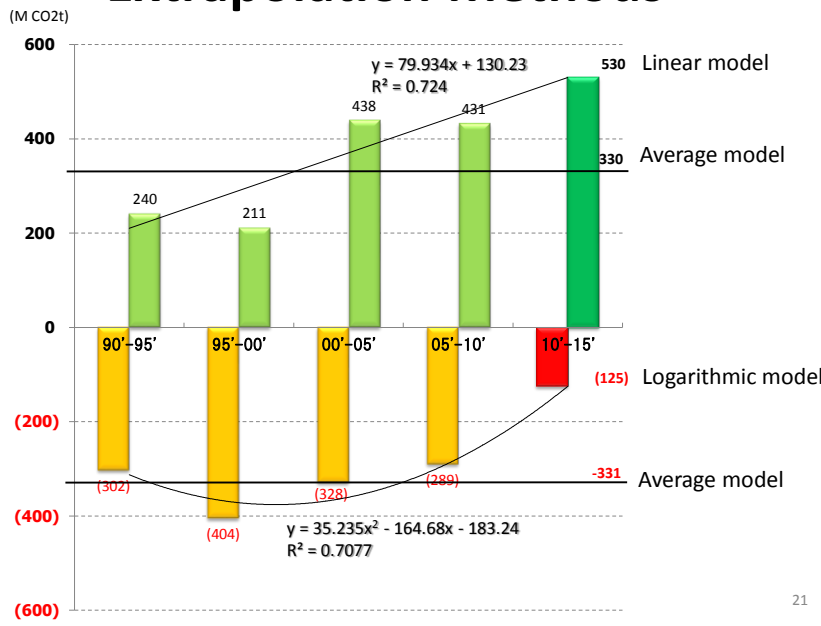
Separate vs. Combined (FRLs)



National vs. Sub-National



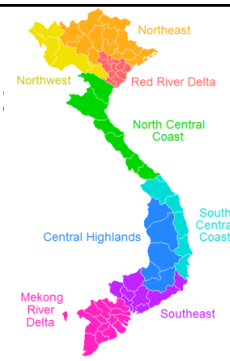
Extrapolation Methods



Extrapolation Methods

- Average model
  - Simple increase trend ➔ lower level future projection
  - Simple decrease trend ➔ higher level future projection
- Regression model
  - Simple increase trend ➔ higher level future projection
  - Simple decrease trend ➔ lower level future projection

Other Consideration



- Stratification used for EF calculation
  - Bio-ecological vs. Agro-ecological
- Number of time points to calculate FRELs/FRLs
  - 3 time points vs. 5 time points

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JICA Study Recommendations

- Sub-national FRELs/FRLs development (and aggregation to the national)
- Separate DD and Plus for FRLs
- Five points in time for FREL/FRL calculation
- Stratification by bio-ecoregion
- BAU extrapolation by different methods depending on the province

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Provincial FRELs/FRLs (Dien Bien Province)

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Provincial FRELs/FRLs

- By the Dien Bien REDD+ Pilot Project (4/2012-12/2013)
- Development of provincial FRELs/FRLs (as a part of the PRAP formulation)
- Developed both FREL and FRL, but FRL recommended for the province as it can take the result of the 661 Program into account

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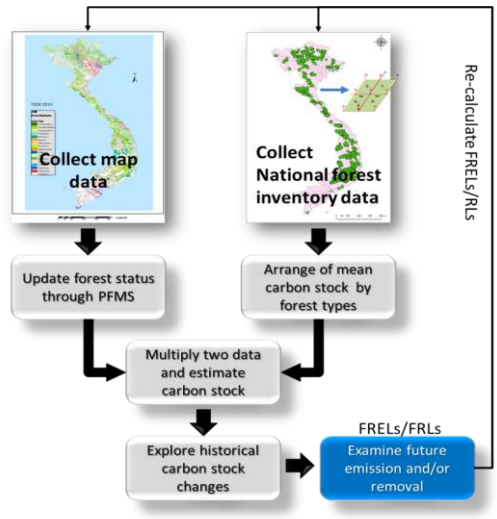
Same FRELs/FRLs Methodology



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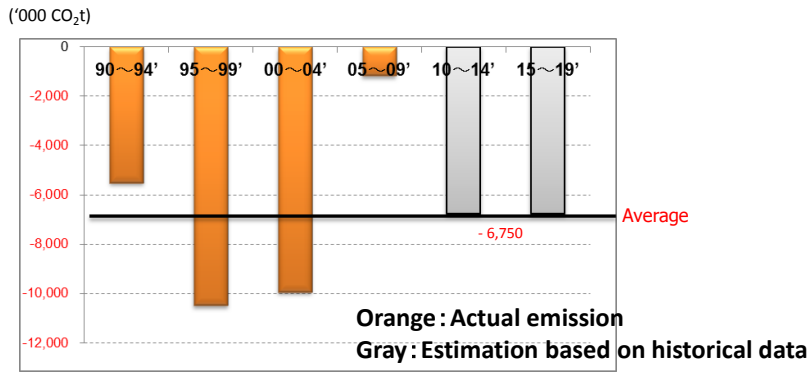
FREL



- Increased gross emission from 1990 to 2004.
- Drastic decrease of gross emission between 2005 and 2009.
- From 2010 to 2019: 1.35 million CO_2 t/year (emission).

