Financial and Economic Evaluation Guidelines for Community Forestry Projects in Latin America

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Table of Contents

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Executive Summary

Projects supporting community forest enterprises (CFEs) and competitiveness in Mexico and Latin America are important for economic development. When the World Bank and its client countries finance such forestry projects they conduct financial and economic analyses in order to evaluate, select, and monitor these projects. This report covers the principles of financial and economic analysis to improve the implementation of forestry projects in Latin America.

A financial analysis considers costs, prices, and profits of carrying out a project or activity in terms of market prices. For a simple production process that occurs in one year, with a fixed production factor, a variable factor of production, and a product, expenses are termed total, variable, fixed, average and marginal costs.

The financial methods can be generalized to consider the costs and benefits of projects for the society as a whole. The analysis of projects under this perspective of society from the country, regional, or community level is termed an economic analysis, which is also referred to as a cost-benefit analysis (CBA) or benefit-cost analysis (BCA). Economic analyses use market prices where available and nonmarket prices are developed for goods and services that lack commercial prices.

The main stages of the financial and economic analysis include defining the project objectives, collecting data for analysis, the estimation of inputs for activities, costs, and prices, the development of cash flow tables, the use of profitability indicators to estimate the financial or economic returns, the actual implementation of the project, and monitoring and evaluation.

The Total Economic Value (TEV) is a new method used to estimate the value of all the economic benefits that society derives from a project or activity. For forests, the TEV involves the value of the benefits that society derives from the forest, so that it considers more than just the value of timber or commodities. The TEV of forests is the sum of use and nonuse values. Use values are divided into direct, indirect and optional while the non-use values include existence and bequest values.

Economic use values involve the interaction between the individual and the environment (including consumptive uses such as timber, hunting products, and non-consumptive uses such as hiking). The non-use values include those with no actual interaction between people and the environment, such as the knowledge that there is an endangered species like the polar bear. Option value is the willingness to pay to be able to choose a given service in the future. The values of goods and services can be used to assess marginal or incremental changes, but not to assess major new options, such as the elimination of an entire ecosystem.

The difficulty and high cost of estimating the value of nonmarket goods and services often means that most analyses of forestry projects do not carry out primary data collection on the values, and most of the analyses are based on data and estimates from prior research. A systematic use of previous research and studies and applications is called benefit transfer.

Economists use various capital budgeting criteria to guide in the selection of projects. The Net Present Value (NPV) converts a series of recurring revenue streams into a single number that can be used to compare mutually exclusive investments at a given discount rate (cost of capital). For single accept/reject investment decisions, positive NPVs indicate that one would accept the investment; for selecting among multiple projects (termed capital budgeting), one would choose the investment with the greatest positive NPV.

The Land Expectation Value or Soil Expectation Value (LEV or SEV) was developed to solve the problem of comparing unequal time periods for forest investment alternatives. The LEV calculates the present value of an infinite series of projects (rotations). The LEV is applied the same as NPV in making investment decisions—individual alternatives that have positive LEVs are acceptable, while negative LEVs would mandate rejection of the project. Similarly, the greatest LEV would be the preferred alternative in a capital budgeting situation, or to select among different forest rotations.

The Internal Rate of Return (IRR) is defined as the discount rate that makes the present value of project revenues equal the present value of project costs. For individual investments, the IRR is usually compared to any alternative rate of return. Alternative projects with an IRR greater than the rate of return are considered acceptable alternatives. Higher IRRs are preferred in capital budgeting among many projects. The Benefit/Cost ratio is used to compare with total discounted revenue divided by the total discounted costs. Ratios greater than 1.0 indicate that the project is acceptable; greater ratios are preferred in capital budgeting decisions.

An economic analysis of forestry projects must be rigorous and well documented. The implementation and monitoring of the project can assess the individual project and its compliance with the plans and identify problems in implementation. This summary reviews the economic and financial analysis of market and nonmarket goods and services, with application to forestry projects in Mexico and Latin America. Financial and economic analyses alone are not sufficient to make all project decisions, but they are necessary to ensure that projects are using scarce capital well and meet the minimum economic standards expected by forestry communities and landowners, foreign aid donors, and technical assistance groups.

As noted in this review, financial and economic analysis can evaluate the profitability and selection of investments in market goods and services in present value terms though capital budgeting analyses. It also can assess the merits of new products and services, such as forest carbon, biodiversity, water quality, and beauty. It can help identify which benefits are more valuable to society and local communities, which is useful for forest policy decisions, such as developing forestry programs for local communities, helping produce goods and services efficiently, making payments for environmental services, and helping conserve valuable ecosystems and community welfare.

Financial and Economic Evaluation Guidelines for Community Forestry Projects in Latin America

Introduction

The World Bank finances a range of forestry investment projects in Mexico and Latin America that are performed by community forest enterprises (CFEs) and small and medium sized forestry enterprises. These projects require financial and economic analysis by the Bank as part of their appraisal, selection, and monitoring efforts. In addition, CFEs aim to target their funds for the projects that are most beneficial for the communities, whether from a purely financial standpoint, or from a larger economic and social stance.

