Critical issues for building national REDD+ MRV capacities and the role of remote sensing

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What is GOFC-GOLD?

- A technical panel of the UN Global Terrestrial Observing System (GTOS/FAO)
- A coordinated international effort:
  - to ensure a continuous program of space-based and field forest and land observations for global monitoring of terrestrial resources
- A network of participants implementing coordinated research, demonstration and operational projects
- A vision to share data, information and knowledge
- GOFC-GOLD operates through:
  - Executive committee, science and technical board
  - Implementation teams and 3 project office (CA, US, Germany?)
  - Dedicated working groups (REDD, GEO task, biomass)
  - 6 Regional networks (Central/West/East Africa, SE-Asia and Latin America)
A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation.
Variability in capacities for REDD monitoring

Consideration of factors:
1. Requirements for monitoring forest carbon on national level (IPCC GPG)
2. Existing national capacities for national forest monitoring
3. Progress in national GHG inventory and engagement in REDD
4. REDD particular characteristics: importance of forest fires, soil carbon, deforestation rate etc.
5. Specific technical challenges (remote sensing): cloud cover, seasonality, topography, remote sensing data availability and access procedures

Source: http://princes.3cdn.net/8453c17981d0ae3cc8_q0m6vsqxd.pdf
Some key issues

- REDD+ participation requires a much higher priority given to MRV than national forest monitoring in the past.
- The development of a national REDD+ MRV system follows a “roadmap”:
  - to build sustained capacities based on international requirements and national needs to implement REDD policy
  - Addresses near-term priorities & long-term targets
- Without a clear linkage between MRV and policy from the beginning, results-based compensation for REDD+ actions will be ineffective.
- Any MRV capacity development progress needs to improve national capacities.
# Needs for guidance, analyses and advice on national MRV

<table>
<thead>
<tr>
<th>Need</th>
<th>Whose need</th>
<th>Key information provided by</th>
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<tbody>
<tr>
<td>International principles and guidance for measuring &amp; reporting on carbon stock changes &amp; emissions</td>
<td>Individual Parties</td>
<td>IPCC Good Practice Guidance for LULUCF and AFOLU (i.e. Penman, et al., 2003)</td>
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<td>UNFCCC/SBSTA decisions</td>
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<tr>
<td>Additional information on methods and procedures for MRV</td>
<td>Individual Parties</td>
<td>GOFC-GOLD Sourcebook (GOFC-GOLD, 2009)</td>
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<tr>
<td>Analysis of current national MRV capacities</td>
<td>Individual Parties; International community</td>
<td>Assessment of national forest monitoring capacities, Study supported by PRP/Norway</td>
</tr>
<tr>
<td>Analysis on costs of developing national MRV systems</td>
<td>Individual Parties; International community</td>
<td>UNFCCC technical paper (UNFCCC, 2009)</td>
</tr>
<tr>
<td>Concepts for national REDD architectures (incl. link of policy and MRV)</td>
<td>Individual Parties</td>
<td>CIFOR book on national REDD architecture and policies (Angelsen, 2009)</td>
</tr>
<tr>
<td>Advice on how to develop national MRV system</td>
<td>Individual Parties</td>
<td>UN REDD program (framework, <a href="http://www.un-redd.org">www.un-redd.org</a>)</td>
</tr>
</tbody>
</table>

(adapted and edited after Dickson, 2009)
Issues to develop a REDD MRV system

• A matter of priorities

• Requirements for national MRV system:
  – **International**: principles and procedures specified by the IPCC Good Practice Guidelines
  – **National**: needs and priorities of the national REDD policy and implementation strategy;

• Bridging the capacity gap:
  – **Assessment**: of existing national forest monitoring technical capabilities versus the requirements for the MRV system;
  – **Develop and implement a roadmap**: to build sustained in-country capacities for MRV
International requirements

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International requirements (IPCC GPG)

• Requires capacity for national estimation and reporting:
  – Activity data and carbon stocks

• Principles:
  – Consistency, transparency, completeness, comparability and accuracy

• Priorities and capacity building:
  – Key category analysis
  – Uncertainty analysis and improve system over time

• Independent international review
CONCEPTS

REDD forest related activities

Conservation

Deforestation

Degradation

SFM

Enhancement of forest C stock

Deforestation

Source: Danilo Mollicone
Process for establishing a national MRV system

Key components

Planning & design
- All relevant national stakeholders understand UNFCCC-REDD, IPCC LULUCF monitoring requirements, and existing national forest carbon monitoring capacities?
- National forest monitoring system complete & accurate & for REDD implementation & LULUCF reporting?
- Data on carbon emissions from land use change?
- Significant emissions from other carbon pools?
- Significant emissions from biomass burning?
- Error sources & uncertainties quantified?
- National establishment of monitoring system?
- Reference (emission) level established & regularly updated?
- National and international reporting on forest carbon changes completed?

