Estimating the opportunity costs of REDD+

A training manual

Version 1.3

Chapter 2. Overview and preparations

Objectives

1. Summarize the content of the training manual,
2. Identify the people and skills required to estimate REDD+ opportunity costs
3. Assess one's knowledge of REDD+ opportunity costs,
4. Provide different tactics for effective manual use,
5. Introduce a "how-to" process guide for conducting a national REDD+ opportunity cost analysis
6. Identify information needed beforehand in order to estimate opportunity costs

Contents

Structure of the training manual

1. If estimating REDD+ opportunity costs were simple, a training manual would not be needed. Here we explain a process to estimate REDD+ opportunity costs. The approach used is based on detailed sub-national data. A strong foundation of empirical information helps to substantiate analysis results and support policy decisions. Sampling and extrapolation procedures are also shown to generate cost-effective and accurate national-level estimates of REDD+ opportunity costs.

2. The manual presents a series of distinct - but related- activities in estimating opportunity costs. An initial step is understanding the REDD+ policy context (Chapter 3). Topics include an evolving UNFCCC eligibility policy, accounting stance (who pays what costs), reference emission levels and nationally-appropriate mitigation actions (NAMAs). Although these policies are evolving within the UNFCCC framework, knowledge of them helps to link opportunity cost estimates within a larger decision framework.

3. Chapter 4, opportunity cost analysis begins with identifying and classifying land uses. An associated task includes estimating *changes* in land use – both historical and likely future trajectories. This latter component also includes analysis of the drivers of deforestation, which helps guide analysis of land use change scenarios and establishing reference emission levels. Histories of land use are helpful in identifying future land use trajectories. Scenario analysis of trajectories (e.g. business as usual and alternatives) is essential in estimating and negotiating reference emission levels of countries within the UNFCCC framework. As indicated above, these activities are closely linked to countries' strategic objectives, as defined in national REDD readiness preparation proposals under the Forest Carbon Partnership Facility (FCPF) of the World Bank or national joint programs under UN-REDD.[23]

4. For the entire range of land uses, Chapter 5 shows how to estimate their carbon stocks, while Chapter 6 illustrates how to estimate their associated profits. In addition to examining a range of land uses, these chapters also discuss how to conduct analysis over multiple year time horizons. With Chapter 4, these two chapters are the basic building blocks of opportunity cost analysis. It important to note that other REDD+ preparation activities may provide data for opportunity cost analysis. For example, countries are developing reference scenarios and operational forest monitoring and carbon accounting systems at the national level.

5. Chapter 7 brings together the information for estimating opportunity costs and creating an opportunity cost curve (Figure 2.1). The building blocks enable the analysis to

[23] That is, land use classification, identification of drivers, and development of historical (and potentially future) reference scenarios are part of a country's REDD+ policy process.

advance in two ways – for estimating the vertical (cost) and horizontal (quantity) components of the curve.

6. The vertical axis is based on an **opportunity cost (oppcost) matrix**, which summarizes the opportunity costs for all land use changes in $/tCO$_2$e. This is developed from the land use classifications along with associated carbon and profit information.

7. The horizontal axis also requires land use and carbon information, as represented by an **emissions matrix**. This matrix contains the quantities of emissions for all land use changes in terms of tCO$_2$e.

