

# REDD+

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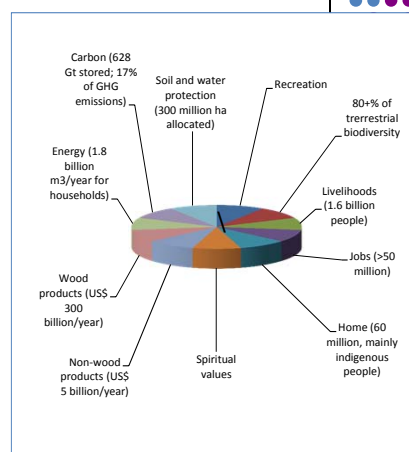
## Part 1: Background to REDD+

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### 1.1 Forests critical for human survival and well-being



- Natural forests provide a range of ecosystem services that are vital to human survival and well-being:
  - *Supporting services* – soil production and nutrient cycling;
  - *Provisioning services* – timber and non-timber products;
  - *Regulating services* – climate and hydrological regulation;
  - *Cultural services* – cultural, religious, recreational and scientific values.



Source: UNFF, 2009  
 (<http://www.slideshare.net/CIFOR/the-un-forum-on-forests-facilitating-and-catalyzing-sfm-financing>)

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## 1.2 But, forests being destroyed at an alarming rate

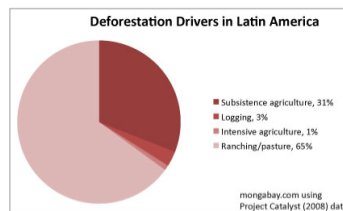
- Almost half of Earth's original forest cover gone, much of it destroyed within past three decades (WRI 1997 )
- Globally, on average 13 million hectares of forest were converted to other uses – mostly agriculture – or lost through natural events each year from 2000 to 2010 (FRA 2010).

Ten countries with largest annual net loss of forest area 2000-2010 (FRA 2010)		
Country	Annual Change	
	(1,000 ha/yr)	%
Brazil	-2,642	-0.49
Australia	-562	-0.37
Indonesia	-498	-0.51
Nigeria	-410	-3.67
United Rep. of Tanzania	-403	-1.13
Zimbabwe	-327	-1.88
Dem. Rep. of the Congo	-311	-0.20
Myanmar	-310	-0.93
Bolivia	-290	-0.49
Venezuela	-288	-0.60

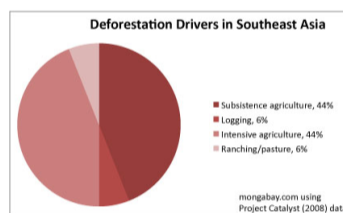


## 1.3 Why? Direct causes

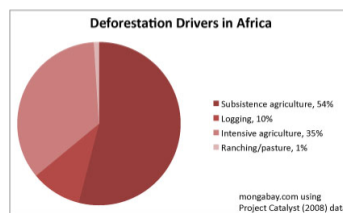
- To generate revenue and employment, governments make forest lands available for plantation and other agricultural development.
- Governments allow selective logging, which is supposed to be sustainable, to generate revenue and employment. But,
  - Bad logging practices can severely degrade the forest, making it more vulnerable to fire
  - Logging roads open up the forests for settlement and agriculture, and provide access to markets, leading to permanent land use change.
- Local people clear forests for both shifting and sedentary agriculture.



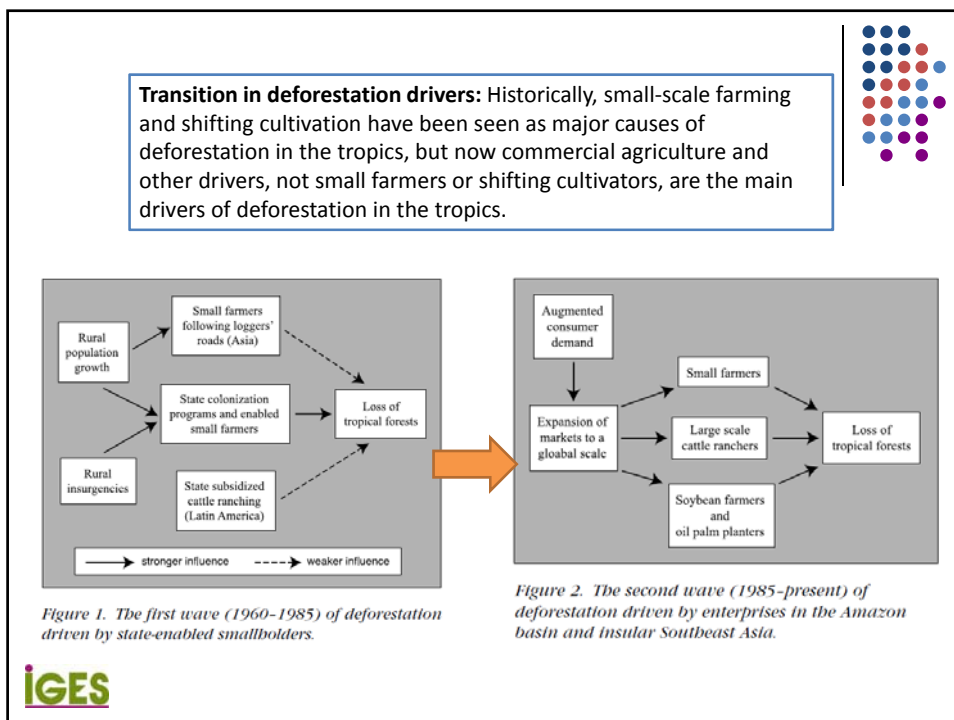
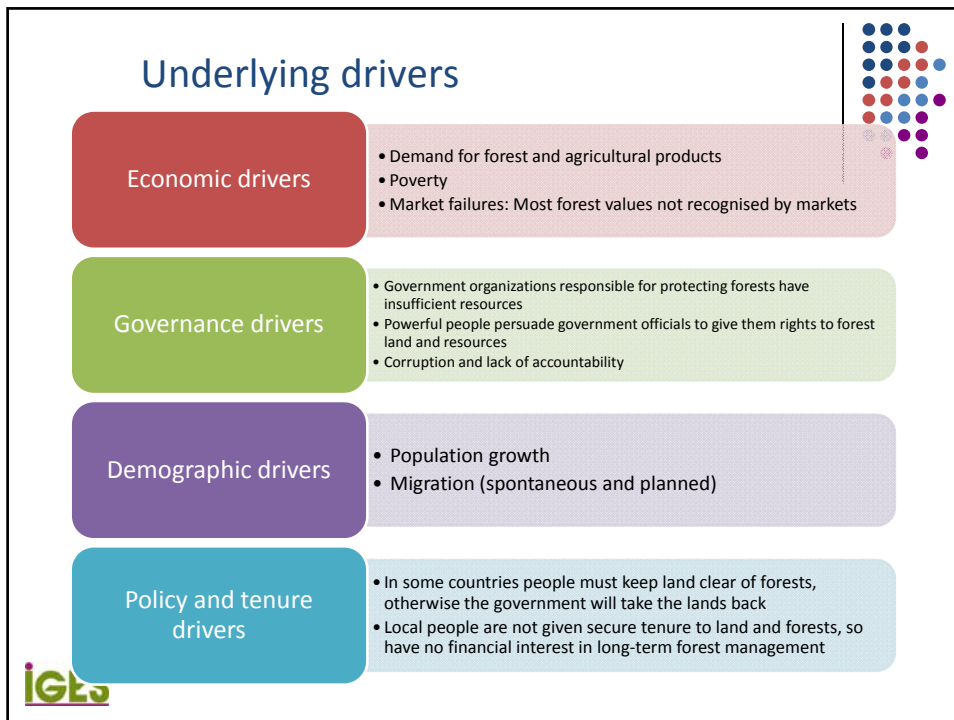
Drivers of deforestation in South America (Neotropics)