Establishment of monitoring system
- Cost categories: 1. <100 K$ 2. 100-250 K$ 3. 250-500 K$ 4. 500-1000 K$ 5. >1 M
- Analysis: human processes, areas affected & emission factors
- Understanding national fire regime and emission factors
- Monitoring national carbon inventory & for targeted local survey
- Analysis of human processes, areas affected & emission factors
- Understanding national fire regime and emission factors
- Expertise in spatial/temporal analysis tools and techniques to establish NEEs
- Analysis of forest change processes, and related emissions, drivers & factors
- Expertise in accounting and reporting procedures for LULUC using IPCC-GGG
- Understanding of uncertainties & procedures for independent review

Indicative cost
- Country capacity: some/none
- Tier 2/3

UNFCCC technical paper on costs for REDD MRV
National requirements – linking MRV and policy

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Further MRV capacity building considerations

• **A key objective**: any MRV capacity development progress needs to establish sustained national capacities

• **National requirements**: a clear linkage between MRV and national policy

• **Systematic national monitoring**

• **Measurement of REDD action areas (sub-national)**: human impacts causing carbon emissions concentrated in specific areas

• **Capacity building**: along a roadmap addressing near-term priorities and long-term target
REDUCTION IN DEGRADATION, SUSTAINABLE FOREST MANAGEMENT AND FOREST ENHANCEMENT (REDD-action Forests)

- Measure changes in forests remaining forest (displacement of emissions?) and impacts of non-spatially explicit policies.
- Measure carbon stock change and verify impact of REDD actions.
- Measure “no change” or permanence.

Other Forests

- Measure deforestation and reforestation area and associated carbon stock changes.

Conservation forests (C)

Forest land

Non-Forest land

Hypothetical Country

GOFC-GOLD
## Drivers and monitoring priorities (Fiji)

<table>
<thead>
<tr>
<th>Processes that effect forest carbon stocks</th>
<th>Importance (carbon impact)</th>
<th>Current data</th>
<th>Suggested activity to fill data gap in the near term</th>
</tr>
</thead>
</table>
| **Forest conversion for expansion of agriculture** | Very high | Some data may be available with NLTB, Forestry & Ministry of Primary Industries, only tracked if commercially logged | 1. Remote sensing based area / land use change assessment  
2. Gather and evaluate existing national data  
3. Conversion of existing inventory data into carbon |
| **Conversion of forest for settlement** | high | Some data with Lands Dept & no data for squatters | 1. Remote sensing based area / land use change assessment  
2. Gather and evaluate existing national data  
3. Conversion of existing inventory data into carbon |
| **Plantation clear-fell harvesting** | high | Data available from forest companies, no government on tracking on when or where | 1. Gather data on national level and evaluate data with remote sensing assessment  
2. Conversion of existing harvest estimates into carbon |
| **Selective logging of native forests remaining forest** | medium | SFM: data at GTZ, FD Local use (no data)  
Commercial use - data from the Forestry Department (spatial data and harvest estimates) | 1. Gather data on national level and evaluate data with remote sensing assessment  
2. Conversion of existing harvest estimates into carbon  
3. Study long-term effects |
| **Accidental burning affecting forests** | medium | Fiji Pine has fire data for their plantation (pine). | 1. Gather data on national level and evaluate data with remote sensing assessment  
2. Targeted ground surveys |
| **Forest clear-fell for mining** | medium | Mining companies should have data or mineral resources division | 1. Gather data on national level and evaluate data with remote sensing assessment |
# Guyana REDD MRV development roadmap


**National strategy (2010/11)** ➔ **Country readiness (2011/12)** ➔ **Implementation (post 2012/13)**

## Objectives
- **Gather and integrate information & fill data gaps for national REDD opportunities, scoping and policy development**
- **Develop capacities, conduct historical monitoring, and implement a (minimum) IPCC Tier 2 national forest carbon monitoring, establish the reference level and report on interim performance**
- **Establish consistent and continuous MRV supporting national REDD+ actions and international IPCC GPG-based reporting and verification**