In the last two decades the forest sector has undergone an important transformation. In particular, the holistic concept of sustainable forest management (SFM) has emerged as a benchmark for ensuring forestry practices conform to high standards for environmental, social, and economic concerns. Also, forestry projects are increasingly incorporating payments for environmental services such as water, carbon, and biodiversity; and community forestry projects frequently include community development activities. Finally, community forestry enterprises and small- and medium-size owners have become increasingly important, sharing more power and authority in forest resource management with governments. The increasingly broad and complex character of forestry projects means that the valuation of forest goods and services must be more comprehensive as well.

Financial analyses cover the costs, returns, and project selection for individual communities, landowners, or firms, with the intent of maximizing the return on capital as measured by market input costs and output prices. *Economic analyses*, often termed cost-benefit analysis (CBA), take a broader social viewpoint, allowing CFEs to compare project costs and returns in social terms, including community capacity building, environmental components, and nonmarket valuation. The basic procedures for making these analyses; the distinction between these analyses; and the appropriate application of each is reviewed here. This primer provides an up-to-date summary of these concepts, drawing on considerable new literature that has developed in nonmarket valuation, sustainable development, and community forest enterprises in recent decades. It covers the common financial and economic principles that are important in making economic evaluations for community forest enterprises in Mexico and Latin America.

The financial and economic guidelines summarized here can be useful for analyzing forestry projects for a wide range of sectors and organizations, although the findings from such analyses might be used differently by those users. For foreign aid donors the guidelines could be useful to assess if the returns to a loan or project investments are acceptable, including the non-quantifiable social and environmental components. For a forestry community, the guidelines could help them determine whether a potential investment makes sense, and they can also help a community identify where improvements could be made to the proposed activities to increase returns. For technical assistance groups, the financial and economic tools may be useful when working with community forestry groups to determine what their returns are and where improvements in efficiency could be made.

Financial and Economic Analyses: Assumptions, Approaches, and Valuation

Table 1 summarizes the principal points made in this review. As noted in the table, both financial and economic analyses assume that individuals and society can measure and try to maximize their net benefits, or utility as referred to in economics literature. Efficiency is the principal financial and economic criterion for project selection. This is measured as maximizing profits or minimizing market costs in financial analyses, and maximizing net social benefits in economic analyses. Financial analyses measure costs, prices, and profits in terms of commercial market prices. Economic analyses use market prices whenever available. When there are substantial market failures or nonmarket environmental benefits (also referred to as externalities), economic analyses use proxies or estimate social value by adapting the analyses to include shadow prices, revealed preference analyses, or stated preference methods.

Table 1. Principal Assumptions, Approaches, and Applications of Financial and Economic Analysis in Forestry Projects

Characteristic	**Financial Analysis**	**Economic Analysis**
Economic Value Assumptions	Individuals have measurable utility; they seek to maximize profit; equilibrium market prices measure individual preferences	Individuals and society seek to maximize utility; aggregate social economic values measure society's preferences
Decision Criteria	Efficiency; profits; financial present values and rates of return	Efficiency; net social benefits; economic present values and rates of return
Production Functions	Growth and yield equations, time studies, long-term production data, historical records	Available equations or data, ecological process measurements
Costs and Prices	Measured by commercial market values	Measured by commercial market values, shadow prices, willingness to pay, and total economic value
Price Measurements	Market costs and prices	Market costs and prices, or the total value of consumer and producer surplus for market and non-market goods
Effects of changes and markets or due to projects	Changes in prices times the quantity change	Changes in the value of the consumer and producer surplus
Data Used	Market prices, price reporting series, historical data, wholesale or retail prices	Market prices, revealed preference analyses, stated preference surveys, benefit transfer
Applications	Financial analysis; individuals, communities, organizations; bank loans; taxes, subsidies	Economic analysis; society, community, or country point of view; individual entities; lending agencies

Prices in financial analyses are based on current market prices, historical data, or future projections. Changes caused by a forestry project use these financial prices, as long as those changes are small enough (marginal) that they do not distort current market costs and prices. These financial prices are also used in economic analyses for marginal changes in well functioning markets. Economic analyses in forestry projects could use methods known as travel cost estimation, hedonic pricing, contingent valuation, and benefit transfer methods to estimate the value of environmental benefits. All of these approaches enable the estimation of supply and demand curves, measure the producer and consumer surplus under those curves, and estimate economic values based on economic theory and empirical or survey data.

Types of Financial and Economic Values

Table 2 summarizes the types of economic values and the common methods that are employed to provide estimates for those values. These methods are complex, and the balance of this report discusses these financial and economic values and measurement techniques, the general methods used to estimate financial and economic values, and the merits of applying and using those methods in Mexico and Latin America.

Table 2. Types of Financial and Economic Values and Means to Measure Them

Analysis Type	**Values Measured and Analyzed**	**Measurement Technique**
Financial Analyses	Market Returns	Market Costs and Prices Taxes and subsidies as costs or income to the individual or organization
Economic Analyses and Cost-Benefit Analyses	Total Economic Value Use Value Direct Indirect Option Value Nonuse Value Existence Bequest	Market Prices Shadow Prices Taxes and subsidies are not relevant Revealed Preferences Travel Cost Hedonic Pricing Substitution, Replacement, and Avoidance Costs Stated Preferences Values are Willingness To Pay (WTP) or Willingness to Accept (WTA) Contingent Valuation Method (CVM) Stated Choice (Conjoint analysis) Benefit Transfer

Financial analyses consider investments from the point of view of an individual entity–a farmer, landowner, group, community, company, or government or nongovernment organization. Costs for goods and services are based on the actual value that is paid or received by the individual, community, or organization—the market price. Financial analyses include cash flows as they occur in the investment, with fixed and operating expenses—land, labor, and capital—occurring each year of expenses and revenues occurred. In a financial analysis, any subsidies, taxes, or transfer payments from an individual, community, company, or organization are considered strictly from the point of view of the cash inflows to or outflows from that entity.

