PRESENTATION GIVEN AT THE TRANSLINKS

PAYMENTS FOR ECOSYSTEM SERVICES WORKSHOP

FEBRUARY 16, 2009

KATHMANDU, NEPAL

HOSTED BY

ENTERPRISEWORKS/VITA

This workshop was made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the terms of the TransLinks Cooperative Agreement No.EPP-A-00-06-00014-00 to the Wildlife Conservation Society (WCS). TransLinks is a partnership of WCS, The Earth Institute, Enterprise Works/VITA, Forest Trends and the Land Tenure Center. The contents are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States government.

Forest Carbon in Nepal:

Where Community Development and Conservation Meet

Presented at *Payments for Ecosystem Services Workshop*

Kathmandu, Nepal, February 16, 2009

Part 1: Overview of Forest Carbon Market and Standards

Part 2: Carbon Readiness for Forest Carbon Projects

Part 3: Some Technical Aspects

Steven De Gryze, PhD
Leslie Durschinger

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Overview of Part 1 - Forest Carbon Market and Standards

- Setting the scene: glossary and terminology
- What is the carbon market?
- Why are forest carbon credits different?
- Typology of the forest carbon market
  - Voluntary
  - Regulatory
  - Pre-compliance
- Project types and available standards
- Indicators for REDD project quality and risks
- Policy outlook
  - REDD in the regulatory market?
  - Project-based REDD, national-level REDD or a hybrid?
  - Offsets versus fund

Setting the Scene: Glossary and Terms

Abbreviation	Explanation
MTCO2e	Metric ton of carbon dioxide equivalent
GHG	Greenhouse Gas
AFOLU	Agriculture, Forestry and Other Land-Use
REDD	Reduced Emissions from Deforestation and Degradation
A/R	Afforestation and Reforestation
IFM	Improved Forest Management
ANR	Assisted Natural Regeneration

What is the Carbon Market?

- Trading of carbon credits.
  - Standard unit = MTCO2e = 1000 kg of CO2-equivalents = "tonnes" ≈ 0.75 – 1 m^3 wood ≈ one 30 cm-diameter tree
- There is no **single** carbon market
  - No global method (yet?) to measure emissions
  - No single agreement on the countries, sectors, or companies that should limit emissions
  - Depending on the registry/standard/methodology used, carbon credits are valid under different markets
- Value of a carbon credit is driven by
  - Legislation
  - Expectation of legislation
  - Public awareness/commitments
  - Cost of reducing emissions in operational entities
  - Costs of project

Carbon Market Typology

- ***Regulatory = compliance market***
  - Cap-and-trade, an operational entity gets a max. of GHG it can emit (the cap). If it emits more, buy credits or allowances; if it emits less, can sell these as allowances
    - "Allowances" = "Emission Rights" = carbon unit from another regulated entity that produced less GHGs than their cap
    - "Carbon credits" = "carbon offsets" = "project-based" From non-regulated entities that reduced emissions or sequestered carbon above the baseline = "project-based carbon credit"
- ***Voluntary market***
  - Carbon credits are purchased out of personal, individual concern = "reduce carbon footprint"
  - Corporate social responsibility
  - Product-based: products become "carbon-neutral"
  - Can be combined with payments for non-carbon ecosystem services
- ***Pre-compliance market***
  - Voluntary at first, buyers may use credits for complying in the future

World Bank internal working paper
State and Trends of the Carbon Market World Bank May 2008
$5/ton - Environment Finance *"A trillion dollar marketplace"*, by Gareth Phillips and Assaad Razzouk, March 2007

Why are Forest Carbon Credits Different?

- Forest definition: A/R versus REDD
- Land eligibility
- Permanence: who takes the risk & how long
- Leakage
- Many are community-based and require reversing behaviors
- Multiple stakeholders
- Long-term nature

Carbon Market Typology

	Regulatory market	Voluntary market
Total volume in 2006	$31 billion	$148 million
Total volume in 2007	$64 billion	$265 million
Total volume in 2008	$118 billion	$499 million
Expected future volume	$1 trillion in 2027	$50 billion in 2012
Price range	$12 to $12.1	$1 to $78/ton
	•Strongly regulated •Strict and bureaucratic rules	= self-imposed standard Quality and price varies significantly, as defined by: •Additionality •Accuracy of initial and on-going monitoring •Potential for double counting •Permanence
AFOLU project type inclusion	Limited. Only A/R, if at all	all AFOLU project types, including A/R, REDD, AF, and rangeland management

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New Carbon Finance

AFOLU Carbon Markets and Standards

- Each carbon market has its own carbon standard with its own rules and methodologies

	Regulatory Market			Voluntary Market		
Main markets		A/R	REDD		A/R	REDD
	•UNFCCC/CDM			VCS	●	●
	•2008-2012: Kyoto	●		CCAR	●	●
	•2009: Copenhagen	●	●?	CCX	●	●
	•European Trading System			CCBA	●	●
	• Single countries/ states					
	•California	●	●			
	•Australia					
	United States, US based United States, international (Cap-and-trade <1-4 years?)	●? ●??	●? ●??			

- Main AFOLU carbon credit standards are VCS and CDM

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The Main Carbon Standards and Project types

Project type	Examples	CDM	VCS
Afforestation/ Reforestation	▪ Reforestation on non-forest land with harvest ▪ Agro-forestry on non-forest land ▪ Assisted natural regeneration (ANR) on deforested land Eligibility	● ● ● Non-forest since 1989	● ● ● Non-forest >10 yrs before project start
Avoided Deforestation (REDD)	▪ Reduction of degradation and deforestation ▪ Enrichment planting or ANR, on degraded lands		● ●
Improved Forest Management	▪ Conversion from commercial to sustainable timber harvesting ▪ Extending rotations of harvests ▪ Other treatments to restore forest value		● ● ●
Agricultural Land Management	▪ Conservation Tillage ▪ Optimized fertilization (reducing N_2O emissions) ▪ Improved water management rice (reducing CH_4) ▪ Range land management		● ● ● ●

Recognition of community and biodiversity benefits can be added through the CCBA standards, as a way to receive payments for ecosystem services

Emergence of REDD Credits

- In Bali December 2007, the UNFCCC put avoided deforestation on the post-2012 roadmap, and details of inclusion are expected in December 2009
- The World Bank is pushing a national level approach with the Forest Carbon Partnership Facility
- However, the REDD *project* market is taking shape and getting some visibility and acceptance by market participants
- A number of REDD projects have been submitted under the Climate, Community and Biodiversity Alliance (CCBA) standard. No highly accurate carbon accounting is required and price of CCBA-only credits is expected to be low.
- The Voluntary Carbon Standard (VCS) provides guidance for accurate carbon accounting (updated in Dec 2008); probably only one methodology has been submitted to date
- It is unclear how much of a premium the market will place on credits with both CCBA and VCS registration
- In Poznan December 2008, the REDD debate centered around rights of indigenous people and forest degradation

VCS Highlights and Process

- Broad guidance is available, but **specific methodologies** must be submitted and dual validated. These methodologies are public and can be re-used.
- One, maybe two methodologies are undergoing validation today
- Approved **third-party validators** include four CDM approved and at least one temporary approved validators
- Selection procedures for second validator being developed by the VCS
- Uses **reserve pool** (= buffer account), with risk-based assignment to address permanence
- Activity-shifting and market **leakage** included
- **Additionality** follows CDM rules

Understanding prices of REDD and AFOLU carbon credits

- General carbon credits (Jan. 30, 2008)
  - EUA: $13.2/MTCO2e
  - Secondary CERs: $12.2/MTCO2e (already went through validation and verification)
  - Primary CERs: $9.6–$10.9/MTCO2e (not yet validated, never been purchased yet)
- AFOLU Carbon Credits
  - Regulatory CDM A/R: $2-$7/MTCO2e
  - Voluntary
    - A/R – Plantation: $8.20/MTCO2e
    - A/R – restoration with Native species: $6.80/MTCO2e
    - REDD: $2-$12, average of $4.80/MTCO2e
    - Agriculture and Soils: $3.90/MTCO2e
- Price depending on
  - Varying deal terms
  - Project quality
  - Project risk (sometimes adjusted by buffer pool)

State and Voluntary Carbon Market 2008,Ecosystems Marketplace

Standards Drive Project Quality

- High integrity for carbon accounting
  - Clean Development Mechanism (CDM) with 10 methodologies
  - Voluntary Carbon Standard (VCS) with detailed guidelines
  - California Climate Action Registry (CCAR), newly revised
- Ensure community and biodiversity co-benefits
  - Climate, Community, and Biodiversity (CCBA)
  - Vehicle to introduce non-carbon ecosystem services
- Other standards covering AFOLU are less used or less rigorous
  - CarbonFix, VER+, CCX

Risk Assessment According to VCS REDD

- Risk rating is assigned, and determines size of buffer account
- Potential for third-party insurance and other risk-reducing structures
- Project risk
  - Land ownership: is the land legally owned, is it legally protected
  - Technical capability and experience of implementer
  - Net revenue to ALL stakeholders
  - Future development of infrastructure
  - Population surrounding the project area
  - Incidence of crop failure
  - Credibility of long-term financial viability
- Economic risk
  - Risk of rising land opportunity costs causing reversal
- Risk of political and social instability
- Natural disturbance risk
  - Fire, pest, disease, weather (importance of global change), geological

Policy Outlook
REDD in the Regulatory Market

- COP-13 (Bali, December 2007): the UNFCCC put avoided deforestation on the post-2012 roadmap, and details of inclusion are expected in December 2009
- COP-14 (Poznan, December 2008): intense discussions around rights of indigenous people and the inclusion of forest degradation, overall pessimism due to economic downturn
- COP-15 (Copenhagen, December 2009): expectations for the inclusion for REDD are still high, but little cohesion
- U.S. waiting for first clear direction with Obama
  - Extension of existing proposals cap and trade based which include forests/agriculture (in U.S. and internationally) OR new direction
  - California will likely influence U.S. both at macro and micro levels

Policy Outlook

Project-based REDD, National-level REDD or a Hybrid

- Project-based REDD
  - Each project defines its own baseline, project activities and leakage potential
- National-level REDD: different interpretations
  - Baseline of deforestation is calculated at a national level, projects must use national-level baseline, but must calculate their own leakage potential
  - Baseline of deforestation and leakage potential is calculated at a national level, projects only define their own actions, and are discounted for leakage through factor
  - Fund-based schemes without direct connection to GHG emissions
  - Cap and trade and command and control schemes
- Little reconciliation between national and sub-national (project) treatment are being discussed

Policy Outlook
Paying for REDD: Offsets or a Fund?

