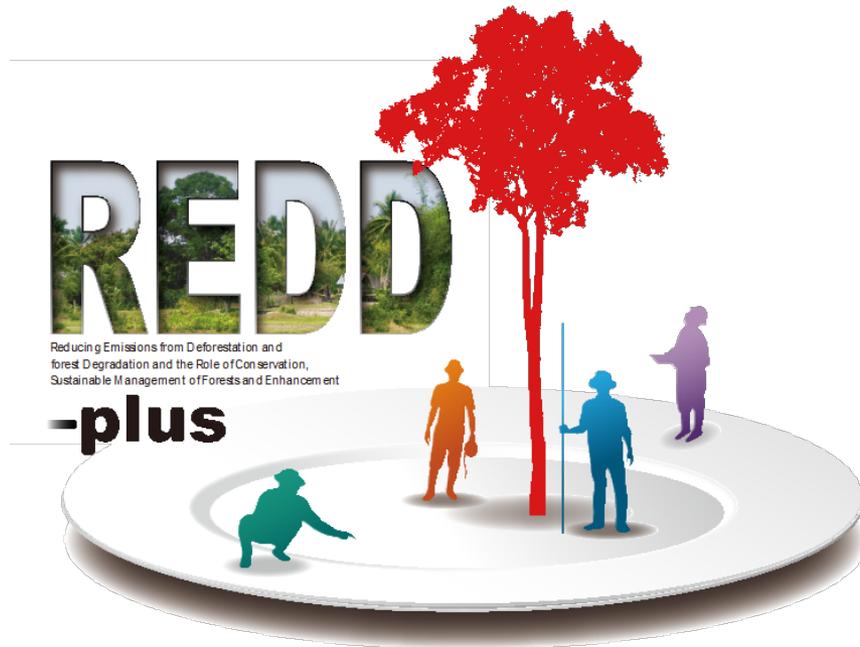


# REDD+ Cook Book :

## How to systematically deal with estimation on GHG emissions and removals in forest land sector

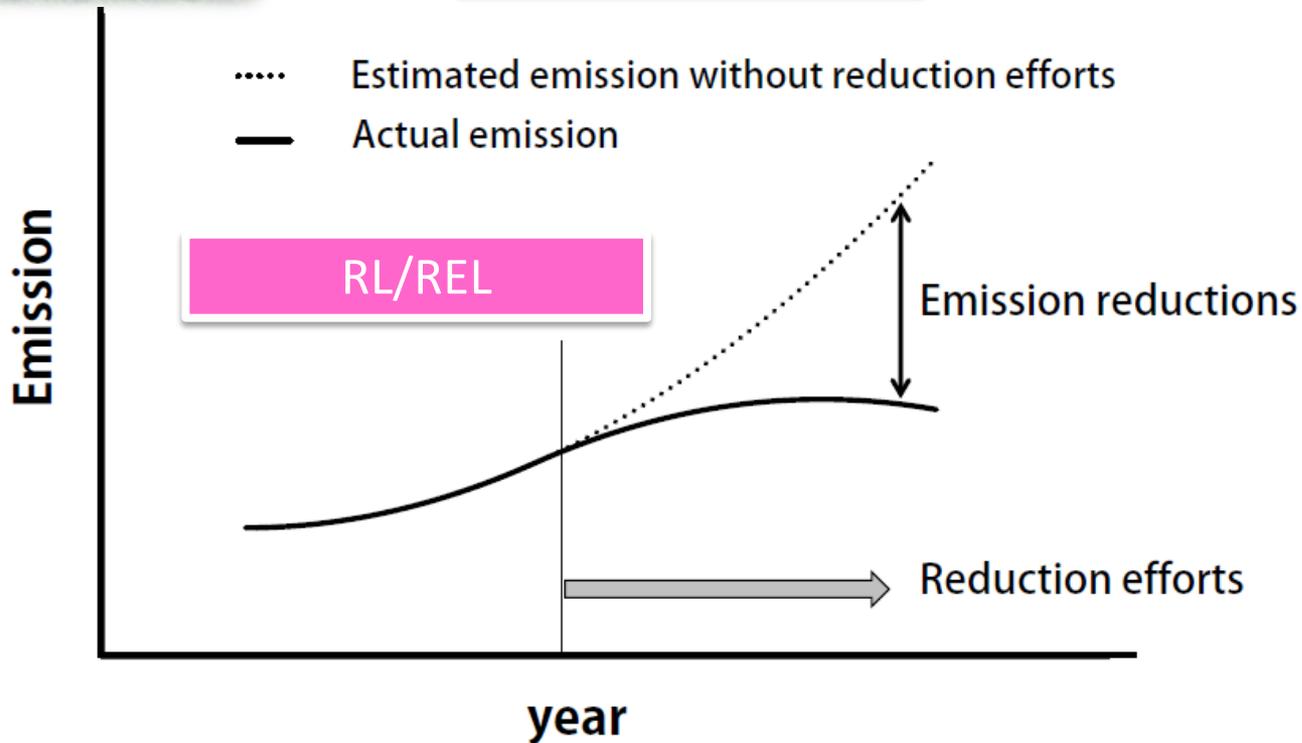


Mitsuo Matsumoto  
REDD Research & Development Center  
Forestry and Forest Products Research Institute