Economic analyses evaluate the costs and returns for a project from perspective of society as a whole. An economic analysis presumes that a project will help the development of the total economy of a country and that its contribution will be great enough to justify using the scarce resources it will need. An economic analysis includes valuing the social benefits and costs of a project; using a method to estimate shadow prices when social costs or benefits differ from market prices; and employing nonmarket valuation and benefit transfer for prices for goods and services that do not have direct market prices (Gittinger 1982).

As summarized in Table 2, economic analyses measure the total economic value (TEV) to society as a basis for project evaluation. TEV measures the market and nonmarket values of a project (Randall 2000). Economic analyses start with the use of market values for costs and prices. However, they also try to measure the other components of total economic value, including the most salient use and nonuse values. For values that do not have the market price, the use or nonuse values may be estimated using a variety of new sophisticated approaches. Some of these approaches try to measure the willingness to pay (WTP) or willingness to accept (WTA) values in order to estimate the social benefit or costs of a specific program or a given natural resource. These WTP/WTA measures are often employed to estimate the value of an environmental good or service that is not priced in the market, such as biodiversity, forest carbon, medicinal plants, or scenic beauty. These measures use the standard utilitarian and anthropocentric view that natural resources have value to individuals that can be aggregated to measure the value to society.

In most World Bank forestry investment projects, both financial and economic analyses are relevant for decisions. World Bank loans ultimately are made on a financial basis, with expectations that the actual loan must be paid back at the financial interest rate that the loan was made for. The World Bank also requires that such a loan meet a host of other social and environmental criteria and reviews for the loan to be made. These may be descriptive, or may include various quantitative economic measures listed above. We will describe general means that these economic values can be quantified subsequently.

Efficiency and Neoliberal Economics

The financial and economic objective of community based forest projects in Latin America or elsewhere would be to maximize their financial and economic returns for their forestry projects. This has an implicit value assumption that efficiency is the best criterion for financial analyses at least, and that one should maximize the total economic value in an economic analyses. This is a utilitarian, human-based view of natural resource value. The sum of the benefits (utility functions) for individuals equals the social benefits (social utility function). Cost-benefit analysis measures the total economic values of use and nonuse values to determine the most efficient use of natural resources.

Efficiency in this sense means producing the greatest quantity of goods and services with a fixed amount of inputs, or conversely, that one produce a given level of output with the least amount of inputs. Efficiency is desirable in that it minimizes the waste of natural or other resources; allows more persons to benefit from a given amount of natural resources; and can ultimately improve the quality of life of more people who can have more goods and services at less cost. For example, Humphries et al. (2011) note the importance of financial viability in the sustainable forest management for community forest enterprises, providing three case studies from the Brazilian Amazon.

There are shortcomings to a purely financial approach to evaluating a forest resource management practice. Critics of financial criteria point out that market analyses and outcomes ignore equity; markets do not price most environmental, common pool, or public goods; that negative environmental externalities are often overlooked; and that dogma about comparative advantages has led to impoverishment, not enrichment, for poor forest based communities. They further criticize the promulgation of these neoliberal principles of unbridled free markets and free trade as part of international development and World Bank programs (e.g., Humphreys 2006). Nevertheless, adding economic and financial analyses regarding the net present values and internal rates of return to other social and environmental assessments is needed to better achieve sustainability (Humphries et al. 2011).

In theory, using the concept of total economic value (TEV) through economic analyses would resolve these criticisms by rolling financial, environmental, social, and other values into a single estimate of the value of the project. In practice, however, it is not so simple, because of the great difficulty in estimating the value of non-financial aspects. Thus economic analyses at least describe, and now attempt to value social and economic components, and nonmarket values that may not be quantified in the financial and economic analyses.

In addition, there is a social justice element to community forestry and that has been instrumental in most community forestry movements, including in particular the origin of the agrarian reform that enabled Mexico community forestry models to emerge. However, even in community forestry, natural resources and financial resources are limited. Thus financial and economic analyses can help analysts and communities assess the current viability of CFEs and help determine how to make them more viable while delivering on the communities' objectives. This would help minimize situations where resource users are unintentionally drawing down their main asset of natural capital to achieve other objectives.

Criticisms of environmental problems, social issues, and associated neoliberal economics led to the comprehensive World Bank Forest Policy 4.36 in 2002, revising the prior Operational Directive 4.36 from 1993 (World Bank 2008). This policy and others have attempted to broaden financial analyses to become broad economic analyses, and to include environmental and social assessments. This Forest Operational Policy (OP) 4.36 strengthened the previous Directive by including a focus on (1) all forest based operations, not just forestry; (2) emphasis on all types of forests in developing countries, including temperate and boreal, not just tropical; and (3) permitting tropical forest harvesting if the forests are not in critical habitats and harvesting is carried out to high standards, typically including independent forest certification.

