3. Estimation and Registration of Projects

As part of the project proposal (design) stage, project developers describe the project activities intended to generate carbon sequestration, establish a project baseline, estimate the project's carbon and monetary returns, and design a monitoring and evaluation plan (see Andrasko et al. 1996). In Figure 4, we present an overview of the approach used in this report in estimating gross and net changes in carbon stock. In this section, we focus on the issues involved in estimating the baseline and gross changes in the carbon stock, since the net change is simply the difference between the gross change and the baseline.

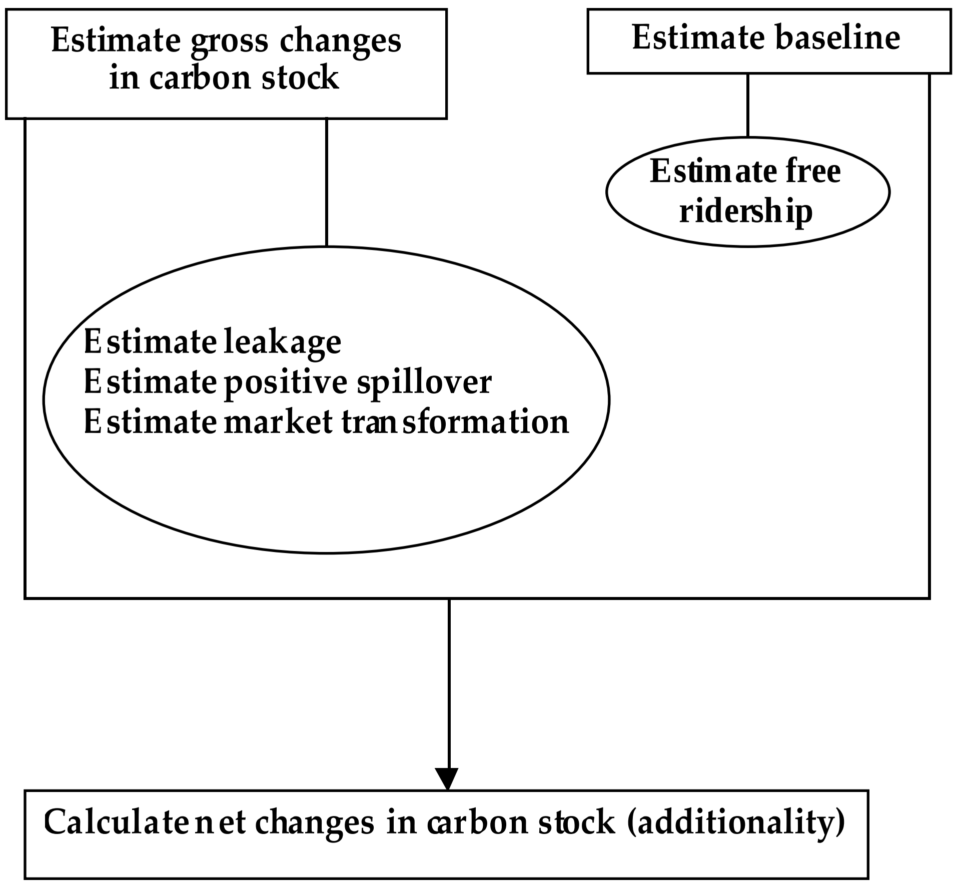

Fig. 4. Estimation Overview

The monitoring and evaluation plan describes the type of data to be collected, the data collection activities (procedures and methods) to be undertaken, and how the data will be evaluated. The plan also specifies the equipment and organizational requirements for monitoring and evaluation.

The monitoring and evaluation plan is an integral part of the implementation of the project and should produce more accurate estimates of impacts at a lower cost. The results from the monitoring will later be used to re-estimate the baseline. In Appendix A, we provide an Estimation Reporting Form for project developers to use when designing a forestry project. The intent of this form is to provide guidance to developers on issues that evaluators and verifiers will examine after a project is implemented.

3.1. Estimating Gross Changes in Carbon Stock

At the project design stage, changes in the carbon stock will be estimated by using one or more techniques: (1) modeling, (2) review and analysis of the literature on similar projects (content analysis), (3) review and analysis of data from similar projects recently undertaken; and (4) expert judgement. The estimation methodology can be either simple or complex, depending on the resources available for conducting the estimation and the concern for reliable results (Watt et al. 1995). Since many assumptions need to be made, project estimates are later compared with measured data to determine the accuracy and precision of the estimated changes in carbon stock. The key issues that need to be addressed in estimating gross changes are: (1) determining the appropriate monitoring domain, and (2) accounting for project leakage, positive project spillover, and market transformation.