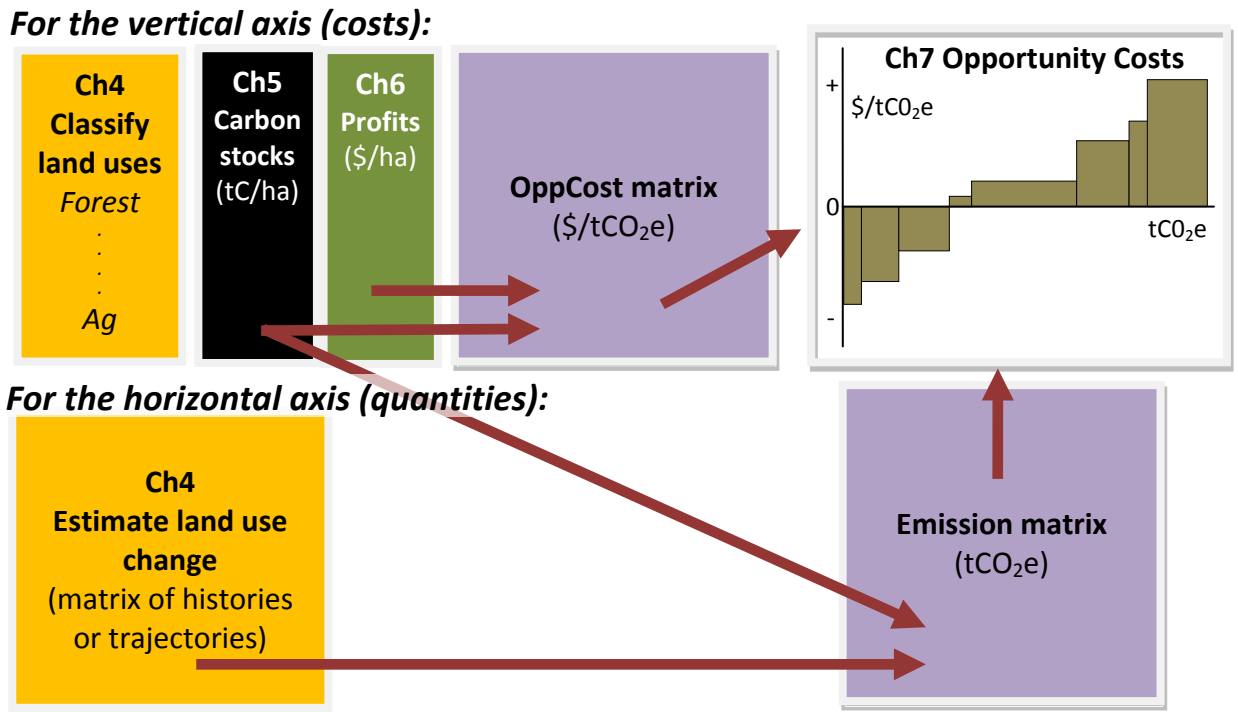

Figure 2.1. Analytical steps for developing an opportunity cost curve

8. In addition, the manual includes discussion of how to improve the precision and accuracy of opportunity cost estimates in a step-wise manner, similar to the IPCC Tiers (1,2,3).

9. In this overview, we introduce four of the more important basic components to estimating opportunity costs: (1) analyzing land use, (2) measuring carbon, (3) estimating profits, and (3) calculating an opportunity cost curve. Throughout the estimation , with discussion and critique process, participation of a range of professional expertises and scientific disciplines make the analytic approach and results not only more precise and accurate, but also more understandable to a wider audience – including those who may be affected by REDD+ policy.

Analyzing land use

10. A framework of land use systems is required to estimate opportunity costs of REDD+. The word *systems* is used because land uses often have multiple activities that my change over time. Although identifying and categorizing lands may seem as a straightforward exercise, a number of challenges confront researchers and policymakers, including (1) a potentially wide array of land uses, and (2) distinguishing between different land use systems from remote-sensing imagery.

11. A mix of national, IPCC and other criteria are used to determine categories. To enable systematic and rigorous analysis of REDD+ opportunity costs, land use systems need to be:

- Unambiguous (pertain to only one land use category),
- A basis from which to integrate multiple types of data,
    - Carbon-relevant (homogenous in C stock),
    - Profit-relevant (homogeneous in profits),[24]
    - Policy-relevant (supports the mandates of different national agencies),
- Valid for different versions of RED(D++),
- Consistent for reporting at multiple scales: global, national, local.

