Module 3.2 Data and guidance on developing REDD+ reference levels

Module developers:

Martin Herold, Wageningen Univ.

Erika Romijn, Wageningen Univ.

Sandra Brown,
Winrock International

After the course the participants should be able to:

- Describe the procedures to develop REDD+ forest reference levels (FRLs)

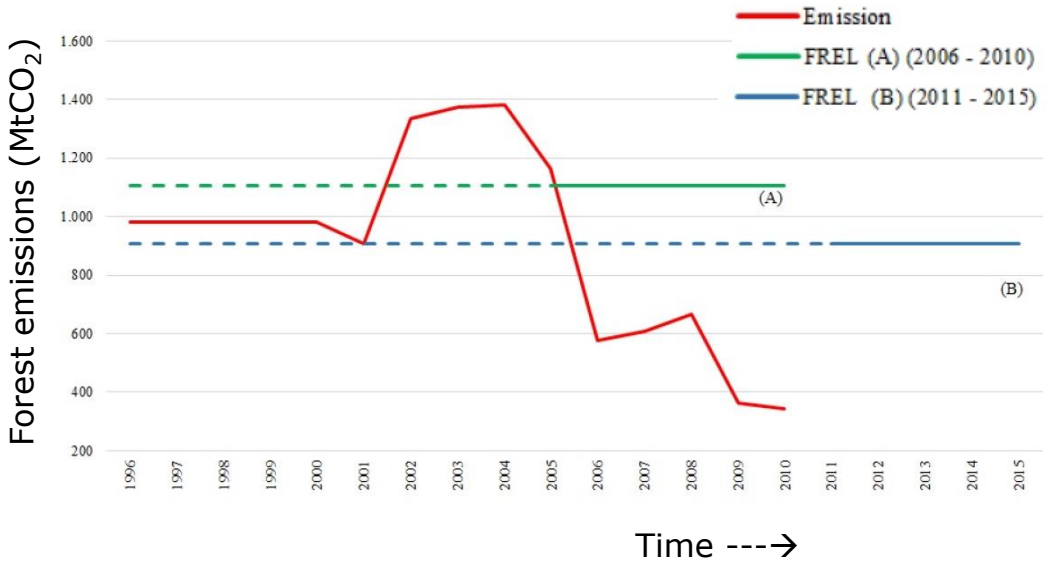


Figure: Representation of FRL development for Brazil. Source: Brazil's submission of FRL to UNFCCC. 2014.

V1, May 2015

WAGENINGEN UR For quality of life

GOFC-GOLD Global Observation of Forest and Land Cover Dynamics

FOREST CARBON PARTNERSHIP FACILITY

Creative Commons License

Background material

- UNFCCC. 2014. Decision 13/CP.19. Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels. http://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf#page=34
- UNFCCC. 2012. Decision 12-II/CP.17 and Annex. Modalities for forest reference emission levels and forest reference levels. http://unfccc.int/resource/docs/2011/cop17/eng/09a02.pdf#page=16
- Meridian Institute. 2011. Guidelines for REDD+ Reference Levels: Principles and Recommendations. http://www.redd-oar.org/
- Meridian Institute. 2011. Modalities for REDD+ Reference Levels: Technical and Procedural issues. http://www.redd-oar.org/
- Winrock International. 2015. The REDD+ Decision Support Toolbox. In partnership with the World Bank FCPF.

Background material

- UN-REDD. 2014. Emerging Approaches to Forest Reference Emission Levels and/or Forest Reference Levels for REDD+. www.unredd.net/index.php?option=com_docman&task=doc_download&gid=13473&Itemid=53
- Herold, M.et al. 2012. A Stepwise Framework for Developing REDD+ Reference Levels. http://www.cifor.org/publications/pdf_files/Books/BAngelsen1201.pdf
- World Bank FCPF. 2013. Carbon Fund Methodological Framework. https://www.forestcarbonpartnership.org/carbon-fund-methodological-framework
- GFOI. 2014. Methods and Guidance from the Global Forest Observation Initiative (MGD). Section 1.4.2. http://www.gfoi.org/methods-guidance-documentation

