

Forest Monitoring & MRV

Location: Livingstone, Zambia

Date: 25-28 Feb. 2014



- **COP 13**, Bali: Bali Action Plan: Non Annex I Parties were requested to undertake **M**easurable, **R**eportable & **V**erifiable NAMAS; REDD+ introduced, with guidance on demonstration activities
- **COP 15** (Decision 4/15, Copenhagen) specifies that Parties should:
 1. should establish robust and transparent national forest monitoring systems, using a combination of remote sensing and ground-based forest carbon inventory approaches for estimating anthropogenic GHGs; and that
 2. the monitoring systems should provide transparent, consistent and accurate estimates, with reduced uncertainties, and results which are readily available for review by the UNFCCC.



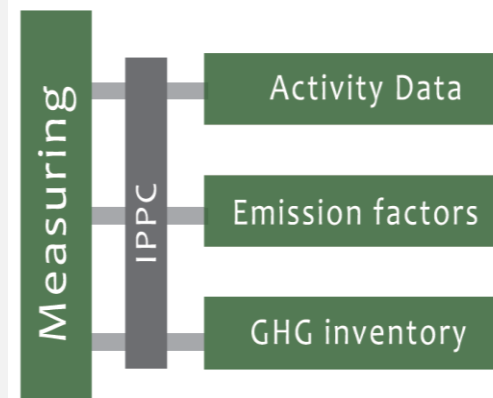
M&MRV Related UNFCCC Decisions [2]

- **COP 16**, Cancun Agreement reaffirmed that Parties should:
 1. develop robust and transparent National Forest Monitoring Systems (NFMS) for monitoring and reporting on REDD+ activities
 2. establish national forest reference emission levels and/or forest reference levels ; and
 3. also confirmed that REDD+ should be implemented in phases, starting with readiness activities and evolving into results-based REDD-plus actions that are to be fully measured, reported and verified (*MRVed*)

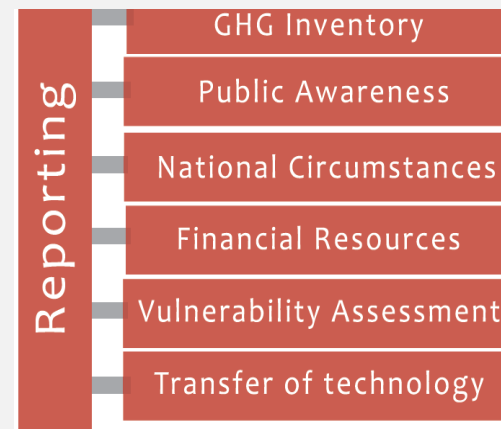


Some Definitions

Measurement: refers to the estimation of Activity Data and Emission Factors which together provide basis for GHG Inventory. Includes the actual measurement of emissions or removals from forest areas, as well as the calculations of different parameters that affect the release or sequestration of Carbon and other GHGs



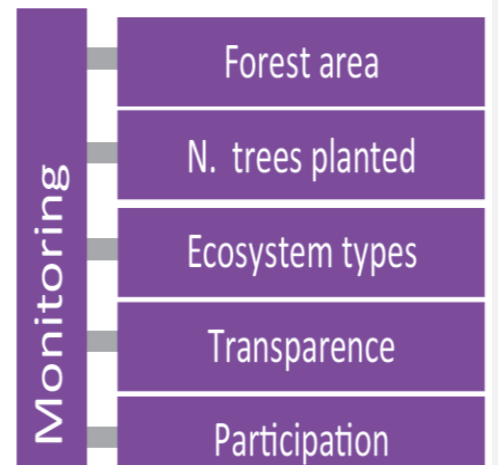
Reporting: Refers to the compilation /documentation of national statistics on GHGs and the methodologies used to derive them , as well as other issues like quality assurance and control (QA/QC), uncertainty estimation etc..



Some Definitions

Verification: Refers to the process of independently checking the accuracy and reliability of reported information and/or procedures used to generate it. The UNFCCC Secretariat through its experts reviews the data reported.

Monitoring: encompasses MRV, governance and related policies and measures (PAMs), as well as the efforts to generate information on the effectiveness of policies and forest management practices as part of REDD+ implementation.



- Monitoring systems allows for credible measurement, reporting and verification of REDD+ activities critical for the successful implementation of any REDD+ mechanism.
- Monitoring forest carbon is essential in order to be compensated for the emissions reductions.
- The objective of the MRV System is to enable the assessment of national GHG emissions and removals in the forestry sector and to report this to the UNFCCC, in a transparent, accountable and verifiable manner.
- The UN-REDD Programme supports countries to develop cost-effective, robust and compatible national monitoring and MRV systems, provide tools, methodologies, training and knowledge sharing to strengthen their technical and institutional capacity for effective MRV systems.