- Debate on whether Carbon Offsets are the right vehicle for financing REDD projects
- Some argue for a **large-scale fund** to invest in REDD projects
  - Brazil, some voices in the European Parliament
  - Main arguments in favor of a fund
    - potential volatility of C market is not compatible with long-term nature of REDD
    - Including REDD projects would flood the carbon credit market
  - Disadvantages of a fund
    - Main categories of project risks (political, social, etc.) **still** exist
    - Metric of success? Carbon? Deforestation rate? A validation bureaucracy is still necessary.
    - By shutting off access to markets eliminates potentially valuable funding sources

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Overview of Part 2: Carbon Readiness

- Preconditions for developing carbon
- Typical funding challenges
- The phases of a project
  - Design phase
  - Implementation phase
- Selling carbon credits
  - Owner versus seller of the carbon credits
  - Types of transaction structures
  - Price discounts depending on who takes the risk
  - Who are the buyers of these credits?
- Revenue sharing structure

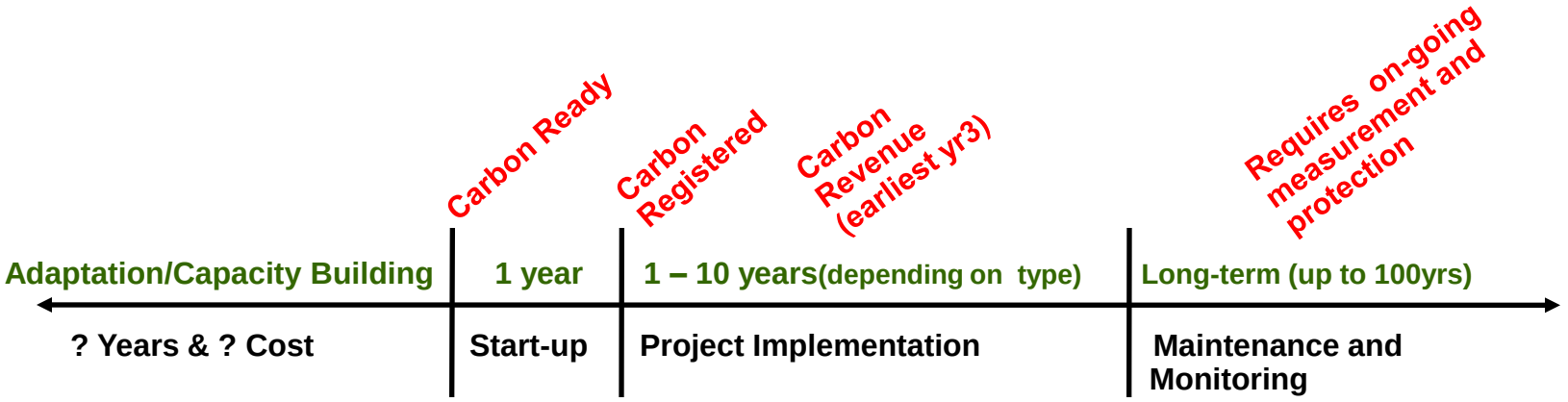
"Carbon Ready" - Preconditions for Developing Carbon

Before a project can even consider or engage in seeking carbon revenue the following conditions are required:

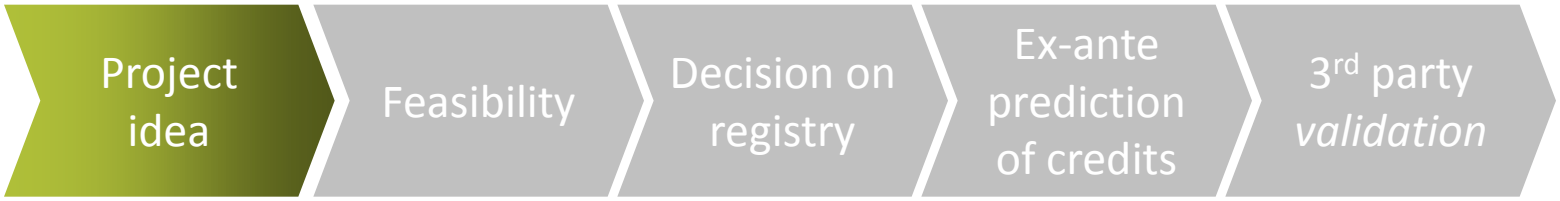
- Project developer has created in-country capacity to successfully implement and maintain project
  - Governments (national and local)
  - Communities
  - Local NGOs
  - Technical implementation expertise
- Project plan is "relatively" developed and partially funded
  - Detailed plan of project actions (where and what)
  - Budget for overall project activities has been created
  - Project development funding

Typical Funding Challenges for AFOLU

- Capacity includes:
  - Mobilizing/training communities
  - Land tenure and zoning changes
  - Engagement and process in government
  - Technical expertise to design and manage implementation
- Start-up costs are upfront project costs and carbon creation costs
- Project implementation costs vary higher for A/R than REDD
- Carbon payments based on actual delivered carbon paid upon delivery (A/R low in early years, REDD relatively flat)



Project Design Phase



- Broad project type
  - Afforestation reforestation (A/R)
  - Assisted Natural Regeneration (ANR)
  - Reduced Emissions from Deforestation (REDD)
  - Agroforestry (A/R)
- Define potential project areas and stakeholders
- Goals for co-benefits
  - Environmental (e.g. Maintain soil fertility through erosion reduction)
  - Provide sustainable livelihood for communities
  - Biodiversity and habitat restoration

Project Design Phase

Project idea | **Feasibility** | Decision on registry | Ex-ante prediction of credits | 3rd party *validation*

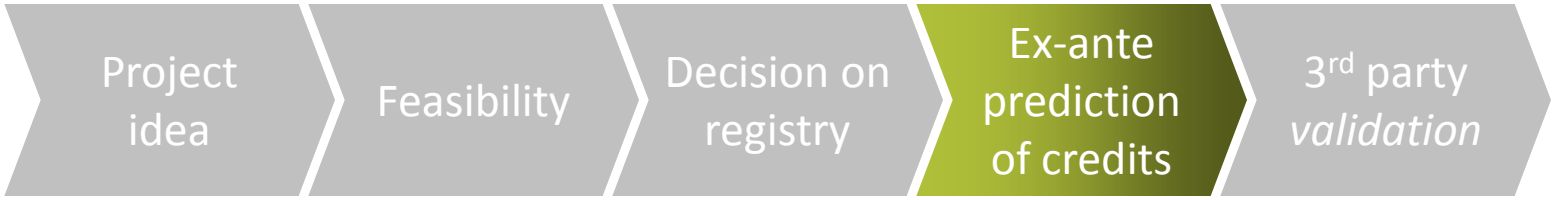
- Initial eligibility screen
  - In case of REDD: was the area forest for at least 15 years?
  - In case of A/R or ANR: was the area not forest for at least 10 years or since 31 Dec 1989?
  - ***Additionality***: will the project activities not happen without carbon credits
    - International scrutiny since BBC report August 2008
  - ***Leakage***: will the project activities just move pressure to a different region
- Project area with exact GPS coordinates
- Detailed management plan
  - Pure technical: which species, silvicultural activities and planting density
  - Specific activities (agricultural intensification, eco-tourism,…)
  - How will all stakeholders be integrated (Local Communities)

Project Design Phase

Project Type	Eligibility and Registry
REDD	If forest is at least 10 years old: VCS
A/R, ANR	If no forest on 31 Dec 1989: CDM, or VCS If no forest 15 years before project start: VCS
IFM	If forest is at least 15 years old: VCS
Grassland management	VCS

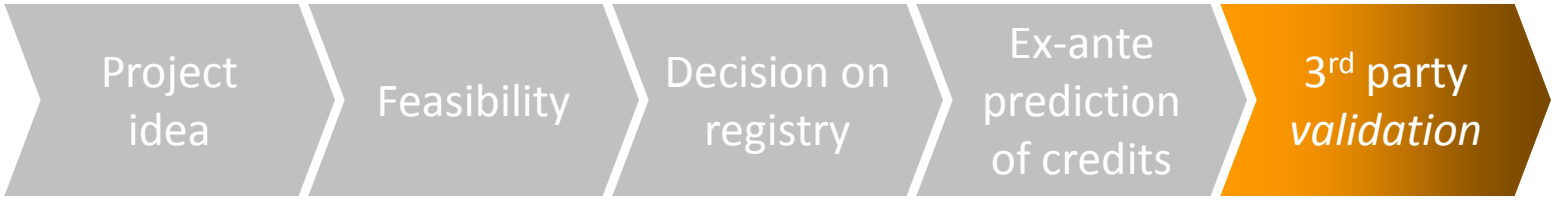
CCBA focuses primarily on biodiversity and community benefits
All of the above can be combined with CCBA for developing higher-quality credits and as a way to integrate payments for ecosystem services

Project Design Phase



- Field measurements
- Social data
- Remote sensing analysis
- Baseline calculation/modeling
- Leakage prediction
- Monitoring plan (incl. co-benefits)

Project Design Phase



- Preparation of new methodology (if necessary)
- Preparation and submission of "Project Document" (VCS) or "Project Design Document" (CDM) to third party validator
- Validation process
  - Field visit
  - Random checking of sampling plots
  - Public comments
  - Interviews with local communities

Project Implementation Phase

- Detailed record of all activities
  - How many ha treated
  - How much fuel is used
  - How much fertilizer is used
- Annual analysis of biomass carbon
  - Permanent forest inventory plots
  - Remote sensing analysis
- Annual social appraisal
  - Are the project activities causing leakage?
- System for stakeholder feedback at all levels
  - Local communities can provide opinion

Project Implementation Phase

Monitoring | **Calculation of ex-post credits** | 3rd party *verification* | Issuance of credits

- Integrate all information from monitoring
- Subtract loss of credits through leakage and the use of fuel and fertilizer
- Provide recommendations for the next validation period, adjust activities if necessary
- Prepare all calculations, and comments in an annual Monitoring Report, agreed on by all the parties

Project Implementation Phase

- Submit the monitoring report for third party verification
  - Local field visit
  - Random checking of sampling plots
  - Random interviews with local communities
  - Independent consultants
  - Period for public comments

Project Implementation Phase

Monitoring → Calculation of ex-post credits → 3rd party *verification* → **Issuance of credits**

- The third party submits the result of the evaluation to the standard's board
- Carbon credits with a unique identification number are tracked in registries

Seller of Carbon Credits

- Seller should be the legal owner of credits or an agent or aggregator (often the project developer) that is AUTHORIZED to act on behalf of owner
- Seller is who signs the ERPA and is legally responsible to meet terms and conditions of the carbon contract
- Ownership of the credits is dependent on the land-ownership and land-tenure status and agreements. Depending on the country, it may be the state, long-term land tenants, or implementer of the project activities.
- Project developers should negotiate agreements with owners (and governments) that cover carbon and detail responsibilities, clarify decision making, risk acceptance and economics of carbon transactions
- Project developers often have significant decision making authority over carbon transactions
- If the government is not the seller, they should be included early in the process to ensure support of required project approvals and carbon ownership

When are Credits Sold and When Are They Paid For?