Drivers of deforestation in Southeast Asia



Drivers of deforestation in Africa



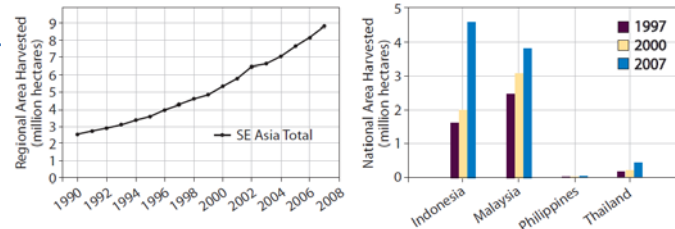
### Example 1: Large-scale conversion to agriculture by investors

#### • Case study: Palm oil

The harvested area of palm oil in Southeast Asia has tripled in just a decade. Compared to levels in 2000, global demand is predicted to more than double by 2030 and to triple by 2050. Over 70 per cent ends up in food, but the biofuels industry is expanding rapidly. Indonesia already has 6 million hectares of oil palm plantations, but has plans for another 4 million by 2015 dedicated to biofuel production alone. (Greenpeace)



The Rapid Growth in Area Harvested for Palm Oil, 1990–2007



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### Example 2: Legal, selective logging

#### • Case study – Selective logging in PNG

- The Forestry Act 1991 requires logging to be on a sustainable yield basis, i.e. logs should be harvested at a rate and using practices that allow the forest to sufficiently recover after logging to maintain harvest yields. But, of about 4 million ha being logged, only 193,000 ha is sustainably managed.
- Politicians support logging to bring development to their communities, but the Forestry Authority has insufficient resources to control the logging. Each field inspector monitors ~ 87,000 ha of forest. In some cases, the inspectors have even had to rely on the logging companies for housing, office space and communications.



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*Example 3: Illegal logging*

• **Case study – Illegal logging in Cambodia**

**Cambodian Reporter Found Murdered After Uncovering Illegal Logging**

A Cambodian journalist who exposed illegal logging and forest crimes involving the local elite has been murdered, police said Wednesday, after his battered body was found in the trunk of his car. Hang Serei Oudom, 42, a reporter for the local Virakchum Khmer Daily newspaper, had been missing since Sunday afternoon and his body was found on Tuesday in northeastern Cambodia's Ratanakiri province, said Ek Vun, the police chief for Balung City, the provincial capital. Authorities are working to identify suspects involved in the murder of the reporter, who had recently written a string of stories about deforestation and timber smuggling in Ratanakiri, where logging and mining in recent years have taken a big toll on the environment.



Confiscated vehicles and equipment of illegal loggers, Seima Protection Forest, Cambodia



*Example 4: Small-scale conversion by local people for shifting agriculture and cash cropping*



**Case study - PNG**

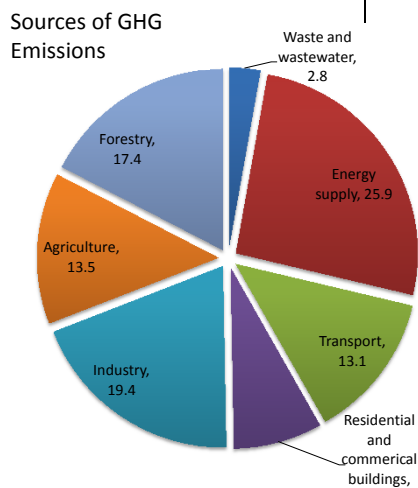
Forest cleared to plant subsistence crops  
 Shifting agriculture puts food on the table  
 Village cocoa production and processing



## 1.4 Why tropical forests need to be better managed for climate change mitigation



- Forestry is the third largest source of greenhouse gas emissions—larger than the entire global transport sector (Eliasch 2008) = huge mitigation potential.
- About 96 per cent of deforestation emissions comes from developing countries in the tropics (Eliasch 2008).
- *Huge mitigation potential*  
Emission from deforestation in tropical regions: 3 billion tCO<sub>2</sub>/yr (Total emission from Japan = 1.3 billion tCO<sub>2</sub>/yr)



Source: IPCC, 2007



## 1.5 Significance of REDD+ to NAMAs



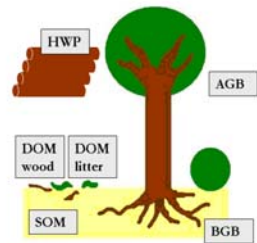
GHG emission and removal (in Gg), 2000

	CO <sub>2</sub> emission	CO <sub>2</sub> removal	CH <sub>4</sub>	N <sub>2</sub> O	PFC	CO <sub>2</sub> e
Energy	247,522		1,437	10		280,938
Industry	40,342		104	0.43	0.02	42,814
Agriculture	2,178		2,419	72		75,420
LUCF	1,060,766	411,593	3	0.08		649,254
Peat Fire*	172,000					172,000
Waste	1,662		7,294	8		157,328
TOTAL	1,524,472	411,593	236,388	28,341		1,377,754

Source: Indonesia Second National Communication, 2009



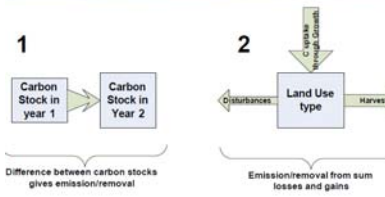
## 1.6 Forests and carbon



**Figure 1. Diagrammatic Representation of Carbon Pools**  
 (AGB above-ground biomass; BGB below-ground biomass; SOM soil organic matter; DOM dead organic matter; HWPs harvested wood products)