Economic analyses should help select the projects and components with the highest net present values and internal rates of return, just like financial analyses. To do otherwise risks wasting resources, however they may be valued. It may mean that other social or environmental criteria are considered most important. Financial and economic viability may not be sufficient alone, but they are necessary for the World Bank loans and for forest owners and enterprises.

Financial Analysis

In financial analysis, costs obviously reflect the expenses of performing a project or activity. For a simple production process that occurs in one year, with one fixed input factor, one variable input factor, and one output, the various types of total, variable, fixed, average, and marginal costs may be represented by the formulas below, and they are defined after that.

Total Cost:	TC	=	FC+ VC	(1)
Fixed Cost:	FC	=	$P_{xf}*X_f$	(2)
Variable Cost:	VC	=	$P_{xv}*X_v$	(3)
Average Total Cost:	ATC	=	TC/Y	(4)
Average Fixed Cost:	AFC	=	FC/Y	(5)
Average Variable Costs:	AVC	=	VC/Y	(6)
Marginal Cost:	MC	=	$\Delta VC/\Delta Y$	(7)

Where:

X_f	=	Quantity of the fixed input factor
X_v	=	Quantity of the variable input factor
P_{xf}	=	Price of the fixed factor
P_{xv}	=	Price of the variable factor
Y	=	Quantity of output or production
Δ	=	Change in quantity or variable cost of output

Fixed costs do not change in the analysis with the amounts of goods or services being produced, such as equipment depreciation, insurance, taxes, or interest. Variable costs change according to the level of production of the enterprise, such as labor costs, fuel, maintenance, or other inputs. Marginal costs are the change in costs for a given measurement unit, either per a single change in one input or a bundle of inputs. Total costs represent the sum of all input costs, and average costs are the total costs divided by output.

These same types of equations are used to calculate total, fixed, and variable revenue, only as a function of output (Y), not input (X). They are shown next for a simple one output case.

Total Revenue: $TR = P_y*Y$ (8)

Average Revenue: $AR = TR/Y$ (9)

Marginal Revenue: $MR = \Delta TR/\Delta Y$ (10)

Where:

Y = Output

P_y = Price of output or product

Δ = Change in quantity of total revenue or product produced

Profit or net returns are then based on the difference between total revenue and total costs:

Profit (or Net Returns): $\Pi = TR - TC$ (11)

These are simple equations for a one fixed factor, one variable factor, and one output case. They can be expanded for many fixed and variable factors by simply summing the price multiplied by the quantity of each input factor. This total cost of many inputs (X_i) at their individual prices (P_i) would be represented by equation 12.

$$TC = \sum_{i=1}^{n} P_i*X_i \qquad (12)$$

The total cost would still be divided by the output (Y) to determine the average cost per output, as shown for the variable input case:

$$AC = \sum_{i=1}^{n} P_i*X_i / Y \qquad (13)$$

Multiple revenues from one project would use the same approach—the total revenue would equal the sum of the price of each output times the quantity of that output. Profit or net return would remain equal to TR – TC, per equation 11.

These concepts are the key ideas that determine costs, returns, and net returns each year. For simple investments, one can use these to calculate the profit of investing funds at the start of a year, and receiving the return in the same year. There may be some interest charge for such an annual investment, but it is often not considered. Planting, raising, and selling crops commonly use this type of cost calculation.

Many forestry projects that need to calculate the cost of harvesting timber or nontimber forest products could use this approach. However, timber harvesting generally requires large and expensive equipment, which must be paid off over many years. Thus these fixed equipment costs are usually calculated as depreciation on an annual basis, and then computed as part of the total costs. Box 1 provides an example of how this would be done for timber harvesting.

Pictures: Converting Logs to Lumber with a Band Saw, Los Bajitos, Mexico

Box 1: A Timber Harvesting Cost Example

As an example, assume one had the following costs for a timber harvest operation to estimate the cost for cutting, skidding, and loading timber onto trucks, ready to take to a mill, per Table 3.

Table 3. Input factors used for financial analysis or timber harvesting operation

Equipment	Purchase Cost	Life Span (years)	Opera-ting Hours /Year	Deprec-iation /Year	Interest, Insur-ance, Taxes /Year	Fuel, Lube, Mainte-nance /Year	Total Equip ment Cost /Year
Chainsaws (2)	$1,000 each	1	1,500	$2,000		$1,000	$3,000
Cable Skidder	$150,000	5	1,400	$30,000	$20,000	$35,000	$85,000
Loader	$90,000	6	1,000	$15,000	$7,000	$15,000	$37,000
Total	$242,000	-	-	$47,000	$27,000	$51,000	$125,000

If the 4 workers received $10 per hour, and worked 2000 hours per year, the gross wages would be $80,000. With fringe benefits for health and safety of 20%, gross costs for all workers would be $96,000 per year. If this operation produced 20,000 m^3 per year, one could calculate the harvesting cost per cubic meter as shown below.

Total costs/yr (TC) = ∑ fixed costs (FC) + ∑ variable costs (VC)

= (depreciation + interest, insurance, taxes)

+ (fuel, lube, maintenance, and labor)

= ($47,000 + $27,000) + ($51,000 + $96,000)

= $74,000 + $147,000

= $221,000

Accordingly, one could calculate the average total cost per m^3 for the entire operation:

Average Total Cost (ATC) = $221,000/yr / 20,000 m^3 / year = $11.05 / m^3

One also could break this cost down into average variable cost, average fixed costs, or average costs per function, including labor costs per function as one worker per piece of equipment, as shown below.