Outline of lecture

1. Importance of REDD+ forest reference (emission) levels and types of reference levels
2. UNFCCC context on developing REDD+ forest reference (emission) levels
3. Considerations for business-as-usual (BAU) baseline estimation and data needs
4. Approaches for estimating BAU baselines
5. Technical assessment of REDD+ forest reference (emission) levels

Outline of lecture

1. **Importance of REDD+ forest reference (emission) levels and types of reference levels**
2. UNFCCC context on developing REDD+ forest reference (emission) levels
3. Considerations for business-as-usual (BAU) baseline estimation and data needs
4. Approaches for estimating BAU baselines
5. Technical assessment of REDD+ forest reference (emission) levels

Importance of REDD+ Forest reference levels

- Basic concept of REDD+ is to provide **incentives for implementing REDD+ activities** and **achieving emission reductions**
- A national forest monitoring system includes the establishment of a reference level (FRL) that provides a **benchmark for assessing a country's performance** in implementing REDD+ activities
- The process of establishing FRLs can **inform development and implementation of (sub)national REDD+ policies:**
    - Information derived from historic emissions: on magnitude, location, and causes of emissions/removals

Difference: FREL versus FRL

- **FREL** – Benchmark for emissions from deforestation and forest degradation → **REDD only**
- **FRL** – Benchmark for emissions from deforestation and forest degradation *and* removals from sustainable management of forests and enhancement of forest carbon stocks → **for all REDD+ activities**

The term FRL will be used throughout this module; it also encompasses FREL.

Two related objectives of FRLs

1) Business as usual (BAU) baseline

- **Projection of emissions** (in t CO_2 / year) in the absence of the REDD+ actions
- To measure the effectiveness of REDD+ interventions and to define emission reductions

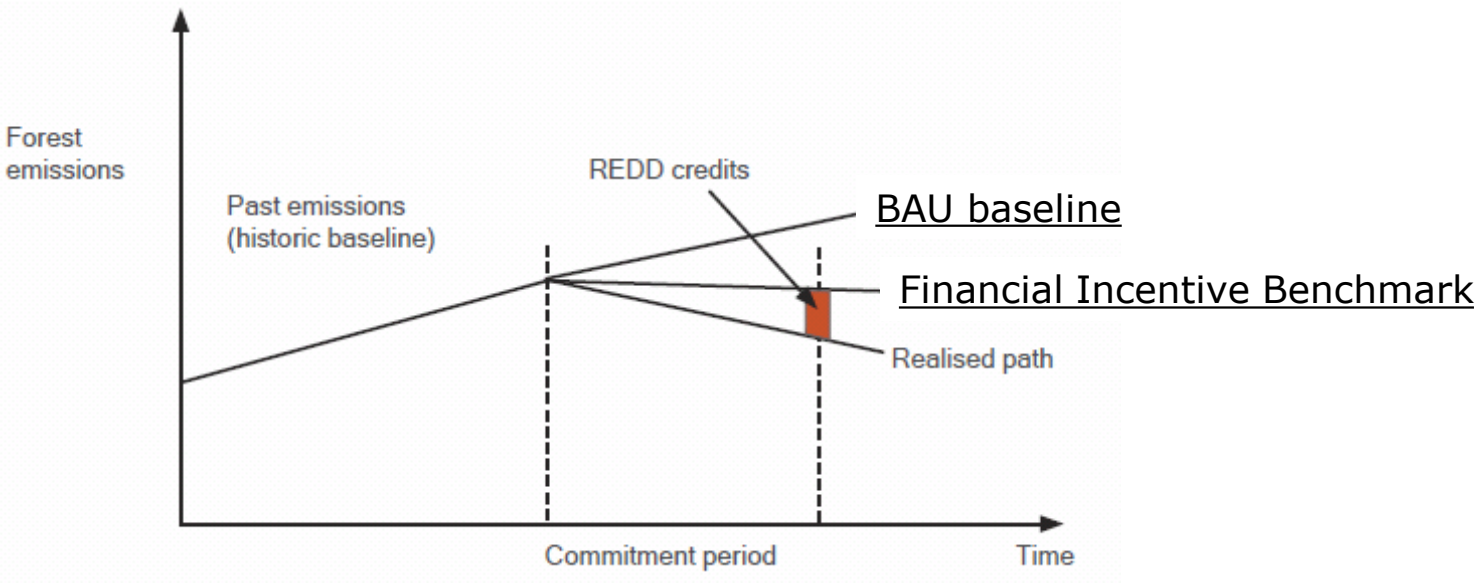
2) Financial incentive benchmark (FIB)