Difficult to measure emissions so we measure carbon stock changes

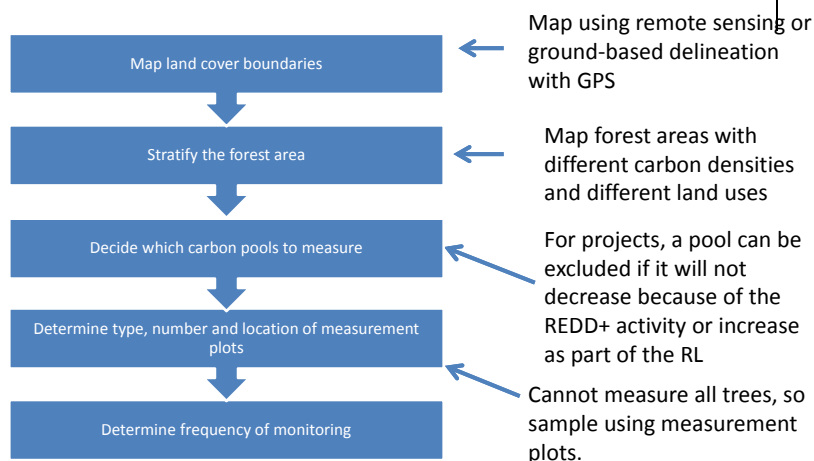
### Estimating Carbon Stock Changes



Forests act as stores and sinks of carbon. Forest carbon is stored in 5 pools: AGLB, Deadwood (standing and lying), Litter, BGLB (roots), and soil



## Basic approach to estimating forest carbon stock and monitoring changes



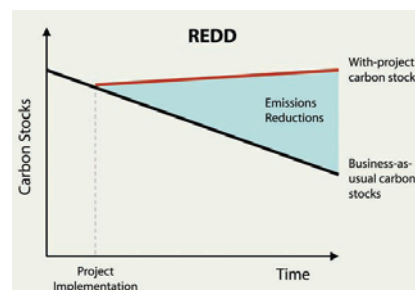


## Part 2: REDD+ basics



### 2.1 What is REDD+?

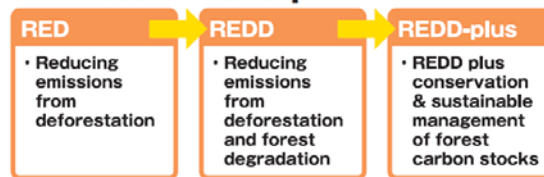
- REDD+ is a mitigation concept being negotiated by Parties to the UNFCCC. REDD+ also exists in some voluntary carbon markets
- REDD+ puts a value on forests for the services they provide as carbon sinks and stores.
- REDD+ provides financial incentives for measurable / verifiable reductions in GHG emission from deforestation & forest degradation and/or increases in GHG removals by standing forests
- REDD+ will be financed based on performance



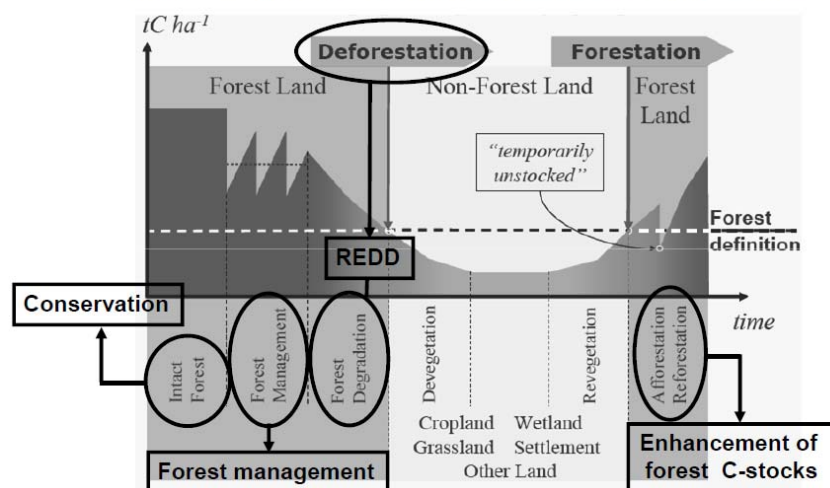
- REDD = reduced emissions from **deforestation** and **degradation**
- “+” = **conservation** of forest carbon stocks, 4. **enhancement** of forest carbon stocks, **sustainable management** of forests
- Can be policies and measures, e.g. regulating best practices for timber harvesting, or projects in a specific geographic area