Average Fixed Costs (AFC) = $74,000 / 20,000 m^3 / year = $3.70 / m^3

Average Variable Costs (AVC) = $147,000 / 20,000 m^3 / year = $7.35 / m^3

Average Felling Costs = ($3,000 + $48,000) / 20,000 m^3 / year = $2.55 / m^3

Average Skidding Costs = ($85,000 + $24,000) / 20,000 m^3 / year = $5.45 / m^3

Average Loading Costs = ($37,000 + $24,000) / 20,000 m^3 / year = $3.05 / m^3

If the logger were paid $11.50 per m^3 to harvest the tract, then the profit would be:

Profit (∏) = $11.50 / m^3 - $11.05 / m^3 = $0.45 / m^3

In this example, depreciation is the means to estimate the costs each year for a piece of equipment. We used simple straight-line depreciation, of the total purchase price divided by the number of years that equipment is used before taken out of service, assuming no salvage cost. If a salvage cost were included, depreciation would be less. The interest, taxes, and insurance costs are fixed, and do not vary no matter what the production levels are. Fuel and lube and repair and maintenance costs, including tires, are variable, depending on how much the machines or workers are working. The sum of these costs per year is the total cost per operation.

The straightforward example shown in Box 1 could be extended to similar applications for tree planting and forest management activities; for transport and sawmilling operations; or any other financial analysis of costs and returns in a given year. Note that the total costs equal the sum of the fixed and operating costs, as well as the sum of the costs for the individual cost components by function. The breakdowns by fixed and operating costs, or by function, allow managers to examine each cost component, and focus on how to reduce these costs if possible.

Cost-Benefit Analysis (CBA)

These formulas for financial estimates of returns and costs can be extended for the application of the benefits and costs of projects for society, community, or a country as a whole. In this case total benefits refer to social benefits, and total costs refer to social costs. This broader perspective of society as a whole is an economic analysis, or now more commonly referred to as cost-benefit analysis (CBA) or social cost-benefit analysis (Boardman et al. 2005). The objective of social cost-benefit analysis is to maximize net social benefits (NSB), which are equal to the benefits (B) minus the costs (C):

$$NSB = B - C \qquad (14)$$

Costs and benefits are estimated each year for long term financial investments or CBA economic analyses. These longer term investments then must account for the cost of capital by using an interest rate or discount rate. These investments are more common in forestry projects, such as when trees require decades to grow. But they also are appropriate for moderate term investment projects, such as ecotourism, which requires large initial expenses in infrastructure and facilities, followed by moderate annual expenses and returns. Terminology for project length varies, but long term investments might be defined as those taking 10 to 20 years or more; moderate length 5 to 10 years; and short term 5 years or less. In practice, the time span is not as important as the financial and economic viability, but the wait for cash inflows in any project is a problem, and worse for longer project durations.

Steps in Economic Analysis of Forestry Projects

The principal steps in the economic analysis and implementation of forestry projects are listed below. These include clarifying the project objectives; collecting data; estimating the input activities, costs, and prices; developing cash flow tables; using capital budgeting criteria to estimate financial returns; implementing the project; and monitoring and evaluating the project. Selected components of the steps in the assessment process listed below are discussed in separate major sections.

- Identify project investment objectives and components
- Identify physical processes, activities, and timing
- Collect data on production functions, yields, forest and manufacturing production rates
- Estimate unit costs of inputs and price of outputs
  - Financial
  - Economic
- Develop physical flow tables
- Develop cash flow tables
  - Financial
  - Economic
- Apply quantitative capital budgeting approaches
- Perform sensitivity analyses
- Discuss employment, community, social, welfare considerations
- Identify qualitative factors, risk, uncertainty
- Make recommendations to decision makers
- Implement the project as selected
- Monitor and evaluate its effectiveness at achieving the project objectives and meeting economic criteria

The World Bank (2008) *Forests Sourcebook* also suggests a potential methodology for economic and financial analyses of forestry projects. This would include the following:

- Review of primary and secondary data sources
- Rapid rural appraisal
- Interviews, including stakeholder interviews, questionnaires, village based surveys for livelihood analysis (including wealth ranking, group interviews, process analysis)

- Cost-benefit analysis
- Market analysis
- Contingent valuation
- Quantitative measures, including total economic value, internal rate of return, net present value.

Identify Project Investment Objectives and Components

The first step in all project investment analyses is to clarify the project objectives from financial, economic, community, environmental, and other perspectives. Obviously, successful project selection and implementation will require clear objectives and project descriptions. Usually, investment analyses will determine overall project objectives and break down those objectives into separate components that will be analyzed.

An analysis of a forestry project entails looking at the activities, costs, and outputs of that project with the new investment or without that new investment. Modern project monitoring and evaluation literature refers to the differences between "factual" (the project impacts) and "counterfactuals" (what would have occurred without the project, also sometimes referred to as business-as-usual). It is important to note that "with and without" or "factual and counterfactual" comparisons may reflect a changing baseline—increases or decreases in the "without" case—not just a constant baseline.

Identify Physical Processes, Activities, Timing

The next step in the project evaluation process is to identify the activities and their timing as part of the project. A project will have many components including the initial preparation, development and building of infrastructure, initial field installation and implementation, and ongoing operations, maintenance, and monitoring. Each of these components requires identification, estimation of the amount of effort and equipment required, and identification of the time in which each activity will occur (Gittinger 1982). A project also may have several activities, which may be funded and analyzed separately or jointly, depending on how the project was funded and developed.