- Most land-use projects sell 10, 20 or 30 years of "vintages" (year in which the credit was created) at once
- Credits can be sold at different times
  - After submission to standard but before positive validation
    - Might be subject to approval
    - Price depends on who will take the registration risk
  - Post-validation yields a higher price
- Credits can be paid at different times
  - Generally, credits are not paid for until the vintage is verified and "delivered" to the buyer
  - Some pre-payment can be negotiable (usually around 15%)

Types of Transaction Structures

- Spot trade – sale of the credits as they are registered, verified and delivered (a.k.a. “sell as you go”)
  - Price floats each period you sell (up or down)
  - Inability to secure long-term certain revenue stream
  - Limits delivery risks, because you only sell what is verified and registered
- Forward delivery agreement (most common)
  - Price is agreed up-front for multiple deliveries into the future
  - Allows future cash flows to be predicted and ensures a buyer
  - Can increase delivery risk (subject to ERPA terms)
  - May include some pre-payment
- Call option
  - Grants buyer the right to buy future deliveries at a set price (could be set at current market levels or above)
  - Allows for some participation in up-side of market
  - Does not ensure sale, but can provide some up-front payments
- Pricing types
  - Fixed price (most common)
  - Floating (based on a benchmark price)
- Vintages – how many years are sold, less any required reserves
- Period of agreed permanence – how long after contract period is seller responsible for protecting credits
- Consideration for frequency of actual measurements and verification (could include Seller based acceleration of verification)

Price Discounts Based on Timing and Risk Acceptance

"Primary" Market Credits – Risk Impact on Pricing

Buyers Risk	Sellers Risk	Price Discount
Methodology, validation registration, and volume risk, BUYER makes some upfront payment		49–68%
Registration and volume risk, BUYER makes some upfront payment	Methodology and validation	35–50%
Volume risk, BUYER pays on delivery	Methodology, validation registration	11–18% (*)
BUYER pays on delivery	Methodology, validation registration, and volume risk	None

(*) likely to be more significant for land-use only carbon credits
IDEACarbon Survey – Weekly Commentary March 20, 2008

Process of Selling Credits

The sales process follows these basic steps between the seller and potential buyer, potentially helped by broker

- Term sheet is created for project and transaction structure
- Potential buyers or market mechanism (such as auction) are identified (1–2 months)
- Indications of interest are taken from potential buyers and term sheet is signed
- Detailed information is provided and due diligence is preformed by buyer (1–3 months)
- Final ERPA terms are negotiated and transaction is completed (1 month)

Characteristics of AFOLU Carbon Buyers

- ***Compliance buyers*** currently limited for forestry (CDM only afforestation/reforestation)
- ***Voluntary buyers***
  - Many companies purchasing credits out of ***corporate social responsibility*** are reluctant to buy land use credits
  - Overall, voluntary buyers are probably more cautious/conservative/strict in their requirements. Main concerns:
    - Permanence
    - Additionality
    - Credibility of standard
- ***Pre-compliance buyers or speculators***
  - ***Emitters***, such as energy companies:
    - look to land use projects as cheap alternative,
    - interested in co-benefits,
    - more realistic about how projects get implemented

Buyers are Looking for (1):

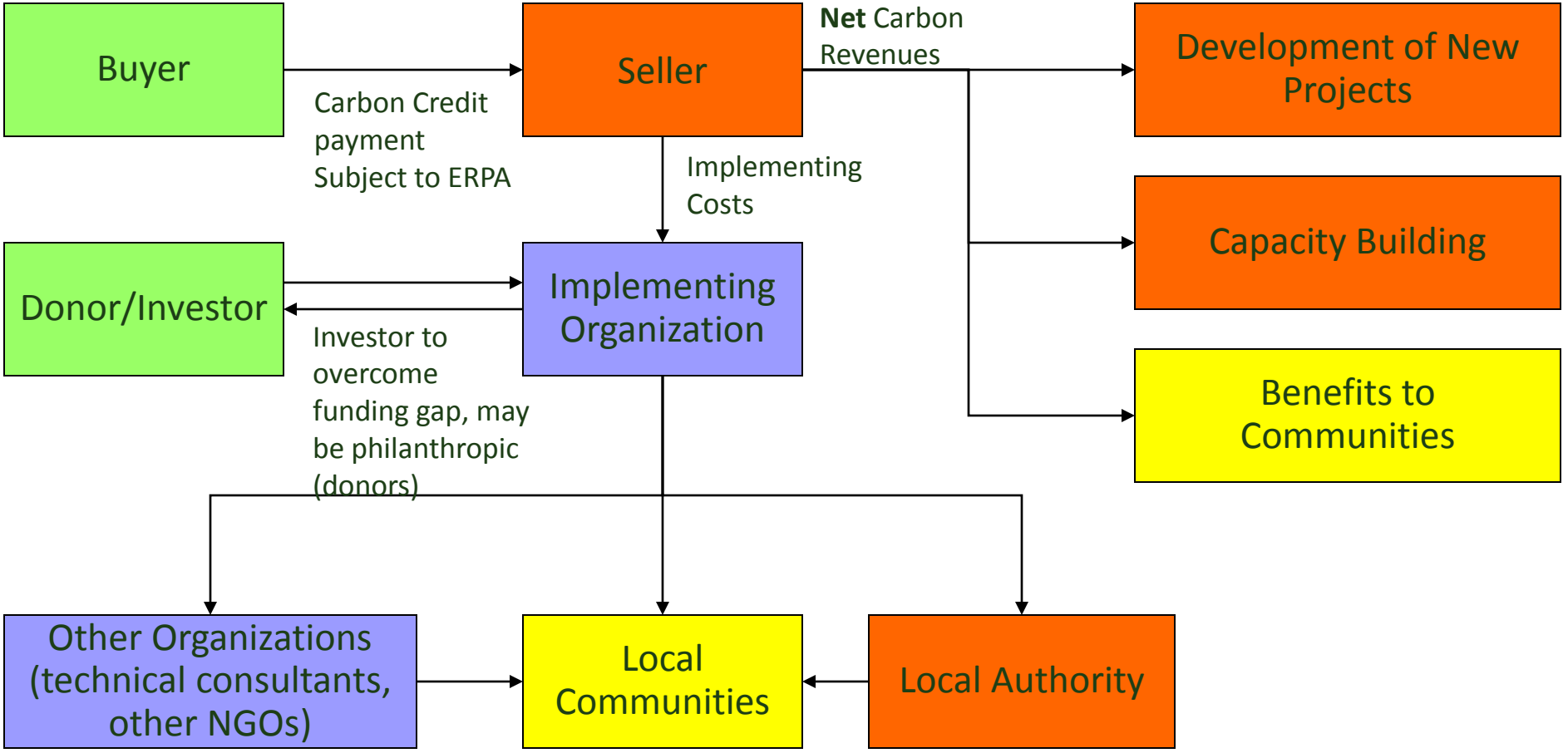
- Robust carbon accounting
  - Projects must meet well established and verified standards: such as CDM, VCS, CCBA, etc.
- Project developers with experience/capacity:
  - Design, formulation of project and proposal,
  - Management and implementation of project
- Multiple benefit projects
  - Biodiversity, poverty alleviation/sustainable livelihoods, CCBA

Buyers are Looking for (2):

- Successful underlying business models
  - As most projects are feasible only if carbon finance complements an underlying project, this must be sound and profitable
- Timing
  - Buyers want to give as little upfront payments as possible, e.g. not more than 10% depending on project quality/risk factors
  - By contrast, buyers want projects with an imminent start, and which provides an short-term and significant stream of credits
- Location
  - Some buyers prefer to invest in geographical areas where they have operations

Revenue Sharing Structure

- Buyer will want complete transparency (e.g. CCBA)
- Margin, ratio of net carbon revenues to total carbon income is very project specific, probable range of 40% to 90%
- The revenue sharing structure is subject to negotiation, EXAMPLE:



Ways that Communities Can Benefit from AFOLU Carbon Projects

- Social-economic benefits from capacity building
- Direct from project actions
  - Employment opportunities
  - Improved livelihood via project actions (agriculture intensification, fuel efficient stoves, etc.)
  - Development of income streams (NFTP, tree crops, sustainable local timber)
  - Direct payments
- Indirect
  - Non-project programs financed by project revenue (education, health)
- Tangential
  - Improved water quality and increases biodiversity

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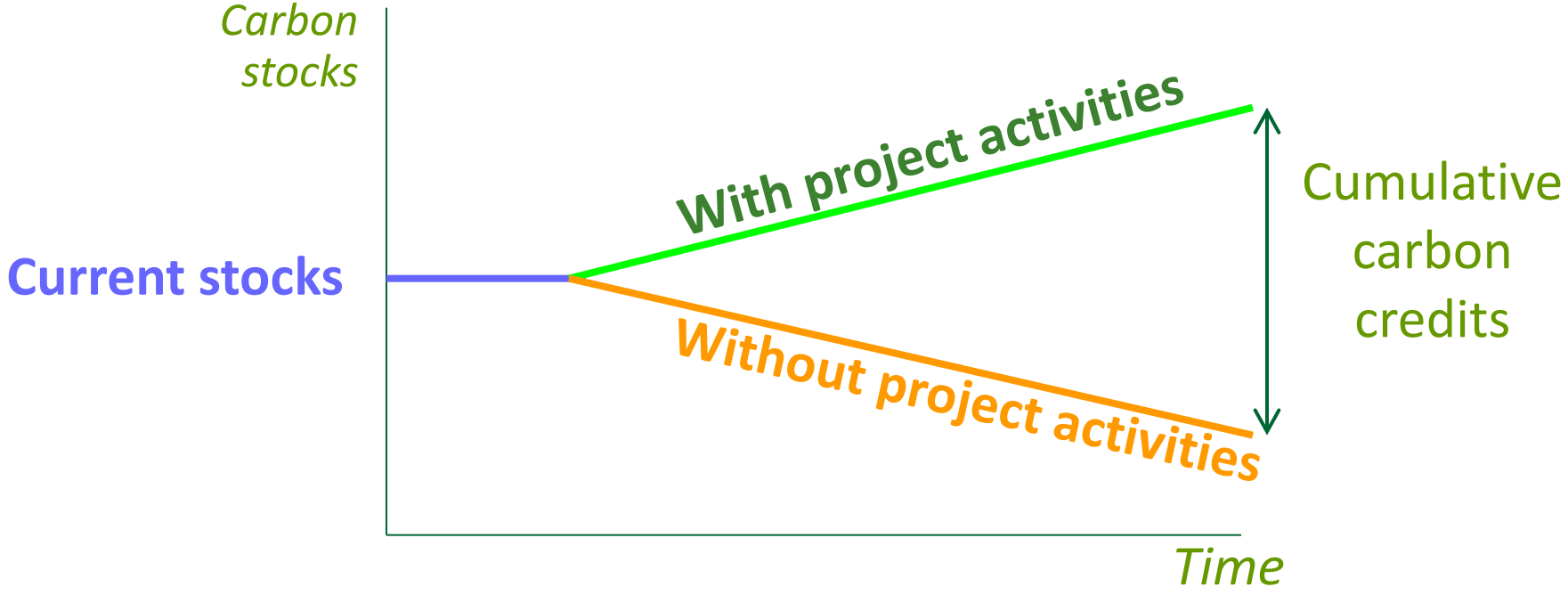
Overview of Part 3: Technical Aspects