12. Easily observable characteristics of rural areas, both bio-physical (e.g., vegetation, elevation, soil quality) and socio-economic (e.g., population density, market accessibility, culturally homogeneous areas, etc.) serve as one of the determinants of land use system categories. Quantification of land use systems is achieved through a process of identifying land covers on maps (typically satellite images) and validating the actual land use systems, often by on-site confirmation.

13. Nevertheless, estimating land use system *changes* is the basis for REDD+ opportunity cost analysis. Past changes are calculated by comparing land use systems from different years. Probable future land use trajectories can be determined by extrapolating past changes and/or by developing land use models. The quantity of each type of land use change affects the estimate of national reference emission levels.

Estimating carbon and profits

14. The collected biophysical data and associated estimation methods are largely based on the general requirements set by the United Nations Framework Convention on Climate Change (UNFCCC). Especially for estimating **carbon stocks**, the training manual follows the available methods provided in the 2003 Intergovernmental Panel on Climate Change

[24] Levels of homogeneity to be determined according to impact on results. In some instances, 5-10% difference may not greatly affect opportunity cost estimates. The topic of precision and rigor is a matter of discussion whereby the costs of data collection and analysis are weighed against the benefits of better estimates.

(IPCC) Good Practice Guidance for Land Use, Land Use Change and Forestry (GPG-LULUCF) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for Agriculture, Forestry and Other Land Uses (GL-AFOLU) on how to estimate emissions from deforestation and forest degradation.

15. In contrast, socioeconomic data do not have protocols for collection and analysis. Similar to biophysical analysis, rigorous data collection, data management and analytical methods facilitate the generation of accurate and robust socioeconomic information needed to estimate **profits** of land uses. One important challenge includes taking account of how revenues and costs differ over multiple years within a land use system.

16. Accurate biophysical and socioeconomic information is not sufficient for opportunity cost analysis. Equally important the ability to ***integrate*** socioeconomic and biophysical information of land use systems identified within the analytical framework. In other words, the information must be based on the same units of analysis – per hectare with annual data transformable into a multi-year analytical framework. To facilitate a better understanding and transparency of the process, the recording of contexts, processes and assumptions are highly recommended.

Estimating opportunity costs and other analyses

17. Opportunity cost analysis of REDD+ generates a money-based representation (e.g., \$/ha, \$/tC or \$/CO_2e) of the tradeoff between storing carbon and generating profits on lands. The graphical representation of this tradeoff, called an *opportunity cost curve*, is a key objective of the analysis.

18. Opportunity costs estimates are a basis for further analysis and discussion. Such topics include:

- sensitivity analysis of opportunity cost estimates to changes in methods, assumptions and data,
- biodiversity and water co-benefits,
- scenario analysis of
    - different future land use trajectories,
    - distributional impacts of REDD+ policies and compensation upon
        - land users (e.g., smallholders, plantation owners), and
        - associated economic sectors (timber, agriculture, etc.)

19. Such analyses related to opportunity cost estimation can help national policymakers understand the implication of REDD+ policies.

Sensitivity

20. Critical review of a REDD+ opportunity cost analysis also includes an evaluation of the data, methods and assumptions used. One way to do so is via *sensitivity analysis*, whereby specific parameters are adjusted, such as technical coefficients (e.g., carbon stock, profit estimates). Discussion of sensitivity analysis and exercises are in Chapter 7.

Co-benefits

21. Forests generate other environmental or ecosystem services in addition to storing carbon. Such services, or *co-benefits*, include biodiversity and water. The value of these services can be significantly greater than the value of carbon alone, and thereby have the potential of lowering the apparent opportunity costs of reducing emissions. Discussion of co-benefits and their implications on opportunity cost estimates are within Chapter 8.