- Benchmark for estimating **results-based payments**: direct payments to countries, subnational units, or projects for emission reductions
- Results-based support is based on difference between actual forest emissions and the FRL

Two related objectives of FRLs

- **BAU baseline**
- **FIB**

  **FIB is not recognized in UNFCCC discussions. However, from an analytical viewpoint it is essential to make the distinction between the two types of FRLs*



Source: www.redd-net.org.

Outline of lecture

1. Importance of REDD+ forest reference (emission) levels and types of reference levels
2. **UNFCCC context on developing REDD+ forest reference (emission) levels**
3. Considerations for business-as-usual (BAU) baseline estimation and data needs
4. Approaches for estimating BAU baselines
5. Technical assessment of REDD+ forest reference (emission) levels

Guidance from UNFCCC on developing FRELs and FRLs

(Source: UNFCCC 2010, 1/CP.16; UNFCCC 2009, 4/CP.15)

Developing countries participating in REDD+ are requested to develop in accordance with **national circumstances** and **respective capabilities:**

- A *national* **FREL** and/or **FRL** or, if appropriate, as an interim measure, *subnational* FRELs and/or FRLs
- Which is done **transparently** taking into account **historical data** and **adjusted for national circumstances**

Modalities for developing FRELs / FRLs

(Source; UNFCCC, 2011, 12/CP.17)

- FRELs/FRLs are expressed in **t CO_2 per year**
- FRELs/FRLs should be **consistent with forest emissions** and removals included in the national greenhouse gas GHG inventories
- Subnational FRELs/FRLs may be elaborated as an **interim measure**, with an eventual transition to a national FREL/FRL
- Countries may use a **step-wise approach** for developing FRELs/FRLs, thereby using better data and improved methods and incorporating additional carbon pools over time
- Countries should **update a FREL/FRL periodically** as appropriate, taking into account new knowledge, new trends and any modification of scope and methodologies

Modalities for developing FRELs / FRLs

- Countries should **submit information and rationale** on the development of their FREL/FRL and technical assessment of the proposed FRELs/FRL should be possible:
  - Historical data, methodological information, scope (pools, gases, activities included), definition of forest
- Information submitted should be *transparent*, *complete*, *consistent*, *accurate*
- Information on submitted FRELs/FRLs will be made available on the **UNFCCC REDD web platform**
- Proposed FRELs/FRLs will be **technically assessed** in the context of results-based payments, following guidelines and procedures, decided by the COP

Scope of REDD+ within IPCC categories

FRLs correspond to the outcomes of all five REDD+ activities, which can be categorized as follows within the IPCC categories:

"Forests converted to other lands"

- deforestation

"Forest remaining as forest"

- Forest degradation
- Conservation of forest carbon stocks
- Sustainable management of forests
- Enhancement of forest carbon stocks (in degraded forests)

"Other lands converted to forest"

- Enhancement of forest carbon stocks (afforestation/reforestation)

For approaches / framework on how to account for REDD+ activities within the IPCC categories, also see GFOI MGD (2014).

Outline of lecture

1. Importance of REDD+ forest reference (emission) levels and types of reference levels
2. UNFCCC context on developing REDD+ forest reference (emission) levels
3. **Considerations for business-as-usual (BAU) baseline estimation and data needs**
4. Approaches for estimating BAU baselines
5. Technical assessment of REDD+ forest reference (emission) levels

Establishing business-as-usual (BAU) baselines

- BAU baselines are an estimate of **future forest GHG emissions and removals**
- To estimate what might happen in the future one must first know what happened in the past
- Therefore, data on **historical deforestation / degradation** and deforestation trends are needed (time series)
- The development of historical land-cover maps can be done using satellite imagery:
    - Since the 1990s it has been possible to accurately map forest areas

