UN-REDD PROGRAMME

REDD+ Academy

National Forest Monitoring Systems for REDD+

Presentation 2

NFMS for REDD+ Part 2

Objectives:

- Identify the components of a national forest monitoring system for REDD+
- Understand the key principles of the IPCC's guidance and guidelines for measurement, reporting and verification (MRV) for REDD+
- Understand the steps involved in MRV for REDD+
- Understand the objectives and tools for forest monitoring for REDD+

UN-REDD PROGRAMME

National Forest Monitoring Systems for REDD+

MRV FOR REDD+: IPCC GUIDANCE AND GUIDELINES

NEWSROOM
Get News on the Latest Climate Action

NEGOTIATIONS

Meetings
Documents & Decisions
Bodies

FOCUS

Overview
Adaptation
Climate Finance
Mitigation
Technology

PROCESS

Essential Background
Kyoto Protocol
Cooperation & Support
Science
Adaptation
National Reports
GHG Data
Methods

REDD Web Platform: IPCC

The Intergovernmental Panel on Climate Change (IPCC) guidelines and good practice guidance provide methodologies that can form the basis for how developing countries estimate and monitor emission reductions from deforestation and forest degradation and changes in forest carbon stocks.

Browse information by:

Country
Organization
Topic

Go to:

REDD Web Platform main page

IPCC Guidance

IPCC-NGGIP	IPCC-National Greenhouse Gas Inventories Programme
2006 IPCC Guidelines	2006 IPCC Guidelines for National Greenhouse Gas Inventories (5 Volumes)
GPG-LULUCF	Good Practice Guidance for Land Use, Land-Use Change and Forestry
Degradation of Forest	Definitions and Methodological Options to Inventory Emissions from Direct Human-induced Degradation of Forests and Devegetation of Other Vegetation Types
GPG2000	Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (accepted and published 2000)
Revised 1996 IPCC Guidelines	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (3 Volumes)(approved in 1996 and published in 1997)
Revised 1996 IPCC Guidelines Software	IPCC Greenhouse Gas Inventory Software for the Workbook (published in 1997; Microsoft Excel 5.0c or later version is necessary)
–	IPCC Guidelines for National Greenhouse Gas Inventories (3 Volumes) (approved in 1994 and published in 1995, out of print, replaced by 1996 Revised Guidelines)

Which IPCC Guidelines to use?

Currently, all the Parties use these under the UNFCCC and the Kyoto Protocol.

Annex I Parties shall use GPG.
Non-Annex I Parties are encouraged to use GPG.

1995 IPCC Guidelines

Revised 1996 IPCC Guidelines

GPG2000 (non-LULUCF)

GPG2003 (LULUCF)

Annex I Parties must use from 2015

2006 IPCC Guidelines

2013 Wetlands Supplement

2013 KP Supplement

Revision/Update by the IPCC

WMO UNEP

IPCC INTERGOVERNMENTAL PANEL ON climate change

IPCC Good Practice Guidance: Key Concepts

- IPCC "Good Practice":
  - Assists countries in producing GHG inventories that are accurate in the sense of being neither over nor underestimates so far as can be judged, and in which uncertainties are reduced as far as possible
  - Provides methods to manage uncertainties
  - Supports the development of GHG inventories that are:
    - Transparent
    - Documented
    - Consistent over time
    - Complete
    - Comparable
    - Assessed for uncertainties
    - Subject to quality control and assurance
    - Efficient in the use of resources available to inventory agencies
    - In which uncertainties are gradually reduced as better information becomes available

IPCC G&G: Key Concepts

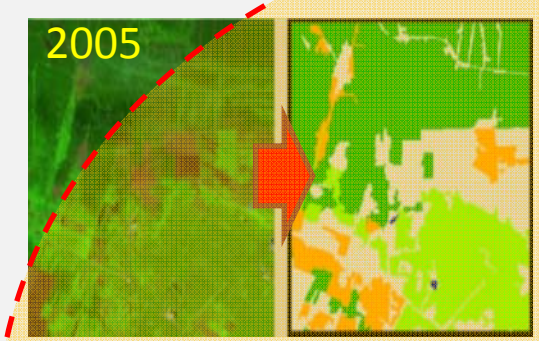
- Activity Data
  - Data on the **magnitude** of human activity, resulting in emissions/removals taking place during a given period of time (e.g. data on land area or management systems)

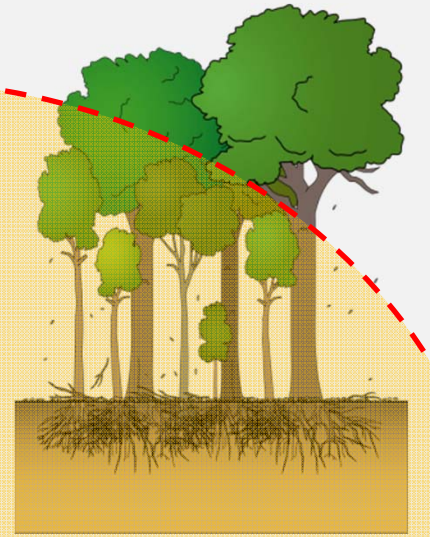
- Emission Factor
  - A **coefficient** that relates the activity data to the amount of chemical compound (e.g. CO_2), which is the source of later emissions

- Removal Factor
  - **Rate** at which carbon is taken up from the atmosphere by a terrestrial system and sequestered in biomass and soil

MRV for REDD+

IPCC Equation for Emission Estimates





CO_2

	FL Wet evergreen	FL Moist evergreen	FL Moist semi-deciduous	FL South-east subtype	FL North-west subtype	FL North-west subtype	FL Dry semi-deciduous	Agricultural land	Savanna	Shrub Ticket	Settlements	Wetlands	Other land	Unclassified	Final Area
FL Wet evergreen	51														51
FL Moist evergreen		42													42
FL Moist semi-deciduous			60												60
FL South-east subtype				52											52
FL North-west subtype					12										12
FL North-west subtype						2									2
FL Dry semi-deciduous							25		2						27
Agricultural land	5	2				2	3	1							13
Savanna			1			3	1		20						25
Shrub Ticket				1						12					13
Settlements						1		10			25				36
Wetland								0				2			2
Other land								5					25		30
Unclassified								9						10	19
Initial Area	56	44	61	52	13	8	29	25	22	12	25	17	25	10	
Net change (Δ = T0-T1)	-5	-2	-1	0	-1	-6	-2	-12	3	1	11	-15	5	9	0

MEASUREMENT

Area change data from satellite remote sensing

Forest carbon stock change data from a national forest inventory

Inventory of greenhouse gas **emissions** from the forest sector

ACTIVITY DATA

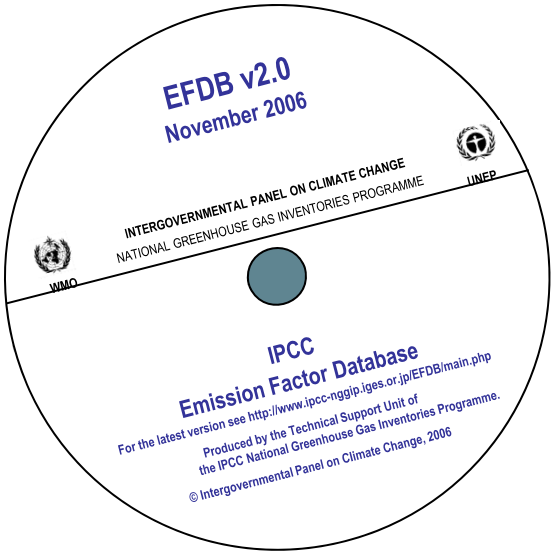
EMISSION FACTOR

EMISSIONS ESTIMATE

IPCC Products – internet, CD & USB

http://www.ipcc.ch/

- IPCC Software
  - Implements methodologies
  - Calculates GHG
- Emission Factor Database (EFDB)
  - Repository of emission factors for use by compilers



WMO UNEP

ipcc
INTERGOVERNMENTAL PANEL ON climate change

The IPCC: Using the Guidelines

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FAO UNDP UNEP

IPCC

- Go to the Guidelines (on internet, CD or USB stick at end of workshop)

2006 GL

- Choose which version of Guidelines to use
- Most up-to-date version of guidance (2006) are "encouraged" but 1996 are min.
- Comprehensive description of Methods

Volume 4

- Volume on Agriculture, Forestry and Other land-use (AFOLU)
- General introduction, land representation, inventory circumstances
- Detailed description of each land-use Category

Aux Docs and soft ware

- Consulting Group of Experts
- IPCC summaries
- UNFCCC Documents, IPCC software available to assist calculations and reporting

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NFIs for Assessing Emission/Removal Factors

IPCC CONCEPTS:
REPORTING TIERS AND KEY CATEGORIES

Emission Factor Reporting Tiers

- **Tier 2:** Applies country- or region-specific emission and stock change factors for the most important land-use categories
  - Country-defined EFs (for climatic regions and land-use categ
  - *IPCC default assumptions + default methodology ('G*
    specific data

- **Tier 3**: Higher order methods are **entory measurement systems**) tailored to ***addres*** ***repeated over time*** and ***driven by high-resol*** ***aggregated*** at sub-national level
  - Estimat tainty than lower tiers
  - ***ve field sampling*** repeated at regular time intervals
    ystems of age, class/production data, soils data
    ecific assumptions + methodology + data

Objective = To reduce uncertainty as much as possible

Assessing Emission & Removal Factors e.g.:

The Hierarchical Tiers for Living Biomass Estimation

Emission / Removal Factor	Tier 1	Tier 2	Tier 3
Annual biomass growth rate	• Default values from IPCC 1996GL and GPG2003 • Emission Factor Data Base (EFDB)	• Default values from IPCC 1996GL and GPG2003 • Country-specific data • EFDB	• National Forest Inventory or modelling approaches • Allometric equations
Carbon fraction of dry matter	• Default data of 0.5	• Default data of 0.5	• Species-specific data from laboratory estimations
Biomass Expansion Factor (BEF)	• Default values of 1.8	• Default values of 1.8 • National data for key forest types	• Species-specific data from measurements

Combining Tiers & Methods

- Can adopt multiple tiers in GHG inventory for the LULUCF sector:
  - *For different land-use categories*
    - *E.g. tier 2 for forest land and tier 1 for grassland*
  - *Within a given land-use category for different carbon pools*
    - *E.g. tier 1 for below-ground biomass and tier 2 for abo*