Scenarios

22. Scenario analysis can reveal how assumptions of future conditions can potentially affect estimates of land use, reference emission levels and associated economic-social-environmental tradeoffs. Related to sensitivity analysis, analysts and policymakers can contrast a range of potential policy actions to identify preferable conservation and development outcomes. A dramatic rise in food and energy prices, for example, may increase incentives to expand agricultural production into forests. Thus, opportunity cost estimates would need to be recalculated. Analytical results from updated opportunity cost analysis can assist policy development and decision processes. Discussion and exercises are found in Chapter 9.

Conclusions and next steps

23. Reviews to and revisions of opportunity cost estimates should be conducted as new technical evidence becomes available (e.g., improved estimates of carbon stocks), when significant shifts in market conditions occur or changes in REDD policy. The opportunity cost models can be used for scenario analysis on an on-going basis. Discussion of revised analyses, communication of results and next steps is in Chapter 10.

Who should do the work?

24. Estimating the REDD+ opportunity costs requires a wide variety of expertises. Moreover, the scope of the work required at the national level is beyond what can be managed by one or two people. Therefore, a first step is getting the correct people and organizations involved. Only then can a country be assured that they can generate valid opportunity cost estimates, critique the methods used to reach the findings, and prepare the best national strategy for participating in REDD+ funds and marketplaces.

25. The chapters in this manual help countries identify the team of both analytic and policy-oriented people required to estimate REDD+ opportunity costs. The team needs the skill from different scientific disciplines and professional backgrounds to work together, such as forestry, economics, agriculture, geography, and policy.

26. Since many are likely to be affected by REDD+, others may want to be aware and participate, such as ecologists, hydrologists, community activists, and private sector.

Therefore, country teams will need to decide how best to balance the benefits of obtaining additional perspectives and insights with the costs of coordinating numerous contributors.

A national REDD+ analytic and policy team

27. National experts involved in REDD+ research and policy analysis should estimate opportunity costs. Since no one person, or even government agency, can do all of the above, a national REDD+ team needs the expertise of:

1. ***geographers / spatial analysts*** to map land uses and changes,
2. ***foresters and carbon specialists*** to measure carbon in land uses,
3. ***agricultural and forest economists*** to estimate profits of land uses,
4. ***hydrologists and biodiversity specialists*** to estimate possible co-benefits,
5. ***sociologists*** to help identify possible adverse social consequences, and
6. ***national REDD+ administrators*** to identify policy responses.

28. Participation of personnel within government agencies fosters discussion REDD+ concepts and helps to link directly with decisionmakers and policymakers (Box 2.1). Non-government organizations and university staff can help ensure continuity and resilience of analytic capacity, since personnel within government agencies can change frequently. Rural community-based organizations and the private sector may also wish to be involved.

Box 2.1. Opportunity cost analysis as a boundary object

An opportunity cost analysis is a *boundary object* that facilitates communication between science and policy. Many IPCC reports, for example, are boundary objects. Boundary objects must meet stringent demands. Their content must be credible and open to scrutiny, while the presentation is sensitive to the needs of policymakers at sub-national, national and international levels.

Working together helps communication and understanding. Crunching numbers, filling databases and generating numbers is not sufficient. Nor is quickly reading final reports and attending policy meetings. The ***process*** of estimating opportunity costs requires discussion amongst scientists and policymakers.

On the way to generating opportunity cost curve estimates, other intermediate boundary objects need to reconcile different levels of understanding: amongst academic distinct disciplines, professional expertise and the policy interests. Some of the most important boundary objects in opportunity cost analysis are the national *typology of land use systems* or *map legend* that serve as the skeleton of the analysis. We foresee a stepwise and iterative learning process to derive an appropriate land use typology.

The overall analysis approach can benefit from the Millennium Ecosystem Assessment and similar multidisciplinary efforts intended for wider audiences. Participation of policymakers in during the work in-the progressing work enables them to express concerns, need and make suggestions to be shared. This collaborative approach can make the final results more meaningful, useful and compelling.