Considerations for BAU baseline establishment

- Decide on a forest definition (See Modules 1.2 and 2.1 on definitions):
  - Definition of forest may determine which lands will be included
  - Low thresholds in % tree cover ensure that practically all lands that contain trees could be eligible for REDD+ incentives—but low threshold could be difficult to detect accurately in imagery
- Consistency with national forest monitoring system (NFMS) and MRV
- Scope of REDD+ activities to be included in the BAU baseline:
  - Deforestation, forest degradation, forest conservation, sustainable management of forests, enhancement of forest carbon stocks
- Which C pools to include in BAU baseline
  - aboveground biomass, belowground biomass, soil organic matter, litter, dead wood
- Scale: national / subnational

Subnational FRLs

- Subnational FRLs (BAU baselines) may be established for selected states / provinces or selected activities / key categories
- Some special considerations:
  - Harmonized criteria
  - Account for leakage
  - Consolidation of subnational FRLs towards national FRL
- Testing development of FRL at subnational scale good for learning-by-doing approach
- Approaches and data should be consistent with future monitoring system

Data needs for BAU baseline estimation

*BAU baselines are based on **historical data** and* may be *adjusted for **national circumstances** to better represent future forest GHG emissions*

- Historical emissions and removals:
  - Activity data – e.g., spatial extent of land cover transition (ha)
  - Emission factors - emissions/removals of GHGs per unit of activity (e.g. t CO2-e/ha)
- National circumstances:
  - Stage in forest transition
  - Drivers of deforestation and forest degradation
  - Development policies

Data needs for BAU baseline estimation

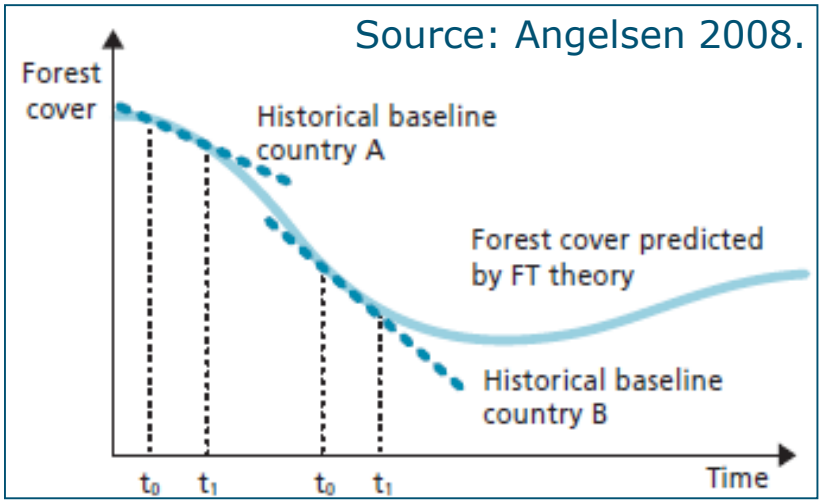
Historical emissions and removals are a combination of ***activity data (AD)*** *and* ***emission factors (EFs)***

- Activity data, based on time series analysis of historical data:
  - Rates of deforestation (Module 2.1)
  - Rates of tree planting (Module 2.1)
  - Rates of forest degradation (Module 2.2)
  - Rates of enhancement by activity type (Module 2.2)
- Emission factors (Module 2.3)
  - Deforestation
  - Forest degradation
- Removal factors (Module 2.3)
  - C stock enhancement

Data needs for BAU baseline estimation

National circumstances *can influence the deforestation trend and should be considered for making a better estimate of BAU baseline*

- General adjustment of BAU baseline to increase reliability:
  - Stage in forest transition (forest cover, GDP)
  - Drivers of deforestation and forest degradation (e.g., agricultural commodity prices) Module 1.3



- Case-by-Case adjustments
  - Restrictions/requirements specified by programs as well as national policies may affect the adjustment of the FRL

Data availability and collection

- For many countries, existing data may be limited and of low quality: New data need to be collected and compiled (See Modules 2.1, 2.2, and 2.3)
- Countries may start developing FRLs at **subnational level**, as an interim measure:
  - On **selected states/provinces** where change in forest cover historically high, or
  - On **selected activity** such as deforestation, where national capacity exists and satellite imagery is available
- Important to establish a set of national standards and requirements concerning data collection that are relevant at subnational and national scale