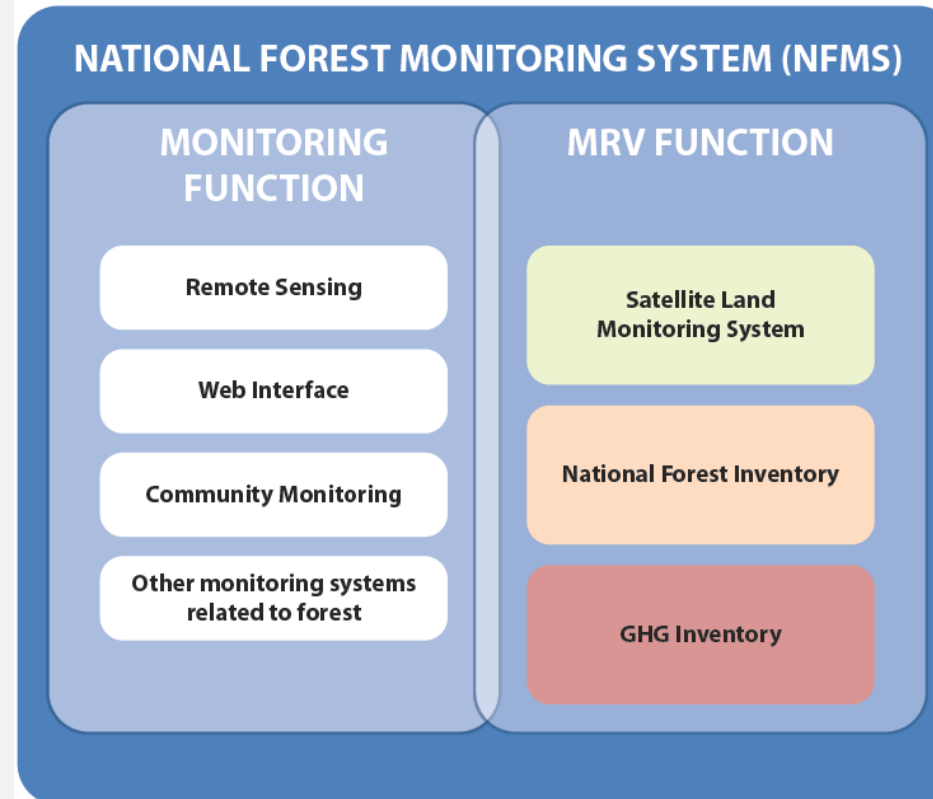
- Countries are requested to establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems that:
 1. Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes;
 2. Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities;



Components of NFMS

NFMS has two main components or functions:

1. **The Monitoring function** (for monitoring outcomes of REDD+ activities), &
2. **The MRV function** for measuring and reporting mitigation performance of REDD+ activities to the UNFCCC



MRV Component

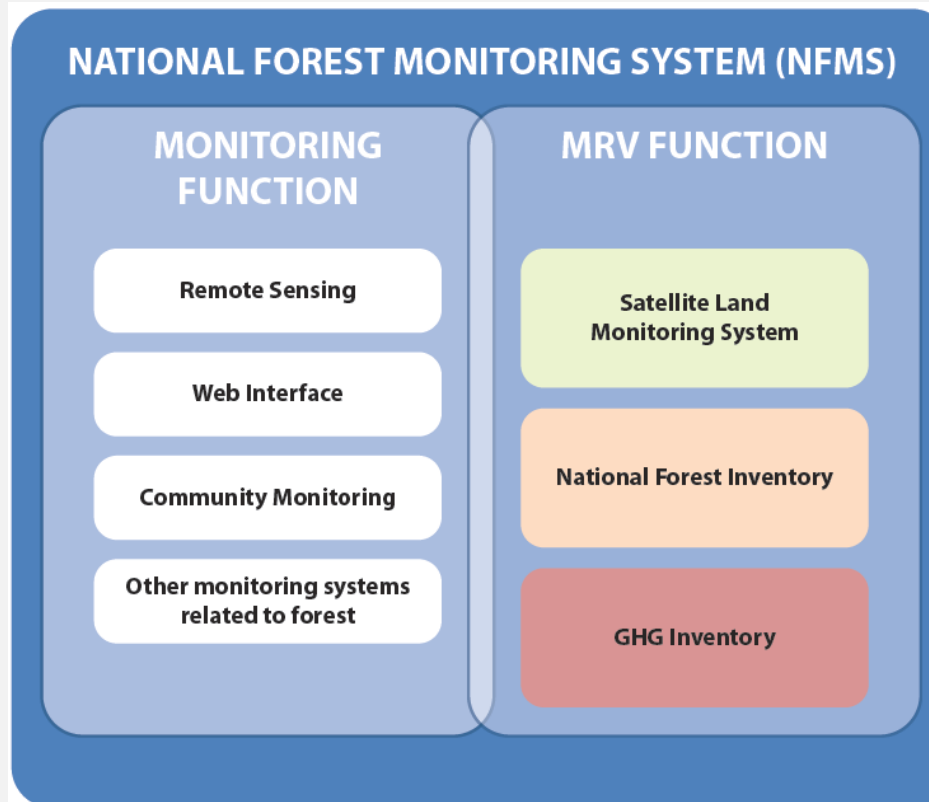


MRV component is supported by 3 “pillars” or building blocks:

•**P1: Satellite Land Monitoring System (SLMS)** for collection and assessment of data on land use/land use change (Activity Data)

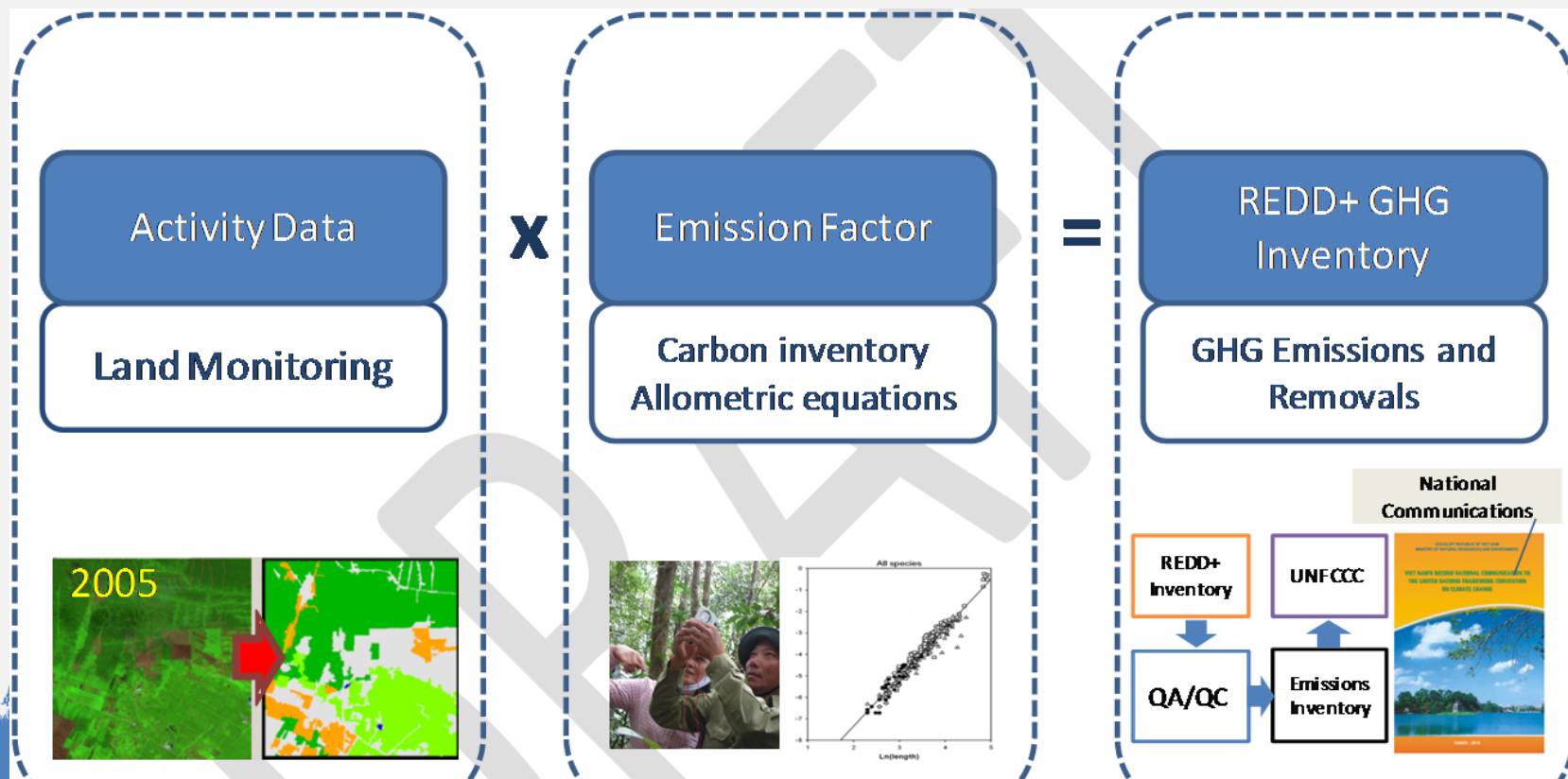
•**P2: National Inventory (NFI)** for collection of information on forest carbon stocks and stock changes, needed to estimate emission factors