For successful implementation, every project will be required to prepare many steps. Each project will require a management plan that lays out all the activities costs and management necessary. Most projects will require extensive discussion within the community forestry enterprise. This will require consensus about the need for the project and the specific project objectives. The project also will require extensive consultation with other interested parties, including community members, government and nongovernment organizations, funding organizations, potential vendors and contractors, and technical experts. All projects will require extensive review of the social and environmental laws that apply to the project. Most projects will require environmental plans or assessments. They also will require consultation with the government agencies to ensure that all laws and regulations are complied with. They also may assess the merits of forest certification as a market based sustainable forest management investment.

Projects will require a detailed business management plan, financial analysis, and pro forma to demonstrate their financial viability. The financial analysis of a forestry project should cover most of the business components required. The business plan will have to examine the financial costs and returns to each participant in the project. It also will need to establish a schedule of income and cost activities. This will help ensure that adequate cash flow will be available for the project to pay for fixed and operating costs during the project and to repay any loans that are made (Gittinger 1982).

The activities and cash flows mentioned above can be used to establish relevant activity flow tables. For example, a forestry project will usually have a list of investment activities associated with it and the year in which they occur. Furthermore, it will have operating activities and income generating activities, such as product harvests that occur after the initial investment. The list of investment activities, including the cost of each activity and the year in which the investment occurs, is the basis for estimating costs in each year.

Collect Data on Production Functions

Obtaining timber yields, the amount of time required to harvest nontimber forest products, differences in biodiversity related to different forest management techniques, different watershed runoff amounts that vary by forest management prescription, or other ecological production functions is difficult. Secondary data may exist from scientific literature or from other production studies. This, unfortunately, is not often the case. Project analysts may need to conduct primary studies to estimate production rates, or collect data from surveys of community forest enterprises based on their records or knowledge of a production process. Reliance on local expert opinion or key informants or other studies will also be necessary. Ideally, good secondary data can be obtained based on previous research or common practice, for current production practices (termed cross-sectional data), or for a longer period (time series data), or for both for a broad set of organizations over time (panel data).

Each project will need to clearly quantify the physical inputs and outputs from the project. Economists refer to these relationships as production functions for individual input – output relationships. These production functions can be for production of a single product at a point in time or for multiple products over an extended time period. Common production functions in forestry relate how much timber is grown per hectare over time; how much lumber is sawn per hour, day, or week; or how many trees are planted per day. These production functions seem obvious, but estimating them accurately is difficult.

Timber growth and yield estimation for natural stands is difficult. There are very few existing models and equations available, and it takes large amounts of time and skill to develop local equations. Often simple point estimates are used, such as using the average growth rates—Mean Annual Increments (MAIs). For example, one might use MAIs of 1 m^3 to 4 m^3 per hectare per year for natural temperate and subtropical forests, including Mexico and the Southern Cone of Latin America. But small differences in forest growth rates can make large differences in financial returns. Similarly, estimating the amount of desirable, commercial timber species in a stand can make a large difference in returns.

If the stand is fairly uniform the growth and yield can be estimated well, but this is often not the case. In many tropical and subtropical forests, perhaps only 20% to 25% of the trees or less will be valuable for timber, so as little as 1 m^3/ha/yr of commercial growth is likely. In contrast, in temperate conifer forests such as in northern Mexico or the southwest U.S., most of the trees may be commercially valuable. While estimating the growth and yield of these mixed stands and estimating the utilization of commercial species is difficult, accurate estimates are crucial for timber investments.

This question of growth and yield or production functions is important for every good and service in a forestry project. For nontimber forest products, such as medicinal and food products, recreation, wildlife, or biodiversity, accurate estimates of yield are even scarcer then for timber products. Thus local knowledge must be used for most production estimates, but verified by estimates from other experts or literature.

For the case of carbon storage, which has become the focus of many new efforts, growth and yield estimation and verification are crucial. This has developed into extensive debates, guidelines, and protocols for estimating the amount of carbon that is stored in forests. This includes estimating the growth and yield of forests under the normal conditions—referred to as business-as-usual (BAU)—and under any specific forest management alternatives that will increase the amount of carbon stored in a forest. The difference between the business-as-usual scenario and the new management prescription can be claimed as the output for payments for carbon storage. Note that the terminology business-as-usual is also used by economists to refer to the "without project" case or the counterfactual case. The treatment to store carbon then refers to the "with project" or factual case.

Estimating production functions for sawmills or for forestry operations in the field can be just as difficult. Often the easiest approach is to obtain gross estimates of the amount of production for an extended time period, such as per week. This at least tends to provide approximate numbers that can be judged based on past experience. One can perform time studies to develop production functions, but this is usually too much effort for initial project analyses. One also may be able to get these types of production functions from other studies, projects, or literature.

Estimate Unit Costs of Inputs and Price of Outputs

The next major step in an economic analysis is to develop a table to display the costs and prices per unit for each activity. Gittinger (1982) notes that while markets are not perfect and aren't ever in complete equilibrium, the market price is generally the best approximation of the value of the good or service that is fairly widely bought and sold. In a financial analysis the market price is always used. In an economic analysis some other price such as a shadow price may be a better value measure of a good or service.