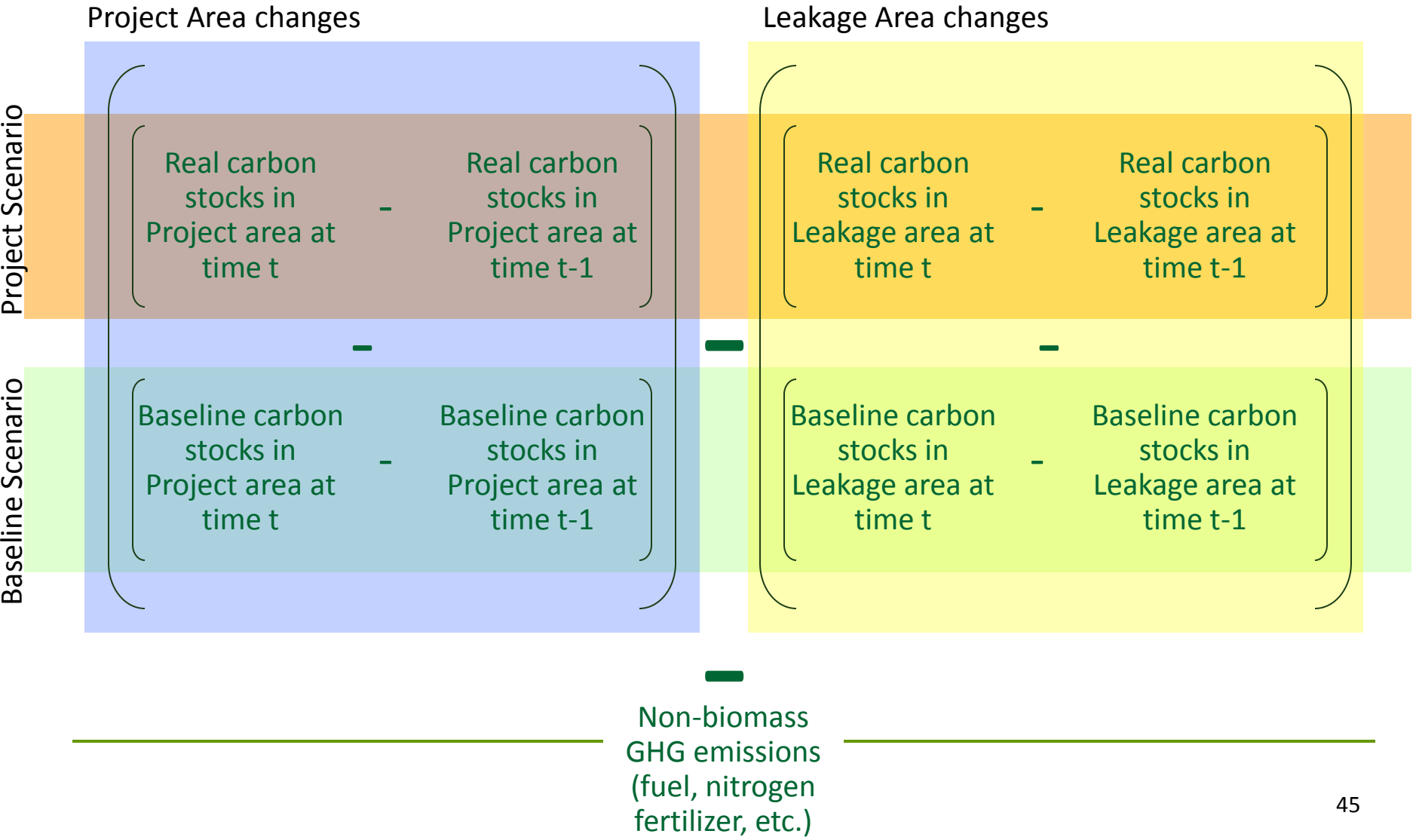
- Four essential technical questions
- Equation to calculate of net emissions reductions
- Deforestation typology
- Techniques to answer the four questions
  - Remote sensing
  - Field sampling
  - Land use modeling
  - Forest growth modeling
- Economies of scale: advantages of a national-level baseline

Four Essential Technical Questions

1. What are the **current carbon stocks**?
2. What are the **future carbon stocks without project activities**?
3. What are the **future carbon stocks with project activities**?
4. What are the **non-biomass related GHG emissions**



Calculation of Net Emission Reductions



Deforestation Typology under VCS

- Determines the carbon accounting procedure
- Mosaic or Frontier
  - ***Frontier***
    - Deforestation occurs from the edge of the forest onwards
    - Due to a lack of roads and tracks, most of the forest is inaccessible
    - Archetype = Brazilian Amazon
  - ***Mosaic***
    - Deforestation occurs in small patches everywhere
    - Many roads exist, and most of the forest is accessible
    - Archetype = South-East Asia
- Planned or Unplanned
  - ***Planned***
    - It is legally allowed to deforest the land
    - AND there are *concrete* plans at a national or local level to deforest the land?
  - ***Unplanned***
    - A number of smallholders deforests the land because of a complex array of deforestation drivers

Deforestation in the Himalayan Context

- Most probably unplanned mosaic deforestation (AUMD)
- The rest of this presentation will focus on technical aspects for avoiding unplanned mosaic deforestation
- Baseline deforestation rates are quantified using a reference region
- Activity-shifting leakage is limited to the areas immediately surrounding the project areas, which are called “leakage belts” or “transfer belts”
- Data and images used from case study in Cambodia

Techniques to Answer the Four Questions

1. *Remote sensing analysis*
   - Image registration and calibration
   - Decision tree to develop locally defined land classes
   - Historical deforestation rates
   - Stratification of the current forests for better quantification of carbon stock densities
2. *Field measurements*
   - Actual measurement of carbon stock densities
3. *Land use change computer models*
   - Predict the future deforestation and degradation rates and location
4. *Forest growth computer models*
   - Predict how fast forests can grow
5. *On-going monitoring procedures and processes (not covered)*

1. Remote sensing analysis

1990

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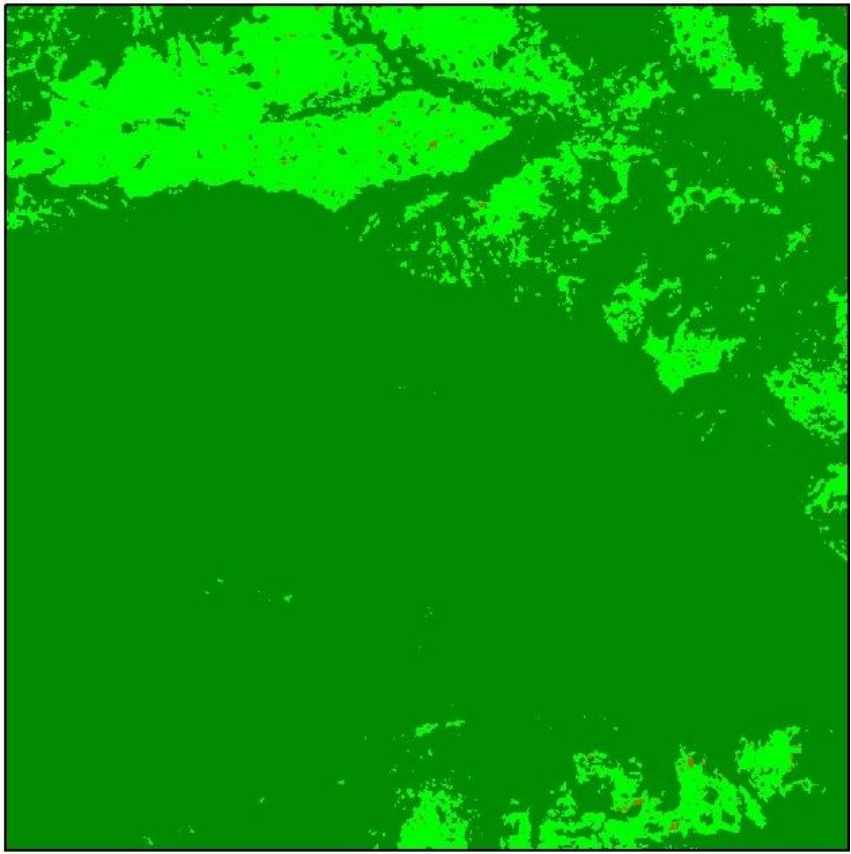