•**P3: A National GHG Inventory (GHG-I)** as tool for reporting on anthropogenic forest-related GHG emissions by sources and removals by sinks to the UNFCCC Secretariat



- IPCC, 2003, 2006), indicates that the simplest methodological approach for MRV consists of combining information on the extent of human activities (called ‘activity data’ or **AD**) with coefficients that quantify emissions or removals per unit activity (called ‘emission factors’ or **EF**)

$$Emissions = AD \times EF$$



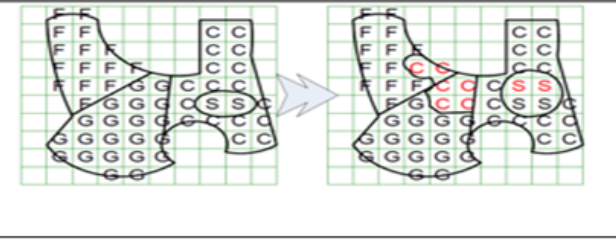
Approach 1:
Identifies the total area for each land-use category individually, with no detailed information about area change between categories; and is not spatially explicit.

| Land-Use | Land Area Mha | | |
|--------------------------|---------------|------------|------------|
| | Initial | Final | Net Change |
| Forest land total | 18 | 19 | 1 |
| Forest land (Unmanaged) | 5 | 5 | 0 |
| Forest land zone A | 7 | 4 | -3 |
| Forest land zone B | 6 | 6 | 0 |
| Afforestation | 0 | 4 | 4 |
| Grassland total | 84 | 82 | -2 |
| Unimproved grassland | 65 | 63 | -2 |
| Improved grassland | 19 | 19 | 0 |
| Cropland total | 31 | 29 | -2 |
| Wetlands total | 0 | 0 | 0 |
| Settlements total | 5 | 8 | 3 |
| Existing Settlements | 5 | 5 | 0 |
| New Settlements | 0 | 3 | 3 |
| Other land total | 2 | 2 | 0 |
| Balancing term | 0 | 0 | 0 |
| TOTAL | 140 | 140 | 0 |

Approach 2:
Generates a land-use transition matrix between time t1 (initial) and t2 (final). For REDD+ activities, only the first column (forest land converted to other land uses) and/or row (land converted to forest land) may be necessary, depending on the REDD+ activity being considered.

| | Initial | Forest land (Unmanaged) | Forest land (Managed) | Grassland (Rough grazing) | Grassland (Improved) | Cropland | Wetlands | Settlements | Other land | Final area |
|---------------------------|---------|-------------------------|-----------------------|---------------------------|----------------------|----------|----------|-------------|------------|------------|
| Final | | | | | | | | | | |
| Forest land (Unmanaged) | | 5 | | | | | | | | 5 |
| Forest land (Managed) | | | 10 | 1 | 2 | 1 | | | | 14 |
| Grassland (Rough grazing) | | | | 2 | 56 | | | | | 58 |
| Grassland (Improved) | | | | | 2 | 22 | | | | 24 |
| Cropland | | | | | | 29 | | | | 29 |
| Wetlands | | | | | | | 0 | | | 0 |
| Settlements | | | 1 | 1 | | 1 | | 5 | | 8 |
| Other land | | | | | | | | | 2 | 2 |
| Initial area | 5 | 13 | 60 | 24 | 31 | 0 | 5 | 2 | 140 | |
| NET change | 0 | +1 | -2 | 0 | -2 | 0 | +3 | 0 | 0 | |

Approach 3:
Generates a transition matrix similar to that from Approach 2 but the land-use changes are identified in a spatially explicit way (geo-referenced).



Adapted from Slides by Thelma Krug (2010)

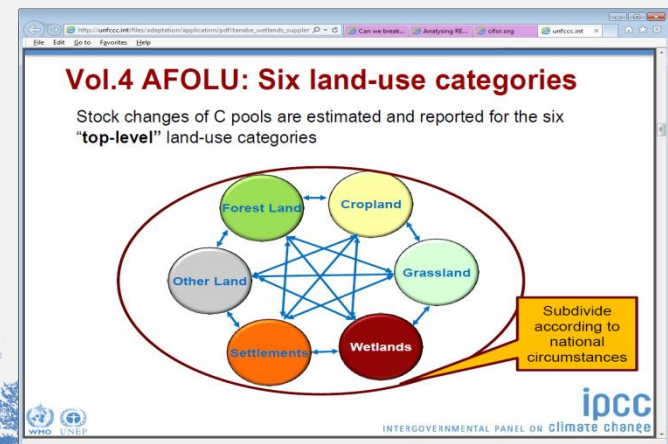


MRV Function: Activity Data (AD)

- Activity Data for the REDD+ MRV System can be generated primarily from remote sensing data, and needs to comply to the IPCC (2006) guidance.
- An operational “wall-to-wall” system based on Approach 3 of the IPCC (2006) is preferable.
- Ideally a consistent land representation of 20 years is expected in order to capture lands that have been Forest Land for more than the transition period required.
- Remote sensing image analysis usually results in a stratification of the country into different land use categories, and the production of transition-matrices.
- Countries have been using different classification systems, but its good to align this with that prescribed by UNFCCC & IPCC (e.g. The AFOLU Six Land Use Categories).