**From RED to REDD-plus**



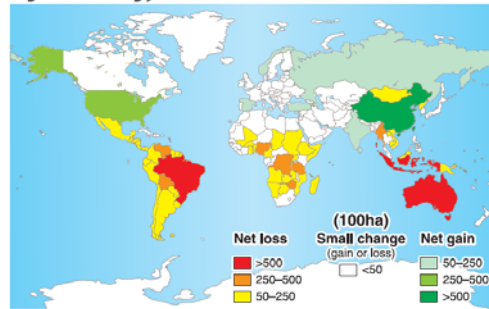
**REDD-plus using IPCC definitions**



## 2.2 REDD+ is designed to be equitable: All forested developing countries should be able to participate

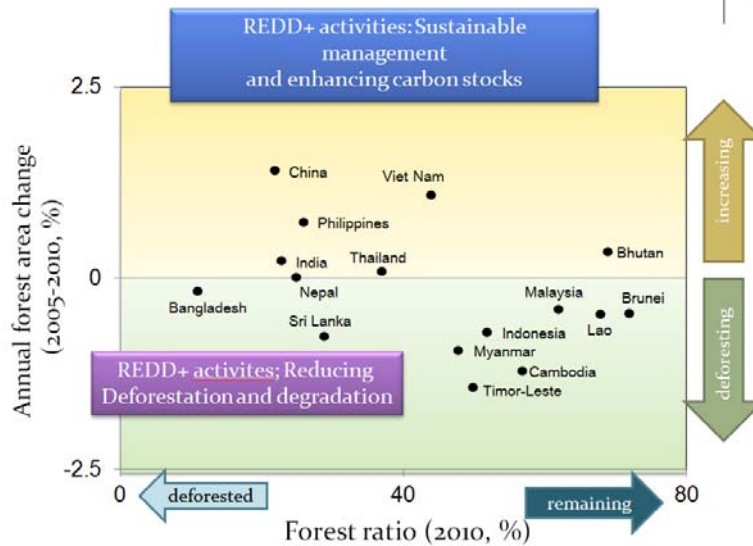


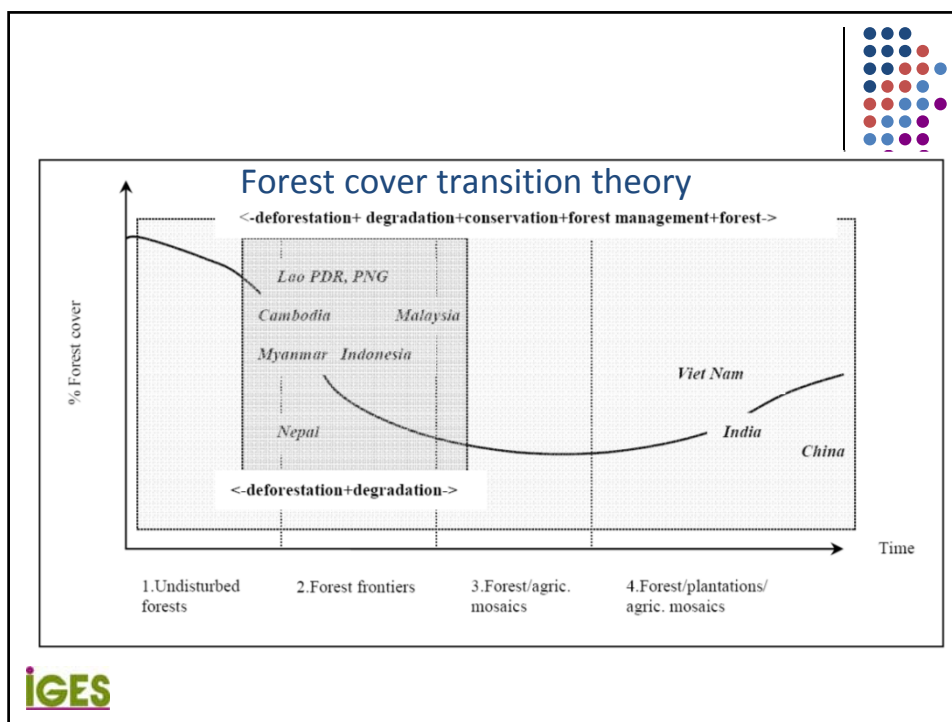
**Annual change in forest area by country, 2005–2010**



Source: Forest Resources Assessment 2010

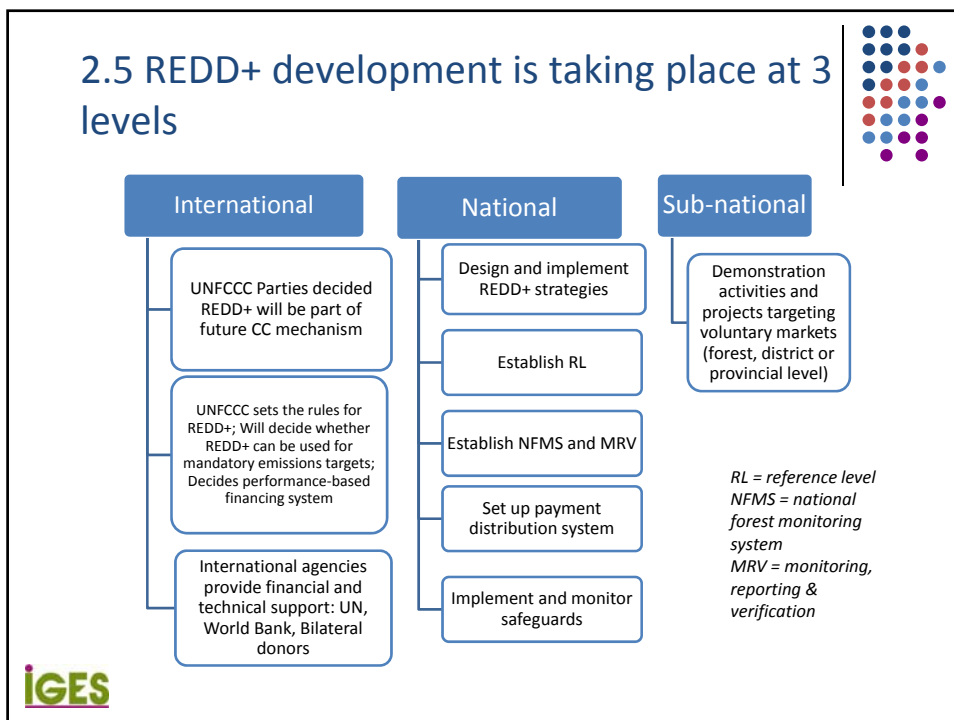
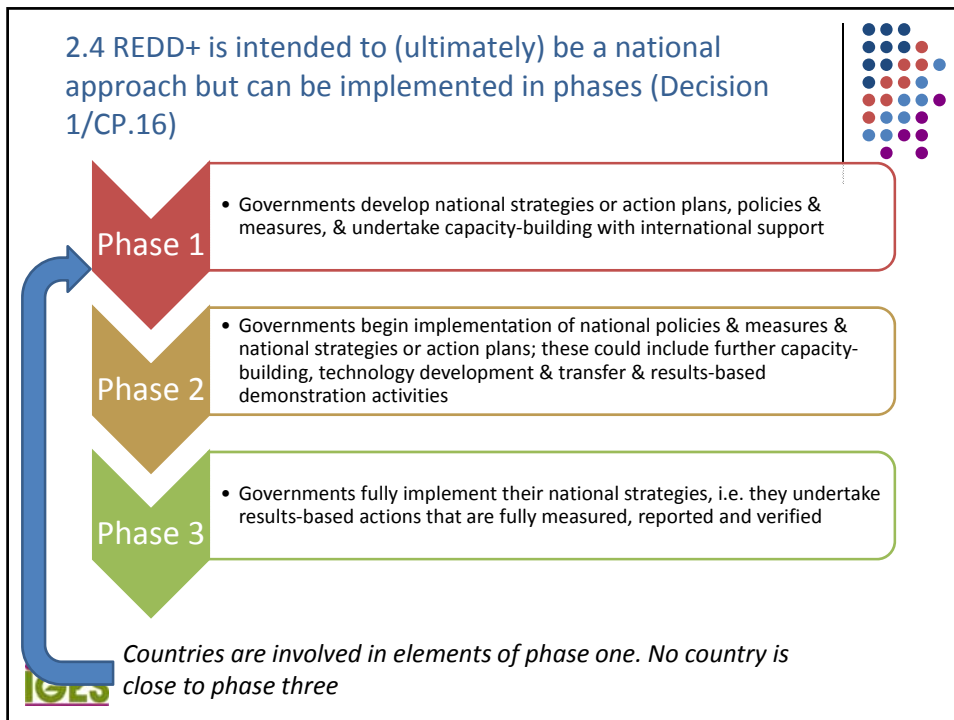
- “+” included as some countries losing and some increasing their forest area
- Participation of all countries important to avoid international leakage





### 2.3 REDD+ has a set of safeguards (Decision 1/CP.16)

- Consistent with the objectives of national forest programmes and relevant international conventions and agreements
- Transparent and effective national forest governance structures, taking into account national legislation and sovereignty
- Respect for the knowledge and rights of indigenous peoples and members of local communities, by taking into account relevant international obligations, national circumstances and laws, and noting that the UN General Assembly has adopted the UN Declaration on the Rights of Indigenous Peoples
- The full and effective participation of relevant stakeholders, in particular indigenous peoples and local communities
- Consistent with the conservation of natural forests and biological diversity, ensuring REDD+ does not lead to the conversion of natural forests, but are instead incentivizes the protection and conservation of natural forests and their ecosystem services, and enhances other social and environmental benefits
- Actions to address the risks of reversals
- Actions to reduce displacement of emissions (leakage)