1. Remote sensing analysis

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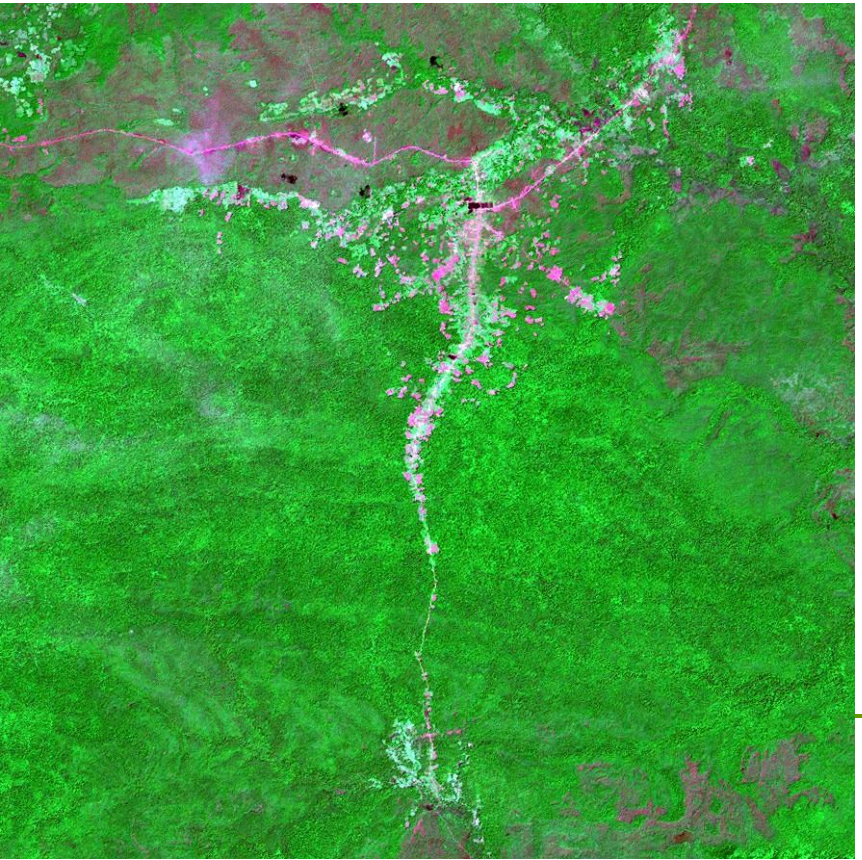

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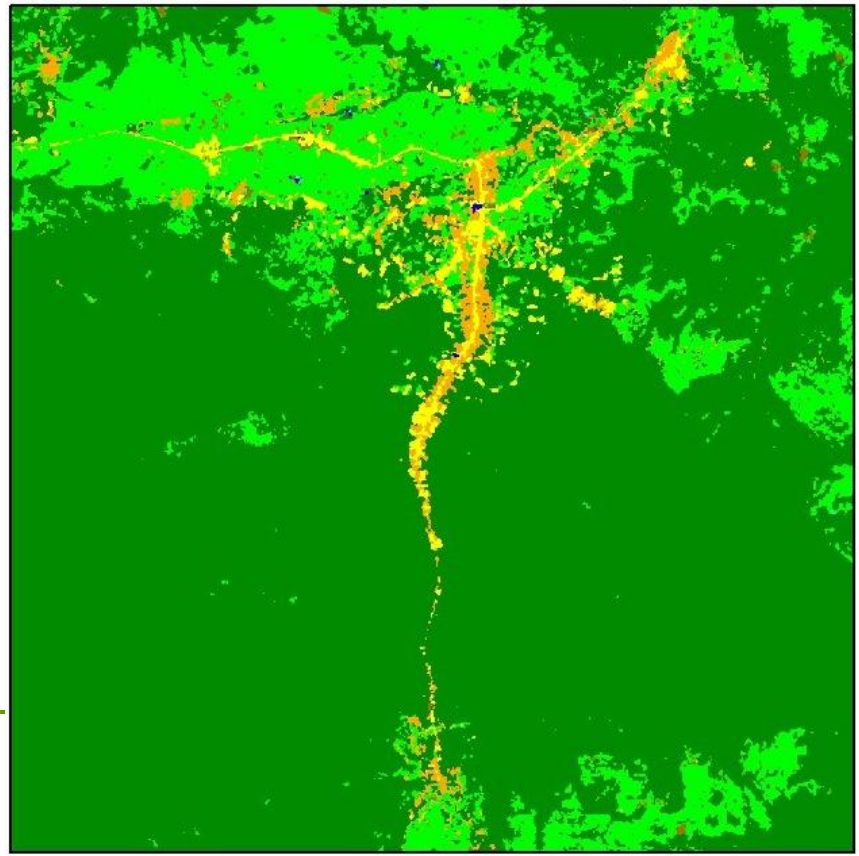
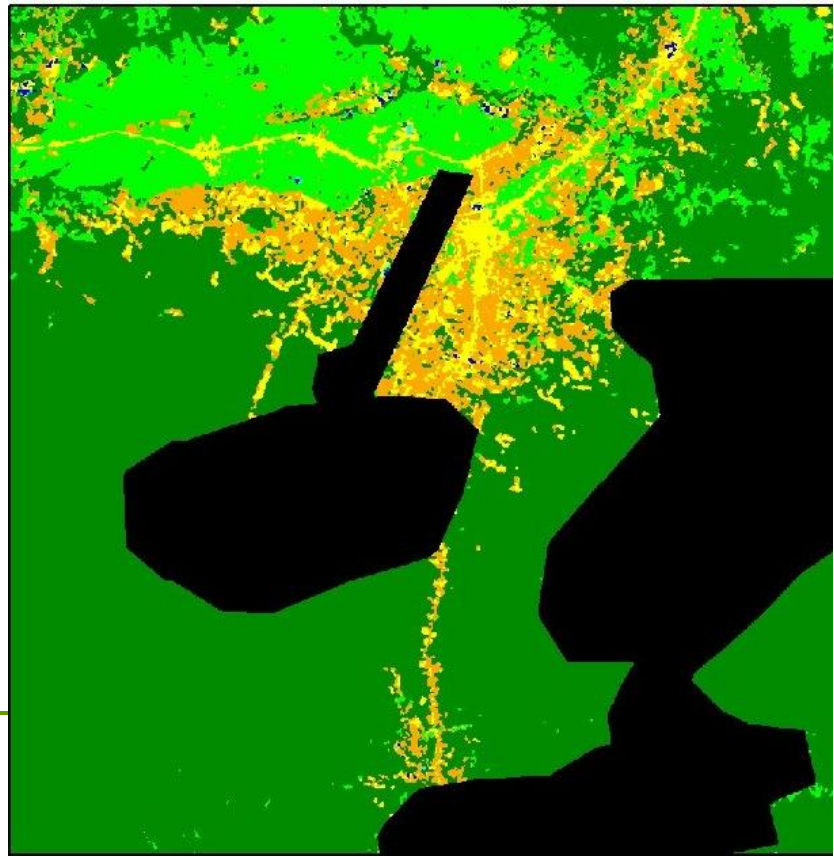


1. Remote sensing analysis

2003

Landsat image:

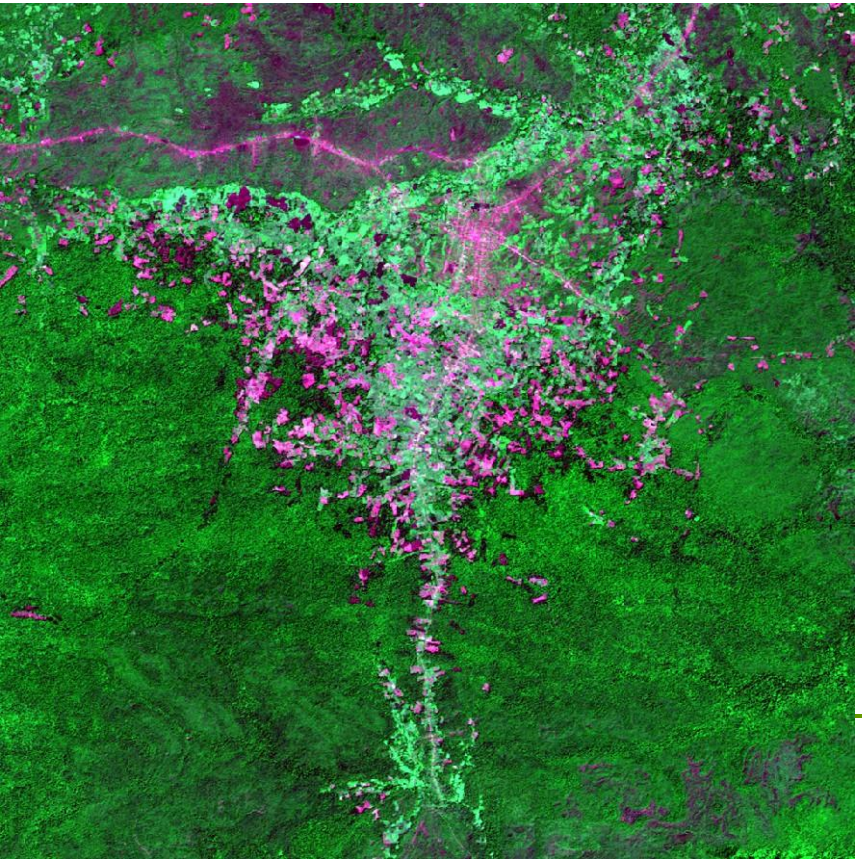
Classification in PD:



1. Remote sensing analysis

2004

Landsat image:



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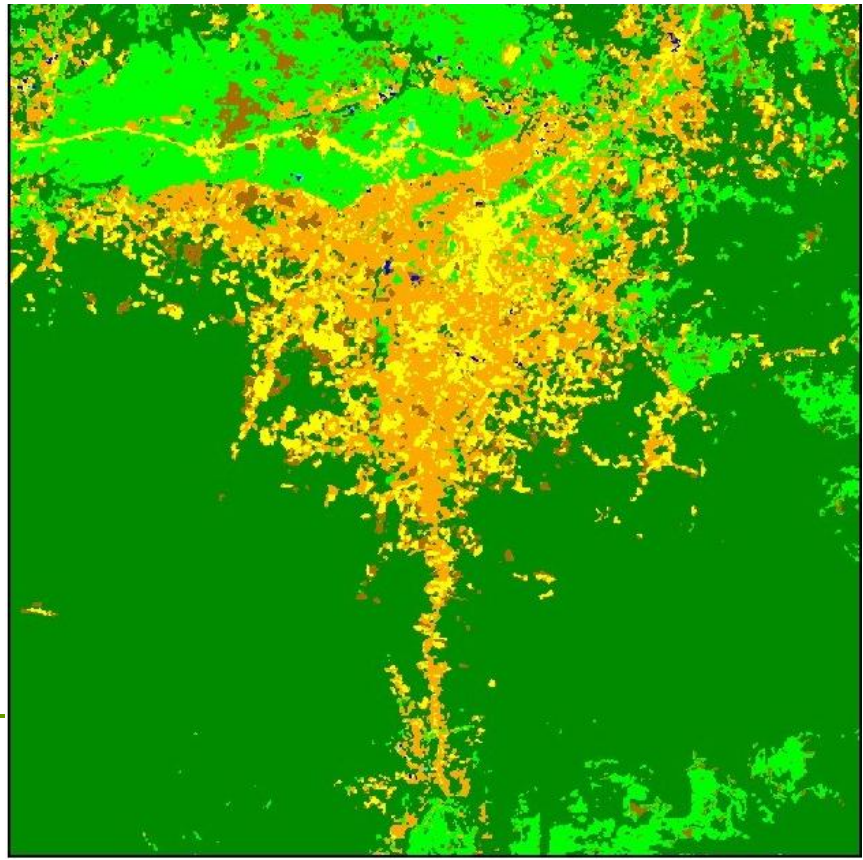
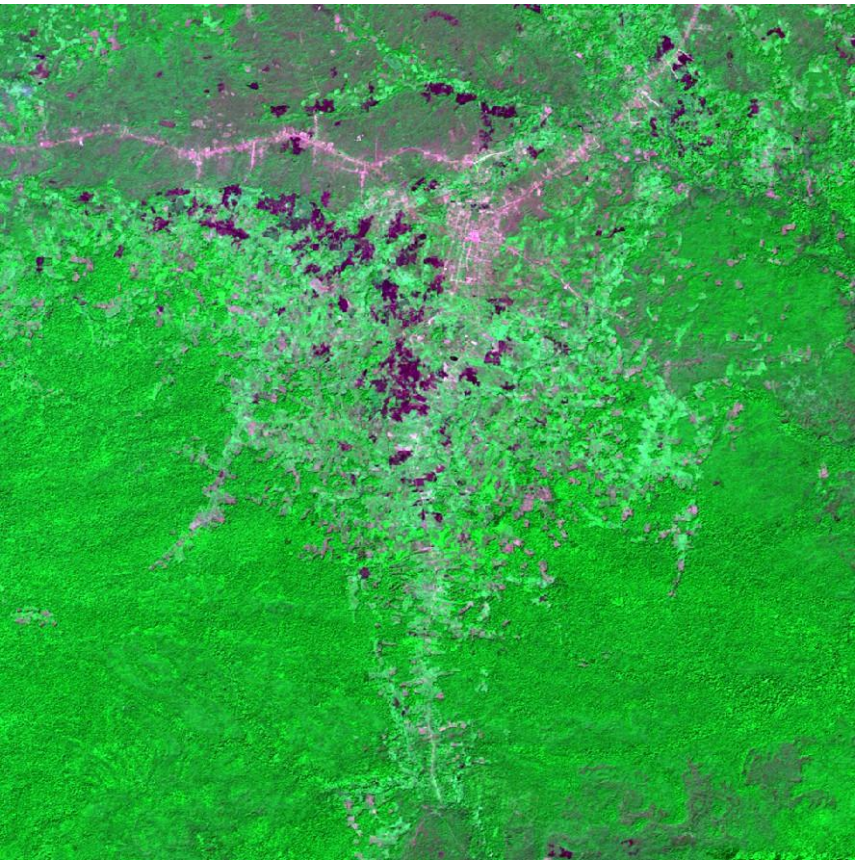


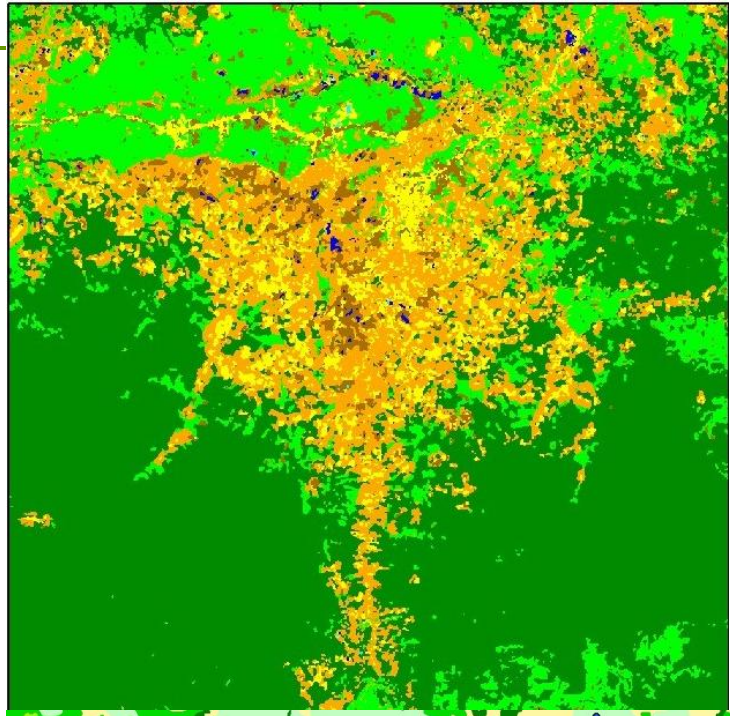
Clouds or background
Evergreen forest
Mixed and Deciduous forest
Wet soil, or shadows
Agriculture
Bare soil, roads, and settlements
Wetlands
Open water

2006

Landsat image:

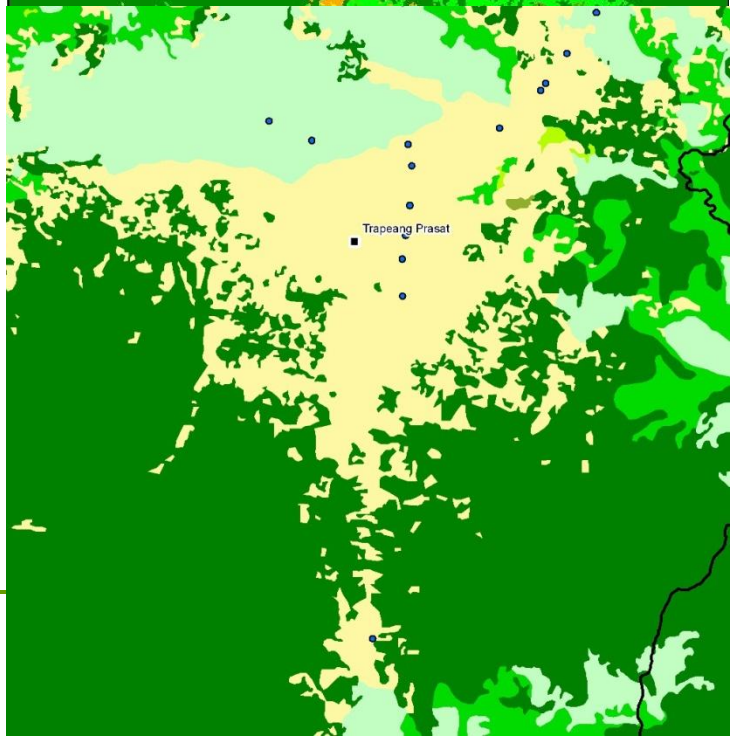


Classificat ion in PD:



- Clouds or background
- Evergreen forest
- Mixed and Deciduous forest
- Wet soil, or shadows
- Agriculture
- Bare soil, roads, and settlements
- Wetlands
- Open water

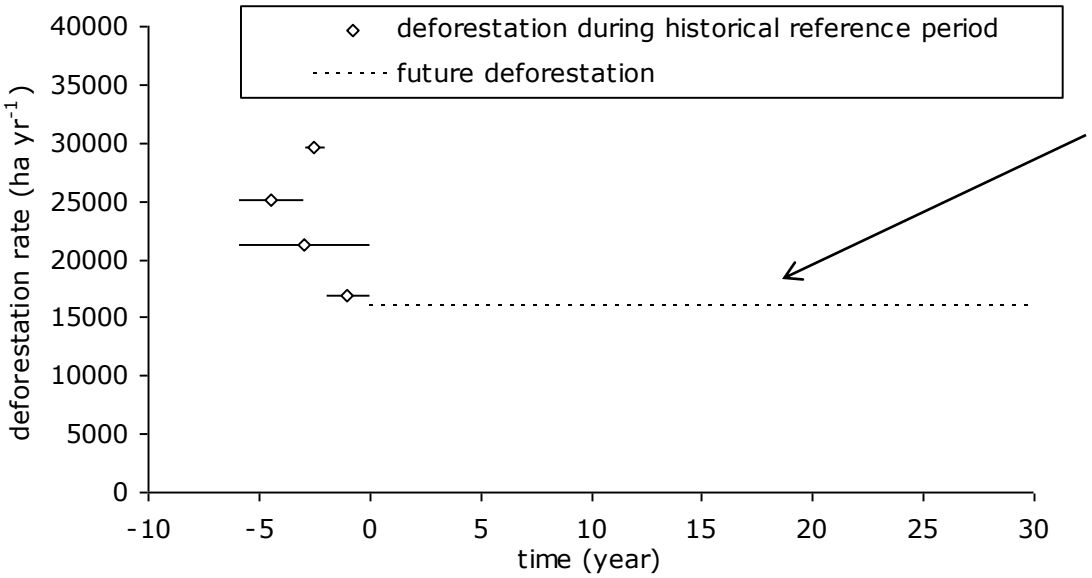
Classification from other studies



- Evergreen forest
- Semi-evergreen forest
- Deciduous forest
- Other forest
- Woodshrub dry
- Woodshrub evergreen
- Non forest

1. Remote Sensing Analysis Historical Deforestation Rates

- Average deforestation rates are calculated for each period in the historical reference period as ha per year



- The same rates are calculated from degradation based on moves between forest classes

2. Field Measurements Sampling Protocol

- Participatory Measurement used for local and community involvement in on-going monitoring

Standard Operations Procedure
For Field Measurements

Installation of new measurement plots for an avoided deforestation p
in the Oddor Maenchey province of Cambodia, version 4

Community Forestry INTERNATIONAL

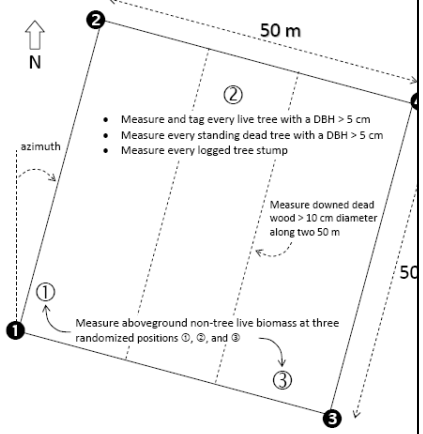
Prepared by Terra GLOBAL CAPITAL

Please send comments, corrections, and suggestions to Steven De Gryze, steven.degryze@terraglobalcapital.com

S.O.P. for field Sampling for installation of new measurement plots for CFI Cambodia - version 4

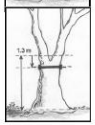
3 Overview of the measurement plot

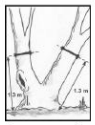
Note that this procedure does not use sub-plots. This means that all trees with a DBH > 5 cm should be measured and tagged.