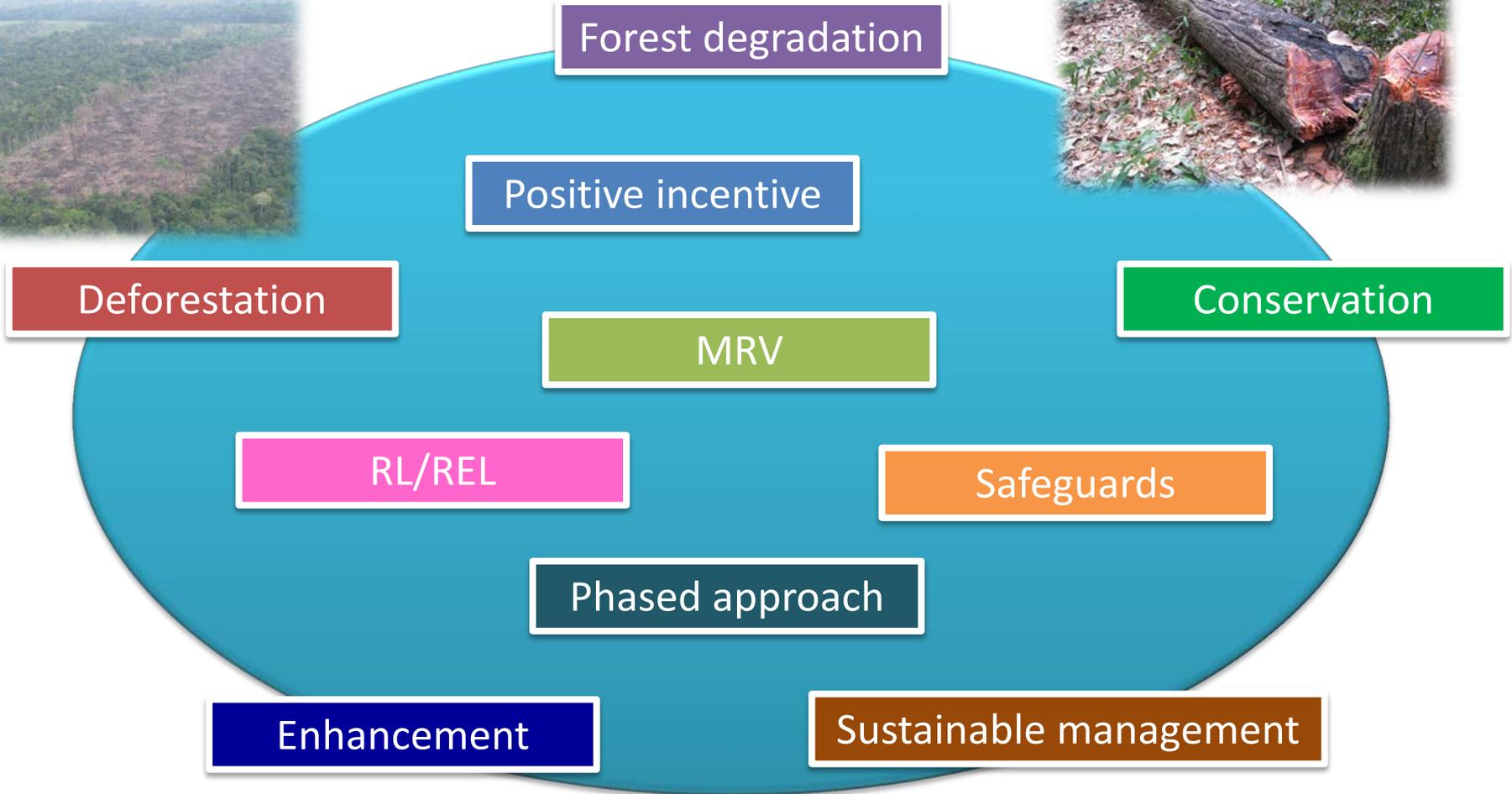
# Recalling REDD(-plus)...



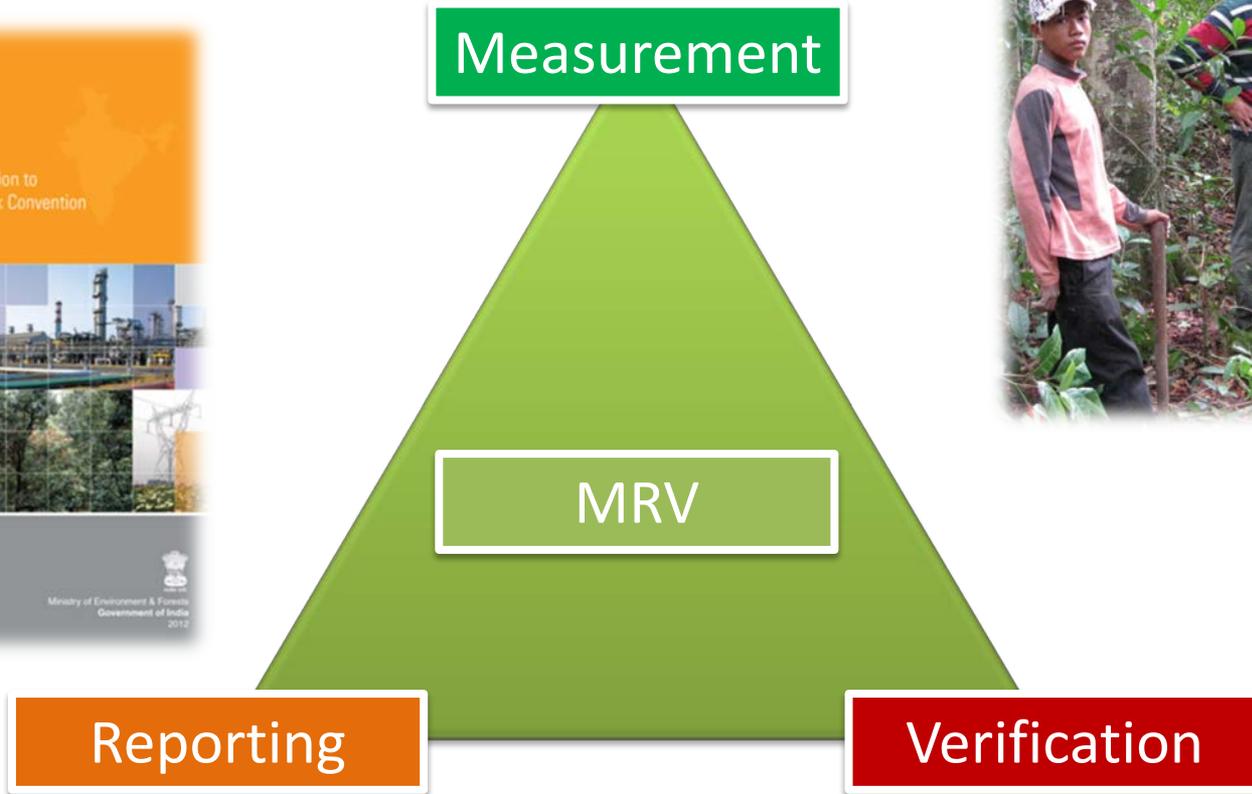
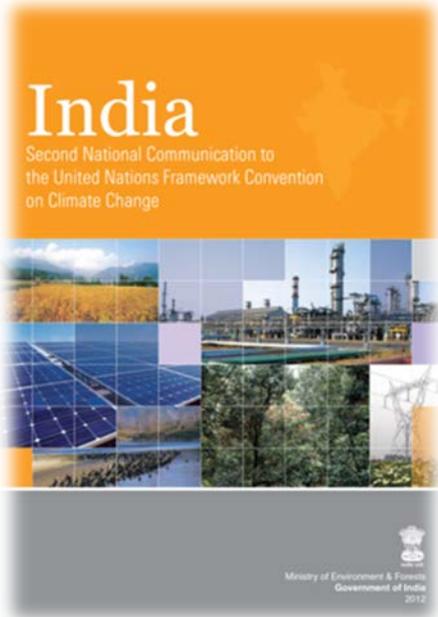
Positive incentive