## 2.6 Examples of voluntary standards



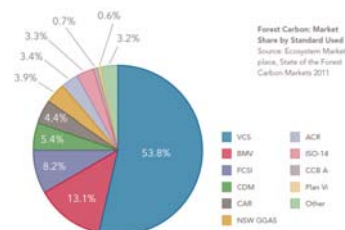
### VCS (the Verified Carbon Standard)

- The most popular standard in the carbon market. Validates methodologies allowing carbon credits to be issued. Does not validate claims of additional environmental or social benefits. Managed by VCS association (an independent, non-profit association)

*Some project proponents have their projects validated against both standards to generate carbon credits and to ensure safeguards are met*

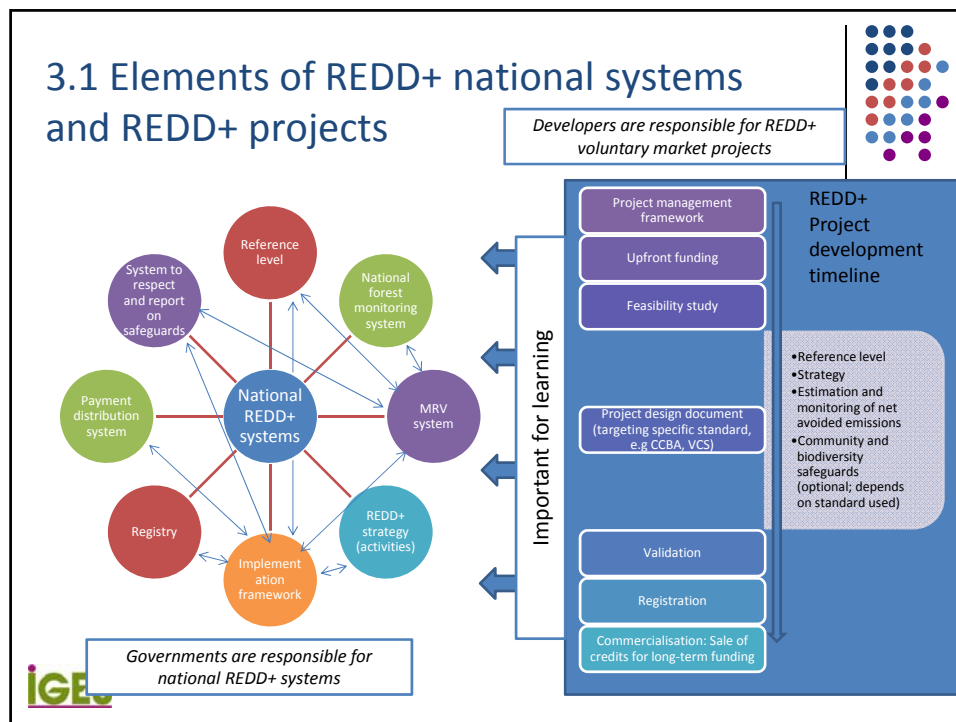
### CCB Standard (the Climate, Community & Biodiversity Standard)

- Aims to show that projects have positive climate, community and biodiversity standards, but does not validate methodologies to estimating carbon stock changes (i.e. does not issue carbon credits). Developed by the Climate, Community & Biodiversity Alliance (a partnership of non-governmental organizations).



## Part 3: REDD+ elements: How they apply to national REDD+ systems and how they are handled by voluntary schemes





### 3.2 Reference level (expected emissions in the without REDD+ scenario)

- **National REDD+ system**
  - UNFCCC requires countries to develop a RL using historical data, which they can adjust for 'national circumstances', and to use a combination of remote sensing and ground-based forest carbon inventory
  - UNFCCC allows countries to take a stepwise approach to strengthen their RL methodology over time. This enables broad country participation and the early development of RLs.
  - Countries must report their RL and RL methodology to the UNFCCC REDD web platform.
  - System to validate RLs under discussion
- **Voluntary market projects:** Use an approved RL methodology or submit their own to a voluntary standard.
- For both national systems and projects, RLs will have to be periodically reviewed to reflect latest trends in forest cover change.

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## Data needed to develop RL



- To develop a RL, we need to assess carbon stocks and estimate how they are most likely to change over time
- The following data are thus needed:

- Activity data (land areas)

- Increasing complexity ↓
  - Approach 1: Only provide area of land use at broad scale
  - Approach 2: Tracking of land-use changes between categories
  - Approach 3: Tracking changes of land-use on a spatial basis

Emissions = activity data X emissions factors

- Emissions factors (emissions from types of land use, i.e. changes in carbon stocks)

- Increasing complexity ↓
  - Tier 1: Use IPCC defaults
  - Tier 2: Use nationally specific data
  - Tier 3: Use more sophisticated and detailed modelling

- Future drivers of forest change

- Activity data and emissions factors are sufficient to estimate historical emissions trends. But, to project future emissions, we also need data on drivers of forest change which may change over time



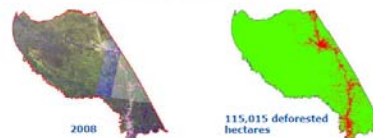
Project example of historical deforestation: Madre de Dios REDD Project, Peru



Fig. 72: Quantification of the deforestation using Landsat image 2000



Fig. 73: Quantification of the deforestation using Landsat image 2008



As shown in the previous figures, the deforested area (ha) has been increasing year by year, losing in just 18 years 78,834 hectares, a very considerable number.



## Adjusting for national (project) circumstances (= changes in drivers of forest change)



- National REDD+ systems: Governments currently free to decide what factors to adjust for.
- Voluntary market projects: Approved methodology will specify adjustments that must be considered.

Project example: Madre de Dios REDD Project, Peru

- Deforestation rates were projected over the life of the project using a linear relationship that was established between population density and deforestation rates.
- Five variables that better determine the future deforestation processes were also selected: Inter oceanic road; Secondary roads of first order; Secondary roads of second order; Roads of third order; Navigable rivers.