Ways to use this manual

29. Achieving proficiency in REDD+ opportunity cost analysis requires different levels of investment, depending on the person involved. Given the quiz above, you probably have a better idea of what type of knowledge could be of use. In the list below, see which objective best matches yours, and identify the likely time investment required:

I need to:

- quickly read to confirm my knowledge (10 – 40 min);
- read to learn something important (1 hour – 1 day), enough to know:
  - who should participate in the training workshops,
  - who should be part of the national REDD+ analytic and policy team;
- thoroughly read to be familiar with a few of the subjects in order to question findings, and policy implications (1.5 – 5 days).
- read, participate in a workshop and practice with examples in order to be well-versed with all the subjects required to critically question findings, analytical methods, and policy implications (5 – 15 days).

Box 2.2. Do I know enough already?

The topic of REDD+ opportunity costs can be confusing and difficult to understand. Some words and terms may be new. How many do you know?

- *Ground-truth – minimum mapping unit – land use trajectory*
- *Discount rate – net present value – accounting stance*
- *Reference emission level – business as usual*
- *Carbon flux – allometric equation*

If you feel comfortable with all these terms, you are a rare person. You earned a score of 10 of 10. For the rest of us, including us authors, understanding the complex and sometimes subtle workings of REDD+ opportunity costs requires a time investment. The contents of this manual and practice exercises will help us reach a high level of expertise.

Likely topic priorities per expertise

30. ***National decisionmakers and policymakers*** would benefit from an ability to interpret, critique and apply the results of opportunity cost studies. Such capacity is necessary to know what policies are needed to develop REDD+ national and sub-national

plans. To achieve such capacity, the information contained the following chapters are considered important within the manual:

- **Introduction**
- **Overview and preparations**
- **REDD+ policy context**
- **Opportunity cost analysis**
- **Tradeoffs and scenarios**
- **Conclusions and next steps**

31. ***Sub-groups of the national REDD+ analytic and policy team*** would concentrate on chapters intended for specific analyses. The following chapters need inputs from the following types of experts:

- **Land use & land use change**: remote sensing experts, geographers and land use planners;
- **Carbon**: foresters, agronomists, carbon measurement specialists;
- **Profitability**: agronomists, foresters, economists, sociologists;
- **Water & Biodiversity Co-Benefits**: hydrologists, ecologists, sociologists, economists.

Process of estimating opportunity costs

Improving accuracy and precision

32. Although countries may not have all the data required to estimate a wide range of opportunity costs, information may be available on similar land use systems in other countries. A preliminary analysis can generate approximate opportunity cost estimates, mirroring the three tier system used by the IPCC for estimating carbon stocks.

33. A recurring challenge of estimating REDD+ opportunity costs is improving their accuracy and precision. Since the carbon price received is likely to be significantly higher for better (substantiated) estimates, a stepwise process with increasing levels of time and money investments is recommended, analogous to the IPCC Tier 1, 2, 3 approach (Box 2.3). Nevertheless, per agreements reached in Cancun, the Subsidiary Body for Scientific and Technological Advice (SBSTA of the UNFCCC) will define C-accounting rules and MRV etc. for national REDD+ systems. The rules may supersede or complement the IPCC Good Practice Guide.

Box 2.3. IPCC reporting tiers

Tier 1: Basic estimation methods and existing data are used. Default values can be used when data is unavailable (e.g., from the IPCC emission factor database). Data are often spatially coarse (e.g., estimates of deforestation rates), and have large error range (e.g., ~70% for aboveground biomass).

Tier 2: Intermediate estimation methods use country-defined emission factors and activity data within the same approach as Tier 1. Estimates for specific regions and land use categories typically require higher-resolution activity data, which need to be collected.

Tier 3: Rigorous estimation methods, such as measurement systems and models, are used repeatedly over time and adjusted to reflect national characteristics. Areas of land use change are monitored. High-resolution activity data is collected with analysis disaggregated at the sub-national or district level. Parameterized models with plot data can be used to analyze all carbon pools. Models typically go through quality checks, audits and validations. Models may incorporate a climate dependency factors and can provide estimates of inter-annual variability.