# Recalling REDD(-plus)...



# MRV of Forest Monitoring



# MRV of Forest Monitoring

## Measurement

- (d) To establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems and, if appropriate, sub-national systems as part of national monitoring systems that:
- (i) Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes;

# Why Cookbook is needed?

- Capacity building for every stakeholders is crucial
- REDD+ needs wide range of technical knowledge (satellite imagery, ground-based survey...)
- Many jargons (phased approach, safeguards...)
- Many good technical manuals are exist but not always user-friendly



# Target of “Cookbook”

## Introduction

for the policy makers and their partner organizations

## Planning

for the REDD-plus implementing organizations/countries

## Technical

for the experts who work on the REDD-plus activities

## Reference Guide

providing users with useful information by proposing or showing examples

# Framework of “Cookbook”

## Introduction

Chapter 1 - About REDD-plus

Chapter 2 - Designing a forest monitoring system

## Planning

Chapter 3 - Basic knowledge needed for REDD+ implementation

Chapter 4 - Measurement, reporting and verification (MRV) of forest carbon

Chapter 5 - Monitoring by the stock change method

## Technical

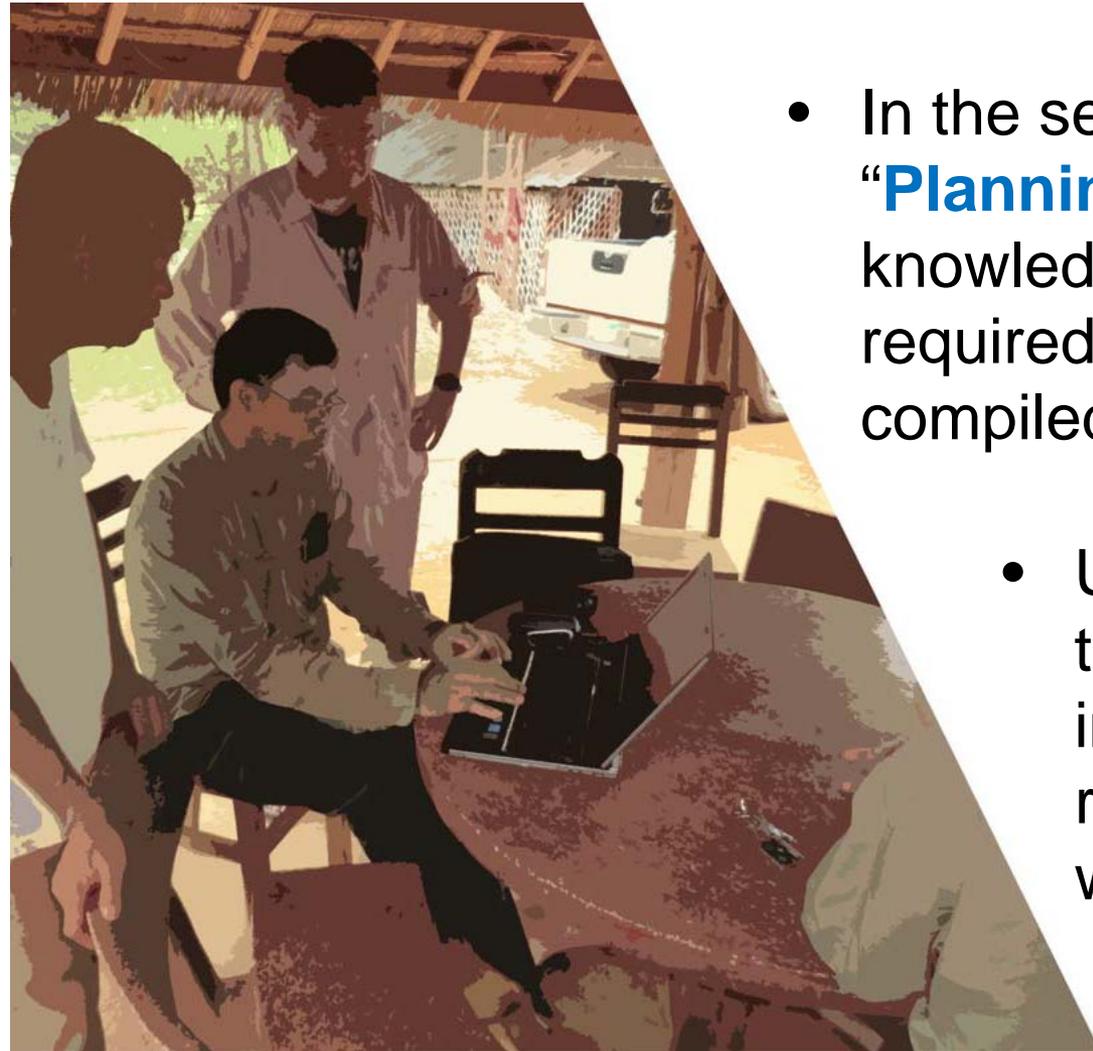
Chapter 6 - Preparation of REDD+ implementation