Outline of lecture

1. Importance of REDD+ forest reference (emission) levels and types of reference levels
2. UNFCCC context on developing REDD+ forest reference (emission) levels
3. Considerations for business-as-usual (BAU) baseline estimation and data needs
4. **Approaches for estimating BAU baselines**
5. Technical assessment of REDD+ forest reference (emission) levels

Approaches for estimating BAU baselines

1. Strictly historical approach
   - Using only average annual rates of deforestation during the recent past (~10 yrs) – assumes no change in trend
2. Adjusted historical approach
   - Uses predictive power of historical deforestation trend
   - Other factors that represent national circumstances are included to improve predictions, such as stage in the forest transition and deforestation drivers
3. Simulation models
   - Basis is often on land rent and the demand and supply of new land for agriculture or other commodities, but also based on prices of minerals such as gold or timber
   - May include historical deforestation rates and collinearity of drivers behavior and deforestation rate

1. Strictly historical approach

- Simple trend projection or average of annual rates of deforestation using national statistics on historical data
- Simple rules (in technical terms)
- No certain driver data available or needed
- Example at subnational scale:
    - Brazil's forest FRL for the Amazon Basin

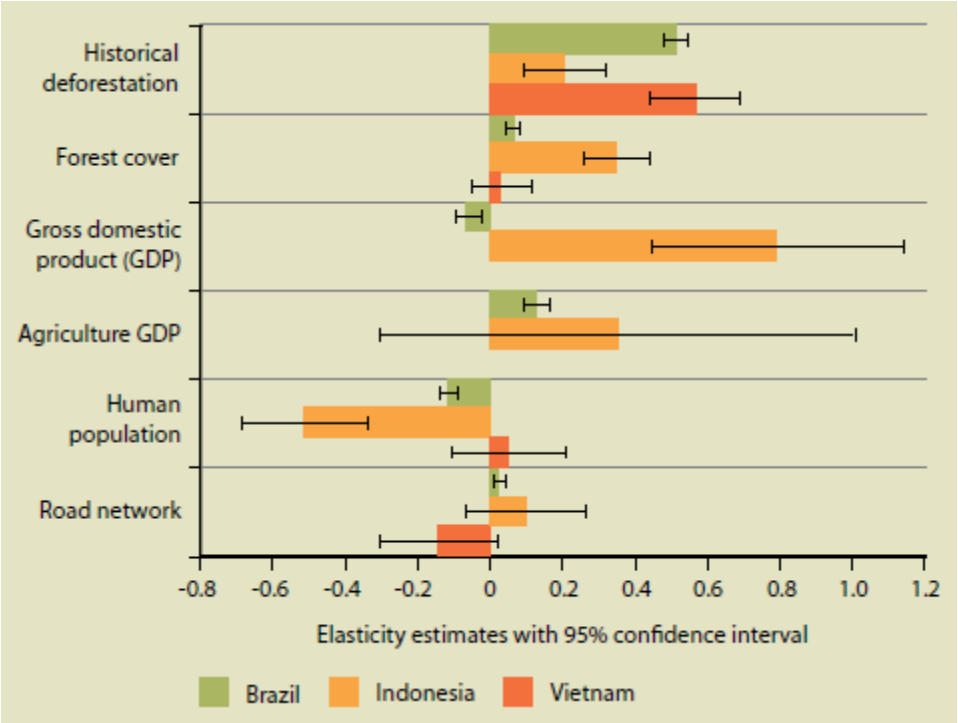
2. Adjusted historical approach (1/2)

- Retain predictive power of historical trend data but move to more driver-based assessment and predictions
- Include data-driven reasoning for deviations from historical trend (i.e., national circumstances):
  - Deforestation and emissions and understanding of historical processes using data on drivers and activities causing forest carbon change
  - Establish relationships with underlying causes (proxies)
  - Justification why and how deforestation varies from historical trend on the level of drivers and activities
- More information on adjusted historical approach in the *REDD+ Decision Support Toolbox* by Winrock International in partnership with the World Bank FCPF (Winrock International, 2015)

2. Adjusted historical approach (2/2)

- Main data needed for establishing BAU baseline, preferably at subnational level:
  - Historical data on deforestation/forest degradation forestation (A/R)
  - Information on national circumstances:
    - Stage in forest transition
    - Quantitative driver data for key activities
    - Socioeconomic factors
  - Accessibility of remaining forest (geospatial context)
- Multiple regression analysis to estimate BAU baseline:
  - To test the importance of historical deforestation and other national circumstances for estimating potential deforestation
  - To predict future deforestation based on historical data and data on national circumstances (e.g., drivers)

Example of regression analysis for establishing BAU baselines (adjusted historical approach)



Source: Herold et al. 2012.