E.g. emissions from land-use often not exactly known

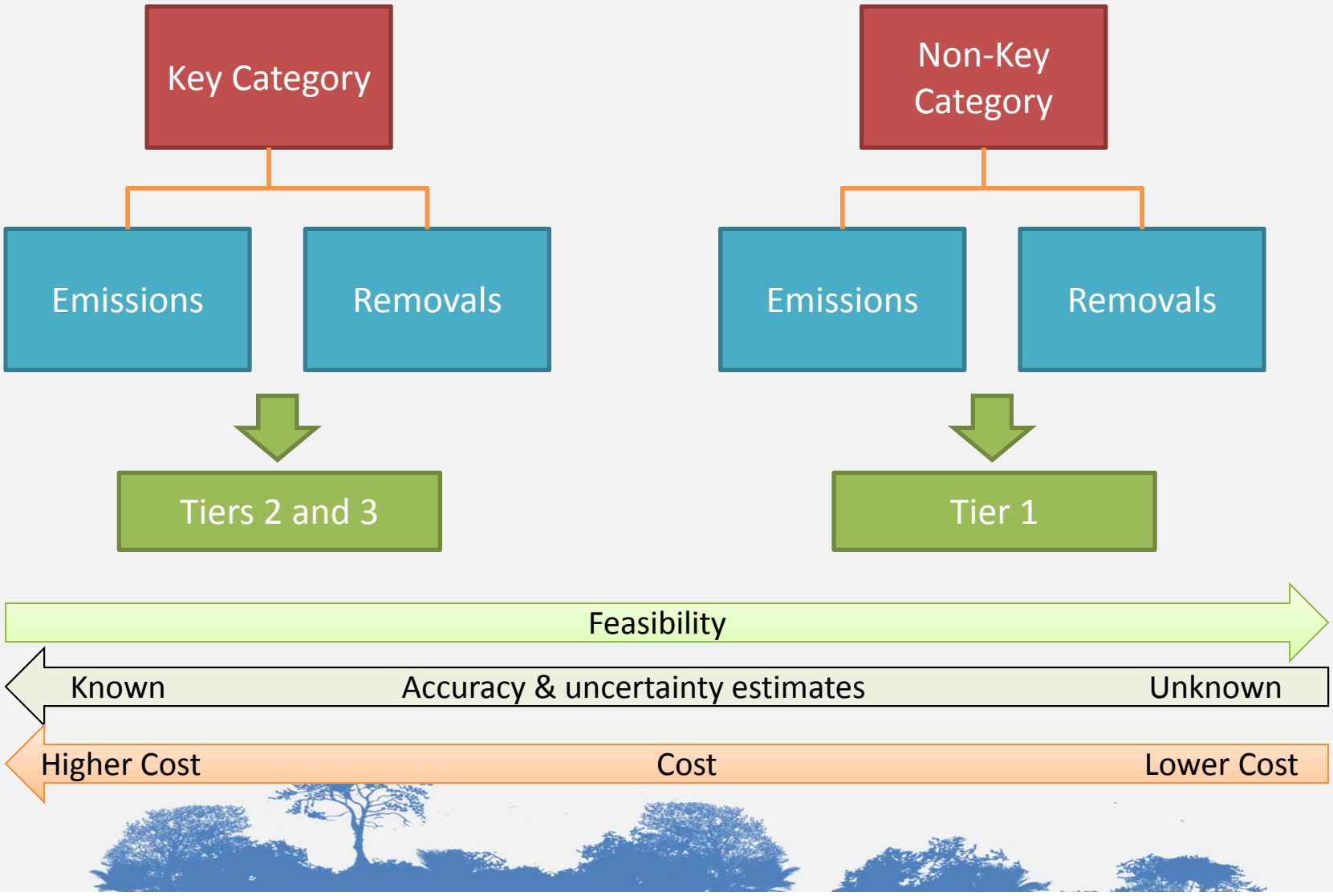
E.g. fast increasing source

- For higher tiers countries need to ocumentation decisio e sophisticated m es or country-defined ameters

E.g. known large source/sink

- **Highe adopted for key categ es (wherever possibl together with the use of cou y-specific, climatic regi -specific emission/ moval factors**
  - *Key Category = "a ca gory that is prioritize d within the nation inventory system because its estim te has a significan influence on a country's total inventory of GHGs in terms of the* ***absolute level, the trend, or the uncertainty*** *in emissions and removals" (**IPCC**)*
    - *HELP TO PRIORITIZE ALLOCATION OF EFFORT AND RESOURCES*

Linking Key Categories and Tiers



Key Category Analysis

- Key category analysis helps a country to achieve the most reliable inventory given the resources available

- Key category analysis is required to identify which:
  - land-use and management activities are significant
  - land-use sub-category is significant
  - CO_2 emissions/removals by sinks from various carbon pools are significant
  - Non-CO_2 gases and from what categories are significant
  - Tier is required for reporting

- A certain land category (e.g., *Land Converted to Forest Land*) and further a certain carbon pool (e.g., above-ground biomass) may contribute to a dominant share of net CO2 emissions/removals →
  - Aim to get better data for this key category

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National Forest Monitoring Systems for REDD+

MRV FOR REDD+: ACTIVITY DATA

IPCC Guidance and Guidelines for GHG Inventories

Key Concepts: Land Representation

Systems for land representation should be:

- **Adequate**: capable of representing land-use categories, and conversions between land-use categories, as needed to estimate carbon stock changes and greenhouse gas emissions and removals
- **Consistent**: capable of representing land-use categories consistently over time, without being unduly affected by artificial discontinuities in time-series data
- **Complete**: that all land within a country should be included, with increases in some areas balanced by decreases in others, recognizing the bio-physical stratification of land if needed
- **Transparent**: data sources, definitions, methodologies and assumptions should be clearly described

IPCC Guidance and Guidelines for GHG Inventories

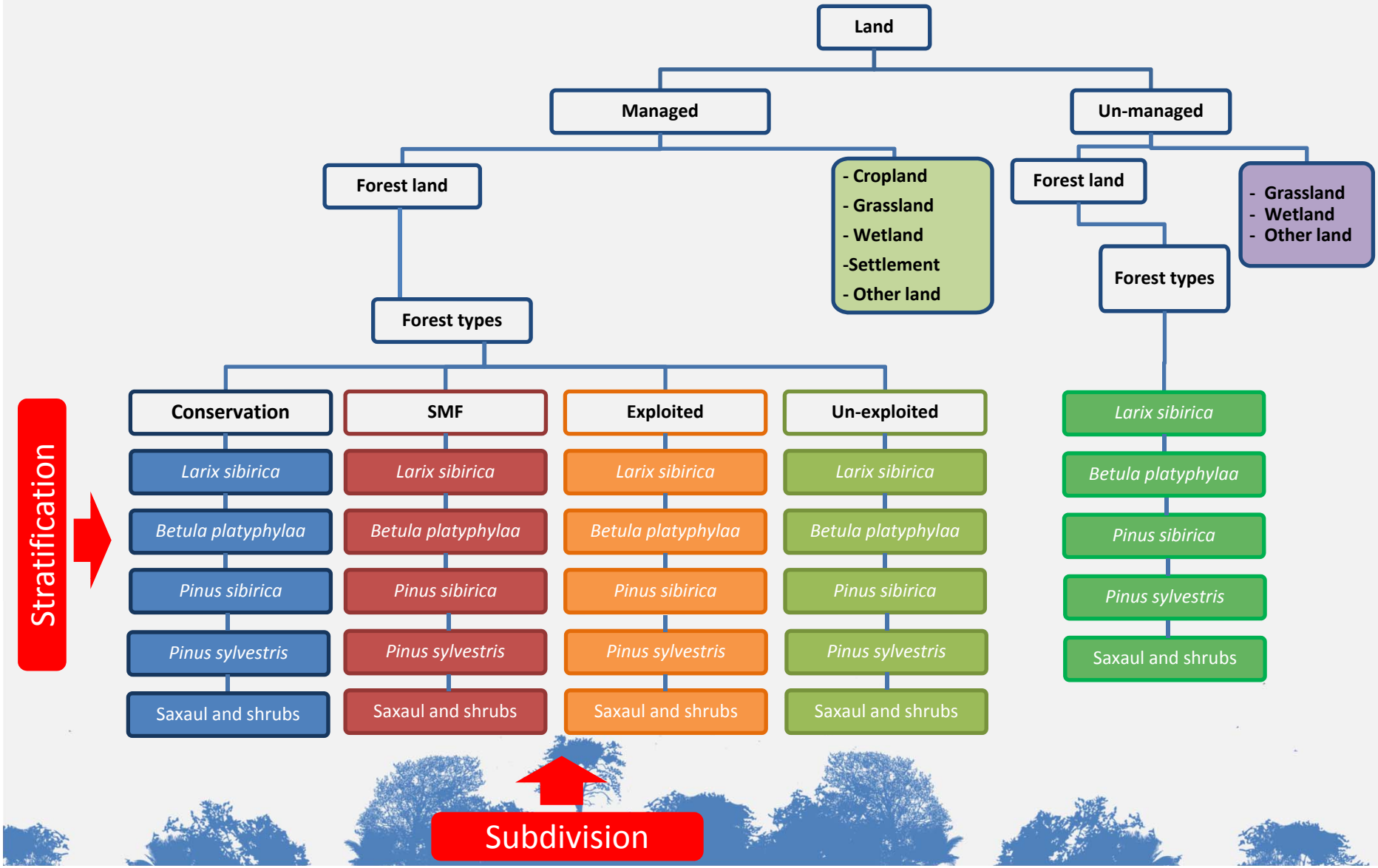
Key Concepts: Land Representation

- IPCC uses 6 land-use categories
  - Forest land, Grassland, Cropland, Wetland, Settlement, Other land

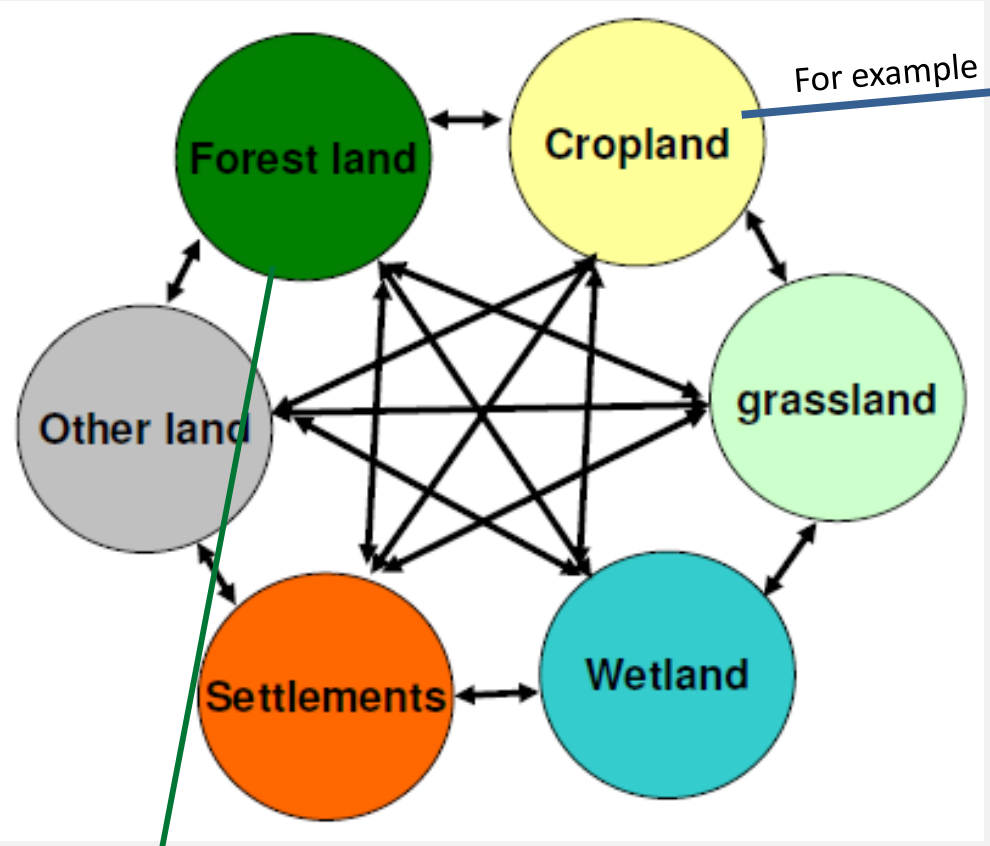
- Each land-use category is further disaggregated to reflect the past and the current land-use, for example under forest land you report the sub-categories:
  - Forest land remaining forest land
  - Lands converted to forest land

- Land-use categories and sub-categories may be further sub-divided according to land-use practices or biophysical characteristics of the land
  - For example: forest land sub-divided by forest type:
    - Lowland tropical forest
    - Mangroves

A Potential Forest Land Stratification for Mongolia & GHG Reporting Sub-Divisions for REDD+



Activity Data: Assessment of change



For example

Time 1	Time 2
Number of hectares	Number of hectares

Number of hectares of
Cropland remaining Cropland

Number of hectares of
Other land-uses converted to Cropland

Number of hectares of
Forest Land remaining Forest Land

Number of hectares of
Other land-uses converted to Forest Land

To assess deforestation, we want to know the area of Forest Land converted to other land-uses – this all gives an indication of the drivers of deforestation