Chapter 7 - Estimation of forest area using remote sensing

Chapter 8 - Permanent sample plot method

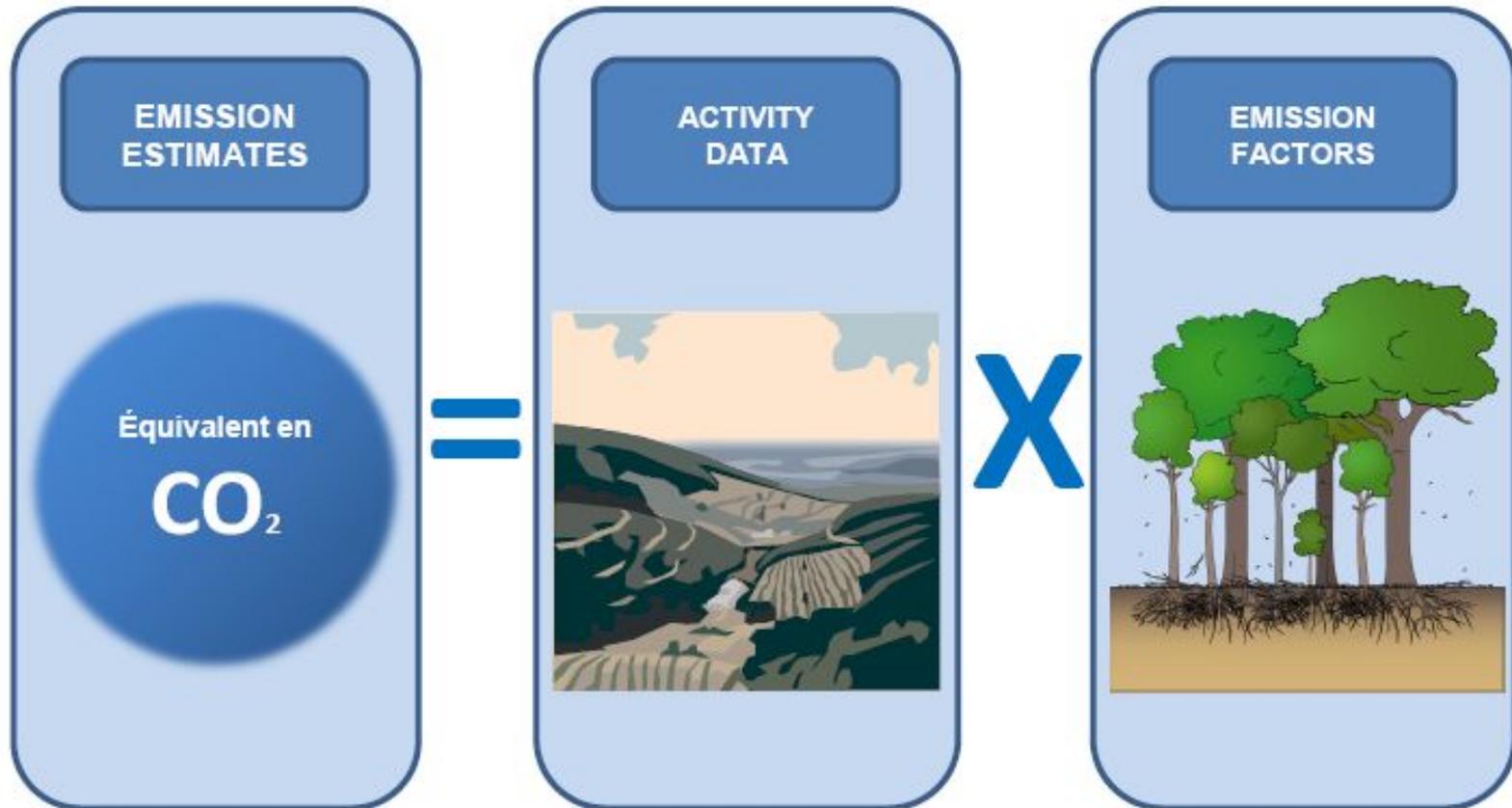
Chapter 9 - Estimation models for forest carbon stocks

# Unit and structure of the “Cookbook”

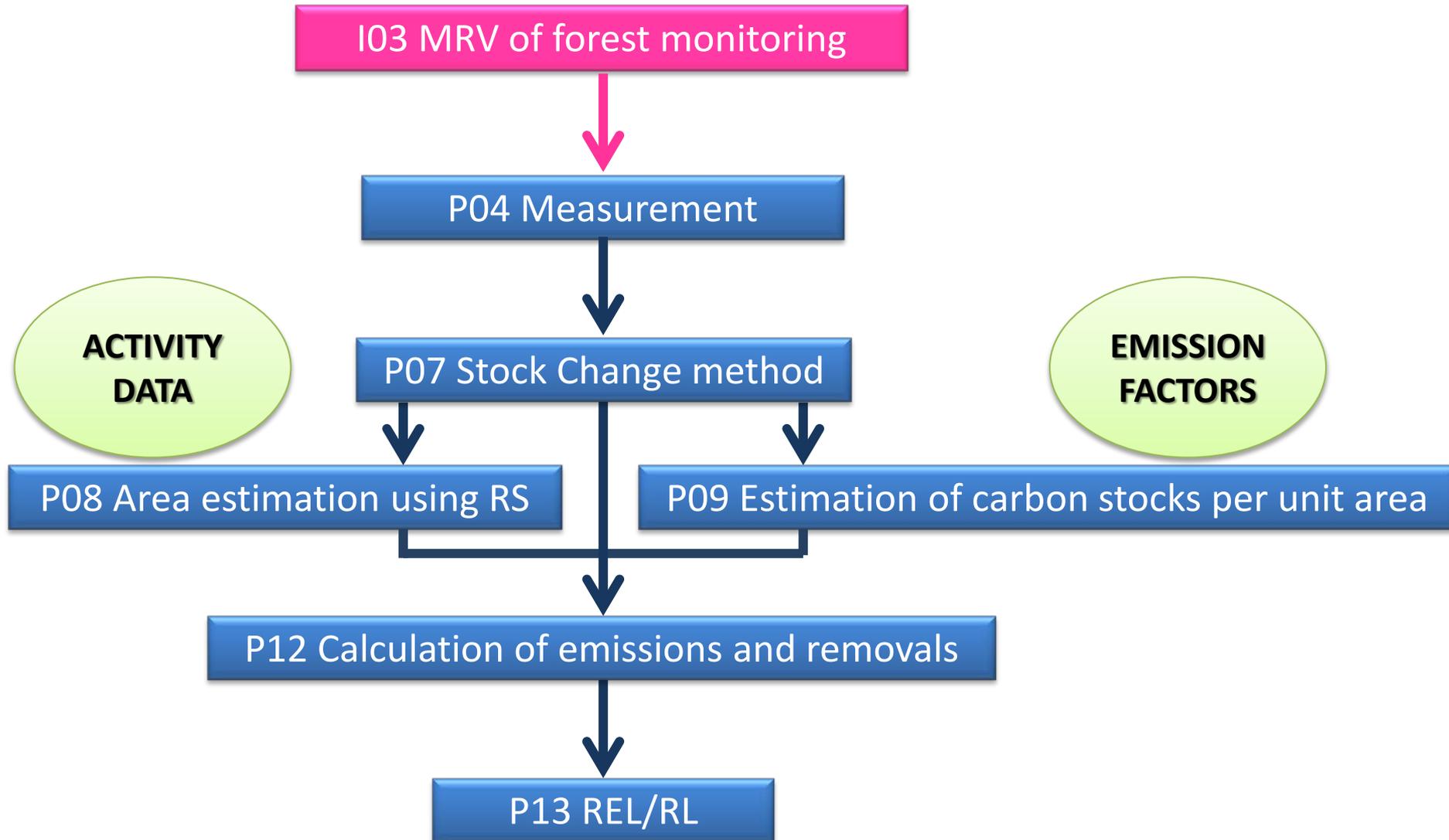


- In the sections “**Introduction**”, “**Planning**”, and “**Technical**”, knowledge and the sufficient skills required to address REDD-plus are compiled in units called “**recipe**”.
- Users can easily go through the items in each recipe to in-depth recipe or references in accordance with **the flow chart**.