S.O.P. for field Sampling for installation of new measurement plots for CFI Cambodia - version 4

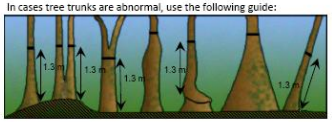

If the tree is leaning, the DBH tape must be perpendicular to the tree stem, according to the tree's natural angle (so, not parallel to the ground).


If the tree is forked at or below 1.3m, measure just below the fork point


If it is impossible to measure below the fork, then measure as two trees. However, wherever possible, measure as a single tree. This will lead to more accurate assessments of forest biomass.

Do not cut any lianas or vines growing on a tree[8]. Pull the liana away from th trunk and run the DBH tape underneath. If the liana is too big to pull away f the trunk, then estimate the DBH by subtracting the liana diameter from the tree diameter. Do not remove any mushrooms, epiphytes, fungal growths, termite nests, or other organisms that are found on the tree.

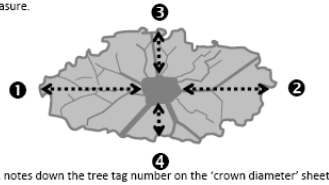
In cases tree trunks are abnormal, use the following guide:



[8] Cutting a liana from a tree should only be a last resort because this will affect the natural dynamics the plot. Over time, this will change affect the biomass in the measuring plot in comparison to the surrounding forest.

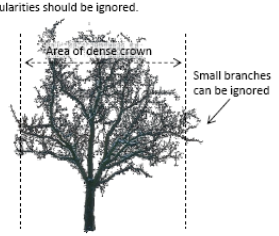
8 Measurements of crown diameters

- When to measure?
  - Measurement of crown covers is **only needed for some plots**. Only if sampling cover sheet (see section 13) shows 'yes' on the crown cover measurements crown diameters should be measured, otherwise proceed to section 9.
  - Crown diameter estimates should **only be done in more open forests** and woodlands and not in closed-canopy forests where crown development is restricted.
- Trees should be already tagged, and DBH measured (see previous section).
- The tree crown diameter is measured on every tree in the sampling plot by measuring the distance between the edges of the projected crown and the stem.
- Two persons are needed. Person 1 stays by the tree stem, holds the tape measure and writes the distances. Person 2 selects the four points and holds the other side of the tape measure.



1. Person 2 notes down the tree tag number on the 'crown diameter' sheet of the data sheet package.
2. Person 1 selects the point where the tree diameter is farthest away from the stem; this is point ❶.

   Person 1 marks the point where the crown is projected on the ground and puts a temporary pole in the ground at this position. Note that the crown edge is defined as the edge where the crown is quite dense. Therefore, very small individual branches and minor crown irregularities should be ignored.



Presentation for TRANSLINKS Nepal workshop, funded by USAID

2. Field Measurement Data Entry

- Data sheets
  - Error prone (no real-time error check)
  - Data entering is source of error and time consuming
  - Use of hand held devices reduces errors

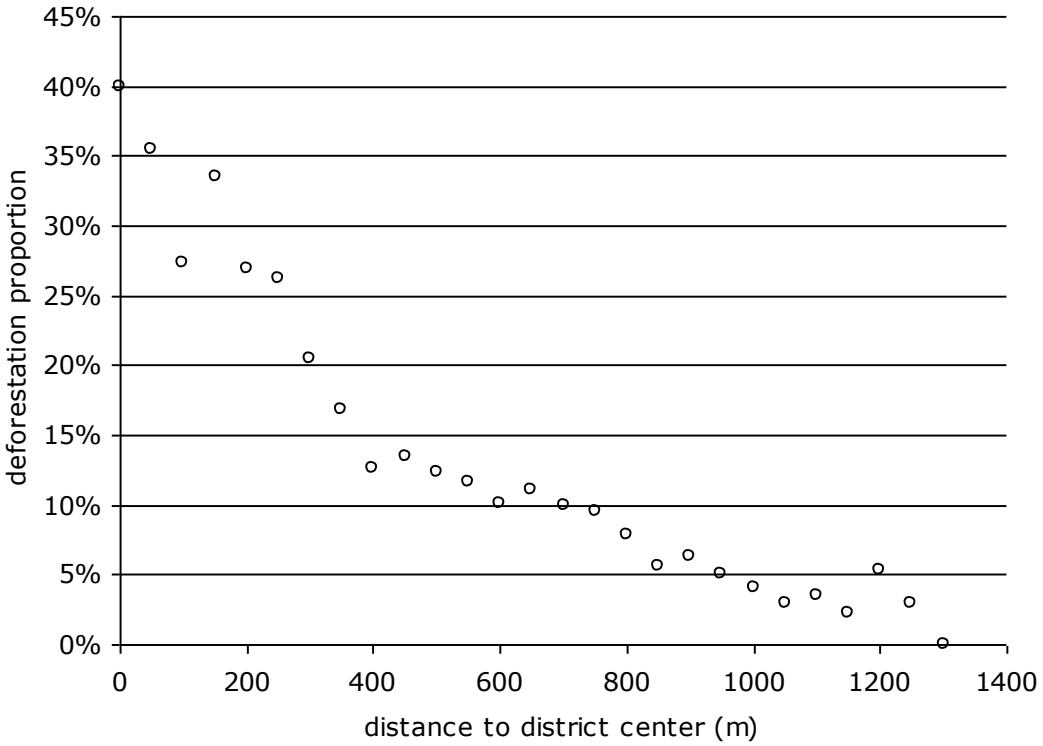
3. Land Use Change Models
Project Actions / Impact in Deforestation

	Project activity										
Driver of Deforestation	**1. Reinforcing land-tenure**	**2. Land-use plans**	**3. Protection**	**4. ANR**	**5. Fuel-efficient Stoves**	**6. Mosquito Nets**	**7. Agricultural Intensification**	**8. NRM Projects**	**9. NTFP Development**	**10. Fire Prevention**	**Total impact reduction**
1. Migrant encroachment			100%								**100%**
2. Conversion to cropland		25%		5%			25%		5%		**60%**
3. Conversion to settlements		50%									**50%**
4. Fuel-wood gathering			25%		25%	25%					**75%**
5. fires induced to "clean" the land		20%	20%					20%		20%	**80%**
6. Hunters inducing forest fires			50%							25%	**75%**
7. Illegal logging for commercial on-sale			90%								**90%**
8. Timber harvesting for local use		20%	50%	20%							**90%**
9. Large economic land concessions	100%										**100%**
10. Small economic land concessions	100%										**100%**
11. Timber concessions	100%										**100%**
Total reduction in forest degr.	**0%**	**5%**	**49%**	**1%**	**8%**	**8%**	**0%**	**4%**	**0%**	**9%**	
Total reduction in deforestation	**0%**	**14.5%**	**43%**	**3%**	**3%**	**3%**	**8%**	**1%**	**2%**	**2%**	

3. Predicting Future Deforestation

- Spatial drivers can explain location of deforestation

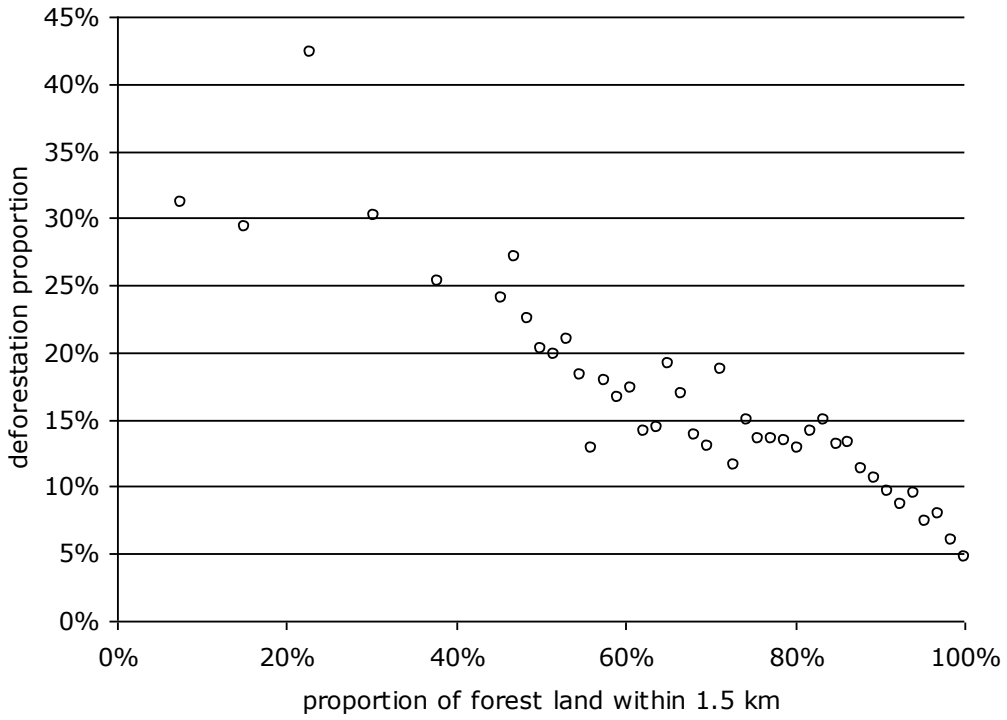
Proximity to Settlements



3. Predicting Future Deforestation

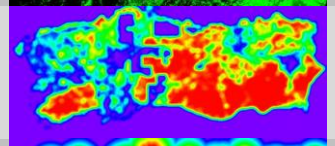
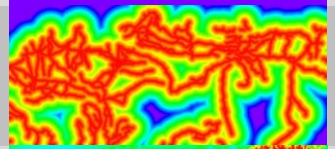
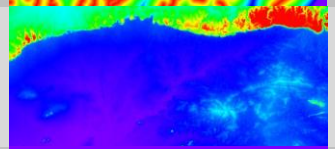
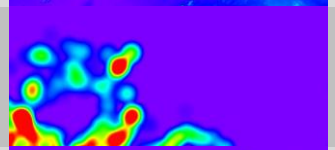
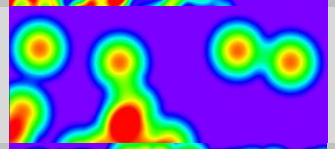
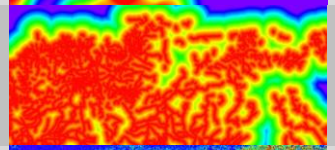
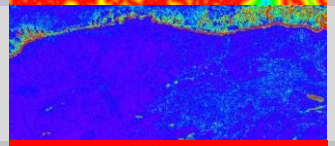
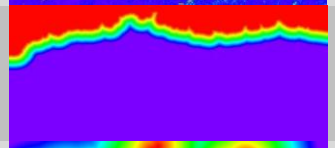
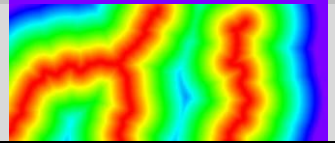
- Spatial drivers can explain location of deforestation