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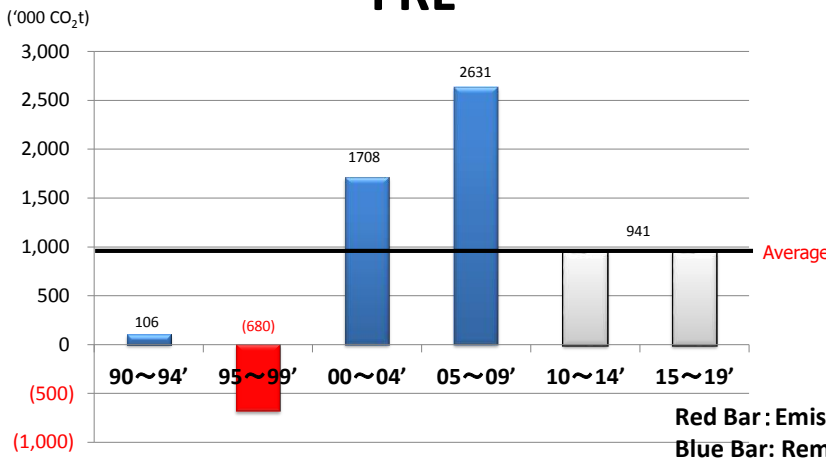
FRL



- Net emission between 1995 and 1999
- Net sequestration from 2000
- From 2010 to 2019: 188,000 CO_2t/year (net sequestration)

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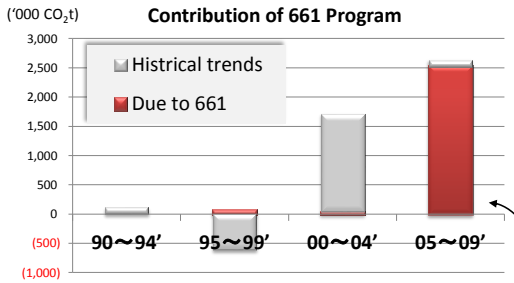
FRL (adjusted with Program 661)



Categories	Effort of 661 Program (ha)		
	2000	2005	2010
Bare land with scatter tree	629	3,991	22,324
Bare land with shurb	343	203	568
Mixed timber and bamboo forest	-	-	476
Natural medium forest 100 - 200 m3/ha	1	-	3,126
Natural poor forest < 100m3/ha	-	-	31
Natural rich forest > 300m3/ha	-	-	-
Plantation	163	179	299
Regrowth forest < 10m3/ha	-	77	7,376
Regrowth forest > 10m3/ha	88	15	9,988
Total	1,225	4,464	44,189

Significant contribution for sequestration

- Prog.661 as national circumstances
- Significant contribution of the Program in the 2005-2009 period

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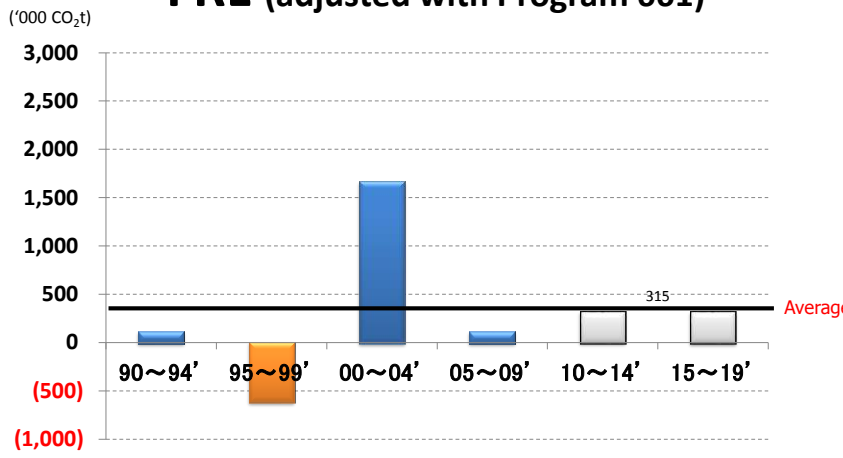
FRL (adjusted with Program 661)



- With the adjustment with the Prog.661 results, BAU net sequestration level went down ➔ more possibility for carbon credit
- From 2010 to 2019: 63,000 CO_2 t/year (net sequestration)

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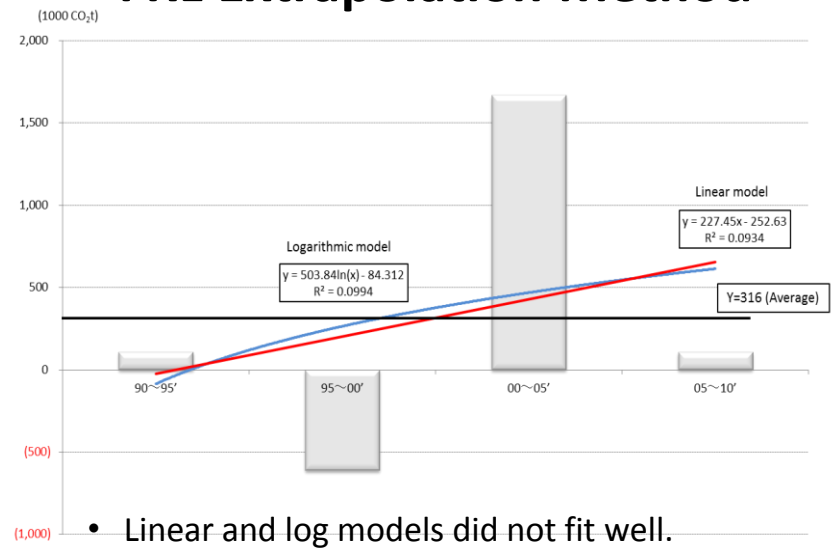
FRL Extrapolation Method



- Linear and log models did not fit well.
- Application of the average model more appropriate.

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Credit Notes

This presentation includes many slides originally made by the JICA REDD+ Study Project and the Dien Bien REDD+ Pilot Project, adjusted and slightly modified by the presenter.

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