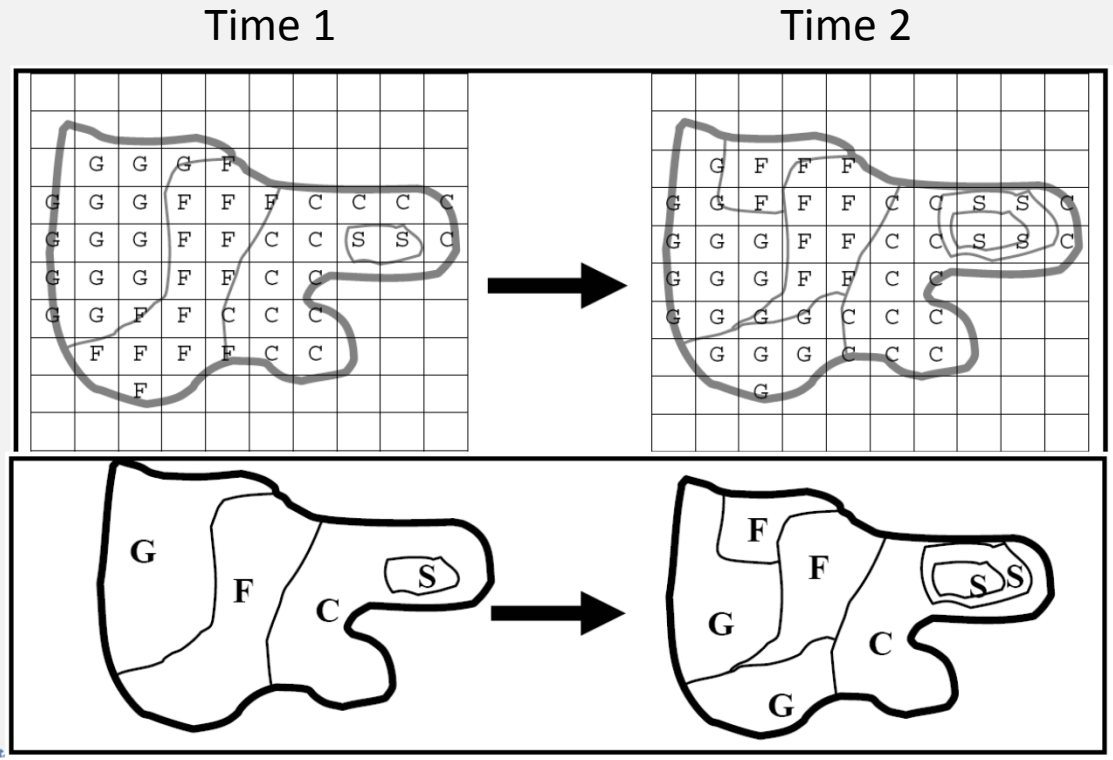
Activity Data: Assessment of Change

- IPCC guidance: Countries should **characterize and account for all relevant land areas** in a country consistently and as transparently as possible.
- Data should reflect the **historical trends in land-use area**
- IPCC 2003 LULUCF Guidance suggests three Approaches:
  - Approach 1: **Basic land-use data** (land-use types in time 1 & land-use types in time 2)
  - Approach 2: **Survey of land-use and land-use change** (changes from & to a category)
  - Approach 3: **Geographically explicit land-use data** (known locations of changes between categories)
- In most developing countries the only way to represent land in a consistent and transparent way with a historical time frame of 20 years is the use of **satellite remote sensing data**, which allows the adoption of Approach 3

Activity Data: Assessment of Change

Approach 3: Geographically Explicit land-use Data

- Requires spatially explicit observations of land-use and land-use change.
- The data may be obtained either by 1) sampling of geographically located points, 2) a complete tally (wall-to-wall mapping), or 3) a combination of the two
- Is comprehensive and relatively simple conceptually but data intensive to implement



Activity Data in the GHG Inventory

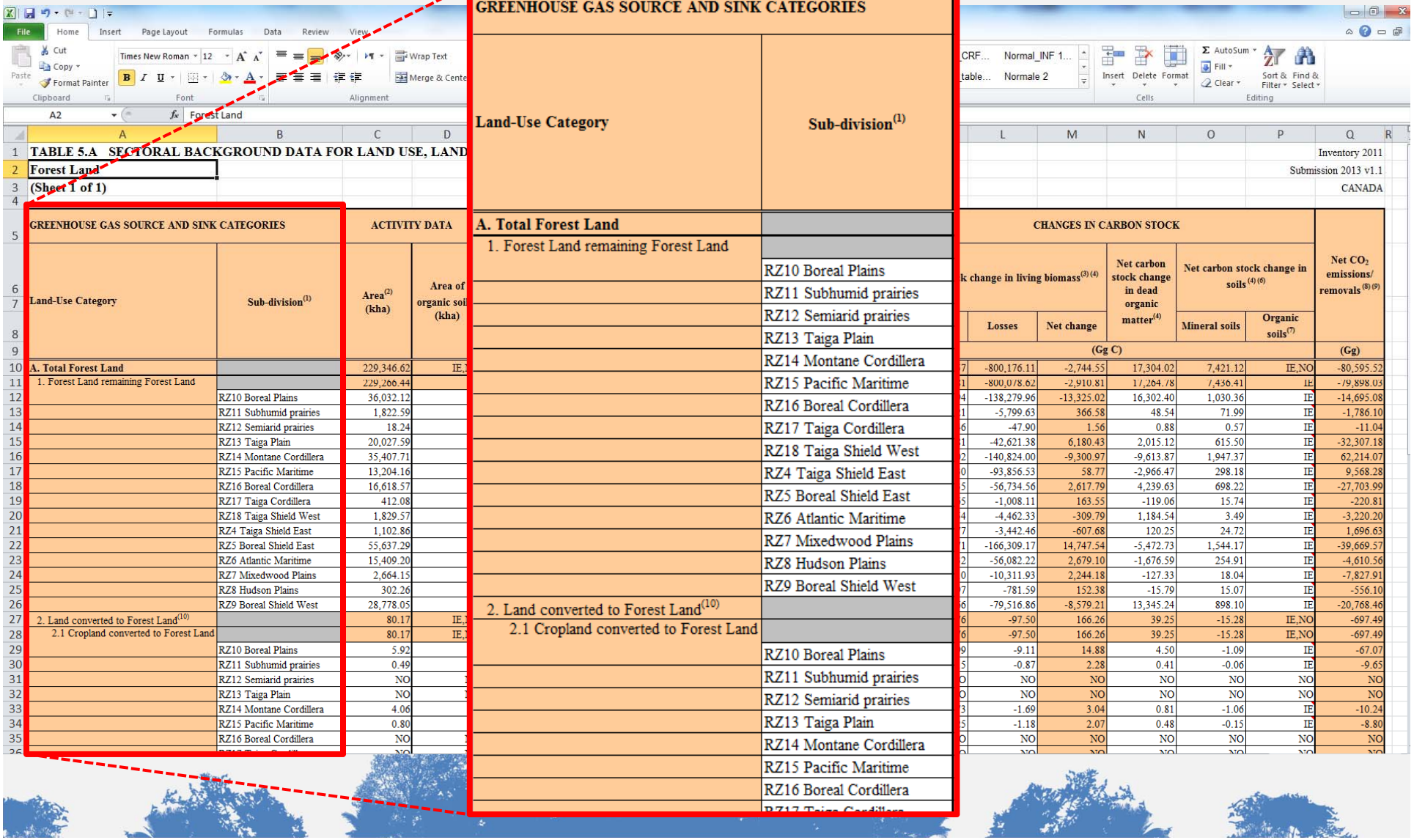


TABLE 5.A SECTORAL BACKGROUND DATA FOR LAND USE, LAND

Forest Land

(Sheet 1 of 1)

Inventory 2011

Submission 2013 v1.1

CANADA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA		CHANGES IN CARBON STOCK					Net CO_2 emissions/ removals[8][9]
Land-Use Category	Sub-division[1]	Area[2] (kha)	Area of organic soi (kha)	k change in living biomass[3][4]		Net carbon stock change in dead organic matter[4]	Net carbon stock change in soils[4][6]		
					Losses	Net change		Mineral soils	Organic soils[7]
						(Gg C)			(Gg)
A. Total Forest Land		229,346.62	IE,1	7	-800,176.11	-2,744.55	17,304.02	7,421.12	IE,NO	-80,595.52
1. Forest Land remaining Forest Land		229,266.44		1	-800,078.62	-2,910.81	17,264.78	7,436.41	IE	-79,898.03
	RZ10 Boreal Plains	36,032.12		4	-138,279.96	-13,325.02	16,302.40	1,030.36	IE	-14,695.08
	RZ11 Subhumid prairies	1,822.59		1	-5,799.63	366.58	48.54	71.99	IE	-1,786.10
	RZ12 Semiarid prairies	18.24		6	-47.90	1.56	0.88	0.57	IE	-11.04
	RZ13 Taiga Plain	20,027.59		1	-42,621.38	6,180.43	2,015.12	615.50	IE	-32,307.18
	RZ14 Montane Cordillera	35,407.71		2	-140,824.00	-9,300.97	-9,613.87	1,947.37	IE	62,214.07
	RZ15 Pacific Maritime	13,204.16		0	-93,856.53	58.77	-2,966.47	298.18	IE	9,568.28
	RZ16 Boreal Cordillera	16,618.57		5	-56,734.56	2,617.79	4,239.63	698.22	IE	-27,703.99
	RZ17 Taiga Cordillera	412.08		5	-1,008.11	163.55	-119.06	15.74	IE	-220.81
	RZ18 Taiga Shield West	1,829.57		4	-4,462.33	-309.79	1,184.54	3.49	IE	-3,220.20
	RZ4 Taiga Shield East	1,102.86		7	-3,442.46	-607.68	120.25	24.72	IE	1,696.63
	RZ5 Boreal Shield East	55,637.29		1	-166,309.17	14,747.54	-5,472.73	1,544.17	IE	-39,669.57
	RZ6 Atlantic Maritime	15,409.20		2	-56,082.22	2,679.10	-1,676.59	254.91	IE	-4,610.56
	RZ7 Mixedwood Plains	2,664.15		0	-10,311.93	2,244.18	-127.33	18.04	IE	-7,827.91
	RZ8 Hudson Plains	302.26		7	-781.59	152.38	-15.79	15.07	IE	-556.10
	RZ9 Boreal Shield West	28,778.05		6	-79,516.86	-8,579.21	13,345.24	898.10	IE	-20,768.46
2. Land converted to Forest Land[10]		80.17	IE,1	6	-97.50	166.26	39.25	-15.28	IE,NO	-697.49
2.1 Cropland converted to Forest Land		80.17	IE,1	6	-97.50	166.26	39.25	-15.28	IE,NO	-697.49
	RZ10 Boreal Plains	5.92		9	-9.11	14.88	4.50	-1.09	IE	-67.07
	RZ11 Subhumid prairies	0.49		5	-0.87	2.28	0.41	-0.06	IE	-9.65
	RZ12 Semiarid prairies	NO		O	NO	NO	NO	NO	NO	NO
	RZ13 Taiga Plain	NO		O	NO	NO	NO	NO	NO	NO
	RZ14 Montane Cordillera	4.06		3	-1.69	3.04	0.81	-1.06	IE	-10.24
	RZ15 Pacific Maritime	0.80		5	-1.18	2.07	0.48	-0.15	IE	-8.80
	RZ16 Boreal Cordillera	NO		O	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	
Land-Use Category	Sub-division[1]
A. Total Forest Land	
1. Forest Land remaining Forest Land	
	RZ10 Boreal Plains
	RZ11 Subhumid prairies
	RZ12 Semiarid prairies
	RZ13 Taiga Plain
	RZ14 Montane Cordillera
	RZ15 Pacific Maritime
	RZ16 Boreal Cordillera
	RZ17 Taiga Cordillera
	RZ18 Taiga Shield West
	RZ4 Taiga Shield East
	RZ5 Boreal Shield East
	RZ6 Atlantic Maritime
	RZ7 Mixedwood Plains
	RZ8 Hudson Plains
	RZ9 Boreal Shield West
2. Land converted to Forest Land[10]	
2.1 Cropland converted to Forest Land	
	RZ10 Boreal Plains
	RZ11 Subhumid prairies
	RZ12 Semiarid prairies
	RZ13 Taiga Plain
	RZ14 Montane Cordillera
	RZ15 Pacific Maritime
	RZ16 Boreal Cordillera