- Predictors of deforestation for Brazil, Indonesia, and Vietnam
- Elasticity estimates show the importance of different factors on predicting future deforestation
- For example, 1% change in historical deforestation in Vietnam gives a predicted future deforestation rate that is 0.57% higher

3. Simulation (& geospatially explicit) models

- Suitable when countries have high-quality data
- For modeling deforestation drivers
- To test different methods for FRL (BAU) setting
- To explore the implications of different policy scenarios
- Examples of simulation models: IIASA's GLOBIOM model, OSIRIS modeling tool
- Examples of geospatially explicit models: Idrisi LCM, MaxEnt, Dynamica
- Uncertainties:
    - Model assumptions
    - Political acceptability

Pros and cons of different approaches for BAU estimation

Approach	Pros	Cons
1. Strictly historical approach	- Simple approach - Requires historical data only	- No deviations from historical trend; might not be representative of actual situation
2. Adjusted historical approach	- Deviations from historical trend are included	- Data demanding: need to collect quantitative information on drivers of deforestation and national circumstances
3. Simulation models	- Possibility to model deforestation drivers - Possibility to test different methods for FRL (BAU) setting	- Complex approach - Suitable only when countries have high quality data - Model uncertainties

Data availability and varying levels of data

- **Data-driven approach is important for setting FRLs**, but data on forest change, emissions, and drivers vary per country
- When historical data are missing, they need to be collected and compiled
- Understanding, reliability, and validity of data for FRL setting will improve over time through the REDD+ phased approach
- **Step-wise approach** for FRL development is key concept to match data availability and quality in a country:
    - Facilitates improvements over time
    - Provides starting point for all country situations
    - Motivation to reduce uncertainties over time

Step-wise approach for FRL development (1/3)

- Consistency: start with a simple FRL (step 1) and make incremental improvements through time (move to step 2 and 3)
- Nesting: Start at subnational level and build towards national FRL

Improving data through step-wise approach

	Step 1	Step 2	Step 3
Activity data	Global datasets (e.g., Hansen et al., 2013)	At least IPCC approach 2	IPCC Approach 3
Emission factors	Global maps (e.g., Saatchi et al. 2011; Baccini et al. 2012)	Tier 2 or 3	Tier 2 or 3
Data on drivers	No driver data available or used	Drivers at national level known with quantitative data for key drivers	Quantitative spatial assessment of drivers/activities; spatial analysis of factors

Adapted from Herold et al. 2012.

Step-wise approach for FRL development (2/3)

Improving methods through step-wise approach

	Step 1	Step 2	Step 3
Approaches as guidance for developing FRLs	Simple trend analysis / projection, using national statistics, based on historical data	Country-appropriate methods for interpolation / extrapolation using historical data and statistical approaches	Potential to use options such as geospatially explicit modelling and other statistical methods for considering both drivers and other factors of forest cover change
Adjustments / deviations from historical trends	Simple rules (in technical terms)	Assumptions and evidence for adjustments of key drivers/activities	Analysis and modelling by drivers and activities
Scale	National or subnational	National or subnational	National (required in REDD+ Phase 3 for results-based payment)

Step-wise approach for FRL development (3/3)