Inter Oceanic Road

Fig. 76: Inter-oceanic variable with its ranges of influence

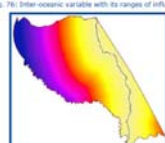


Fig. 77: Secondary roads of first order variable with its ranges of influence

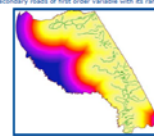


Fig. 78: Secondary roads of second order variable with its ranges of influence

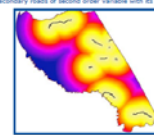
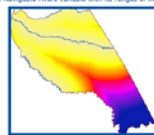


Fig. 79: Navigable rivers variable with its ranges of influence



## How a step-wise approach for national RLs might look



- Phases 1 and 2 of the REDD+ mechanism, could prioritise the following activities:
  1. Analysing national historical data to estimate activity data with at least three time intervals;
  2. Collecting and analysing preliminary field data to produce a national conservative estimate for the emission factors (focusing on main carbon pools) for the forest types where significant deforestation and forest degradation have occurred; and
  3. Analyse the drivers of deforestation and forest degradation at the national and subnational levels

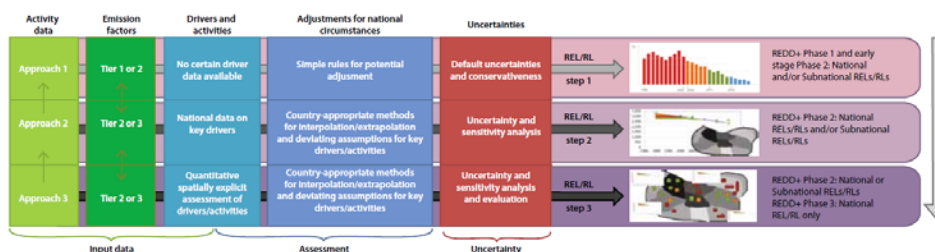


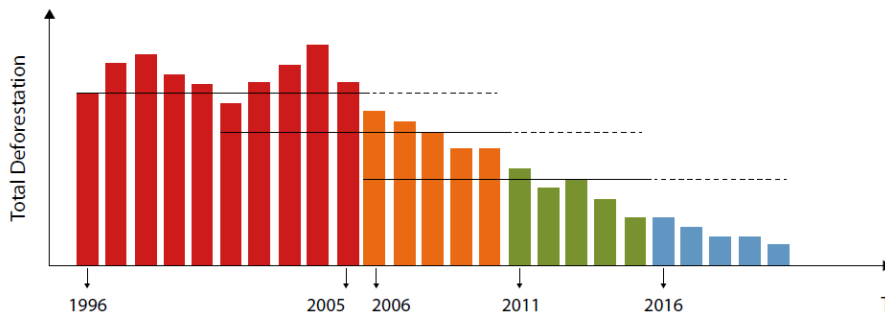
Figure 2. Framework for a step-wise approach for developing forest RELs/RLs on a national and/or subnational level (as an interim measure) in accordance with the three REDD+ phases



Source: CIFOR (2012), <http://www.cifor.org/online-library/browse/view-publication/publication/3788.html>

### Example of step 1 approach

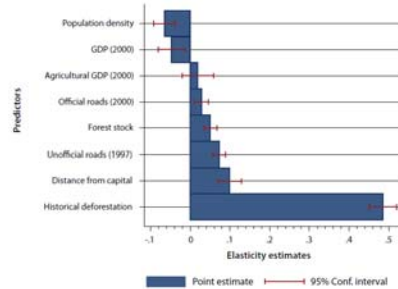
- The Amazon Fund subnational REL is based on gross deforestation of aboveground biomass and a conservative estimate of aboveground carbon stocks of 100tC/ha. The annual deforestation rates used in the calculation of emission reductions are compared to the average



### Example of step 2 approach

#### Box 1. Forecasting future deforestation in Brazil using a Step 2 approach

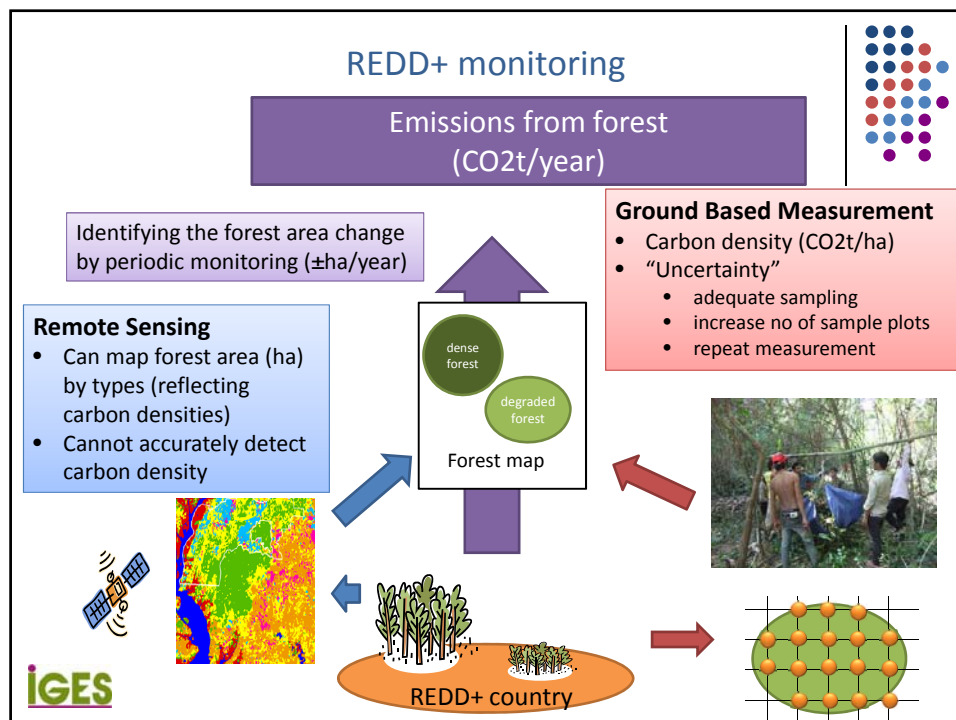
One way of predicting future deforestation is through regression analysis, which seeks to establish the link between rates of current deforestation and historical deforestation and other predictors (potential 'national circumstances'), including forest cover, roads and income level. A simple regression equation (ordinary least squares, logarithmic) was estimated, using deforestation at municipality level for the Brazilian Amazon provided by INPE (Brazil's National Institute for Space Research). 'Historical deforestation' is the annual average for the period 2000–2004, while 'predicted deforestation' is the annual average for the period 2005–2009. In terms of predictive power, historical deforestation is the most effective as it explains about 79% of the variation. However, other factors also contribute to the predictive power of the model. The result in Figure 4 shows that the elasticity of historical deforestation (indicating how a percentage change in each variable changes the current deforestation) equals 0.49, which indicates that a simple extrapolation of historical rates would overestimate future deforestation in the case of Brazil. Forest stock (cover) and distance from the capital have positive elasticities, proportionally higher rates of deforestation in remote and high forest cover areas. Roads also contribute to accelerating deforestation, while high population density and income (GDP), perhaps surprisingly, have the opposite effect.



### 3.3 Monitoring, reporting, and verification system

- National REDD+ systems:
  - Governments must develop robust and transparent national forest monitoring systems (NFMS), but can begin with subnational monitoring (Decision 1/CP.16).
  - The relationship between NFMS and MRV is not clear. SBSTA 36 proposed that governments should develop national MRV systems (not yet a UNFCCC decision). Governments are already developing MRV with international support.
- Voluntary market projects: Defined by scheme

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## How to handle leakage and permanence

- National REDD+ systems: For now, only part of safeguards.
- Voluntary market projects: Defined by scheme

### Voluntary market: How the Verified Carbon Standard handles leakage and permanence

- All projects must define, mitigate, monitor and account for any leakage using approved methodologies
- Using the Non-Permanence Risk Tool, projects conduct an analysis of the internal, external and natural risks to a project's carbon stock over a 100-year period. As a buffer against this risk, a percentage of credits may be withheld in a buffer account. They are lost when there is a reversal, but may also be released back to the project over time.