3.1.1. Monitoring domain

The domain that needs to be monitored (i.e., the monitoring domain, see Andrasko 1997 and MacDicken 1997) is typically viewed as larger than the geographic and temporal boundaries of the project. In order to compare GHG reductions across projects, a monitoring domain needs to be defined. Consideration of the domain needs to address the following issues: (1) the temporal and geographic extent of a project's direct impacts; and (2) coverage of project leakage and positive project spillover.

The first monitoring domain issue concerns the appropriate geographic boundary for evaluating and reporting impacts. A forestry project might have local (project-specific) impacts that are directly related to the project in question, or the project might have more widespread (e.g., regional) impacts. Thus, one must decide the appropriate geographic boundary for evaluating and reporting impacts. Similarly, the MERVC of changes in the carbon stock of forestry projects can be conducted at the point of extraction (e.g., when trees are logged) or point of use (e.g., when trees are made into furniture), and when forests are later transformed to other uses (e.g., agriculture, grassland, or range). Thus, depending on the project developer's claims, one may decide to focus solely on the changes in the carbon stock from the logging of trees at the project site, monitor the changes over time from the new land use type, or account for the wood products produced and traded outside project boundaries.

The second issue concerns coverage of project leakage and positive project spillover, and they are discussed in the next two sections. It is important to note that not all secondary impacts can be predicted. In fact, many secondary impacts occur unexpectedly and cannot be foreseen. And when secondary impacts are recognized, a commitment needs to be made to ensure that resources are available to evaluate these impacts.

One could broaden the monitoring domain to include, for example, project leakage and off-site baseline changes (which are normally perceived as occurring outside the monitoring domain). Widening the system boundary, however, will most likely entail greater MERVC costs (see Section 9) and could bring in tertiary and even less direct effects that could overwhelm any attempt at project-specific calculations (Trexler and Kosloff 1998). Consequently, project developers should devote most of their resources to the immediate monitoring domain, but include all carbon pools (e.g., forest products). During the monitoring and evaluation stage, the monitoring domain can be expanded if warranted.

3.1.2. Project leakage

Leakage occurs because the project boundary within which a project's benefits are calculated may not be able to encompass all potential indirect project effects. In this report, negative indirect effects are referred to as "project leakage" while positive indirect effects are referred to as "positive project spillover" (Section 3.1.3). For example, projects affecting the supply of timber products can affect price signals for the rest of the market, potentially counteracting a portion of the calculated benefits of the project: the establishment of forestry plantations could lead to a decrease in timber prices, leading to a higher incentive to convert forests to agricultural purposes. Another example of leakage occurs when a forest preservation project involves protecting land that was previously harvested by the local population for their personal consumption as fuel wood (MacDicken 1998; Watt et al. 1995). Although this area is now protected from harvesting, people from the surrounding communities still require wood for fuel and construction. Preserving this forest area has shifted their demand for fuel wood to a nearby site, leading to increased deforestation. This off-site deforestation will at least partially offset the carbon sequestration at the project site. Furthermore, some projects may involve international leakage: e.g., in 1989, when all commercial logging in Thailand was banned, the logging shifted to neighboring countries such as Burma, Cambodia and Laos as well as to Brazil (Watt et al. 1995).

Leakage may occur not only after a project has been completed but also during project development. For example, in the Rio Bravo Carbon Sequestration Pilot Project, a local timber company used the money from the sale of the land to project participants for upgrading their equipment, allowing for the possibility of an increase in output of plywood (Programme for Belize 1997). However, this increase in output did not occur. Similarly, the land purchases for the Rio Bravo project could also motivate competitors that had wanted to purchase that land to intensify clearance of the land already in their possession, or intensify production from the land, increasing emissions from agricultural inputs and machinery. However, this also has not occurred (Programme for Belize 1997).

Leakage needs to be accounted for if off-site GHG emissions are to be accounted for, rather than those at a particular site. However, leakage can be difficult to identify and even more difficult to estimate and quantify. Nevertheless, because the developer's project is responsible for leakage and a project's estimate of carbon storage may be later reduced due to project leakage, it is the developer's responsibility to monitor leakage and assume responsibility for the carbon lost.

3.1.3. Positive project spillover

When measuring changes in carbon stock, it is possible that the actual reductions in carbon are greater than measured because of changes in participant behavior not directly related to the project, as well as to changes in the behavior of other individuals not participating in the project (i.e., nonparticipants). These secondary impacts stemming from a forestry project are commonly referred to as "positive project spillover." Project spillover may be regarded as an unintended consequence of a forestry project; however, as noted below, increasing project spillover may also be perceived as a strategic, intended mechanism for reducing GHG emissions.