Source: Adapted from Havemann, 2009 and IPCC, 2003.

34. To increase the level of analytical precision and accuracy , the REDD+ analytic and policy team can follow a requires an iterative process of data identification and collection. Tier 1 - type analysis generates initial estimates that provide an initial sense of the orders of magnitude regarding opportunity costs. With these results, targeted efforts can improve key aspects of the information required for analysis, which might use either Tier 2 or Tier 3 methods, or a mix, depending on time and resources available, country land use context and the potential benefits of improved estimates.

Opportunity costs analysis within a REDD+ readiness process

35. Despite opportunity cost analysis not being required explicitly with REDD+ readiness processes, opportunity cost estimates inform the formulation of national REDD+ strategy. The inquiry process, analytical results, and critical review from stakeholders helps to identify optimal national strategies within Readiness Preparation Proposals (RPPs), presented to the FCPF of the World Bank (see FCPF, 2009; FCPF and UN-REDD, 2010). In addition, some investment and operating costs can be shared across other REDD+ preparations, such as collecting data and associated analytical frameworks for reference emission levels (RELs) and carbon measurement, reporting, and verification (MRV).

36. While speedy availability of results is valuable for informing decisions, accurately estimating opportunity costs requires substantial data inputs and rigorous analytical methods. If the needed data is not readily available, significant investments of time and cost can be made as Tier 1 or 2 type analyses are be advanced.

37. REDD+ preparation is a process, and countries can be at different stages. Figure 2.2 summarizes three phases for implementing a comprehensive REDD+ program and associated levels of opportunity cost analysis. The phased approach allows policymakers to have important information in a timely manner in order to support discussion of potential REDD+ impacts within REDD+ readiness, consultation, consensus building, strategy development and negotiation processes (REDD+ Phase 1). Improved opportunity cost results will also help with policy design and implementation within national development strategies (REDD+ Phase 2).

38. During these phases, some of the technical information (e.g., profitabilities, carbon stocks) may indeed be general estimates applied to national conditions. As a country moves up the tiers, increasing amounts of national and sub-national technical information is required. Matured opportunity cost analysis enables countries to improve REDD+ policy effectiveness and efficiency (REDD+ Phase 3). Government ownership of the process and commitment from key actors in a country are important for successful REDD+ planning and implementation.

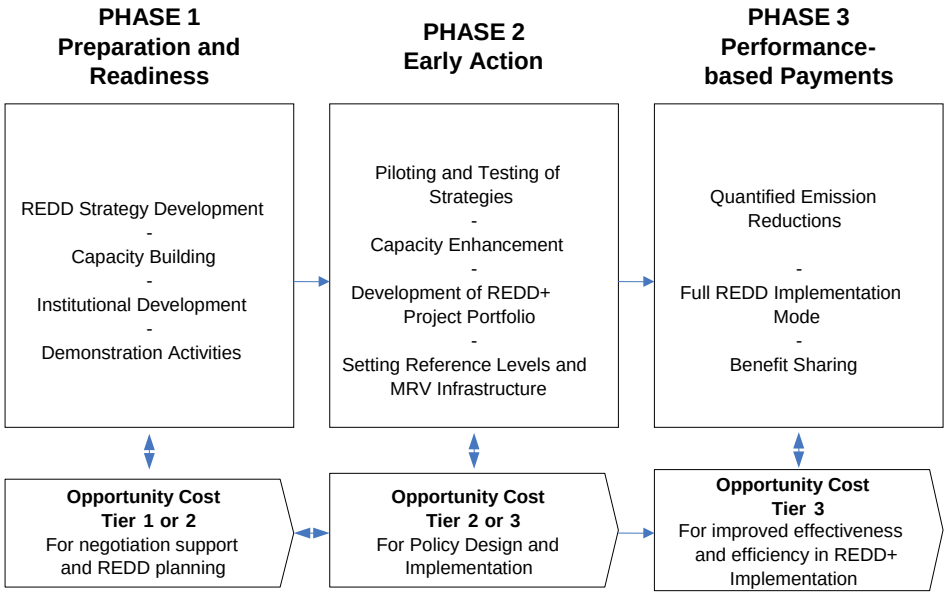

Figure 2.2. Stages of opportunity cost analysis within REDD+ program development
Source: Authors.