Project example for leakage: Oddar Meanchey REDD Project, Cambodia

**Define:** (1) Activity-shifting leakage within the leakage belt, immediately adjacent to the project sites (2) Activity-shifting leakage outside of the leakage belt, and (3) Market leakage.

**Mitigate:** Project activities to increase livelihoods or reduce need for land or fuel-wood

**Monitor:** Leakage belt established next to project area to monitor activity shifting

**Account:** Estimate leakage and deduct from credits

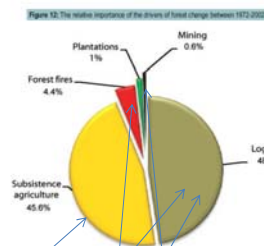
Deforestation Driver	Leakage Cancellation Rate (%)		
	Activity-Shifting Inside Leakage Belt	Activity-Shifting Outside Leakage Belt	Market
1. Migrant encroachment	0%	50%	0%
2. Conversion to cropland	10%	0%	0%
3. Conversion to settlements	10%	0%	0%
4. Fuel-wood gathering	10%	0%	0%
5. Forest fires induced to "clean" the land	10%	0%	0%
6. Hunters inducing forest fires	0%	70%	0%
7. Illegal logging for commercial on-sale	0%	0%	70%
8. Timber harvesting for local use	0%	50%	0%
9. Large economic land concessions	0%	50%	0%
10. Timber concessions	0%	50%	0%



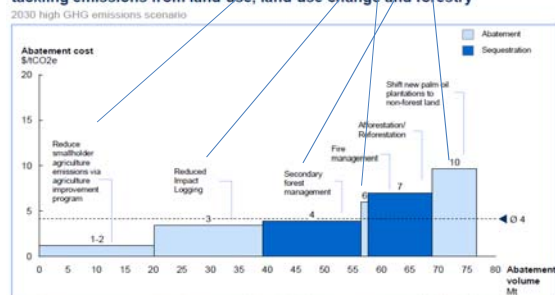
## 3.4 REDD+ strategies

- Both national REDD+ systems and voluntary market projects must set out strategies to reduce emissions or enhance carbon stocks

Example: Possible REDD+ activities identified by PNG's Climate Compatible Development Strategy



There is up to 77Mt of abatement potential in 2030 from programs tackling emissions from land-use, land-use change and forestry



Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below USD 90 per tCO<sub>2</sub>e if each lever was pursued aggressively, starting with the most affordable levers. It is not a forecast of what role different abatement measures and technologies will play. Assumes a 6% societal discount rate.





## Part 4 - IGES Community-based Forest Monitoring Project



### 4.1 Project aim

- **Aim:** To develop, test and implement approaches to engage local communities in monitoring their forests, including changes in carbon stocks

Decision 4/CP.15: The Convention of the Parties  
*“encourages, as appropriate, the development of guidance for effective engagement of indigenous peoples and local communities in monitoring and reporting.”*



## 4.2 Rationale

- 1.3 billion poor people live in or near forests and depend on forests for at least some part of their livelihoods

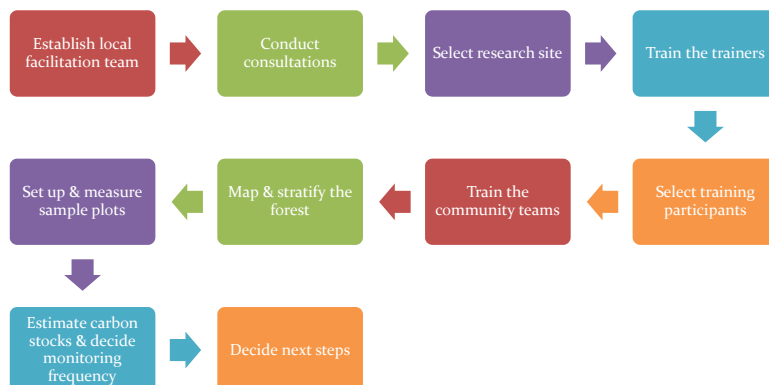
- Local communities are the largest forest stakeholder group and the area of forests under community management is increasing. Their participation in REDD+, including forest monitoring, is essential to ensure:

- Sustainable local benefits
- Understanding and ownership of REDD+ activities
- Prevention of leakage

Who owns the World's forests?  
 - Mostly governments, but in developing countries, community reserves and ownership total at least 22% of all forests —approximately three times the amount held by private individuals and firms (White and Martin 2002)



## 4.3 Project methodology – Action research



### **Step 1: Establish research/facilitation team, consult with stakeholders, select site**

- Consultation with local government, community leaders and other stakeholders
- Only communities interested in managing their forests selected



Project sites and partners

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環境省

**APN**

THE CENTER FOR PEOPLE AND FORESTS

**dnr**

WILDLIFE CONSERVATION SOCIETY

**FPCD**

### **Step 2: Conduct training of trainers**

- Trainers require knowledge on forest monitoring (for commercial volume and biomass estimates) and skills for community facilitation
- Training takes 3 days, with possible further technical trainings



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### Step 3: Training of communities

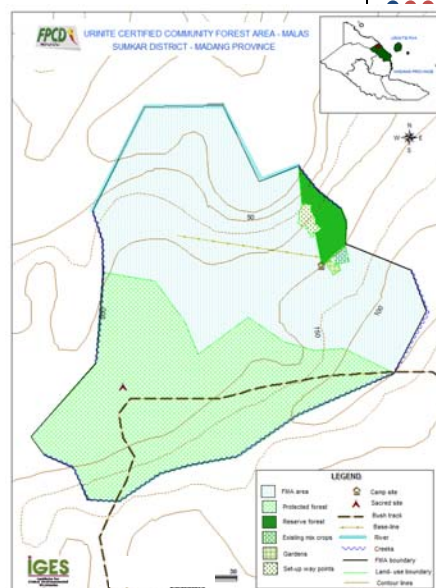
- Initial 3-4 day training course
- Takes place in classroom and forest
- Challenges:
  - Teaching measurement and data recording
  - Explaining value of forest monitoring
  - Explaining carbon



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### Step 4: Mapping and stratification

- For REDD+ projects, must map land cover and land use
- Foresters and community delineate forest and strata boundaries using GPS
- Communities can assist with ground-truthing for satellite imagery interpretation
- Additional data important for communities incorporated
- Data uploaded to GIS

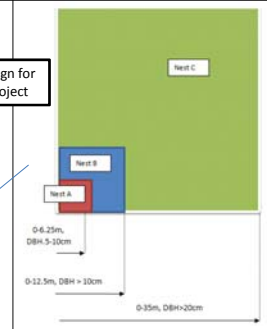


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## Step 5: Sampling

- For the IGES projects, the purpose of sampling is mostly to assess and monitor commercial timber volumes and carbon stocks. This determines what variables are measured.
- The community teams position the sample plots systematically using GPS according to pre-determined locations.
- Plot dimensions are determined for maximum sampling efficiency.
- Biomass in living trees is estimated using allometric equations and then converted to carbon by dividing by 2. Other carbon pools are also included in some of our projects.
- For living trees, in the sample plots the community teams must identify the tree species (wood density varies between species) and measure tree diameter. They may estimate tree height, but diameter height models can also be developed to estimate height.
- We then convert the estimates for all carbon pools measured to a 1 hectare basis and multiply by the total forest area (or stratum area) to calculate the total carbon stock.