The intent of some forestry projects is often not only to induce project developers to adopt certain forestry measures, but more broadly to transform neighboring areas for implementing similar measures. For example, in the Rio Bravo Carbon Sequestration Pilot Project, other projects have been implemented to preserve forests, catalyzed by the successful launch of the Rio Bravo project (Programme for Belize 1997). In the CARE/Guatemala project, which increased fuelwood availability and agricultural productivity by providing trees through CARE-sponsored tree nurseries, the project's techniques have been adopted in other areas beyond the project's boundaries by participants setting up their own tree nurseries (Brown et al. 1997).

Positive project spillover effects can occur through a variety of channels including: (1) an individual hearing about a project measure from a participant and deciding to pursue it on his or her own ("free drivers"); (2) project participants that undertake additional, but unaided, forestry measures based on positive experience with the project; (3) wood product manufacturers changing the nature of their products, to reflect the demand for more wood products created through the project; (4) governments adopting new forestry policies and legislation because of the results from one or more forestry projects; (5) technology transfer efforts by project participants which help reduce market barriers throughout a region or country; or (6) the emergence of ecotourism.

Because of the multiple actors that may be involved in causing positive project spillover, it is unclear on how much of these changes should be attributed to the project developer. Since spillover is an unintended consequence, and the project developer is a passive recipient of the benefits of spillover, it should not be his responsibility for expending resources for an assessment of project spillover. Project spillover still needs to be evaluated, but not assessed in the estimation stage.

3.1.4. Market transformation

Positive project spillover is related to the more general concept of "market transformation," defined as: "the reduction in market barriers due to a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced or changed" (Eto et al. 1996). The concept of market transformation has been used in many fields, most recently in the energy sector. Increasing market transformation is expected to be a strategic mechanism (i.e., an intended consequence) for reducing carbon emissions in the forestry sector for the following reasons:

- To increase the effectiveness of forestry projects: e.g., by examining market structures more closely, looking for ways to intervene in markets more broadly, and investigating alternative points of intervention.
- To reduce reliance on incentive mechanisms: e.g., by strategic interventions in the market place with other market actors.
- To take advantage of regional and national efforts and markets.
- To increase focus on key market barriers other than cost.
- To create permanent changes in the market.

As a hypothetical example, consider a bioenergy project that grows trees on a rotational basis and harvests the trees as an energy resource for a community hospital. The developer of the project needs to make sure there are no technical, financial, administrative, or policy barriers to the implementation of this project, and to determine if there are other large, energy-intensive end users who could take advantage of this resource (e.g., industrial customers?). The project developer could also examine what partnering opportunities exist for promoting the bioenergy project (e.g., developing a voluntary labeling program that labels customers as "green energy users"). Once the labeling program is in place, additional projects might emerge, creating an expanded market for bioenergy projects. Finally, the developer could try to extend the proposed labeling program to other regions, in order to enlarge the market for the project's trees.

Two examples in the forestry sector show the beginnings of market transformation: (1) the availability of improved biomass cook stoves, an important technology for reducing deforestation, has influenced many nonparticipants to purchase cook stoves as these programs develop (Bialy 1991); and (2) the reduced impact logging project in Malaysia (Box 3) is being replicated in Brazil and other parts of Indonesia (personal communication from Pedro Moura-Costa, EcoSecurities, Ltd., Sept. 15, 1998; Jepma 1997).

In the case of market transformation, the project developer is one of the responsible parties for engendering change in the carbon stock and, therefore, should be responsible for estimating the amount of market transformation. However, because of the multiple actors involved in causing market transformation, the developer should not be solely responsible for assessing and later monitoring and evaluating market transformation.[1] The amount of resources devoted to assessing market transformation, therefore, will depend on how much carbon storage can be attributed to this project which may be reflected in contracts among parties involved in transforming markets.

3.2. Estimating a Baseline

For joint implementation (Article 6) and Clean Development Mechanism (Article 12) projects implemented under the Kyoto Protocol, the emissions reductions from each project activity must be "additional to any that would otherwise occur," also referred to as "additionality criteria"

---

[1] Other challenges in proving attribution include the following: (1) multiple interventions occur (e.g., changes in standards, products offerings and prices and activities of other market actors (e.g., regulators and regulatory intervenors)); (2) programs and underlying change factors interact with one another; (3) the effects of different programs are likely to have different lag times; (4) changes in different technologies are likely to proceed along different time paths; (5) changes are likely to differ among different target segments; (6) the lack of an effective external comparison group; (7) data availability; and (8) large, complex interconnected sociotechnical systems are involved, with different sectors changing at different rates and under different influences.

(Articles 6.1b and 12.5c).[1] Determining additionality requires a baseline for the calculation of carbon sequestered, i.e., a description of what would have happened to the carbon stock had the project not been implemented (see Violette et al. 1998). Additionality and baselines are inextricably linked and are a major source of debate (Trexler and Kosloff 1998). Determining additionality is inherently problematic because it requires resolving a counter-factual question: What would have happened in the absence of the specific project?