Activity Data in the GHG Inventory

UN-REDD PROGRAMME

GEOGRAPHICAL LOCATION[2]	ACTIVITY DATA		
Identification code	Subdivision[3]	Area subject to the activity (kha)	Area of organic soils[7] (kha)
Total for activity A.2.		**6,501.52**	**NO**
NSW		1,020.73	NO
	Acacia Forest and Woodland	61.17	NO
	Acacia Open Woodland	0.44	NO
	Acacia Shrubland	93.21	NO
	Callitris Forest and	48.32	NO
	Casuarina Forest and	51.32	NO
	Eucalyptus Low Open	1.38	NO
	Eucalyptus Open Forest	243.31	NO
	Eucalyptus Open	82.39	NO
	Eucalyptus Tall Open	20.71	NO
	Eucalyptus Woodland	338.73	NO
	Heath	1.62	NO
	Low Closed Forest and	1.98	NO
	Mallee Woodland and	69.97	NO
	Melaleuca Forest and	0.79	NO
	Other Forest and Woodland	0.55	NO

TABLE 5(KP-I)A.2 SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGE FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

Article 3.3 activities: Deforestation[1]

AUSTRALIA
Inventory 2011
Submission 2013 v1.1

GEOGRAPHICAL LOCATION[2]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE					CHANGE IN CARBON STOCK[6]									
				Carbon stock change in above-ground biomass per area[4],[5]			Carbon stock change in below-ground biomass per area		Carbon stock change in above-ground biomass[4],[5]		Carbon stock change in below-ground biomass[4],[5]			Net carbon stock change in litter[4]	Net carbon stock change in dead wood[4]	Net carbon stock change in soils[4]		Net CO_2 emissions/ removals[8]
Identification code	Subdivision[3]	Area subject to the activity (kha)	Area of organic soils[7] (kha)	Gains	Losses	Net change	Gains	Losses	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils[9]	(Gg CO_2)
				(Gg C)														
Total for activity A.2.		**6,501.52**	**NO**	**0.00**	**-0.39**	**-0.39**	**0.00**		**-2,561.09**	**-2,560.59**	**0.23**	**-1,135.73**	**-1,135.50**	**-958.47**	**-2,185.90**	**-3,044.52**	**NO**	**36,244.92**
NSW		1,020.73	NO	0.00	-0.80	-0.80	0.00		-812.57	-812.30	0.12	-350.44	-350.32	-331.81	-416.51	-556.98	NO	9,049.08
	Acacia Forest and Woodland	61.17	NO	IE	-0.18	-0.18	IE		-10.92	-10.92	IE	-4.95	-4.95	-8.59	-10.92	0.69	NO	127.18
	Acacia Open Woodland	0.44	NO	IE	-0.52	-0.52	IE		-0.23	-0.23	IE	-0.22	-0.22	-0.10	-0.15	0.02	NO	2.49
	Acacia Shrubland	93.21	NO	IE	-0.12	-0.12	IE		-11.28	-11.28	IE	-10.86	-10.86	-14.21	-5.86	-1.38	NO	159.82
	Callitris Forest and	48.32	NO	IE	-0.46	-0.46	IE		-22.01	-22.01	IE	-10.10	-10.10	-14.15	-7.29	-9.17	NO	229.99
	Casuarina Forest and	51.32	NO	IE	-0.39	-0.39	IE		-20.05	-20.05	IE	-9.03	-9.03	-11.68	-23.06	-2.53	NO	243.29
	Eucalyptus Low Open	1.38	NO	0.19	IE	0.19	0.09		IE	0.27	0.12	IE	0.12	-0.28	-0.69	-0.32	NO	3.31
	Eucalyptus Open Forest	243.31	NO	IE	-1.39	-1.39	IE		-337.78	-337.78	IE	-153.70	-153.70	-140.17	-265.00	-299.61	NO	4,386.28
	Eucalyptus Open	82.39	NO	IE	-1.58	-1.58	IE		-129.86	-129.86	IE	-54.14	-54.14	-24.56	7.77	-43.77	NO	896.73
	Eucalyptus Tall Open	20.71	NO	IE	-2.37	-2.37	IE		-49.12	-49.12	IE	-6.52	-6.52	-15.80	-42.64	-28.29	NO	522.03
	Eucalyptus Woodland	338.73	NO	IE	-0.62	-0.62	IE		-210.38	-210.38	IE	-88.79	-88.79	-89.27	-50.82	-134.55	NO	2,103.99
	Heath	1.62	NO	IE	-1.38	-1.38	IE		-2.23	-2.23	IE	-2.19	-2.19	-0.96	-0.81	-2.57	NO	32.09
	Low Closed Forest and	1.98	NO	IE	-0.29	-0.29	IE		-0.57	-0.57	IE	-0.56	-0.56	-0.27	-0.08	-0.61	NO	7.70
	Mallee Woodland and	69.97	NO	IE	-0.08	-0.08	IE		-5.57	-5.57	IE	-5.40	-5.40	-7.74	-5.47	-25.31	NO	181.40
	Melaleuca Forest and	0.79	NO	IE	-2.35	-2.35	IE		-1.86	-1.86	IE	-0.86	-0.86	-0.15	0.26	-0.98	NO	13.15
	Other Forest and Woodland	0.55	NO	IE	-0.08	-0.08	IE		-0.04	-0.04	IE	-0.02	-0.02	-0.14	-0.12	-0.19	NO	1.89

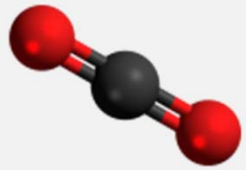
UN-REDD PROGRAMME

National Forest Monitoring Systems for REDD+

MRV FOR REDD+: EMISSION & REMOVAL FACTORS

Emission/Removal Factors

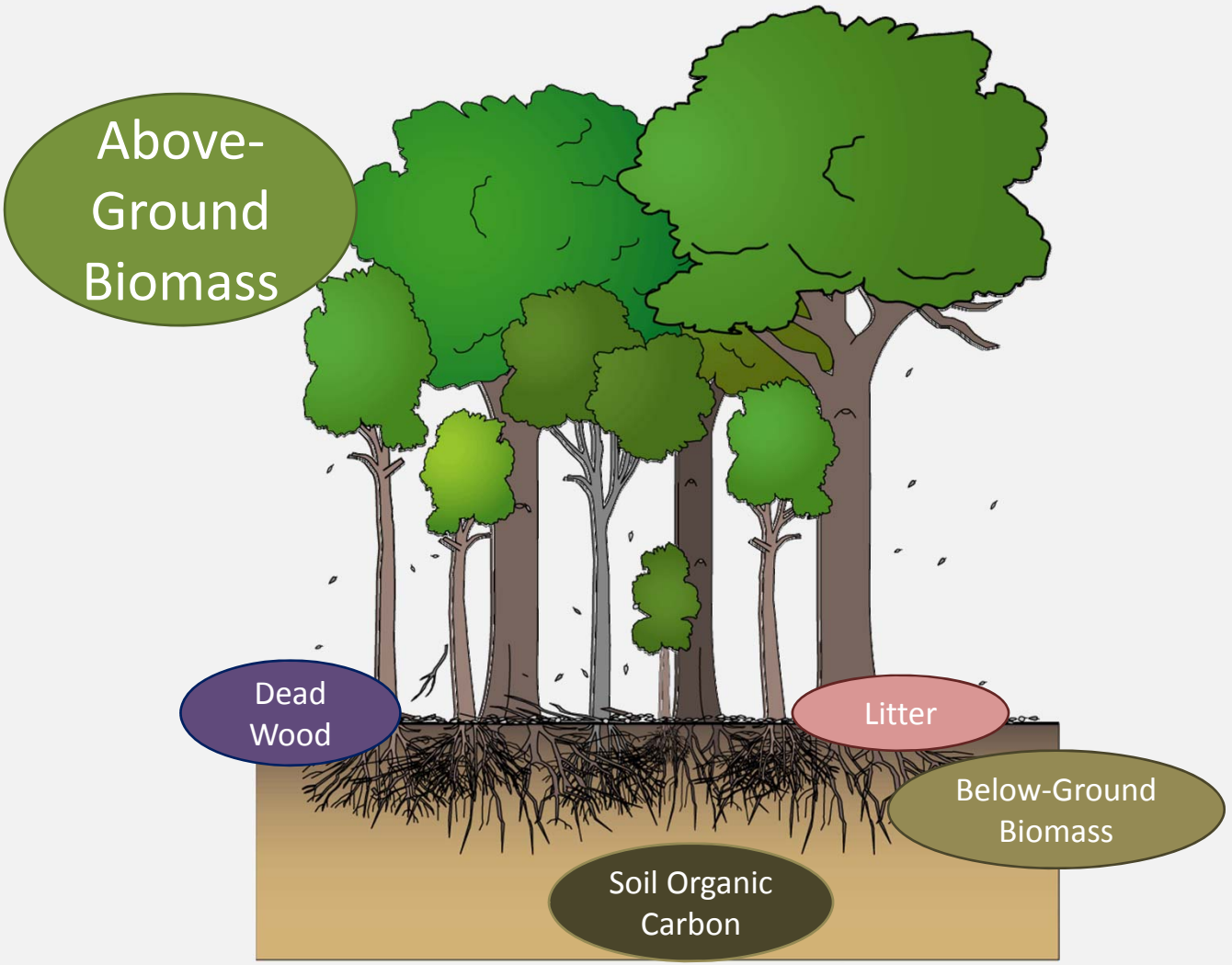
- **Emission factor**
  - *A coefficient that relates the activity data to the amount of chemical compound that is the source of emissions*
  - *LULUCF: emissions of CO_2, CH_4, CO, N_2O and NO_x resulting from land-use (change) and forestry activities (measured in tonnes CO2 eq. /ha)*



- **Removal factor**
  - *Rate at which carbon is taken up from the atmosphere by terrestrial systems and sequestered (stored) in biomass and soil (measured in tonnes CO2eq./ha)*

- *Emission/removal factors are often based on a sample of measurement data averaged to develop a representative rate of emission or removal for a given activity level under a given set of operating conditions (e.g. logging, deforestation, reforestation)*

The 5 Forest Carbon Pools



Emission/Removal Factors in a GHG Inventory (example from a UNFCCC table)

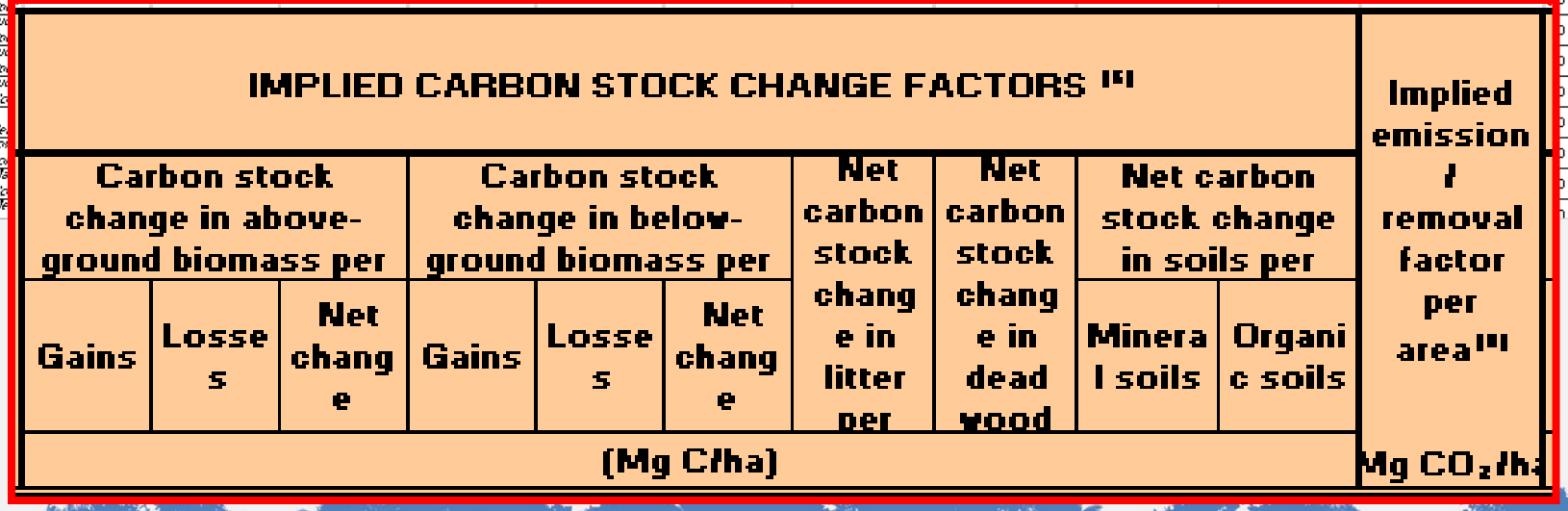
UN-REDD PROGRAMME

TABLE 5(KP-I)A.2. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

Article 3.3 activities: Deforestation [1]