Table 1. Example of land use change matrix.

| Initial \ Final | FL Managed/ Montane forest | FL Managed/ Mangrove forest | FL Managed/ Limestone forest | FL Unmanaged/ Mixed timber and bamboo forest | FL Unmanaged/ Bamboo forest | FL Unmanaged/ Timber forest | GL Managed/ Cattle pasture | GL Managed/ Steppe | Crop Land | Wet Land | Settlement Land | Other Land | Final Area (T1) |
|--|----------------------------|-----------------------------|------------------------------|--|-----------------------------|-----------------------------|----------------------------|--------------------|-----------|----------|-----------------|------------|-----------------|
| FL Managed/ Montane forest | 51 | | | | | | | | | | | | 51 |
| FL Managed/ Mangrove forest | | 42 | | | | | | | | | | | 42 |
| FL Managed/ Limestone forest | | | 60 | | | | | | | | | | 60 |
| FL Unmanaged/ Mixed timber and bamboo forest | | | | 50 | | | | | | | | | 50 |
| FL Unmanaged/ Bamboo forest | | | | | 26 | | | | | | | | 26 |
| FL Unmanaged/ Timber forest | | | | | | 20 | | | | | | | 20 |
| GL Managed/ Cattle pasture | | | | | | | 13 | | | 13 | | | 36 |
| GL Managed/ Steppe | | | | | | | | 2 | 10 | | | | 12 |
| Crop Land | | | | | | | | | 29 | | | | 29 |
| Wet Land | | | | | | | | | | 0 | | | 0 |
| Settlement Land | | | | | | | | | | | 5 | 15 | 20 |
| Other Land | | | | | | | | | | | | 5 | 5 |
| Initial Area (T0) | 51 | 42 | 60 | 63 | 26 | 20 | 12 | 10 | 47 | 0 | 15 | 5 | 351 |
| Net change (Δ = T0-T1) | 15 | 0 | 0 | -13 | 0 | 0 | 24 | 2 | -18 | 0 | -5 | 0 | 0 |



MRV Function: Emission Factors (EF)



- REDD+ MRV System also requires information on GHG emission factors (EF) for forest lands and each of the forest-related land use change types.
- National Forest (Carbon) Inventories are needed, including the development and use of allometric equations and Conversion /expansion factors.
- The generation of EFs require extensive field-based data collection, and can be undertaken for specific ecological regions and land use types
- Estimates have to be made for different carbon pools



- The “**Tiers**” system represent different levels of methodological complexities, and vary from Tiers 1 to Tiers 3.
 1. **Tier 1** is basic and is used as s default EF data, provided by IPCC Guidelines & Guidance, and can also be obtained from the Emissions factor Database (EMFDB). It is appropriate for countries where national data is scarce or absent and hence default values have to be used.
 2. **Tier 2** is intermediate but uses EFs that are country- or region-specific for the most important or “**Key Carbon Pools**”.
 3. **Tier 3** uses higher order methods , including models and inventory measurement systems tailored to address national circumstances.
 4. **Tier 2 & 3** are sometimes referred to as higher order tier methods and provide more accurate estimates of greater certainty than Tier 1.