Because investors and hosts of forestry projects have the same interest in a forestry project (i.e., they want to get maximum carbon sequestration through the project), they are likely to overstate and over-report the amount of carbon sequestered by the project (e.g., by overstating business-as-usual changes to the carbon stock). Cheating may be widespread if there is no strong monitoring and verification of the projects. Even if projects are well monitored, it is still possible that the real amount of carbon sequestered is less than estimated values. Hence, there is a critical need for the establishment of realistic and credible baselines.

Future changes in carbon stock may differ from past levels, even in the absence of the project, due to growth, technological changes, input and product prices, policy or regulatory shifts, social and population pressure, market barriers, and other exogenous factors. Consequently, the calculation of the baseline needs to account for likely changes in relevant regulations and laws, changes in key variables (e.g., population growth or decline, economic growth or decline, deforestation, development of markets for wood products, and how future land use patterns (e.g., gradual deforestation) affect the carbon cycle) (Andrasko et al. 1996; Michaelowa 1998). For example, for a forest protection project, a simple baseline would try to account for how many hectares might be lost in a year, how the loss would occur (e.g., through burning or timber harvest), what biomass would replace the forest, and whether the forest would return after the land has been abandoned. Ideally, the baseline would track this information annually.

Forward-looking benchmarks might be based on national forestry policy or land use simulation models. Mitigation scenarios can evaluate the carbon sequestration potential of various policies such as afforestation, reforestation, or forest management practices (e.g., fire suppression). However, results at the end of long planning or modeling horizons can be very imprecise. One could define a

[1] In this report, the criterion of additionality refers only to carbon emissions. The related criterion of "financial additionality" is not described in LBNL's MERVC guidelines. Financial additionality refers to the financial flows of a project (Andrasko et al. 1996): would the expenditures involved been made without the carbon offset project? This question addresses: (1) the sources of funding for the project, (2) the alternative uses of that funding, and (3) the motivation for choosing the carbon offset projects (Swisher 1998). We expect financial additionality to be addressed when the proposed project is registered (see Section 1.1).

median baseline or a set of baselines with different assumptions, which are weighted according to their probability (Andrasko et al. 1996).

Ideally, when first establishing the baseline, carbon stocks should be measured for at least a full year before the date of the initiation of the project. The baseline will be re-estimated based on monitoring and evaluation data collected during project implementation.[1] Finally, in order to be credible, project-specific baselines need to account for free riders.

3.2.1. Free riders

It is possible that forestry projects are undertaken by participants who would have conducted the same activities if there had been no project and, therefore, the carbon sequestered by these "free riders" would not be perceived as "additional" to what would otherwise have occurred (Vine 1994). Although free riders may be regarded as an unintended consequence of a forestry project, free ridership should still be estimated, if possible, during the estimation of the baseline. The project developer is responsible for monitoring and evaluating free riders after the project is implemented, for re-estimating the baseline (Section 4.3). While free riders can also cause leakage and spillover, these impacts are typically considered to be insignificant compared to the impacts from other participants.

3.2.2. Performance benchmarks

Concerned about an arduous project-by-project review that might impose prohibitive costs, some researchers have proposed an alternate approach, based on a combination of performance benchmarks and procedural guidelines that are tied to appropriate measures of output (e.g., Lashof 1998; Michaelowa 1998; Swisher 1998; Trexler and Kosloff 1998). In all cases, measurement and verification of the actual performance of the project is required. The performance benchmarks for new projects could be chosen to represent the high performance end of the spectrum of current commercial practice (e.g., representing roughly the top 25th percentile of best performance). In this

[1] In some cases, allometric equations for estimating carbon emissions may be used, but only under special conditions: e.g., when environmental conditions are not variable, in managed forests (e.g., plantations), and in areas of increased homogeneity (see Box 2). In forestry, an allometric equation characterizes the predictable form of a tree by relating one or two easy-to-measure variables (e.g., diameter at breast height and/or height) to other more difficult-to-measure variables (e.g., biomass and tree volume) (personal communication from Steve Hamburg, Brown University, Feb. 9, 1999).

case, the benchmark serves as a goal to be achieved. In contrast, others might want to use benchmarks as a reference or default baseline: an extension of existing technology, and not representing the best technology or process.

A panel of experts could determine a baseline for a number of project types, which could serve as a benchmark for the UNFCCC. This project categorization could be expanded to a categorization by regions or countries, resulting in a region-by-project matrix. Project developers could check the relevant element in the matrix to determine the baseline of their project. Most of the costs in this approach relate to the establishment of the matrix and its periodical update. Before moving forward with this approach, analysis is needed to consider the costs in developing the matrix and its update, the potential for projects to qualify, and the potential for free riders. The U.S. EPA is assessing the feasibility and desirability of implementing a benchmark approach for evaluating additionality (e.g., see Hagler Bailly 1998).