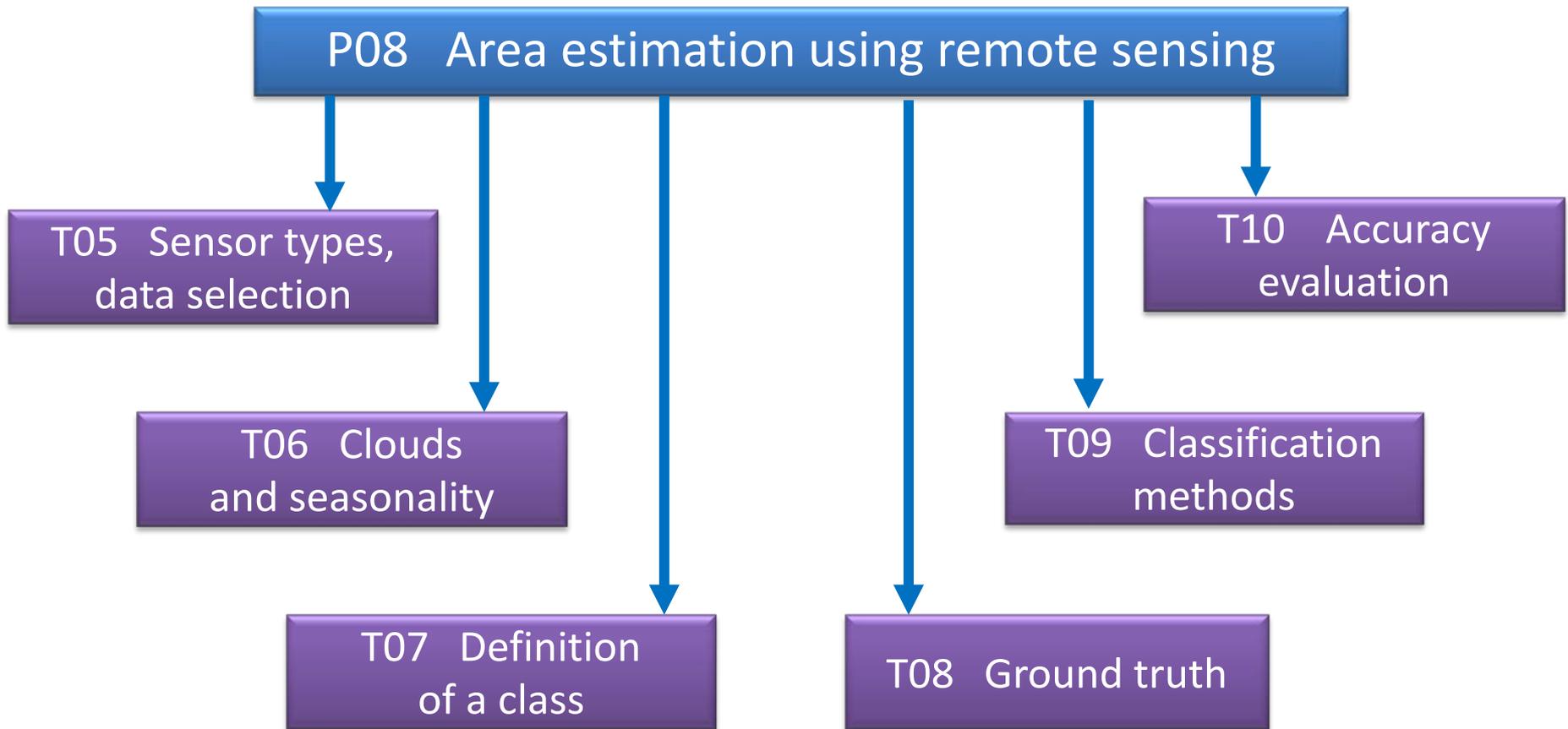
# IPCC method to estimate GHG gas emissions from activities related with LULUCF sector



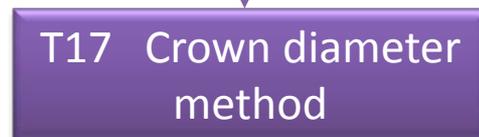
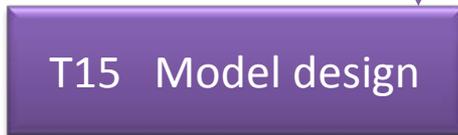
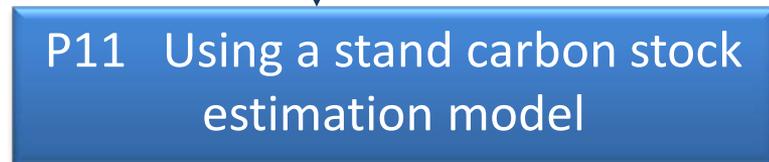
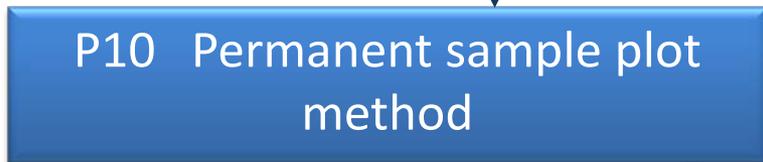
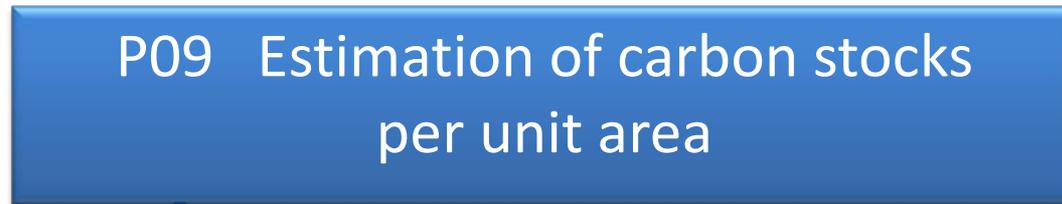
# Main flow of forest carbon monitoring