AUSTRALIA
Inventory 2011
Submission 2013 v1.1

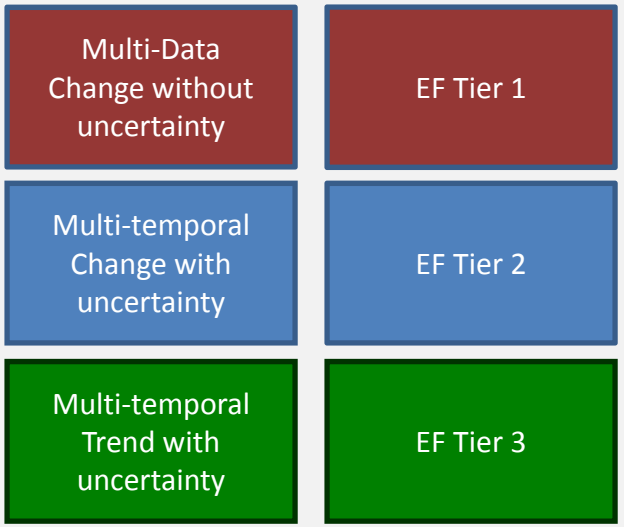
GEOGRAPHICAL LOCATION [2]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [5]										CHANGE IN CARBON STOCK [5]										Net CO_2 emissions/ removals [5]
Identification code	Subdivision [3]	Area subject to the activity	Area of organic soils [4]	Carbon stock change in above-ground biomass per			Carbon stock change in below-ground biomass per			Net carbon stock change in litter per	Net carbon stock change in dead wood	Net carbon stock change in soils per		Implied emission / removal factor per area [5]	Carbon stock change in above-ground biomass [5]			Carbon stock change in below-ground biomass [5]			Net carbon stock change in litter [5]	Net carbon stock change in dead wood [5]	Net carbon stock change in soils [5]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [5]	
		(kha)	(kha)	(Mg C/ha)										Mg CO_2/ha	(Gg C)									(Gg CO_2)
Total for activity A.2.		6,561.52	NO	0.00	-0.39	-0.39	0.00	-0.17	-0.17	-0.15	-0.34	-0.47	NO	5.57	0.50	-2,561.09	-2,560.59	0.23	-1,135.73	-1,135.50	-958.47	-2,185.90	-3,044.52	NO	36,244.92
NSW		1,220.73	NO	0.00	-0.80	-0.80	0.00	-0.34	-0.34	-0.33	-0.41	-0.55	NO	8.87	0.27	-812.57	-812.30	0.12	-350.44	-350.32	-331.81	-416.51	-556.98	NO	9,049.08
	Acacia Forest and Woodland	61.17	NO	IE	-0.18	-0.18	IE	-0.08	-0.08	-0.14	-0.18	0.01	NO	2.08	IE	-10.92	-10.92	IE	-4.95	-4.95	-8.59	-10.92	0.69	NO	127.18
	Acacia Open Woodland	0.44	NO	IE	-0.52	-0.52	IE	-0.50	-0.50	-0.22	-0.33	0.04	NO	5.61	IE	-0.23	-0.23	IE	-0.22	-0.22	-0.10	-0.15	0.02	NO	2.49
	Acacia Shrubland	93.21	NO	IE	-0.12	-0.12	IE	-0.12	-0.12	-0.15	-0.06	-0.01	NO	1.71	IE	-11.28	-11.28	IE	-10.86	-10.86	-14.21	-5.86	-1.38	NO	159.82
	Callitris Forest and Woodland	48.32	NO	IE	-0.46	-0.46	IE	-0.21	-0.21	-0.29	-0.15	-0.19	NO	4.76	IE	-22.01	-22.01	IE	-10.10	-10.10	-14.15	-7.29	-9.17	NO	229.99
	Casuarina Forest and	51.32	NO	IE	-0.39	-0.39	IE	-0.18	-0.18	-0.23	-0.45	-0.05	NO	4.74	IE	-20.05	-20.05	IE	-9.03	-9.03	-11.68	-23.06	-2.53	NO	243.29
	Eucalyptus Low Open	1.38	NO	0.19	IE	0.19	0.09	IE	0.09	-0.20	-0.50	-0.23	NO	2.40	0.27	IE	0.27	0.12	IE	0.12	-0.28	-0.69	-0.82	NO	3.31
	Eucalyptus																								4,386.28
	Eucalyptus Open																								896.73
	Eucalyptus Open																								522.03
	Eucalyptus Woodland																								2,103.99
	Heath																								32.09
	Low Open Forest																								7.70
	Mallee Woodland																								181.40
	Melaleuca																								13.15



IMPLIED CARBON STOCK CHANGE FACTORS [5]									Implied emission / removal factor per area [5]
Carbon stock change in above-ground biomass per			Carbon stock change in below-ground biomass per			Net carbon stock change in litter per	Net carbon stock change in dead wood	Net carbon stock change in soils per	
Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils	
(Mg C/ha)									Mg CO_2/ha

Designing National Forest Inventories (NFIs) to Assess EFs

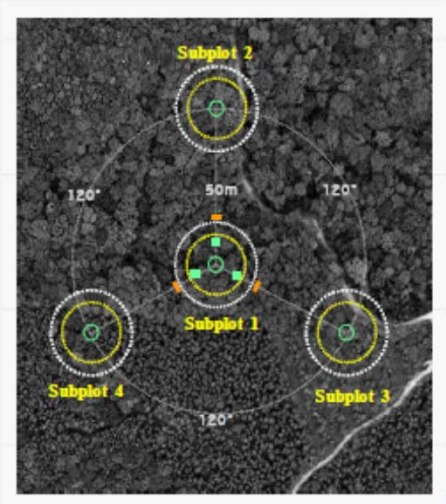
- Estimation must be made:
  - For carbon stock **CHANGES**!
  - For diverse ecological conditions and/or management regimes
  - Emissions and removals due to human activity
  - For changes in all 5 carbon pools (wherever poss.)

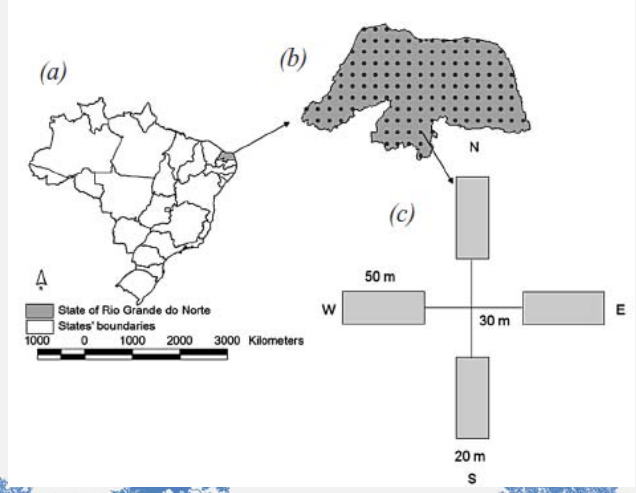


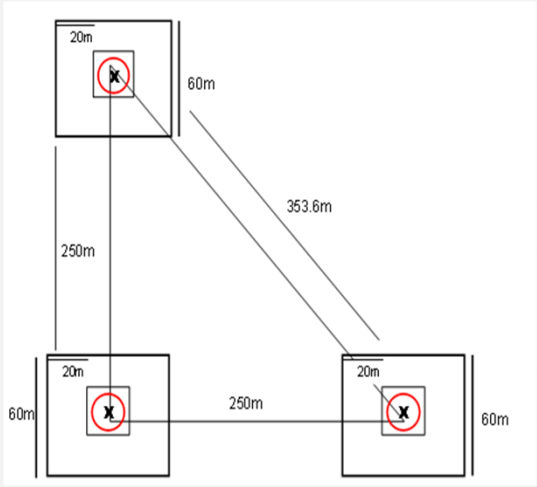
- IPCC requirements for NFIs
  - Estimations of Emission Factors made to Tier 2 or Tier 3 level – this requires:
    - Country-specific estimates of emission factors
    - Multi-temporal inventory data
    - Uncertainty analysis
    - Quality Assurance / Quality Control (QA/QC)

National Forest Inventories (NFIs)

- The goal of a NFI is to generate information for:
  - Decision making (national / sub-national)
  - Monitoring in forestry & related sectors
- 41 out of 42 Annex 1 countries use NFIs as a data source to compile their national GHG inventory
  - Fulfills IPCC requirement of 'completeness'
- Diverse approaches around the world







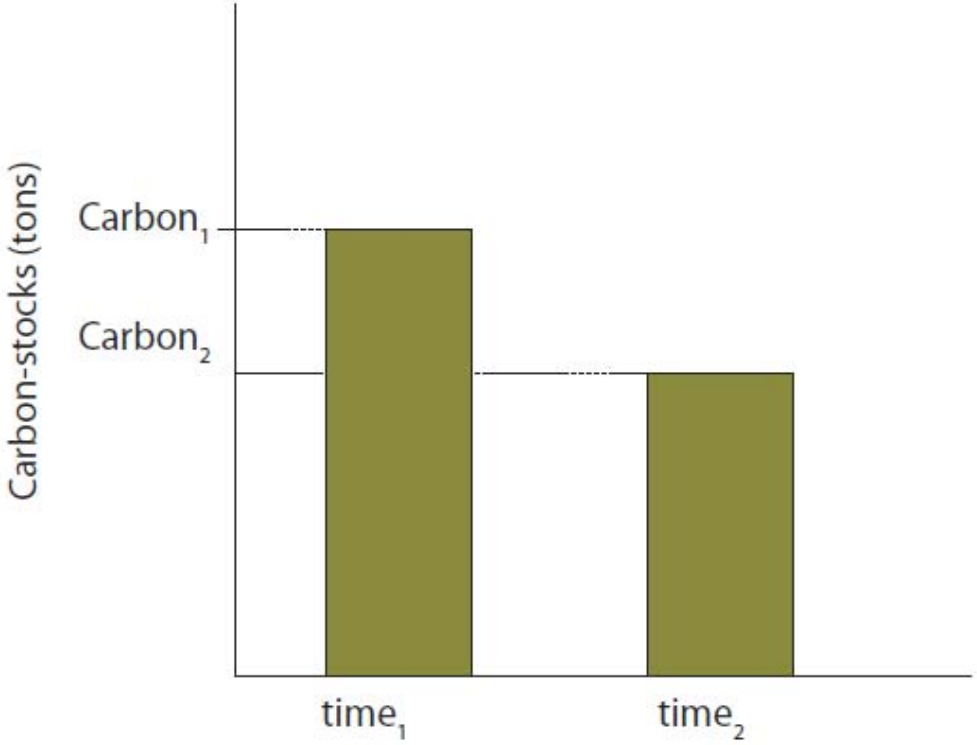
2 ways of Measuring Changes in forest carbon