Degree of already present deforestation in the vicinity



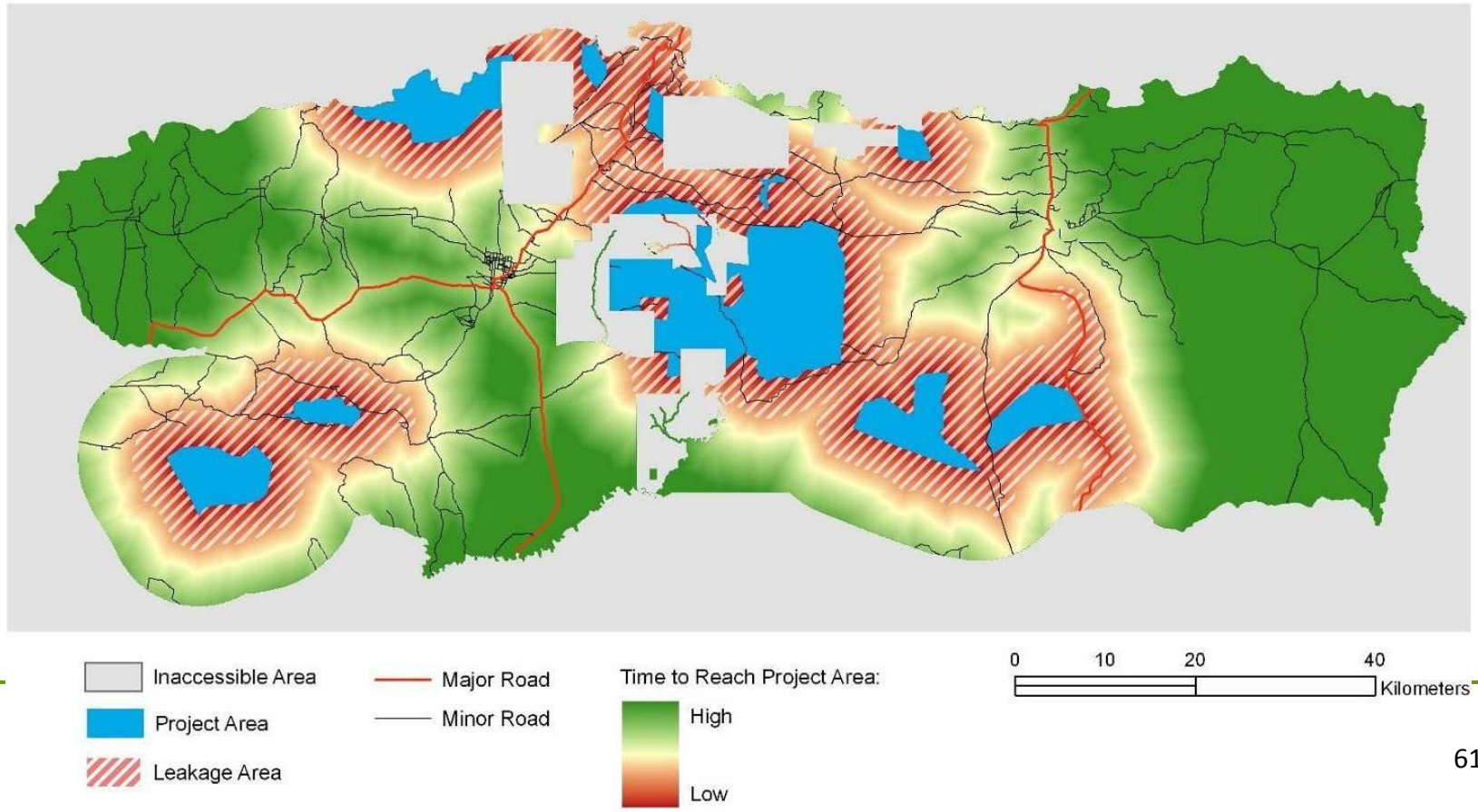
3. Predicting Future Deforestation

Total set of spatial drivers, logistic regression model is used to predict future deforestation

Variable	Graphic representation	Δ-2 log ℓ	$P > \chi^2$
Forest Type		90	<.0001
Forest Density		56	<.0001
Minor Roads Distance		25	<.0001
Elevation		19	<.0001
Village Density		19	<.0001
District Center Density		17	<.0001
Tracks Distance		9	0.0022
Slope		8	0.0041
Distance from Thailand		7	0.0091
Major Roads Distance		5	0.0296

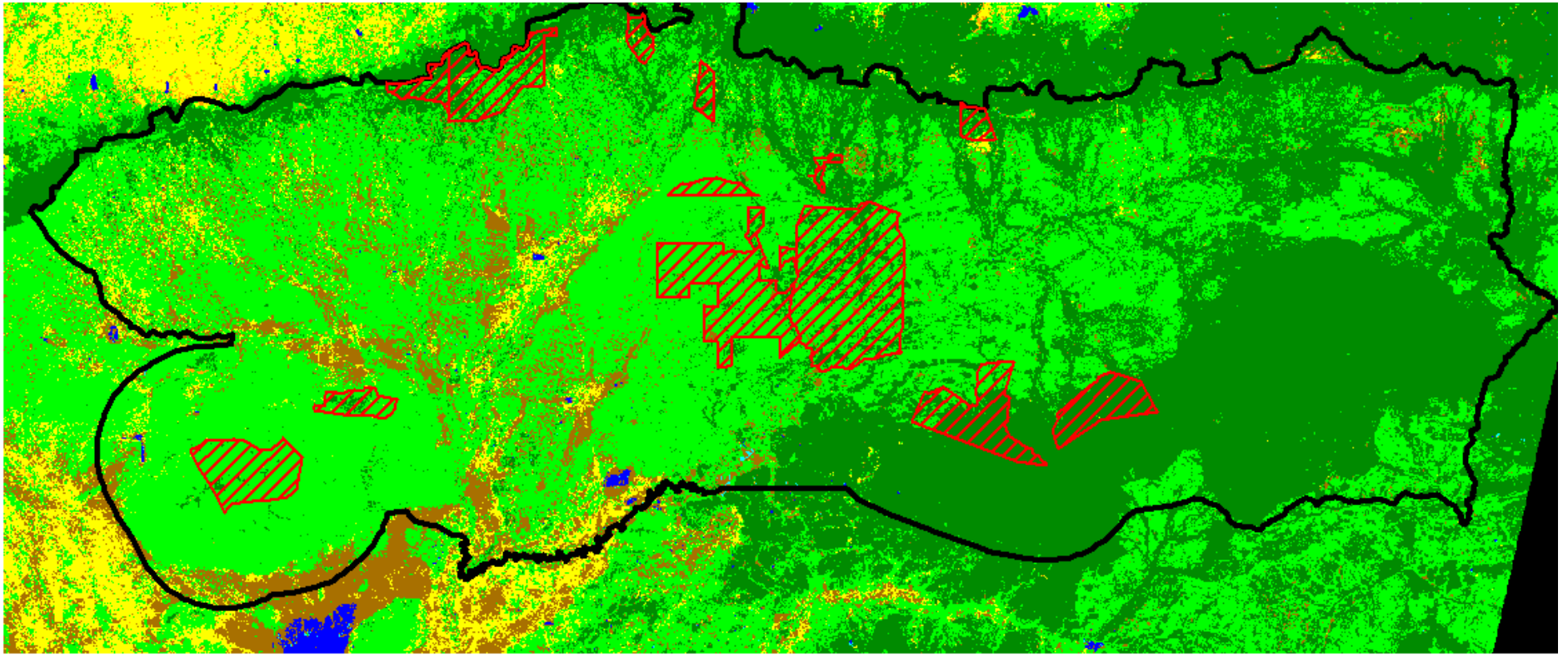
3. Predicting Future Deforestation - Leakage

- Taking into account higher deforestation rates around the project areas: leakage
- Leakage area and location based on road network



4. Forest growth model

- The maximal biomass in the forests are based on the condition of the forests
- Used to drive estimated of maximum potential biomass



Project and Regional REDD Methods Can be Leveraged to National Level

- Identical algorithms for classification can be applied to multiple scales
- Work-flow can be streamlined using scripting, and automatic quality checking
- Discount available when purchasing Remote Sensing data in high volumes
- A national-level deforestation baseline can support project-level actions
- Consistent classification and approach allows for input from in-country and international experts
- Participatory measurements done by local communities will be cost-effective to increase accuracy
- National-level approach allows for easy and automatic quality assurance

Next steps

- Case study in the Nepal Himalayan context will be developed by the end of March
  - Concrete steps to become carbon ready in Nepal
  - Overview of project types and their eligibility
  - Overview of the data and work required to design a carbon project
  - Summarize all the options in Nepal, given the already existing capacity and the community forestry agreement laws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The Earth Institute AT COLUMBIA UNIVERSITY
EnterpriseWorks/VITA
Fighting Poverty With Profit
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Land Tenure Center
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Comprehensive glossary

Abbreviation	Explanation
MTCO2e	Metric ton of Carbon Dioxide Equivalent
GHG	Greenhouse Gas
AFOLU	Agriculture, Forestry and Other Land-Use
REDD	Reduced Emissions from Deforestation and Degradation
A/R	Afforestation and Reforestation
IFM	Improved Forest Management
PD	Project Document
ha	hectare
AUMD	Avoided Unplanned Mosaic Deforestation
VCS	Voluntary Carbon Standard
CCBA	Climate, Community and Biodiversity Alliance
CDM	Clean Development Mechanism
ERPA	Emissions Reduction Purchase Agreements
NTFP	Non-Timber Forest Products
GPS	Global Positioning System
ANR	Assisted Natural Regeneration
COP	Conference Of the Parties
UNFCCC	United Nations Framework Convention on Climate Change
CCX	Chicago Climate Exchange
VER+	Verified Emission Reductions
CCAR	California Climate Action Registry