# Area estimation using remote sensing



# Estimation of carbon stocks per unit area



# Design of “Recipe”

## Measurement, reporting and verification (MRV) of forest monitoring

The preceding Recipe is  
Recipe I02 Key REDD-plus concepts

Measurement, Reporting, and Verification (MRV) is a system to enable objective evaluation of the implementation status of REDD-plus policies and emissions and removals for the credit mechanism. How to implement MRV at national and sub-national levels for REDD-plus is still under discussion, but for voluntary credit verification systems used by the private sector (e.g., Verified Carbon Standard (VCS); see T04), the framework for MRV implementation at the project level, the Clean Development Mechanism (CDM), takes into account institutional design. In this chapter, what is meant by “measurement”, “reporting”, and “verification” is outlined and the MRV requirements of forest monitoring for REDD-plus are explained.

### INFO

1) The MRV concept was introduced in the Bali Action Plan, which was adopted by UNFCCC COP 13, held in Bali, Indonesia, in 2007, to realize domestic and international actions for the mitigation of climate change and to guarantee the quality of the actions. MRV stands for Measurement, Reporting, and Verification. For example, use in the form of the measurement and the report in the National Communications (NCs) in the Copenhagen agreement, and the International Assessment and Review (IAR) which verify them.

### INFO

2) UNFCCC (2009) Decision 4/CP.15, FCCC/CP/2009/11/Add.1, 11-12, UNFCCC

### INFO

3) IPCC (2003) Good practice guidance for land use, land-use change and forestry. IGES <http://www.ipcc-nggip.iges.or.jp/public/gpgluc/fgpgluc.htm>

## MRV

The concept of MRV was introduced in the Bali Action Plan agreed at COP 13 in 2009<sup>1)</sup>. According to this plan, GHG mitigation actions and commitments must be measurable, reportable, and verifiable. However, international discussions on the specific purpose and target of MRV and on who is responsible for implementing it are still in progress. As of 2012, MRV modalities of forest monitoring for REDD-plus were also under consideration by SBSTA. Data on GHG emissions and removals obtained by using appropriately designed MRV will be an important basis for evaluating the effectiveness of REDD-plus activities.

## Measurement (see P04)

REDD-plus activities are evaluated according to the emissions reductions and removals that result. Thus, these amounts must be measured. In forest monitoring, “measurement” means the continuous measurement and collection of data on anthropogenic forest-related GHG emissions by sources and removals by sinks, forest carbon stocks and forest area changes<sup>2)</sup>.

More specifically, REDD-plus participating countries must measure forest cover changes and emissions and removals per unit of land area<sup>3)</sup> (Figure I03-1) where the activities are carried out, in accordance with guidance provided by the UNFCCC, and calculate total forest GHG emissions and removals from the acquired data. The measurement system must be transparent, consistent, and accurate, and uncertainty should be minimized, but it must also be feasible for the participating country. In the future, “measurement” for safeguards and other forest-related functions will also be required.

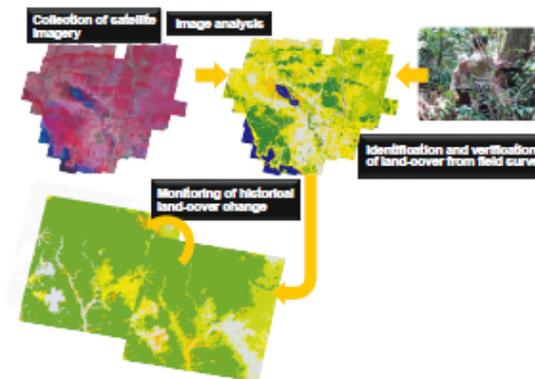


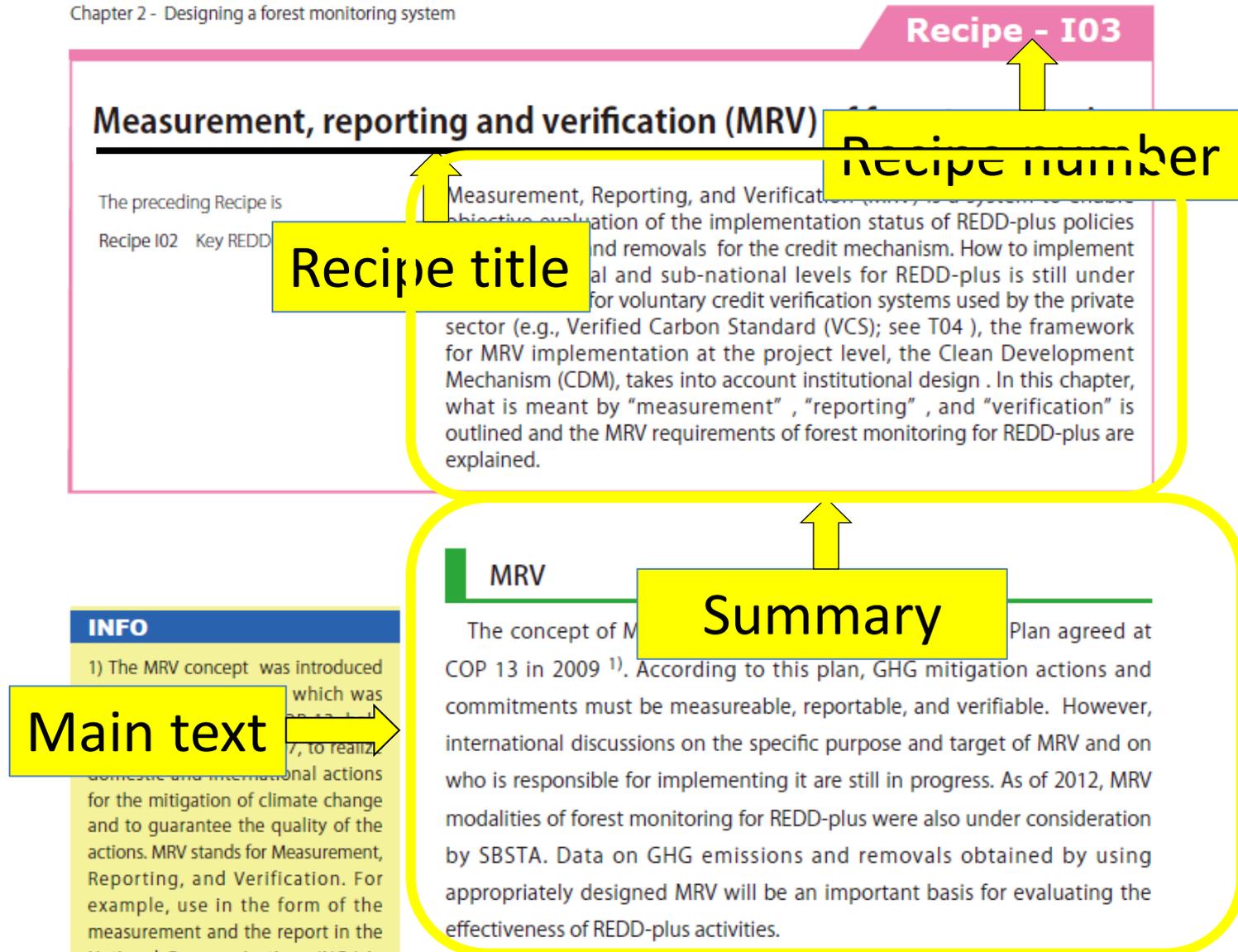
Figure I03-1 Measurement of forest cover changes and emissions and removals per unit of land area