Plot design for PNG project



Allometric used in PNG project

$$AGLB (kg) = 0.0776[pD^2TH]^{0.940}$$

where  $D$  = diameter (cm),  $TH$  = total height,  $p$  = wood specific gravity ( $g/cm^3$ )

If monitoring is to assess commercial timber volume as well as biomass, both commercial and total tree height are estimated



## Plot establishment

- Communities are trained to use GPS, compass, measurement tapes, etc.



### *Tree tagging and marking*

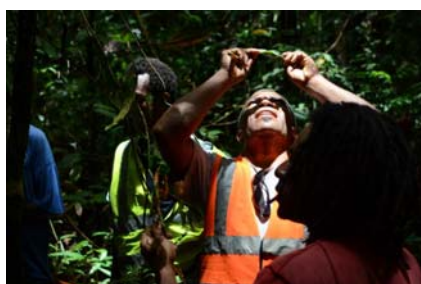
- *Tags and marking must be inexpensive and durable*



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### *Species identification*

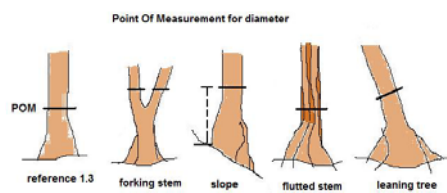
- The community records species using their local names
- Foresters develop a species database so the local names can be matched with the botanical names



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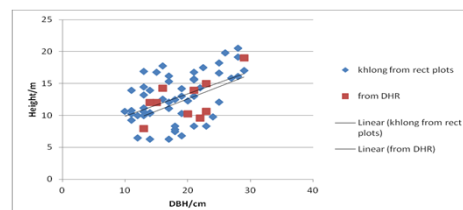
## Diameter measurements

- Community team needs to understand protocols for “problem trees”.



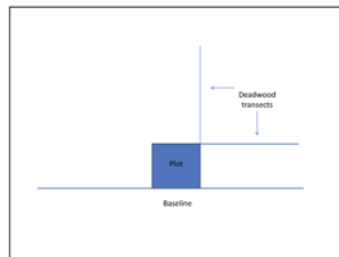
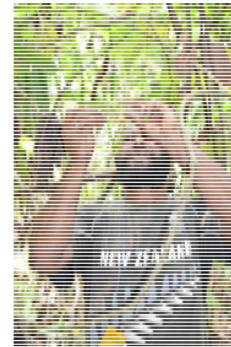
## Height estimates

- Difficult in dense forests, esp. on sloping ground
- Alternative is to develop species specific diameter height relationships



## Deadwood measurements

- Simple method lying deadwood uses transects. Diameter of wood along transect measured and decay estimated with “machete test”
- Volume of standing deadwood in plot estimated from measurement of tree diameter at base and estimated diameter at bole top.



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## Data recording

- Done by literate community members
- Challenge is to ensure recorders correctly enter the information called out by other team members
- Before leaving plot, Team leader must check and sign off the field sheets



Measurements		Height measurements	
Type	Species	DBH	Height
#1	...	...	...
#2	...	...	...
#3	...	...	...
#4	...	...	...
#5	...	...	...
#6	...	...	...
#7	...	...	...
#8	...	...	...
#9	...	...	...
#10	...	...	...

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## Observations

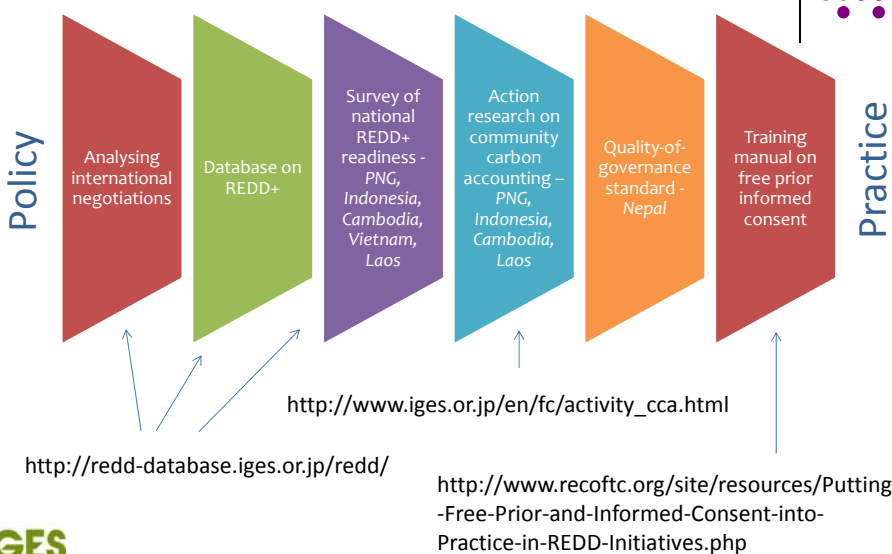


1. Local people can make good forest monitors.
  1. Can take accurate forest measurements
  2. Have good motivation to participate
  3. Are well-adapted to working in difficult forest environments
2. Well-tailored training programs and ongoing support required

IGES Project sites	Forest type and condition	Estimates from community measurements	Estimates in published literature for similar forest types
Madang Province, PNG	Mostly lowland and montane primary moist tropical forest (Hm class)	129.5 ± 75.8 tC/ha	106.3 ± 22.7 tC/ha - same province and forest type (Fox et al. 2010)
Mondulkiri Province, Cambodia	Deciduous forest	Rectangular plots - 75.5 ± 19.6 Circular plots - 72.2 ± 23 tC/ha	73.8 ± 8.6 (std. error) - same forest patch (Vathana 2010)
Yogyakarta & Central Java Provinces, Indonesia	1. Dryland woodlots 2. Home gardens	1. 32.1 ± 22.5 ± 22.5 tC/ha 2. 34.2 ± 20.6 tC/ha	1. No data 2. 35.3 ± 21.2 tC/ha - Lampung province (Roshetko et al. 2002)



## For further information on IGES Research on REDD+





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