MRV Function: GHG-Inventory

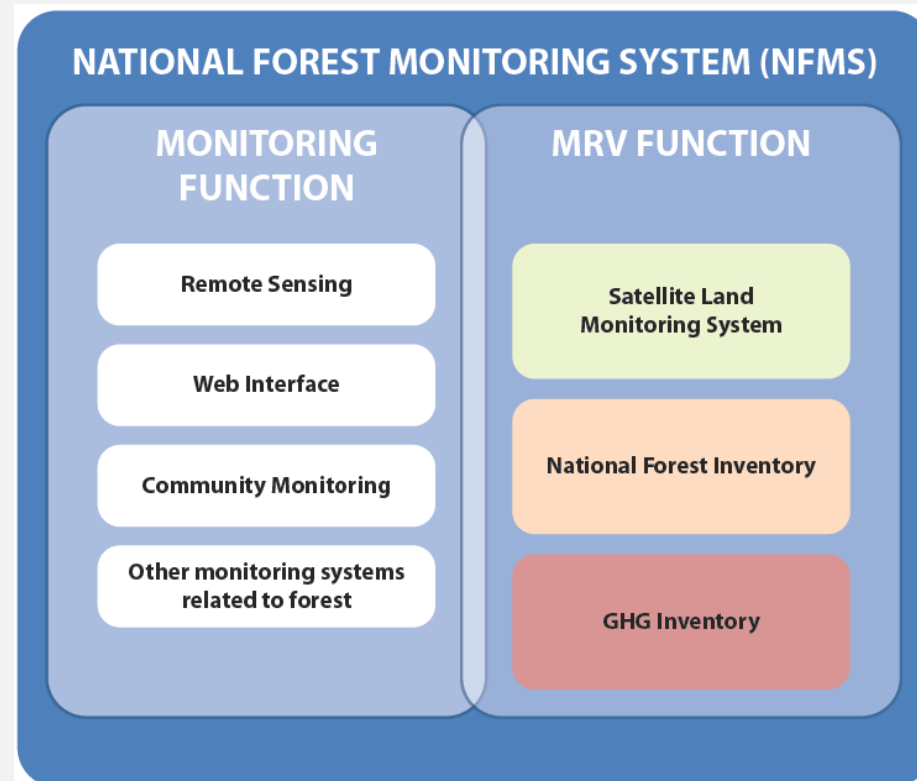


- The National Forest Inventory and the Satellite Monitoring System together provide the information required for a Green House Gas (GHG) Inventory for a country.
- With the full development and operation of the two elements (AD and EF) of the MRV system a country can generate its REDD+ related National GHG-I, for reporting to the UNFCCC (*in Phase III of REDD+*).
- The National GHG-I for REDD+ is incorporated into the National GHG-I, which will be submitted every four years as its National Communication (NC) to UNFCCC.
- Information reported in GHG-I represents an essential link between science and policy, and provides the means by which the Conference of Parties (COP) can monitor progress made by Parties in meeting their commitments and in achieving the Convention's ultimate objectives.



Monitoring function intends to monitor REDD+-specific & Non_REDD+-specific aspects. REDD+ - specific aspects include:

1. Monitoring to assess the performance of REDD+ Demonstration activities in Phase 2
 2. Monitoring of the performance of national REDD+ PAMs (policies & measures)
- Performance of REDD+ activities, & PAMs, can be assessed through direct monitoring of emissions stocks /removals and indirectly through proxy indicators.
 - Remote Sensing is also used as monitoring tool, and ground-based monitoring approaches can be utilized, including community monitoring.



Monitoring Governance [1]



- Although MRV had focused on carbon; governance, livelihood & ecosystem service issues are now emerging as requisite elements of NFMS systems
- Monitoring of governance focuses on the performance of a country's capacity and governance. The success of REDD+ depends on the country's capacity to coordinate and collaborate between different governmental bodies, channel important amounts of funds, build capacities, fight corruption and deliver transparent data on GHG emissions.
- Good & efficient governance of forest resources & distribution of benefits are central to the success of REDD+ strategies; as demonstrated in Copenhagen negotiations where 3 out of 7 safeguards supported REDD+ activities related to governance.



Monitoring Governance[2]



- Core governance parameters to be monitored for REDD+ include:
 1. Clear & coherent policy, legal, institutional & regulatory frameworks (e.g. land tenure/carbon ownership & use rights),
 2. Effective implementation, enforcement and compliance (e.g. cooperative enforcement of REDD+ relevant laws..)
 3. Transparent & accountable decision-making and institutions (e.g. stakeholder participation in REDD+ design and implementation)



- The implementation of REDD+ activities could lead to some adverse effects on co-benefits (e.g. biodiversity conservation & improved livelihoods and governance),
- Parties reached broad consensus (prior to Copenhagen) on the need to promote 7 safeguards when undertaking REDD+ activities, including environmental, social and governance safeguards.
- For delivery of these co-benefits to be demonstrated, safeguards must be subjected to monitoring, reporting and verification (MRV) and should be built into REDD+ programmes from the beginning, to ensure that:
 1. REDD+ provides real and sustainable benefits to people, biodiversity and ecosystems, and supports improved governance;
 2. REDD+ programmes are effective and to reduce the risk of non-permanence; and
 3. there is transparency, full participation, and accountability

Monitoring Multiple Benefits, Safeguards & Governance

- **Multiple Benefits**

Monitoring of multiple benefits identifies the additional benefits that REDD+ can harness, in addition to carbon. Examples of multiple benefits can be socio-economic, like improved livelihoods, or ecosystem services, such as protection of biodiversity and watersheds. By identifying and monitoring multiple benefits it is possible to adapt national REDD+ strategies in order to avoid harm and maximize multiple benefits.