Market prices may be obtained from many sources. These include farmers, small merchants, importers and exporters, extension officers, technical service personnel, government market specialist and statisticians, or maybe in published price statistics. Prices for farm and forest products usually are set at the farm gate or in the forest, such as on the stump—"*madera en pie*" or "*stumpage*."

However, when conducting a financial or economic analysis, the analyst must take into account that "average" or "typical" prices may not represent likely prices for a specific investment project. For example, stumpage prices are affected by the distance from the forest to the mill, and likewise lumber prices are affected by the distance from the mill to markets such as population centers, meaning that forests that are farther from mills and population centers are likely to receive lower than average prices for timber.

Financial Analyses

A financial analysis estimates the cost and returns of a project from the point of view of an individual entity or organization. The use of market prices is thus appropriate not only for forestry owners and farmers, but also for government organizations. These market prices form the basis for all financial analyses and techniques. Financial analyses and textbooks such as Brealey et al. (2008) rely completely on these market costs and prices. The financial analysis simply examines cash inflows and cash outflows from the point of view of that individual entity.

The most common example of a financial analysis in forestry is the calculation of the optimal timber rotation for a given site under alternative management regimes, costs, and prices. Other financial examples include the costs and returns from individual forest treatments, such as thinning, pruning, timber harvesting, or regeneration methods. These individual analyses are combined for various levels in forest products processing chain, from the forest, to harvesting, to transport, to a sawmill or other manufacturing facility for a project level financial analysis. Similarly, the costs and prices of multiple inputs and outputs may be considered, including for nontimber forest products that have a market price and buyer.

Economic Analyses

As noted, economic analyses take the standpoint of society as a whole. This broader perspective of economics from the point of society is often termed cost-benefit analysis (Boardman et al. 2005). Economic analyses also will require a list of financial cost and price data as noted above, which will form the foundation for the economic analysis. The economic analysis then complements the financial analysis with estimates of nonmarket costs and benefits for a complete valuation of a project. The economic analysis still must be sure to account for the financial cash flows in order to ensure that funds are available to all entities during the project duration.

A host of nonmarket values have become important in justifying protection of forests, and the estimation of these nonmarket values has advanced rapidly. However, reliance on such nonmarket values alone to justify projects is perilous, and at the very least may create large discrepancies between financial, cash flow revenues and economic, societal benefits. We review economic valuation of forestry benefits here, but warn that those subsequent economic analyses must be compared with financial analyses to compare the results and estimate how much cash or other benefits the government or others will need to transfer to the enterprise owners in order to obtain the economic benefits.

Intangible costs and benefits can be considered in the economic analysis. Intangible costs and benefits might include considerations such as income distribution the number of jobs created, regional development, national security, ecological or ecosystem services, recreation, or aesthetic value. For these project analyses, we suggest that nonmarket costs and benefits be identified and listed separately at the very least. An analyst usually can at least quantify nonmarket benefits or costs such as the jobs created, the ecosystems protected, the watersheds improved, or the area of land retained in natural state.

Boardman et al. (2005) discuss the use of shadow prices as proxies when the observed prices do not reflect the social value of a good or when actual market prices do not exist. A shadow price of a limited resource is equal to the increase in total benefit (or social value) achieved by acquiring one more unit of that resource. Shadow prices may not be used if social value is very difficult to determine, or if the differences between shadow prices and market prices are small. Shadow prices reflect the explicit or implicit willingness to pay by consumers in aggregate. They can be valued as the opportunity cost or benefit that a project may incur.

If the market for resources is efficient–there are no market failures–and the purchase of the resource has no noticeable effect on prices, then market prices are sufficient to reflect opportunity costs. Conversely, large input purchase impacts or market failures indicate the need for shadow pricing. In the case of large project purchases, budget outlays often only slightly overstate project opportunity costs. In the case of market failures, budget expenditures may substantially overstate or understate project opportunity costs.

Total Economic Valuation

Total economic valuation (TEV) is a new approach to identify and estimate the value of all economic benefits that society derives from a project or activity. For forests, TEV goes well beyond just timber values, in order to account for the idea of other products and services provided by a forest system. TEV of forests is the sum of their use and non-use values. Use values are divided into direct, indirect, and option values; while non-use values include bequest and existence values. Direct, indirect, and option values refer to the use values of a good or service now or in the future. Bequest values refer to the ability for future generations to use a good or service; existence values may not require use by a person to have value.

Use values are estimated for on-site or off-site uses of an environmental benefit. Past and current use values may be estimated based on past experience. Expected future values of use can be for values that will occur if a project is implemented. Option value estimates a possible premium for retaining and actual resource so that it can be used in the future. Quasi-option value estimates the special preferences for preservation versus development. Existence value is one where individuals value a service or good but have no personal intentions to use it (Randall 2000).

Examples of the various use values include the following (World Bank 2008):

Direct uses—timber, fruits, nuts, mushrooms, medicinal plants, forage, hunting and fishing, tourism and recreation, genetic resources, and educational uses

Indirect uses—watershed and soil protection, windbreaks, climate control, and nutrient cycling

Option—potential future direct and indirect uses

Two classes of methods for evaluating nonmarket goods and services have gained acceptance. These include revealed preference methods, such as the travel cost method and hedonic pricing method, and stated preference methods, or contingent valuation methods, which are based on opinions of individuals gathered through experiments in well designed surveys.