## Reporting (see P05)

Reporting means providing information on the estimated GHG emissions and removals, on the methods and procedures used to determine them, and on the status and future outlook for measurements of emission reductions and removals by sinks in accordance with the forms and procedures prescribed by the reporting institutions. The form of the report should be chosen according to the subject being reported and the purpose of the report. For example, reporting at the national level is under UNFCCC guidance and project level reporting should conform to requirements of the CDM or other voluntary verification scheme. In any case, reports should include all information needed for verification so that additional information does not need to be submitted later. The UNFCCC obliges the Parties to report a country's national greenhouse gas inventory (see P05), and the report conform to the following five principles: transparency, consistency, comparability, completeness, and accuracy. All reports of REDD-plus activities must conform to these five principles. Transparency is particularly important for developing countries, because adequate historical data is often lacking and data collection is difficult.

# Structure of “Recipe”

Chapter 2 - Designing a forest monitoring system



# Reference Guide

Reference Guide

## Chapter 4: MRV of forest carbon

No. 19	Emissions factors. Converting land use change to CO <sub>2</sub> estimates. In: <i>Analysing REDD+ Challenges and choices</i>	EN	2012	Verchot et al.	CIFOR
P04	<p>This chapter in <i>Analysing REDD-PLUS Challenges and Choices</i> introduces the measuring of forest carbon in REDD-plus, and describes the current state of non-Annex I countries with regard to capacity and information available for the measurement, and concludes by summarizes future challenges. It gives detailed explanations of the Gain-Loss Method (including an approach for peatland) and the Tier 1 approach, which the Cookbook discusses only briefly. Furthermore, this chapter covers a range of topics, from the currently available emission factors and the possibility of improving them to a potential integration of community carbon monitoring with national carbon monitoring. This chapter is particularly recommended for people who wish a concise presentation of forest carbon measurements not covered by the Cookbook.</p>				
National, Sub-national, Project					
<a href="http://www.cifor.org/online-library/browse/view-publication/publication/3805.html">http://www.cifor.org/online-library/browse/view-publication/publication/3805.html</a>					

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# Points for MRV

- We recommend to use “Stock Change Method” for estimation of emission/removals in forests.
- Time series forest maps based on satellite images are essential for monitoring area of deforestation and forest degradation
- Repeating carbon stock survey at permanent sample plots is important for monitoring carbon stock of forests
- Combination of forest type maps and carbon stock gives forest carbon maps
- Differences of time-series forest carbon maps mean removal/emission of carbon

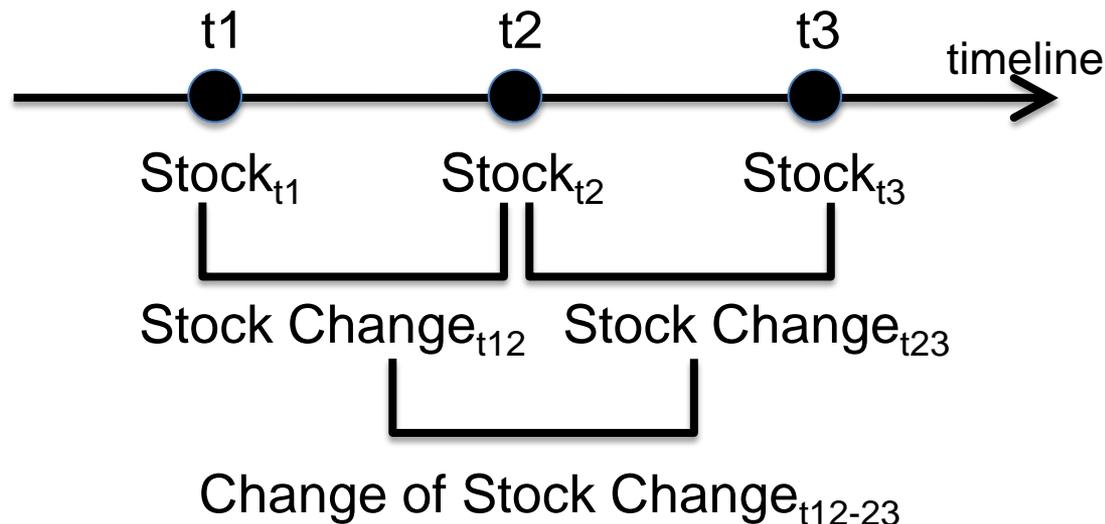
# IPCC Methods for Estimation of Carbon Stock Changes