Improving methods through step-wise approach steps

	Step 1	Step 2	Step 3
Inclusion of REDD+ activities	May focus on only one or two activities with a need to consider emissions, i.e., deforestation and/or degradation	Aims to focus on all five REDD+ activities, but emissions (deforestation and forest degradation) to be considered as minimum	Aims to focus on all five REDD+ activities, but emissions (deforestation and forest degradation) to be considered as minimum
Omission of pools and gases	Focus on key category pools and gases with conservative omissions	Focus on key category pools and gases with conservative omissions	Aims to consider all pools and gases in context of full IPCC key category analysis
Uncertainty assessment	No robust uncertainty analysis possible; use of default uncertainties and/or conservative estimates* * See Module 2.7 on conservativeness	Modelling to accommodate uncertainties and testing using available data	Independent and quantitative uncertainty analysis possible, sensitivity Analysis, and verification using available data

Outline of lecture

1. Importance of REDD+ forest reference (emission) levels and types of reference levels
2. UNFCCC context on developing REDD+ forest reference (emission) levels
3. Considerations for business-as-usual (BAU) baseline estimation and data needs
4. Approaches for estimating BAU baselines
5. **Technical assessment of REDD+ forest reference (emission) levels**

Technical assessment of proposed FRLs

- The UNFCCC secretariat will prepare a synthesis report on the technical assessment process (UNFCCC 2014, 13/CP.19)
- Technical assessment of data, methodologies, and procedures used for developing FRLs will focus on:
  - Consistency of FRL with the forest emissions and removals included in the national GHG inventories
  - How historical data have been taken into account
  - The extent to which the information provided is *transparent*, *complete*, *consistent,* and *accurate*
  - Whether descriptions of changes to previously submitted FRLs have taken into account the step-wise approach

Technical assessment of proposed FRLs

- Technical assessment of data, methodologies, and procedures used for developing FRLs will focus on *(continued)*:
  - Pools and gases, and activities included, and justification of omitting pools and/or activities
  - The definition of *forest* that has been provided
  - Whether assumptions about future changes to domestic policies have been included
  - The extent to which the FRL is consistent with the information and descriptions provided by the Party
- After technical assessment, areas for technical improvement and capacity building needs may be identified

In summary (1/2)

- FRL development needs to be based on historical behavior of the country, which is important for:
  - Location of country in forest transition model
  - Understanding of drivers to explain potential deviations from historical trend
- Considerations for FRL development: Issue of forest definition; activities and C pools to include; subnational or national scale
- Different approaches for developing BAU baseline:
  1. Strictly historical approach
  2. Adjusted historical approach
  3. Simulation (geo-spatial explicit) models

In summary (2/2)

- Country forest monitoring capacities and available data vary → Start FRL development at subnational level and use step-wise improvements for establishing national FRLs
- Establishing FRL for degradation should consider historical activity data limitations for some small-scale, locally driven degradation types
- Establishment of FIB still under discussion
- The FRL is about legitimacy: it is based on data but also on sound use of it, and as such it is a political rather than technical decision

Country example and exercise

Country example

- Brazil's submission of a subnational forest reference emission level to the UNFCCC
- Guyana's submission of a national forest reference emission level to the UNFCCC

Exercise

- Developing a forest reference level for Indonesia using different historical datasets: implications of different types of activity data on FRL development

Recommended module as follow-up

- Module 3.3 to continue with guidance on reporting REDD+ performance using IPCC guidelines and guidance

References

- Angelsen, Arild. 2008. "How Do We Set the Reference Levels for REDD Payments?" In A. Angelsen, ed., *Moving Ahead with REDD: Issues, Options and Implications*. Bogor, Indonesia: Center for International Forestry Research.
- Baccini, A., S. J. Goetz, W. S. Walker, N. T. Laporte, M. Sun, D. Sulla-Menashe, J. Hackler, P. S. A. Beck, R. Dubayah, M. A. Friedl, et al. 2012. "Estimated Carbon Dioxide Emissions from Tropical Deforestation Improved by Carbon-Density Maps." *Nature Climate Change* 2: 182–185.
- Ecofys. 2013. *Testing Methodologies for REDD+: Deforestation Drivers, Costs and Reference Levels*. London: Ecofys, CIFOR, UMB, University of Wageningen for UK Department for Energy and Climate Change, DECC. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/273332/testing_methodologies_for_redd.pdf.
- GFOI (Global Forest Observations Initiative). 2014. *Integrating Remote-sensing and Ground-based Observations for Estimation of Emissions and Removals of Greenhouse Gases in Forests: Methods and Guidance from the Global Forest Observations Initiative*. (Often GFOI MGD.) Geneva, Switzerland: Group on Earth Observations, version 1.0. http://www.gfoi.org/methods-guidance/.