## Key results and national capacities developed

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<tbody>
<tr>
<td>1. Comprehensive MRV roadmap developed and national MRV steering body operational</td>
<td>1. Capacities in place for consistent and continuous acquisition and analysis of key data for Tier 2 nationally and Tier 3 for demonstration/activity sites including international reporting using IPCC LULUCF; uncertainty assessment MRV improvement plan developed</td>
<td>1. IPCC key category analysis and assessment for Tier 3 approaches completed and implemented (if desired)</td>
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<tr>
<td>2. Improved national capacities on LCDS, REDD, IPCC-LULUCF, and carbon dynamics</td>
<td>2. Reference level established based on historical data, and future developments using internationally accepted methods</td>
<td>2. Independent international review of full MRV system completed</td>
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<tr>
<td>3. Framework and capacities to demonstrate REDD implementation and interim performance</td>
<td>3. All data available and accessible for an updated national REDD implementation plan</td>
<td>3. Capacity in place and implementation to deliver verification and compliance assessment for REDD results-based compensation</td>
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<tr>
<td>4. All data available and accessible (including acquisition of new forest carbon data) on drivers and processes needed for developing a national REDD policy and interim implementation plan</td>
<td>4. Regular reporting on REDD demonstrations and interim performance</td>
<td>4. National data infrastructure of forest greenhouse gas inventory and assessment in place for regular reporting</td>
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<td>5. Established communication and participation mechanism to involve relevant stakeholders nationally and internationally</td>
<td>5. Continued engagement with key national stakeholders for REDD implementation and assuring long-term sustainability of MRV capacities (i.e. universities)</td>
<td>5. Implementation plan to use new and proven technologies to reduce uncertainties and increase efficiency of MRV system</td>
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<td>6. Approaches for setting reference levels, linking MRV and policy, and MRV co-benefits and synergies are explored and defined</td>
<td>6. Monitoring system explored to cover key variables for other ecosystem services</td>
<td>6. Framework developed that links REDD into LCDS monitoring, reporting and verification system</td>
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Role and issues for remote sensing

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www.fao.org/gtos/gofc-gold
www.gofc-gold.uni-jena.de
Role of remote sensing

• Use of remote sensing essential for many developing countries to derive activity data
  – Compare historical and future deforestation rates

• Experiences in Annex 1 and India, Brazil, Mexico

• Take advantage of potentials but understand limitations and cost implications:
  – Operational applications today
  – Role of evolving technologies and need for research and development
  – Understand and communicate the limitations and challenges
Some technical challenges for remote sensing

Mean annual cloud cover

Country coverage of Landsat 5 receiving stations

Mean annual cloud free country coverage with SPOT data 2006-08

Seasonality

Variability in cloud cover (%)

Topography

Area with steep slopes (%)

Average internet download speed

Source: Herold, 2009 http://princes.3cdn.net/8453c17981d0ae3cc8_q0m6vsqxd.pdf
Current availability of fine-scale satellite data sources and capacities for global land change observations

<table>
<thead>
<tr>
<th>Satellite observation system/program</th>
<th>Technical observation challenges solved</th>
<th>Access to information on quality of archived data worldwide</th>
<th>Continuous observation program for global coverage</th>
<th>Pre-processed global image datasets generated &amp; accessible</th>
<th>Image data available in mapping agencies for land change analysis</th>
<th>Capacities to sustainably produce/use map products in developing countries</th>
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<td><strong>OPTICAL</strong></td>
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<td>LANDSAT TM/ETM</td>
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<td>ASTER</td>
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<td>SPOT HRV (1-5)</td>
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<td>IRS / Indian program</td>
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<td>DMC program</td>
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<td>ALOS/PALSAR + JERS</td>
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<td>ENVISAT ASAR, ERS 1/2</td>
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<td>TERRA SAR-X</td>
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<td><strong>HR</strong></td>
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<td>IKONOS, GEOEye</td>
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<td>ICESAT/GLAS (LIDAR)</td>
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(Note: dark gray=common or fully applicable, light gray=partially applicable/several examples, white=rare or no applications or examples)

Increase usefulness through demonstration
Costs for remote sensing

The implementation of a satellite-based monitoring system includes a number of cost factors:

- Satellite data including data access and processing;
- Software, hardware and office resources, including satellite data archive;
- Human resources for data interpretation and analysis;
- Monitoring in readiness phase;
- Operational monitoring;
- Accuracy assessment;
- Regional cooperation for capacity building and technical assistance.
# Potentials for regional cooperation

<table>
<thead>
<tr>
<th>Regional capacity</th>
<th>Opportunity for reducing costs &amp; efforts</th>
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<tbody>
<tr>
<td>Centralized access and pre-processing of key remote sensing datasets for national analysis and estimation of forest area change</td>
<td>Reduce cost for data access and pre-processing, while interpretation may still be done within country</td>
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<tr>
<td>Establish regional remote sensing data interpretation facility</td>
<td>Reduce costs for technical/office resources and human resources</td>
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<tr>
<td>Regional processing and analysis of coarse resolution satellite data for near real-time detection of forest fires and deforestation</td>
<td>Increase availability of and reduce costs on useful data and observations</td>
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<tr>
<td>Focal point for technical capacity-building for forest monitoring in the region</td>
<td>Reduce costs for continuous training, technical support, and foster South-South cooperation</td>
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<td>Support for verification and independent accuracy assessments</td>
<td>Standard procedures for transparent and independent verification of results</td>
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<tr>
<td>Standardization of methodologies for LULUCF estimation and reporting</td>
<td>Inter-regional exchange of results and experiences, and integration with carbon crediting / reducing transaction costs</td>
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1. Existing regional networks and activities (FAO, GOFC-GOLD etc.)
2. Foster South-South cooperation
A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests, remaining forests, and forestation.
A community effort