## Default Method or Gain-Loss Method

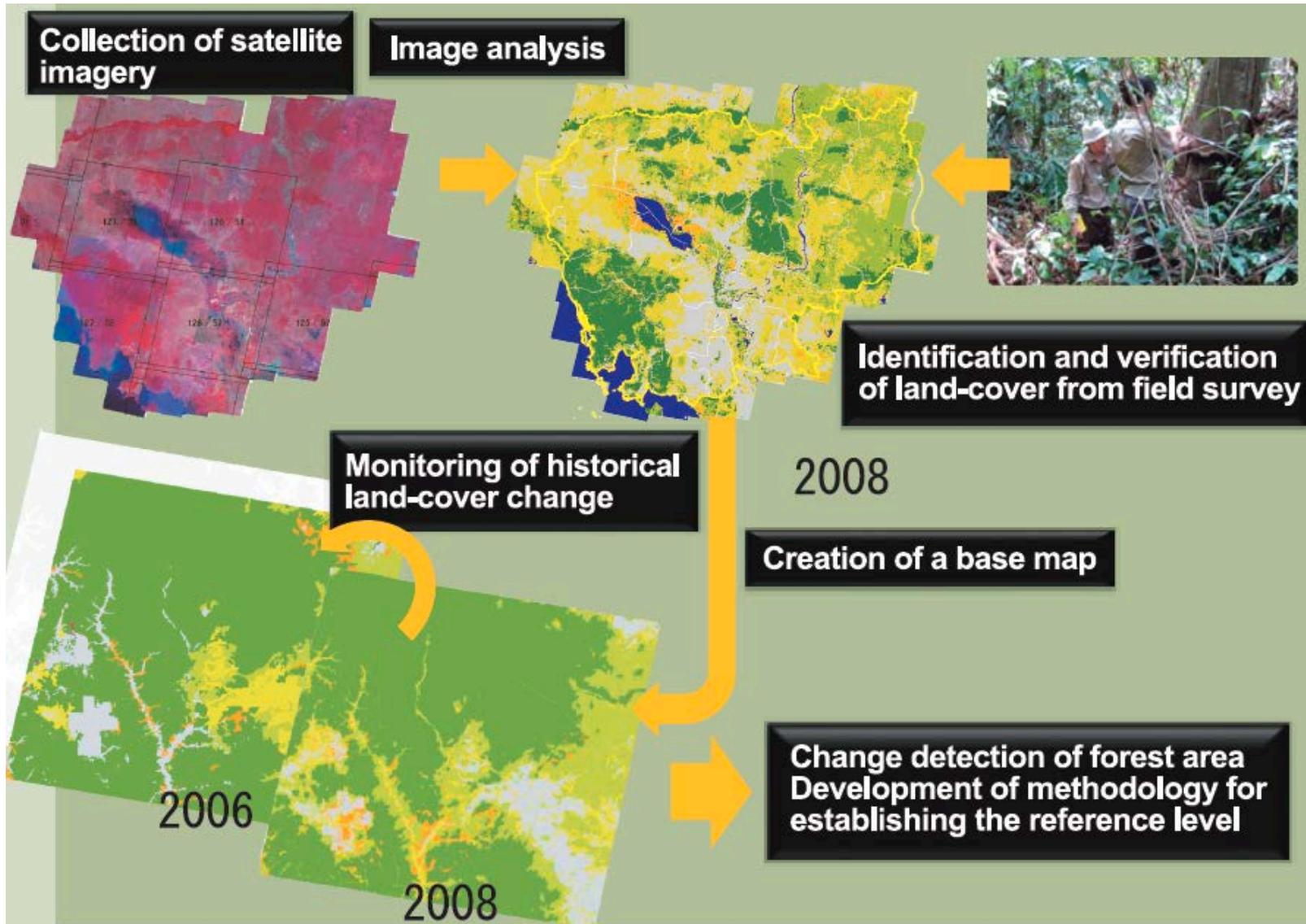
Changes in carbon stocks  
= Gain by growth – Loss by disturbance

## Stock Change Method or Stock-Difference Method

Changes in carbon stocks  
= (Carbon stocks<sub>t2</sub> – Carbon stocks<sub>t1</sub>)/(t2 - t1)



# Analysis of satellite images



# Forest carbon monitoring for REDD+

## Remote sensing

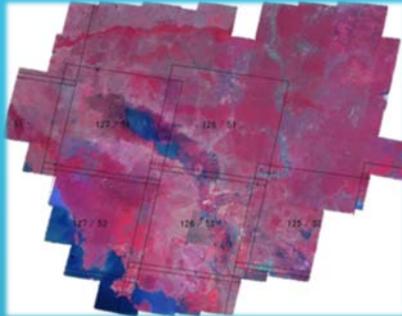


Image  
classification

Verification

Forest area  $_i$

Decision of  
forest classes  
(Example)

Evergreen

Deciduous

Others

e.g. Rubber, Mangrove

## Field survey



Plot survey

Allometry

Mean carbon stock  $_i$

$$\text{Total carbon stock} = \sum (\text{Forest area}_i \times \text{Mean carbon stock}_i)$$

# How to estimate averaged carbon stock

- Applying Permanent Sampling Plots (PSPs)
- Estimating biomass using allometry equations
- Appropriate forest type classifications for reduction of uncertainty
- Estimating carbon stock changes with repeated measurements



## Example of forest type classifications

### Cambodia

Evergreen forests  
(including Semi-evergreen forests)

Deciduous forests

### Malaysia

Lowland dipterocarp forests

Hill dipterocarp forests

# Approach to Reduce Uncertainty



**Setting up distinct stake within each sampling plot**



**Marking measuring position**

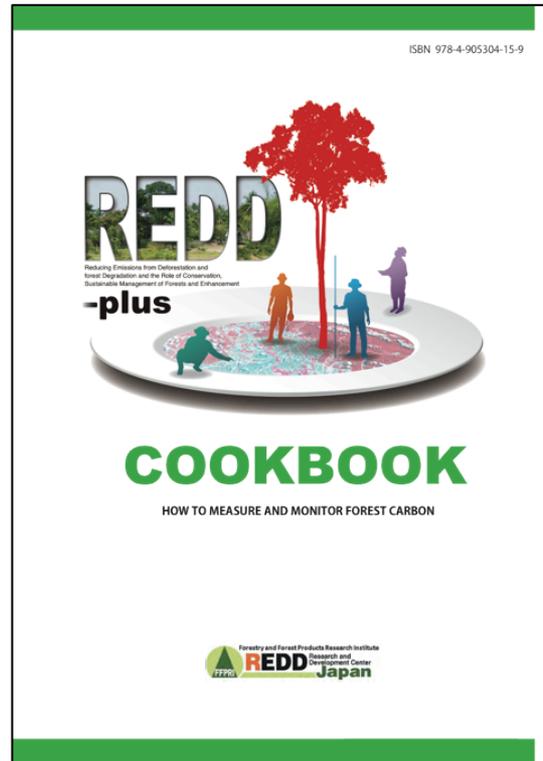


**Making clear rules for DBH measuring**

# Download it Now And Let's cook REDD+!

<http://www.ffpri.affrc.go.jp/redd-rdc/en/reference/cookbook.html>

English  
Spanish  
&  
Japanese



Bon appetit!