- **Monitoring safeguards**

The UN-REDD Programme supports countries on how to build systems for providing information on safeguards (SIS) and how safeguards can be implemented and respected throughout the implementation of REDD+

- **Governance**

Monitoring of governance focuses on the performance of a country's capacity and governance. The success of REDD+ depends on the country's capacity to coordinate and collaborate between different governmental bodies, channel important amounts of funds, build capacities, fight corruption and deliver transparent data on GHG emissions



- Decision 4/CP15 (Copenhagen, 2009) in article 3:
“..... encourages as appropriate, the development of guidance for effective engagement of indigenous peoples and local communities in monitoring and reporting”.
- At Bonn (SBSTA30 Bonn, 2009) the need for full and effective engagement of indigenous peoples and local communities in, *monitoring and reporting of activities relating to (REDD+)* was emphasized and, the development of guidance for effective engagement of indigenous peoples and local communities in *monitoring and reporting*, encouraged.



- Research by the Kyoto: *Think Global, Act Local* program has already shown that communities may be trained to use standard forest inventory protocols for carbon stocks following IPCC recommended procedures, and that this is as reliable, but very much cheaper than, expert inventories, meaning that the transaction costs of REDD+ may be reduced if communities do the monitoring themselves
- Community-based monitoring can be reliable and economic (cost effective), can enhance ownership and motivation, and can greatly enrich the national forest accounting database.



Monitoring Web Portals

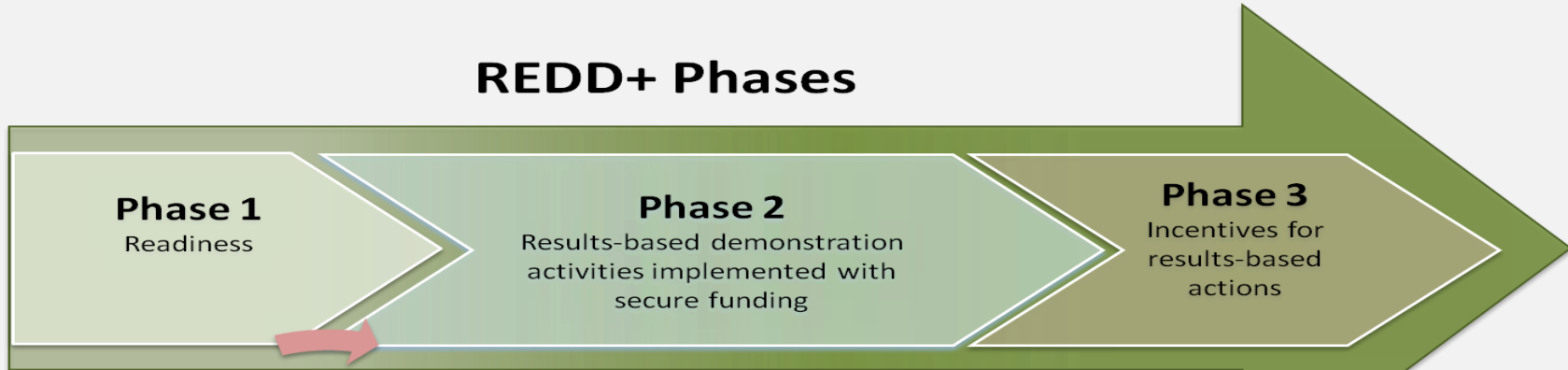
- UN-REDD Programme, FAO and the Brazilian National Institute for Space Research (INPE) jointly support the set-up of national satellite monitoring systems in interested UN-REDD Programme partner countries
- These forest monitoring portals allow users to follow and have open access to available forest data, updated frequently to present national forest conditions within each country
- The use of remote sensing data and GIS technology allows a high frequency of data availability as well as the possibility for wall-to-wall monitoring of the forests.
- Through FAO and the UN-REDD Programme a number of such portals have been (are being) set-up to support of the national satellite monitoring systems (e.g. DRC, Zambia, Paraguay, Vietnam...).