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Registered users: 830 (voluntary)
1 INTRODUCTION
   1.1 PURPOSE AND SCOPE OF THE SOURCEBOOK
   1.2 ISSUES AND CHALLENGES

2 METHODOLOGICAL SECTION
   2.1 GUIDANCE ON MONITORING OF CHANGES IN FOREST AREA
   2.2 ESTIMATION OF CARBON STOCKS IN VEGETATION
   2.3 ESTIMATION OF SOIL CARBON STOCKS
   2.4 METHODS FOR ESTIMATING CO2 EMISSIONS FROM DEFORESTATION & DEGRADATION
   2.5 METHODS FOR ESTIMATING GHG’S EMISSIONS FROM BIOMASS BURNING
   2.6 UNCERTAINTIES
   2.7 STATUS OF EVOLVING TECHNOLOGIES

3 PRACTICAL EXAMPLES FOR DATA COLLECTION
   3.1 METHODS USED BY ANNEX-1 COUNTRIES FOR NATIONAL LULUCF INVENTORIES
   3.2 OVERVIEW OF EXISTING FOREST AREA CHANGES MONITORING SYSTEMS
   3.3 NATIONAL FOREST INVENTORY: INDIA’S CASE STUDY
   3.4 DATA COLLECTION AT LOCAL / NATIONAL LEVEL
   3.5 RECOMMENDATIONS FOR COUNTRY CAPACITY BUILDING

4 GUIDANCE ON REPORTING
   4.1 SCOPE OF CHAPTER
   4.2 OVERVIEW OF REPORTING PRINCIPLES AND PROCEDURES
   4.3 MAJOR CHALLENGES FOR DEVELOPING COUNTRIES
   4.4 THE CONSERVATIVENESS APPROACH
森林減少、森林劣化による炭素収支、および植林により引き起こされる、人為起源の温室効果ガスの排出と吸収のモニタリングと報告のための手法と手順についてのソースブック

ソースブックの背景と論拠

本書は、発展途上国における森林減少・森林劣化からの排出の削減（REDD）、のための実施されている国際的な温室効果ガス（GHG）のインパクトの定量化に関連する方法論の課題について地球観測と炭素の専門家のグローバル・コミュニティーからの一足先の展望を提供する。REDDを実施するための国際的な政策とメカニズムが今なお国連気候変動枠組条約（UNFCCC）で議論されている一方、2009年12月のコペンハーゲンにおけるUNFCCC締約国会議の間期中に議論される政治的合意に、森林減少および森林劣化の排出削減のみならず、森林保全、持続的森林経営、炭素貯蔵の増進も含まれることになっていることを強調しておく。REDDについてのUNFCCCでの交渉と関連の各国からの意見提出において、方法論と手段が計画可能な実現性のレベルで森林減少と林陥からの排出と吸収の推定のために利用可能になっていることが示されてきている。現時点における交渉とUNFCCCで認められている方法論に基づき、本書はREDDの早期活動と国家REDDモニタリングシステムを構築するための迅速なメカニズムを提示するための追加的な解説、解釈、方法論を提供することを目的とする。本書は気候変動に関する政府間パネル（IPCC）の土壌利用、土地利用変化と林業（LUCC）のための良好な実践ガイドライン（グッドプラクティスガイドライン）を補足している。本書ではリモートセンシングの役割を森林被覆変化的モニタリングの重要な手段として強調し、信頼性の観点の推定値をいかにして得るかについてのガイダンスを提供し、また、国家レベルでの森林炭素蓄積における変化から炭素の排出と吸収を推定し報告するためのIPCCガイドラインの解釈を提供する。
Remarks for REDD+ NRV

1. Guidance for monitoring and implementation provided under the UNFCCC;
2. Monitoring should be part of national REDD+ policy and implementation strategy and objectives;
3. Knowledge in the use and application the methods of IPCC LULUCF good practice guidelines;
4. Use existing and improve national forest monitoring capabilities along a roadmap;
5. The consideration of different capabilities for monitoring forest changes in the historical and for the future;
6. Important role of remote sensing.
Web resources

- **GOFC-GOLD:**

- **GOFC-GOLD land cover project office:**
  - http://www.gofc-gold.uni-jena.de/

- **GOFC-GOLD REDD sourcebook:**
  - http://www.gofc-gold.uni-jena.de/redd

- **UNFCCC/ SBSTA technical paper on costs of monitoring for REDD**