Measuring Carbon Emissions

Measuring Carbon Emissions looks for ways to enable better carbon accounting so that emission reductions can be reliably measured and verified.

The basic idea of REDD+ is to give rewards for successfully reducing the amount of carbon emitted through deforestation and forest degradation. To determine whether a REDD+ activity has been successful in reducing carbon emissions — and hence to allocate rewards — it is obviously essential to measure the size of the emission reductions.

To calculate the size of emission reductions attributable to a REDD+ intervention, we need to know two things: (1) the amount of carbon emitted after the intervention; and (2) the amount of carbon that would have been emitted if there had been no intervention (known as the "reference level" or "baseline"). The volume of emission reductions is calculated as the actual emissions after REDD+ minus the reference emissions.

A critical element of REDD+ in each country, therefore, is a credible and accurate "MRV system": a system for measuring the results of REDD+ activities, reporting those results to the international community, and then verifying the reports.

However, developing MRV systems involves a lot of technical challenges. Our research focuses on generating the information, methods and tools needed to overcome these challenges and to build capacity.

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The tasks are technically challenging

Because measuring carbon emissions is a cornerstone of REDD+, the technical challenges must be overcome before REDD+ can get fully underway.[1] Key tasks include: defining what is a forest and what constitutes deforestation and forest degradation; conducting inventories of carbon stocks in forests, to measure how much carbon is in an area;[2] determining so-called emission factors, which are used to assess the change in carbon stock caused by an activity;[2] developing so-called allometric equations, which are used to convert measurements from forest inventories into biomass estimates and then into carbon numbers;[2] identifying present and past root causes (or drivers) of deforestation and assessing how they are likely to evolve in the near future;[3] estimating the likely extent of deforestation in the near future as a result of these drivers; and estimating the amount of carbon that would have been emitted in the absence of REDD+ ("reference level").[4]

Reference levels are critical to REDD+

REDD+ cannot get fully underway in a country until there is agreement on the reference level — the amount of carbon that would have been emitted in the absence of any intervention.[4] The reference level is first used to set targets for emission reductions. Then, once activities are underway, the reference level is used as a benchmark against which actual emissions are compared. The reference level also serves as a benchmark for possible payments. The reference level is calculated using historical rates of deforestation and forest degradation; these rates vary greatly, which makes it difficult to accurately project future rates.[4] Because national circumstances differ, the development of reference levels has to be flexible.

Formula for calculating emission reductions

$$\text{Emission reductions} = (\text{Activity data} \times \text{Emission factors}) - \text{Reference emissions}$$

area of land changed   *carbon stock change*   *Emissions without REDD+*

Lack of quality data is a serious constraint

We cannot yet make accurate and precise estimates of carbon emissions.[2] Setting the baseline and measuring carbon emissions are very challenging tasks because of the lack of quality country- and region-specific data and the lack of emission factors for important types of land-use change and carbon pools. Also lacking are equations for converting the data to carbon numbers. Data could be improved through targeted, coordinated investments, as well as partnerships between technical services, intergovernmental agencies and research institutes.[2]