- Griscom, B. Shoch, D., Stanley, B., Cortez, R., Virgilio, N. "Sensitivity of Amounts and Distribution of Tropical Forest Carbon Credits Depending on Baseline Rules." *Environmental Science and Policy* 12: 897–911.

- Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." *Science* 342: 850–53. http://earthenginepartners.appspot.com/science-2013-global-forest.

- Herold, M. 2009. *An Assessment of National Forest Monitoring Capabilities in Tropical Non-Annex I Countries: Recommendations for Capacity Building*. Report for the Prince's Rainforests Project and the Government of Norway. Jena, Germany: Friedrich-Schiller-Universität Jena and GOFC-GOLD. http://princes.3cdn.net/8453c17981d0ae3cc8_q0m6vsqxd.pdf.

- Herold, M., A. Angelsen, L. V. Verchot, A. Wijaya, and J. H. Ainembabazi. 2012. "A Stepwise Framework for Developing REDD+ Reference Levels." In Angelsen et al., eds., *Analysing REDD+; Challenges and Choices*, 279–299. Bogor, Indonesia: Center for International Forestry Research.

- http://www.cifor.org/publications/pdf_files/Books/BAngelsen1201.pdf.

- Huettner, M., R. Leemans, K. Kok, and J. Ebeling. 2009. "A Comparison of Baseline Methodologies for 'Reducing Emissions from Deforestation and Degradation.'" *Carbon Balance and Management* 4 (1): 4.

- Martinet, A., C. Megevand, and C. Streck. 2009. *REDD Reference Levels and Drivers of Deforestation in Congo Basin Countries*. Washington, DC: World Bank.
- Meridian Institute. 2011a. *Guidelines for REDD+ Reference Levels: Principles and Recommendations*. Dillon, CO: Meridian Institute. http://www.redd-oar.org/.
- Meridian Institute. 2011b. *Modalities for REDD+ Reference Levels: Technical and Procedural Issues*. Dillon, CO: Meridian Institute. http://www.redd-oar.org/.
- Romijn, E., M. Herold, L. Kooistra, D. Murdiyarso, and L. Verchot. 2012. "Assessing Capacities of non-Annex I Countries for National Forest Monitoring in the Context of REDD+." *Environmental Science and Policy* 19–20: 33–48.
- Saatchi, S. S., N. L. Harris, S. Brown, M. Lefsky, E. T. A. Mitchard, W. Salas, B. R. Zutta, W. Buermann, S. L Lewis, S. Hagen, et al. 2011. "Benchmark Map of Forest Carbon Stocks in Tropical Regions across Three Continents." *Proceedings of the National Academy Sciences* 108: 9899–9904.
- Soares-Filho, B. S., D. C. Nepstad, L. M. Curran, G. C. Cerqueira, R. A. Garcia, C. A. Ramos, E. Voll, A. McDonald, P. Lefebvre, and P. Schlesinger. 2006. "Modelling Conservation in the Amazon Basin." *Nature* 440(7083): 520–523.

- UNFCCC COP (United Nations Framework Convention on Climate Change Conference of the Parties) Decisions. This module refers to and draws from various UNFCCC COP decisions. Specific decisions for this module are listed in the "Background Material" slides. All COP decisions can be found from the UNFCCC webpage "Search Decisions of the COP and CMP." http://unfccc.int/documentation/decisions/items/3597.php#beg.
- UN-REDD. 2014. *Emerging Approaches to Forest Reference Emission Levels and/or Forest Reference Levels for REDD+*. Rome: Food and Agricultural Organization. www.unredd.net/index.php?option=com_docman&task=doc_download&gid=13473&Itemid=53.
- Winrock International, 2015. *REDD+ Decision Support Toolbox*. Winrock in partnership with the World Bank FCPF www.forestcarbonpartnership.org/dst
- World Bank FCPF. 2013. *Carbon Fund Methodological Framework. Final*. Washington, DC: World Bank. https://www.forestcarbonpartnership.org/carbon-fund-methodological-framework