1) Stock-Difference and 2) Gain-Loss

METHOD 1

Stock-difference

The difference between carbon stocks gives carbon emissions



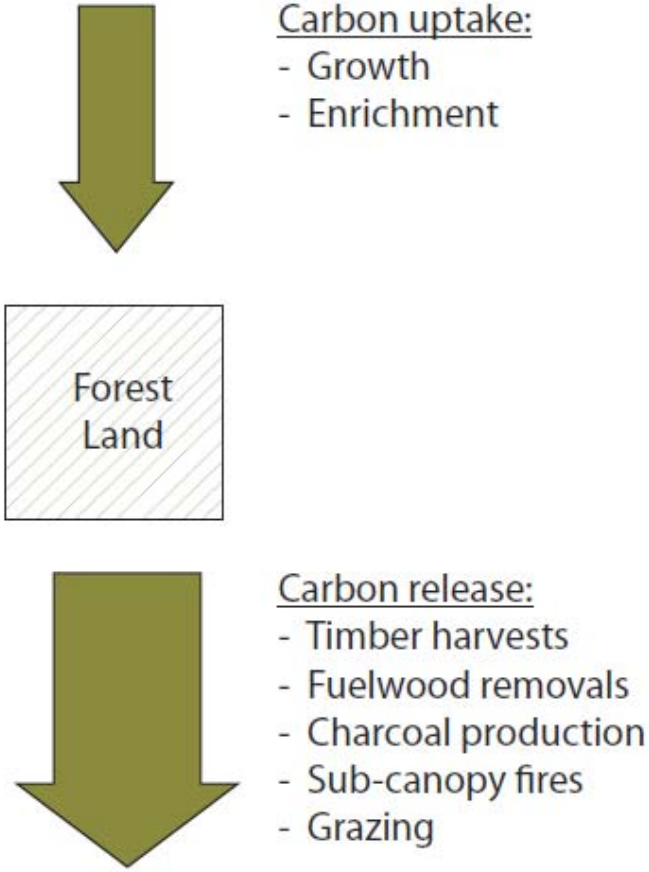
Carbon$_1$: Carbon stocks time$_1$

Carbon$_2$: Carbon stocks time$_2$

METHOD 2

Gain-loss

Carbon emissions are calculated from gain minus loss



UN-REDD PROGRAMME

National Forest Monitoring Systems for REDD+

MRV FOR REDD+: REPORTING

What is Reporting for REDD+?

- Two ways for countries to report to the UNFCCC on progress with REDD+:
  1. National communications (shortened to NC)
  2. Biennial Update Reports (shortened to BUR)

- Countries voluntarily report with a Technical Annex to the BUR if they want to access REDD+ finance, based on results from the implementation of REDD+ activities

- National Communications include data and information on:
  - National circumstances
  - Vulnerability assessment
  - Financial resources and technology transfer for climate change
  - Education, training, public awareness
  - National GHG inventory

Reporting for REDD+

UN-REDD PROGRAMME

Transparent

- Sufficient and clear documentation showing how inventory was compiled
- Following Good Practice requirements

Complete

- Estimates are reported for all sources, sinks and gases
- National coverage

Comparable

- Reporting should follow international guidance and templates

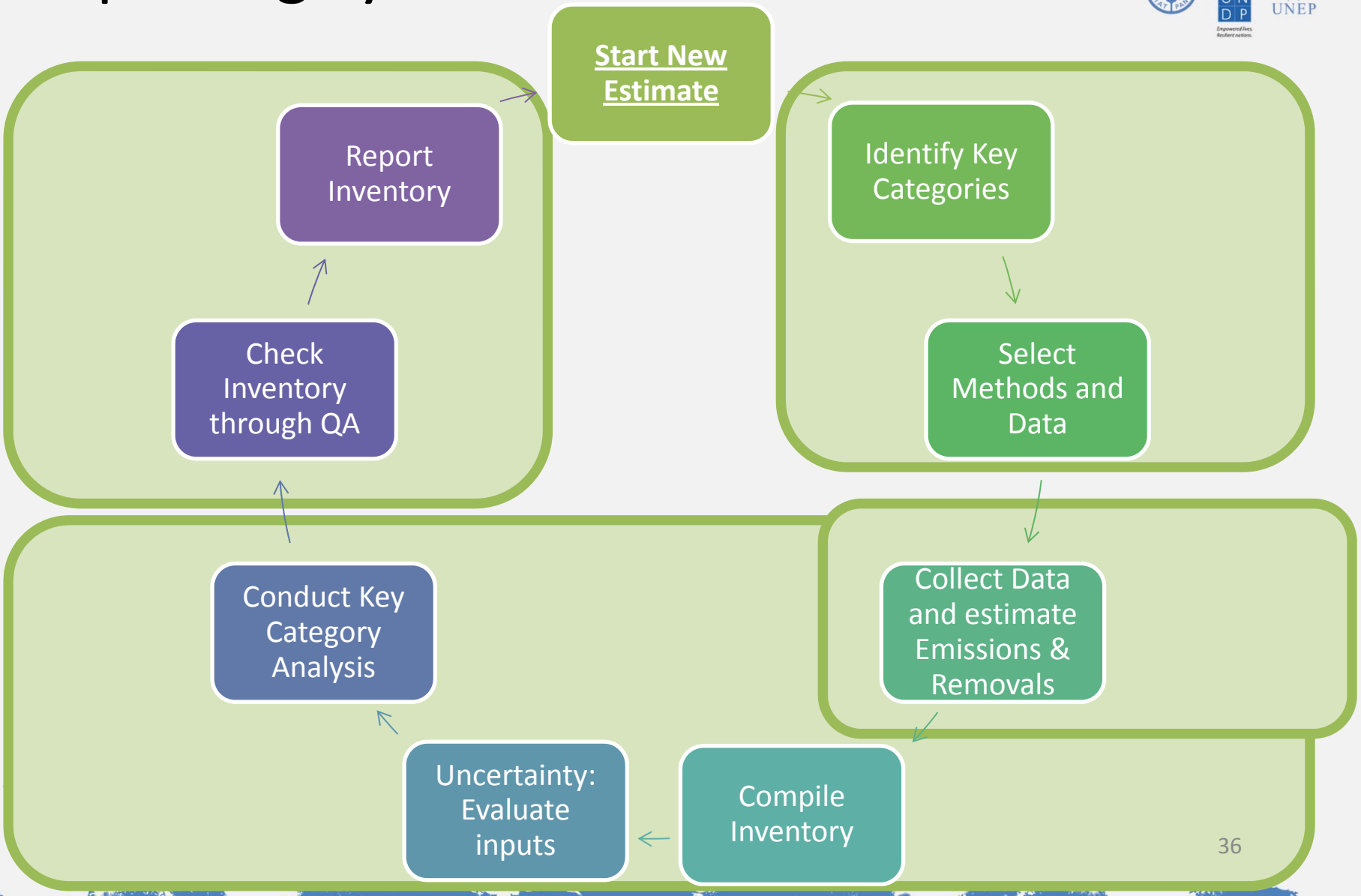
Consistent

- Inventories should aim to reflect the real fluctuations in emissions and removals
- Not be subject to changes resulting from methodological differences

Accurate

- GHG inventory contains neither under- nor over-estimates so far as can be judged
- Efforts have been made to reduce bias

Reporting cycle for REDD+



Reporting for REDD+ QA and QC

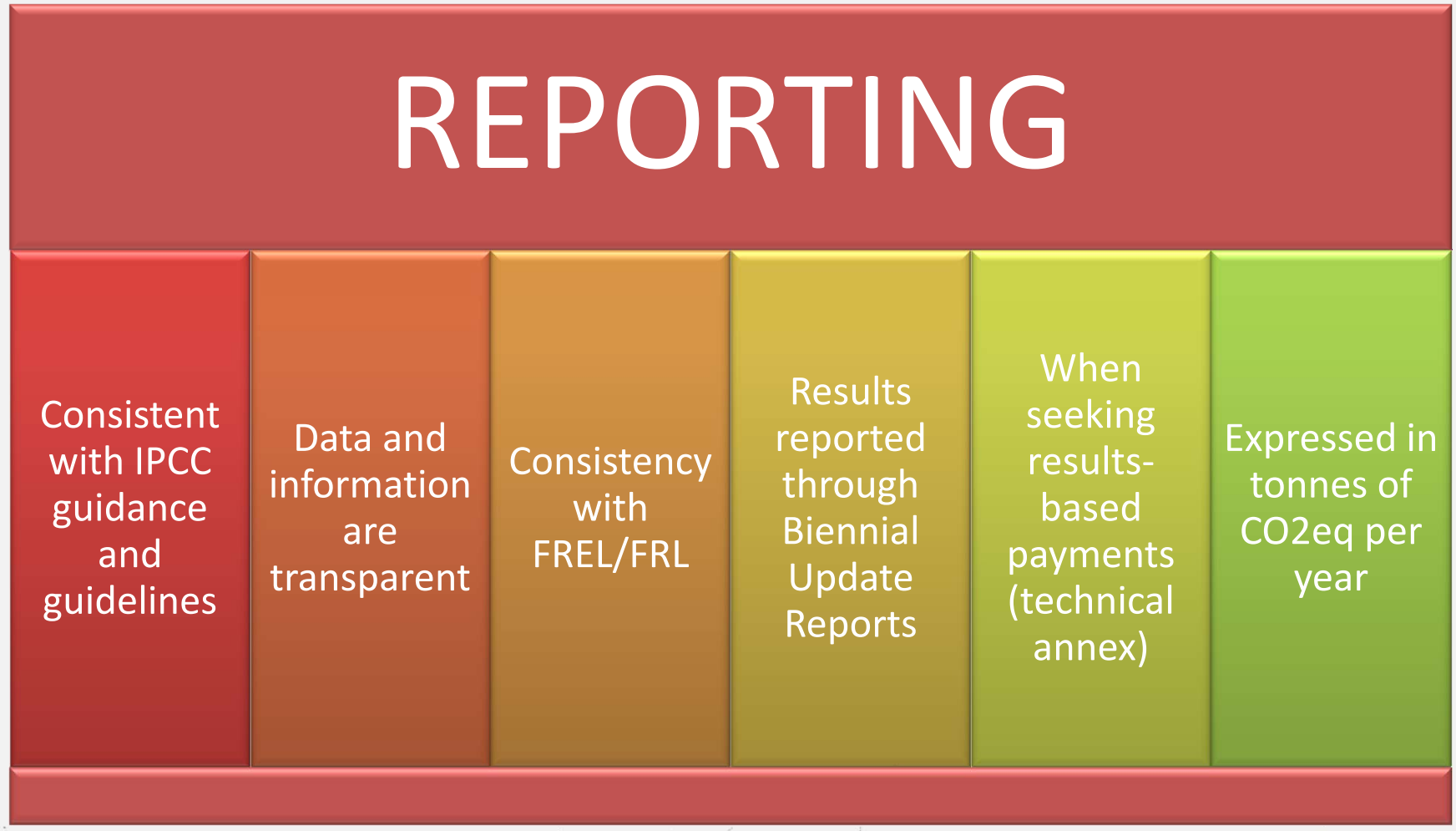
Quality Control

- Routine and consistent checks to ensure data integrity, correctness and completeness
- Identify and address errors and omissions
- Document and archive inventory material and record all QA activities

Quality Assurance

- Reviews, preferably by independent third parties, should be performed upon a finalized inventory following the implementation of QC procedures

Reporting for REDD+



Reporting for REDD+: Biennial Update Reports (BURs)