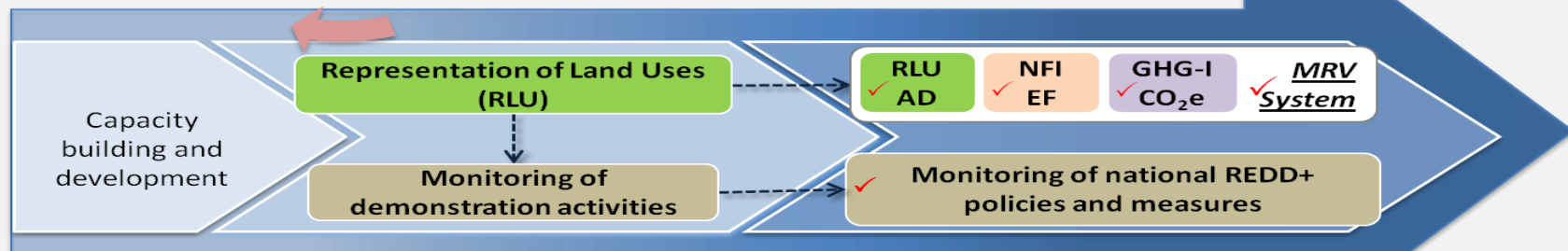
- The 3 pillars of the NFMS are developed alongside with the three phases of REDD+:
 1. In order to assess results-based demonstration activities in Phase 2, and
 2. The full MRV of performance of REDD+ activities in Phase 3.
- **Phase 1** - planning & development of tools for the Monitoring Function for REDD+, including
 - selection of technical systems,
 - capacity building & technology transfer,
 - definition of national REDD+ policies,
 - measures and institutional arrangements, and
 - development of action plans for NFMS.
- **Phase 2:** - implementation of national REDD+ PAMs
 - Monitoring of land use/land use change over demonstration areas.
 - Testing Satellite Land Monitoring System (SLMS) and refinement prior to its full implementation
- **Phase 3** monitoring for REDD+ is expanded to cover the national territory to assess outcomes of REDD+ activities being implemented and thus which PAMs are truly results-based.



REDD+ Phases



↑ **Technical activities throughout the phases** ↓




Monitoring & MRV Phases



Existing NFMS in Africa



Empowered lives.
Resilient nations.



MRV for REDD+ in Tanzania

CAPACITY BUILDING FOR MRV

The UN-REDD Programme works together with the Ministry of Natural Resources and Tourism (MNRT), Forestry and Beekeeping. UN-REDD works towards: "increased capacity for capturing REDD elements within National Monitoring, Assessment, Reporting and Verification Systems (MRAVS)".

The basic elements for a national MRV system need to be developed in accordance with the guidance and guidelines of the IPCC. Therefore the elements focused on are: Satellite Monitoring System, National Forest Inventory, and Green House Gas Inventory.

NATIONAL FOREST INVENTORY DATA

In collaboration with the Forestry and Beekeeping Division, the UN-REDD programme will develop an approach to use the data from the National Forest Inventory (NFI) for the estimation of carbon stocks and determination of the reference emission levels for the country.

The protocol for carbon measurements at the forest level for the NFI has already improved. This improved protocol allows assessing the forest carbon content according to the IPCC LULUCF. Experts will use the data to calculate Emission Factors.

NATIONAL SATELLITE FOREST MONITORING SYSTEM

The UN-REDD programme aims to support the establishment of a robust monitoring system building on existing experience of the Ministry of Natural Resources and Tourism. Satellite imagery will be used to monitor land use change. In addition, the global UN-REDD programme offers possibilities for collaboration with various institutions in different countries, such as the National Institute for Space Research (INPE) in Brazil. This specific collaboration provides the opportunity among interested REDD+ countries to learn and provide experience about setting up an autonomous national satellite forest monitoring system that will also be valuable as a tool to report GHG emissions following the IPCC Guidelines and Guidance. Such sharing between countries can benefit Tanzania and other countries.

GREEN HOUSE GAS INVENTORY

The National Forest Inventory and the Satellite Monitoring System together provide the information required for a Green House Gas Inventory for Tanzania. The resulting information will be shared and linked with other activities implemented in the country, such as establishment of the National Carbon Monitoring Centre (NCMC), Tanzanian National Carbon Accounting System (NGAS-T) and others.

REDD+ IN TANZANIA

Tanzania has a total of 35.3 million hectares of forests and woodlands, rich in biodiversity and in carbon. Carbon stored in trees plays an important role in climate change mitigation. When emitted during deforestation or forest degradation, the carbon contributes to anthropogenic climate change. Through the current discussions under the United Nations Framework Convention on Climate Change (UNFCCC), there is a possibility for developing countries to receive financial benefits for reducing emissions from deforestation and Forest Degradation, forest conservation, sustainable management of forests and enhancement of forest carbon stocks (REDD+). As REDD+ is a result-based mechanism, countries will be required to quantify their achievements in REDD+. Therefore, it is a key priority for countries to establish robust and transparent forest carbon monitoring systems.

FOREST CARBON MONITORING

The most commonly debated subject under forest carbon monitoring is measurement, reporting and verification (MRV) of forest carbon. That is, how can we easily account for the amount of forest carbon, including changes over time? This is the core monitoring challenge in REDD+, well-defined in GHG reporting standards and the inter-governmental Panel on Climate Change (IPCC) guidelines, and addressing the direct objective of REDD+. The main focus is on the national level reporting to the UNFCCC, and the subsequent, anticipated accounting of valuable carbon credits for the country as a whole.



John Fonweban

John.fonweban@fao.org

Thank You

Website: <http://www.un-redd.org>