39. Table 2.1 provides a summary of tasks and associated expertise needed to accomplish them. Within the table, tasks appear in the rows and the required expertise are represented by the columns. Some tasks only require one type of expertise and can be advanced without much collaborative input from other members of the national REDD+ team. Given the nature of REDD+ opportunity cost analysis, however, many tasks require participation of different types of professionals.

40. Independent tasks have only one colored cell, whereas collaborative tasks requiring meetings have multiple colored cells. National workshops can be divided into sub-national workshops to focus on different contexts within a country.

What information is needed upfront?

41. To estimate the opportunity costs of REDD+ at the national level, a country will need to know:

- the **area of all land uses** (e.g., agriculture, pastures, forest),
  - and likely future land uses (i.e. trajectories),
- the **profits** of all land uses in the country (e.g., agriculture, forests, pastures etc.),
- the **carbon stock** of each type of land use,

  (*also helpful:* information on **co-benefits of water & biodiversity**).

In other words, three sets of information are the building blocks. Fortunately, all this work does not need to start from zero. Many studies typically exist within a country that can be used, including National Biodiversity Strategy and Action Plans (NBSAP) and National Action Plans for Climate Change (NAPCC), national forest plans and other land use planning information. Information on the profitability of at least some land use systems is often available from Ministries of Agriculture and/or producer groups.

42. By using existing data, collecting new data, conducting analyses and reviewing results, the team will be able to estimate the opportunity costs of REDD+ (and other costs of REDD+, the training manual contains guidance on this too.)

Technical and analytic support

43. Support for the training material and workshops on REDD+ opportunity costs is part of the Forest Carbon Partnership Facility (FCPF) effort to test and evaluate different approaches to REDD+ in tropical and subtropical countries. Opportunity costs are within issues identified in Step 4 (Planning: Define the issues to consult on) of the FCPF technical guidance on how to prepare an effective consultation and participation plan (FCPF, 2009).

Table 2.1. Process planner and checklist

Topic	Task	Required expertise/skills								Process
		Geography /remote sensing	*Forestry*	*Carbon measure*	*Economics (Ag,For)*	*Field (Ag,For)*	*Hydrology*	*Ecology*	*Policy*	
Team preparation										
	Participant identification									
	Workshop training									Regional workshop
	Invitation and TOR of presentation									
	Identify deforestation drivers									National workshop 1
Land use	Diagnose and review data and analysis									
	Develop a national land use framework									National workshop 1
	Create land use maps									
	Validate land uses and classifications									Meetings
	Estimate land use change									
	Identify land use trajectories									National workshop 1
Carbon	Coordinate with national accounting system									Meetings
	Diagnose and review data and analysis									
	Establish sampling procedure									
	Measure C in different land uses									Sub-team activity
Profits	Diagnose and review data and analysis									
	Clarify accounting stance and other assumptions									Meeting
	Develop enterprise budgets									Sub-team activity
	Estimate profits from land uses									
	Estimate NPV of land use trajectories									
Water & BioD Co-benefit	Diagnose and review data and analysis									
	Identify co-benefit areas									Meeting
	Prioritze co-benefit areas									National workshop 2
Analysis & discussion	Estimate opportunity costs									
	Map the REDD opportunity costs									
	Analyze scenarios and sensitivity of results									National workshop 2
	Discuss policy implications									National workshop 2
	Develop national REDD strategy									National workshop 3

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