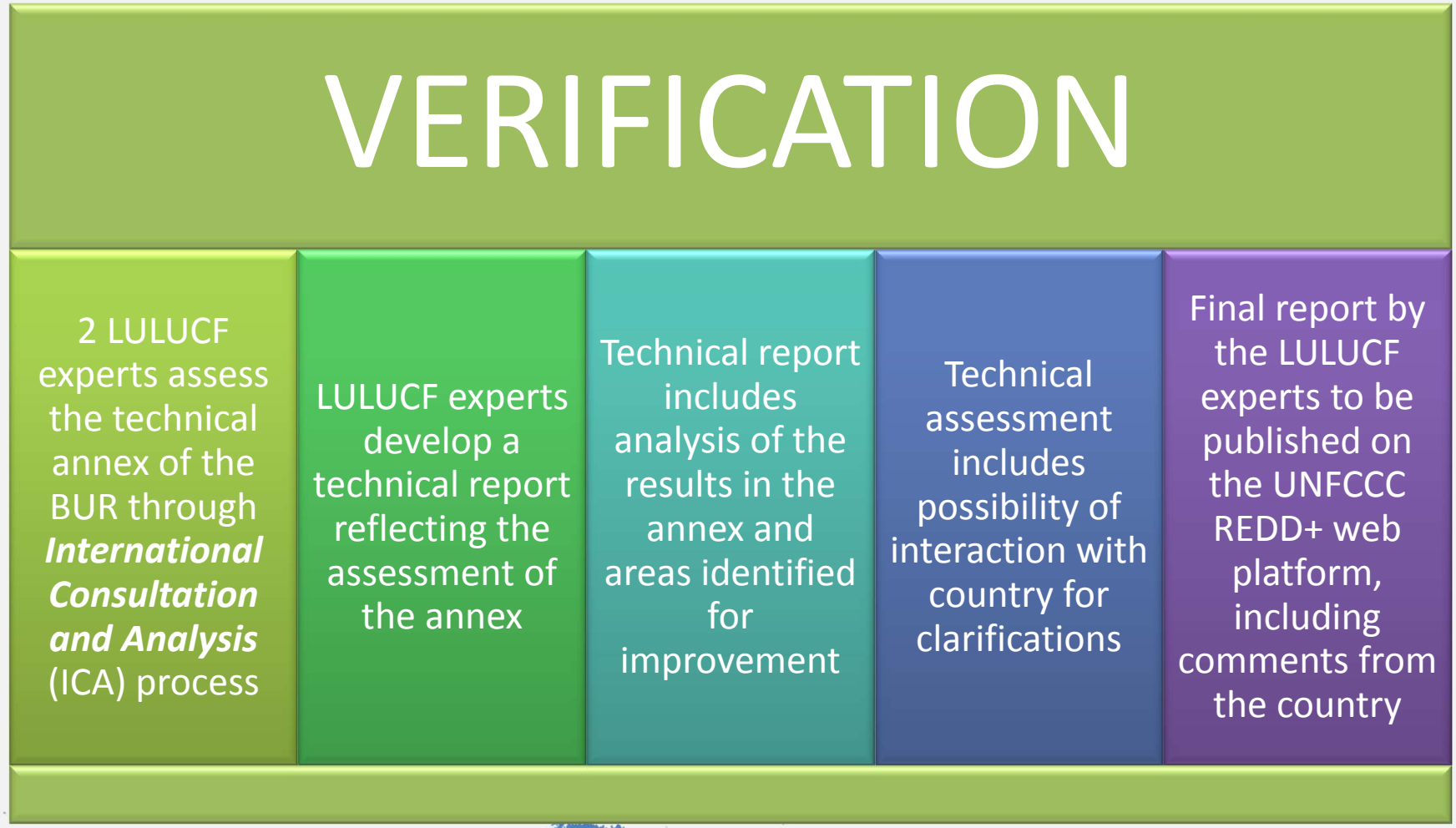
- To provide an update on the most recently submitted national communication in the following areas:
  - National circumstances and institutional arrangements
  - National GHG inventory
  - Mitigation actions and their effects, including methodologies
  - Constraints and gaps and related financial, technical and capacity needs
  - Level of support received to prepare and submit the BUR
  - Domestic measurement, reporting and verification
- REDD+ results to be reported through a technical annex to BUR
- No specific structure yet (templates being prepared by GIZ)
- Non-Annex 1 countries requested to submit by December 2014

UN-REDD PROGRAMME

National Forest Monitoring Systems for REDD+

MRV FOR REDD+: VERIFICATION

What is Verification for REDD+?



Summary: Measurement, Reporting and Verification (MRV) for REDD+

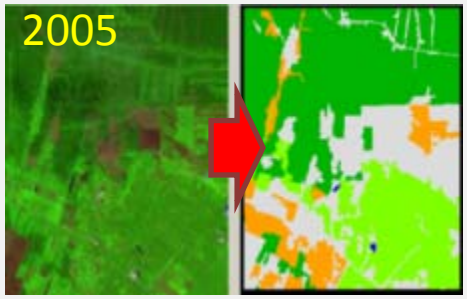
UN-REDD PROGRAMME

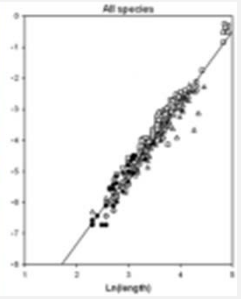
Measurement

ACTIVITY DATA
Satellite land monitoring system

x

EMISSION FACTOR
National Forest Inventory

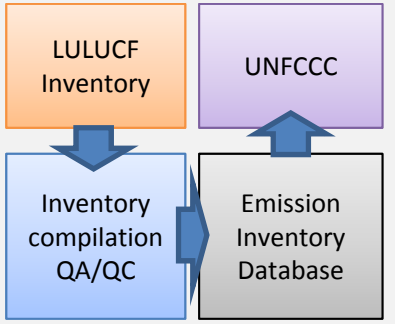




Reporting

=

GHG Inventory for the LULUCF sector



Verification

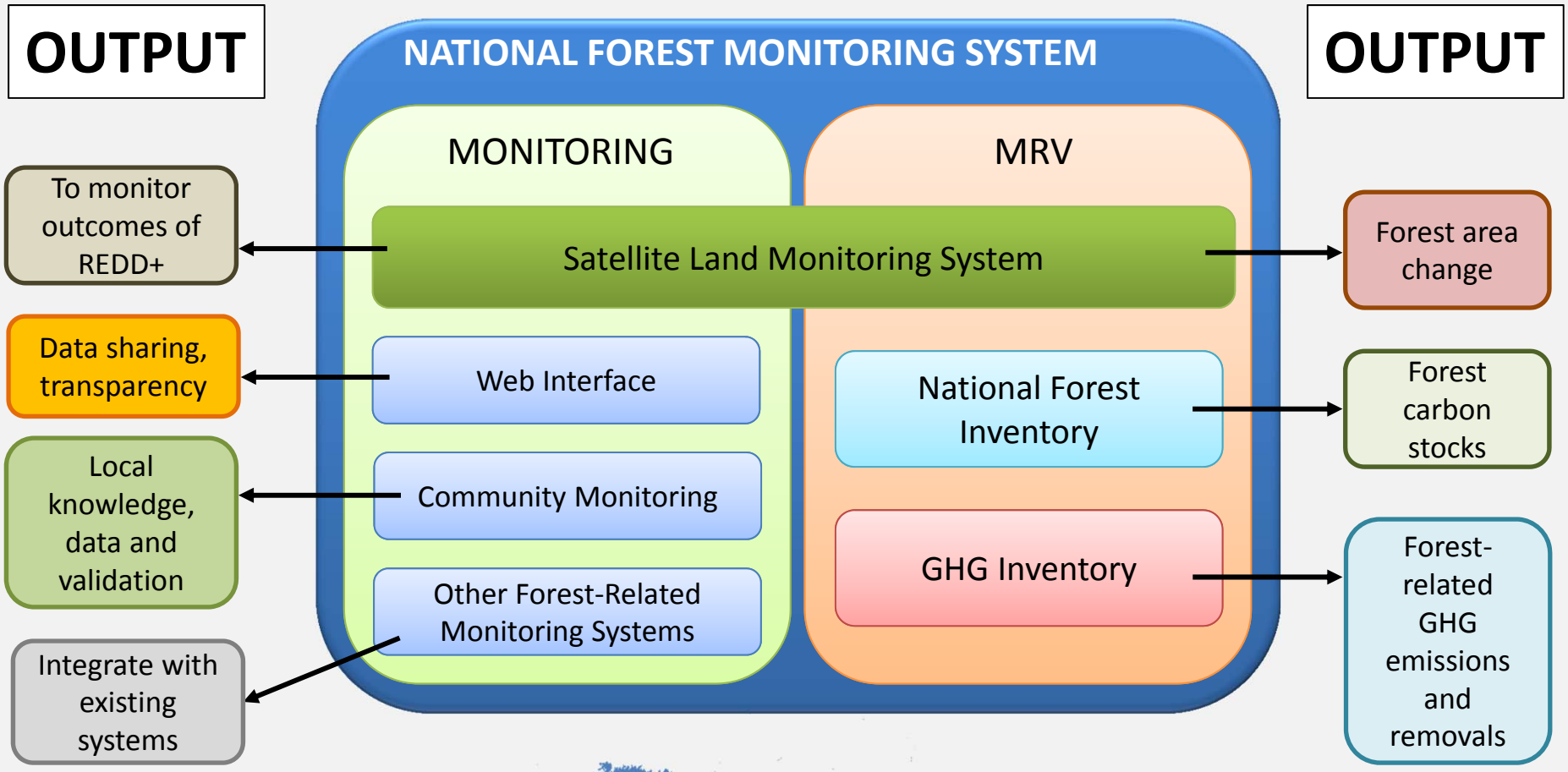
Roster of Experts (UNFCCC Secretariat)

UN-REDD PROGRAMME

National Forest Monitoring Systems for REDD+

FOREST MONITORING FOR REDD+

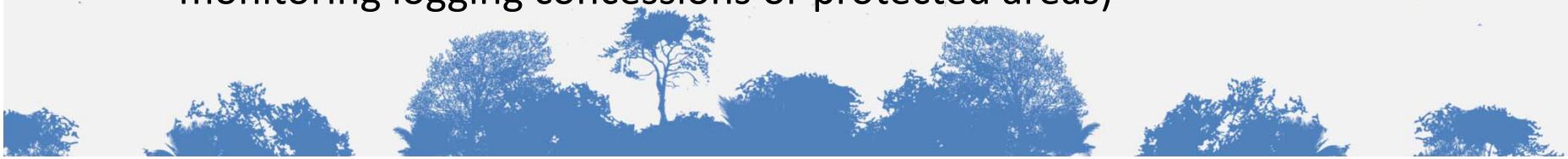
Two functions of a National Forest Monitoring System for REDD+