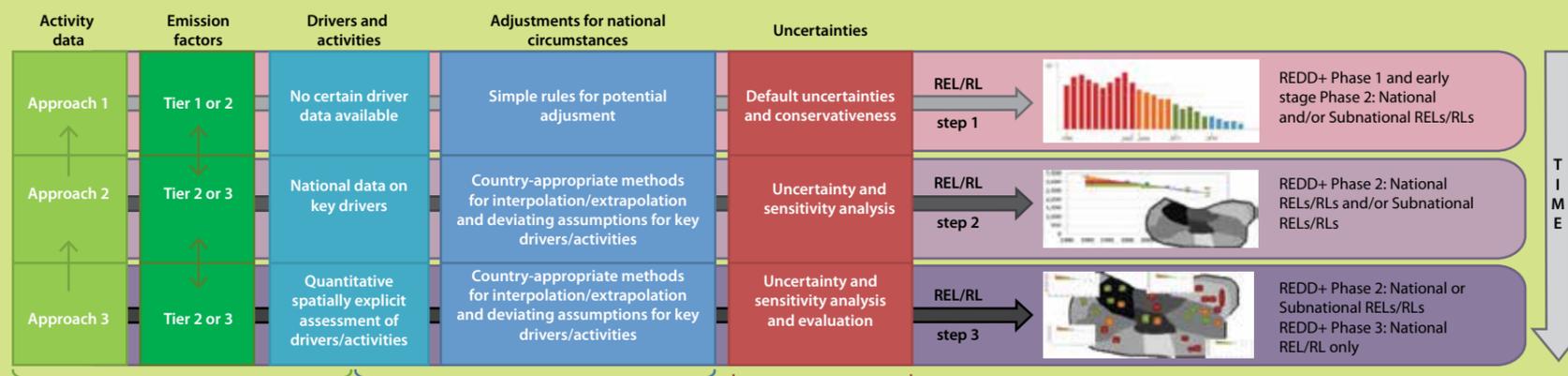## Capacity building and technology transfer are essential

An assessment[5] of 99 non-Annex I (developing) countries found that only 19 have good capacity to implement a complete and accurate national monitoring system using guidelines created by the Intergovernmental Panel on Climate Change. Similarly, a survey of 17 REDD+ sites[5] found capacity was generally low for measuring most carbon pools and for using specific biomass equations.[6] This lack of capacity hampers countries' efforts to fully engage in REDD+. For efficient capacity building, the top 19 countries should be prioritized for timely interventions to raise their level to that needed for full REDD+ implementation ("phase 3").[6] Longer-term investments will be needed for countries with poorer capacity. A stepwise approach that builds on existing strengths and then fills key gaps has been proposed as a model for capacity development.[7]

Our stepwise approach can get countries started

We developed a stepwise approach[7] to setting reference levels that reflects different country circumstances (see figure bottom left). It takes into account the fact that countries differ in terms of the data they have for measuring forest area and carbon stock changes, their knowledge of the drivers of deforestation, and their technical capacity. The framework gives countries a place to start, whatever their quality of data or level of capacity. This should help facilitate broad participation and motivate efforts to improve over time. In 2011, the UNFCCC adopted our approach[8] as the reference emission level framework, and we are now expanding our approach to the whole MRV system.

Community-based MRV is an important element

It will also be necessary to involve in MRV the people who live or depend on the land where REDD+ activities are taking place. Most methods for measuring, reporting and verifying carbon are highly technical, expensive and ultimately, in practice, may not be fully applicable at the local level;[4] local involvement can ground-truth measurements and improve accuracy. Community involvement in REDD+ monitoring is particularly relevant given the large impact of local drivers of deforestation and forest degradation.[9] Approaches for engaging local people in monitoring are being developed and tested.[9] Integrating community data into national MRV systems is another challenge, and we are exploring options in several countries.

Activity data	Emission factors	Drivers and activities	Adjustments for national circumstances	Uncertainties			
Approach 1	Tier 1 or 2	No certain driver data available	Simple rules for potential adjustment	Default uncertainties and conservativeness	REL/RL step 1		REDD+ Phase 1 and early stage Phase 2: National and/or Subnational RELs/RLs
Approach 2	Tier 2 or 3	National data on key drivers	Country-appropriate methods for interpolation/extrapolation and deviating assumptions for key drivers/activities	Uncertainty and sensitivity analysis	REL/RL step 2		REDD+ Phase 2: National RELs/RLs and/or Subnational RELs/RLs
Approach 3	Tier 2 or 3	Quantitative spatially explicit assessment of drivers/activities	Country-appropriate methods for interpolation/extrapolation and deviating assumptions for key drivers/activities	Uncertainty and sensitivity analysis and evaluation	REL/RL step 3		REDD+ Phase 2: National or Subnational RELs/RLs REDD+ Phase 3: National REL/RL only

TIME

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