Forest Monitoring for REDD+

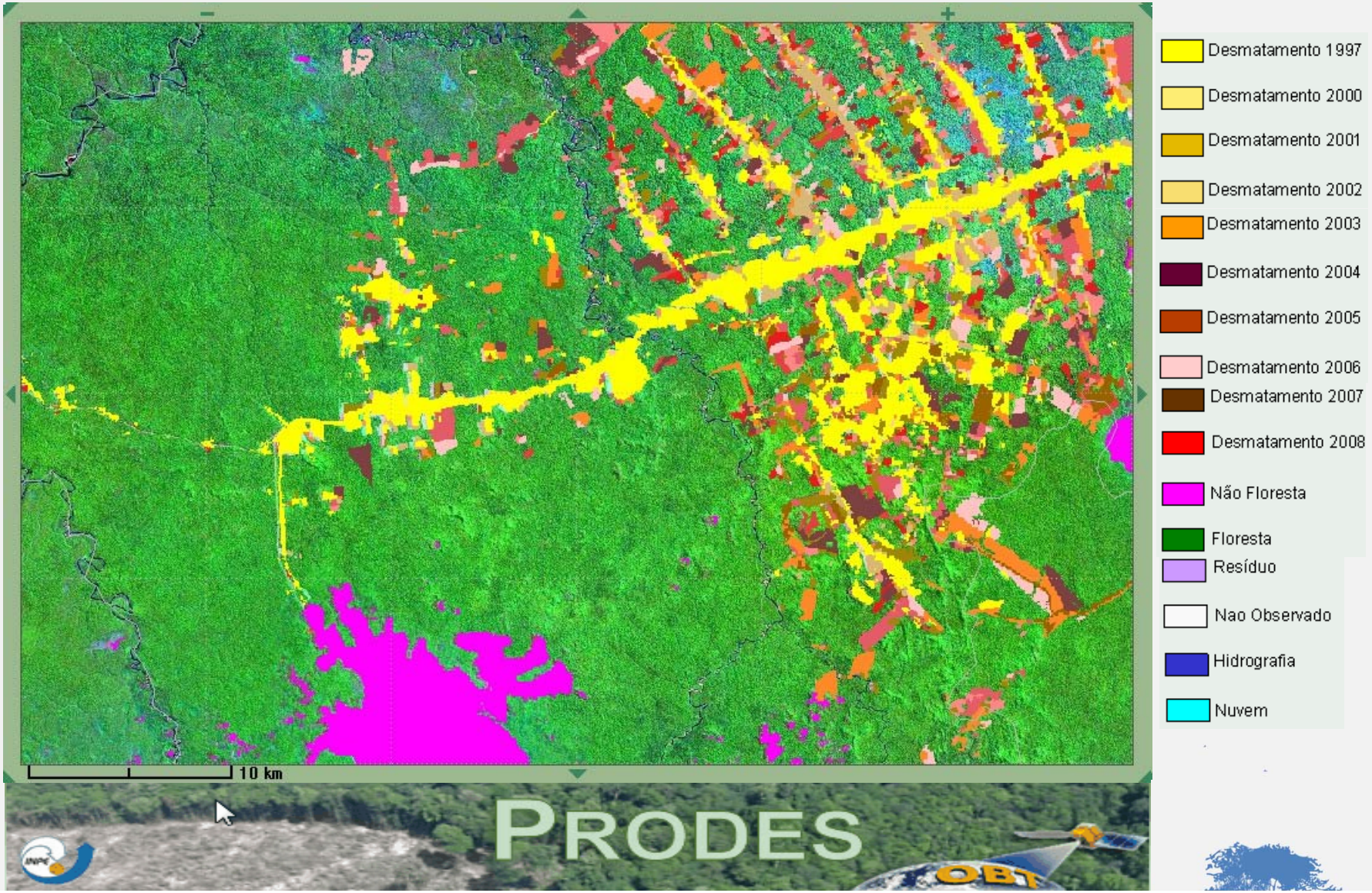
- Purpose of monitoring for REDD+: To assess whether REDD+ activities are working
- Phased implementation of monitoring for REDD+
  - ***Phase 1***: Getting ready for REDD+, data, systems and capacity development
  - ***Phase 2***: Monitoring of REDD+ demonstration activities
  - ***Phase 3***: National monitoring of REDD+ policies and measures

- Combination of tools to gather a range of data/information
  - ***Satellite remote sensing***: Cost-effective to large area coverage
  - ***Web-GIS portal***: To share data transparently
  - ***Community monitoring***: Bottom-up validation of satellite data, incorporation of local knowledge into national monitoring
  - ***Other forest monitoring systems***: Build on existing systems (e.g. systems to monitoring logging concessions or protected areas)



Forest Monitoring for REDD+

Satellite Remote Sensing: Brazil: PRODES



Forest Monitoring for REDD+

Web-GIS Portals

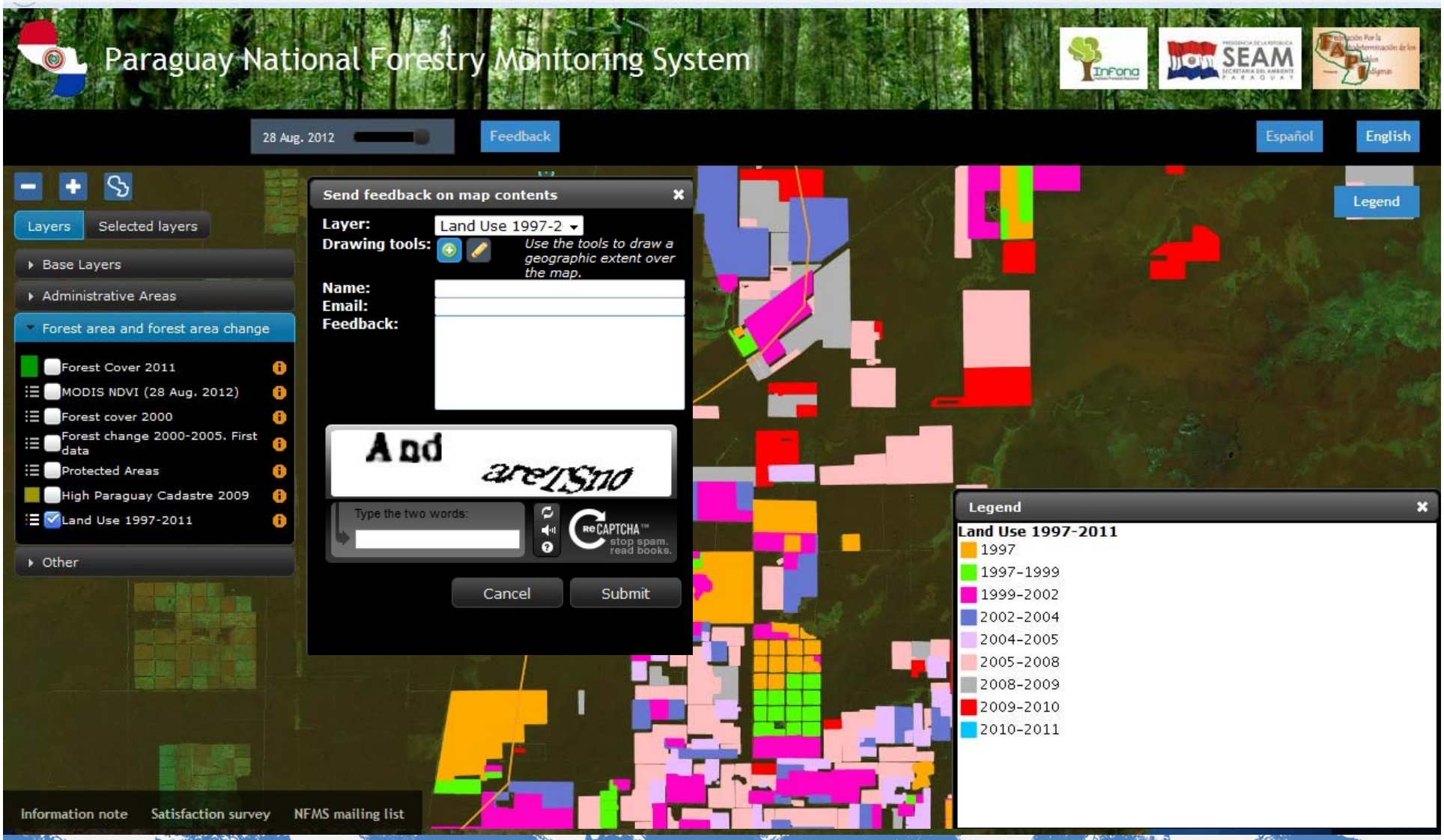
- Allows a country to monitor the outcomes of the implementation of its REDD+ policies and measures and communicate the results to the international community (transparent and open reporting process)
- Allows any user to interact with the system through a user-friendly web-interface
  - Visualise data
  - Manipulate data layers, e.g. to select areas and layers of interest
  - Download statistics
  - Visualise information on logging concessions, protected areas, REDD+ activities, etc.
- Allows users to provide feedback, e.g. on areas of deforestation

Forest Monitoring for REDD+
Web-GIS Portals: Democratic Republic of Congo

http://www.rdc-snsf.org

Forest Monitoring for REDD+

Web-GIS Portals: Paraguay



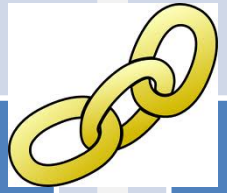
UN-REDD PROGRAMME

National Forest Monitoring Systems for REDD+

LINKING NFMS, MRV & IPCC

Linking NFMS, MRV and IPCC

Monitoring	Activity Data	×	Emission Factor	=	Emissions
Assess performance of REDD+ activities	Representation of land-uses		National Forest Inventory		National GHG inventory
Emissions & removals proxies	land-use change matrix		Forest carbon stocks and changes		Forest-related GHG emissions by sources and removals by sinks



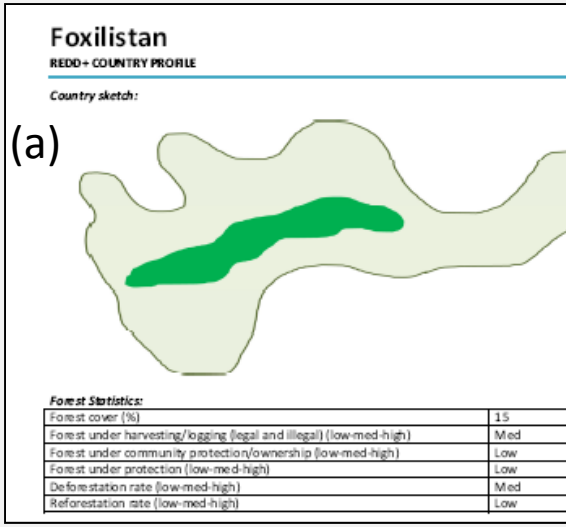
Summary of NFMS and MRV

- Main components of a National Forest Monitoring System for REDD+ include a Satellite Land Monitoring System and a National Forest Inventory
- Key principles of IPCC's guidance for measurement, reporting and verification (MRV) for REDD+
  - Transparent, Documented, Consistent over time, Complete, Comparable, Assessed for uncertainties
- What's involved in MRV for REDD+
  - Measurement: Activity data x Emission Factors = Emissions
  - Report through NC and BUR on GHG emissions tonnes CO2 eq.
  - Verification – preferably by 3rd party reviewers
- Countries can design their own systems

Introduction to exercise 2 on NFMS – 30 minutes please

- Break into 9 groups and examine 1 of the 9 fictional countries (a) for your group number
- Examine the guidance document (b) and discuss among the group the different questions
- During the discussion designate a note-taker to compile your discussion points and decisions
- At the end of the exercise consider your priority actions and reflect among the group
- If you need any guidance on the exercise please ask a facilitator
- Enjoy!

(a)



Foxilistan

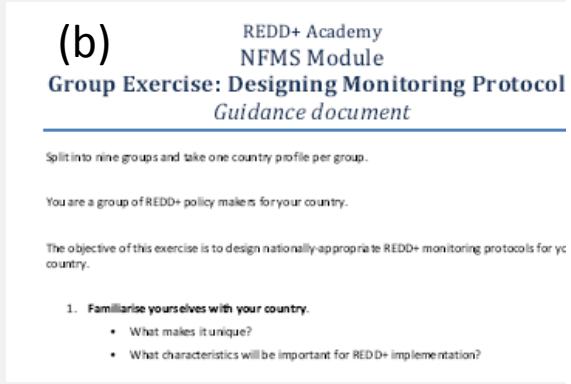
REDD+ COUNTRY PROFILE

Country sketch:

Forest Statistics:

Forest cover (%)	15
Forest under harvesting/logging (legal and illegal) (low-med-high)	Med
Forest under community protection/ownership (low-med-high)	Low
Forest under protection (low-med-high)	Low
Deforestation rate (low-med-high)	Med
Reforestation rate (low-med-high)	Low

(b)



REDD+ Academy

NFMS Module

Group Exercise: Designing Monitoring Protocol

Guidance document

Split into nine groups and take one country profile per group.

You are a group of REDD+ policy makers for your country.

The objective of this exercise is to design nationally-appropriate REDD+ monitoring protocols for yc country.

1. **Familiarise yourselves with your country.**
   - What makes it unique?
   - What characteristics will be important for REDD+ implementation?