In the hedonic pricing methods, the demands for the environmental benefits or amenities are not directly priced in ideal markets, so are revealed through choices made in the markets for related goods. Stated preference methods estimate values through surveys of people’s opinions.

Coconut, honey, and jam, Ixtapa, Mexico

Indigenous handicrafts, Cataratas de Iguazú, Argentina

Agroforestry windbreak establishment, Chile

Native bird in forest, Cataratas de Iguazú, Argentina

Pictures: Nontimber Forest Products and Environmental Values, South America

For example, one might value the benefits of forests in Mexico as habitat for monarch butterflies either by estimating the travel costs of the thousands of tourists who visit an area, or by asking citizens of North America for their stated preference about how much they value those forests for butterfly habitat and breeding.

An example of calculating total economic values for Mexico is contained in Box 2.

Box 2: Total Economic Value of Forests in Mexico

Adger et al. (1995) estimated the total economic value of forests in Mexico using the same taxonomy of definitions listed by Randall (2000). Direct use values included revenues from timber and nontimber forest products. Using direct market prices for nature tourism and multipurpose visits of tourists, the estimated the total benefit of tourism and recreation in Mexico ranged between $US 30 million and $34 million per year. Use values for nontimber forest product values, such as resins, turpentine, and chicle, were estimated by direct market prices or by shadow prices.

Functional values were estimated for carbon storage and watershed protection. Carbon values were estimated to be $US 650 to $3400 per hectare, for an annual value of $US 22 to $100 per hectare per year. Watershed protection included reduced costs from sedimentation and improved water flows from watersheds. The option value of pharmaceuticals also was estimated, ranging up to $US 20 per hectare. Existence values were estimated based on benefit transfer techniques and ranged from $US 1.2 to $64 per hectare per year.

The study showed that the lower bound of the value for services of Mexico's forests was about $4 billion per year. These values stemmed from the nonmarket services provided by non consumptive use; from future potential uses of the genetic resources and from pure existence values; and the economic value coming from the functional values of hydrological and carbon cycling. This value of $4 billion divided by the area of 50 million ha of forests would yield a net value of $US 80 per ha per year. The authors also discuss means of capturing these economic values, which exceed market values (Adger et al. 1995).

We might note that this annual TEV per ha probably exceeds the commercial market value of timber and nontimber forest products in Mexico, or the values of natural forests in most countries in the world, and finding buyers or purchasers for such a large non-incremental value would not be possible. This illustrates the necessity for estimating both financial returns from a forestry project, which could be realized at market prices, and the total economic value, which is an aspiration of total value that might be received.

Nonmarket Valuation Approaches

In the last four decades, economists have developed new approaches for valuing nonmarket goods and services. These nonmarket valuation techniques have been widely applied in cost-benefit analysis and economic analysis of forestry projects to estimate environmental values and shadow prices. Nonmarket values may be classified in the various categories above. For these analyses we will use the classes of use value, option value, and non-use or existence value. Thus the total economic value would equal the sum of all three components.

Mendlsohn and Olmstead (2009) provide a thorough review of the economic valuation of environmental amenities and disamenities. They note the premise that decision-makers can use cost-benefit analysis and nonmarket valuation to maximize the net benefits or the social welfare.

For resources traded in markets, such as oil, land, timber, or crops, the value of small or incremental changes in the quantity of market goods can be measured by their observed price. In order to value larger changes one must use a demand and supply function and value people's willingness to pay for that good or service. Non-marginal changes in market goods cannot be measured correctly by the net change in consumer or producer surplus. Similarly, for goods and services not traded in markets, proxies for these demand and supply functions must be used.

Economic use values involve an observable interaction between the individual in the environment including consumptive uses such as hunting, and nonconsumptive uses, such as hiking. Non-use value involves no actual interaction between people and the environment, such as just knowing that an endangered species such as a polar bear exists. Option value is a willingness to pay to have the choice of using a service in the future. Nonmarket valuation can be used to value marginal or incremental changes, but not new choices, such as the elimination of an entire ecosystem.

Economic values also depend on who is valuing them. For goods traded in world markets the world price would be consistent, such as carbon storage. For local impacts, values must be determined based on the ecological and social context. High value ecological systems, such as freshwater or coastal wetlands, will be more valuable than common ecological systems such as uplands. Lesser developed countries (LDCs) will place less value on an environmental benefit than industrialized countries because LDCs will have a higher opportunity cost in comparison to other goods, services, and incomes of the citizens, and a lower ability or willingness to pay for environmental services. Valuation varies over time as well, with present values being relatively more valuable than future values (Mendlsohn and Olmstead 2009).

Revealed Preference Methods. Revealed preference valuation methods are based on the fact that many environmental goods are inputs into production processes, so their value can be calculated through market analysis. Economists have a professional bias toward revealed preference approaches because they reveal actual choices individuals make in markets. Example revealed preference calculations can be estimating the net revenues gained from collecting nontimber forest products per hectare or the value of land that is flooded through sea level rise.

Travel cost demand models are used to measure the benefits that people receive from recreating at natural sites when they pay no or extremely small entrance fees. These models gather data on the time and money spent to travel to the site, which can be used to estimate and demand function as a proxy for the price (value) of the site. This travel cost method serves as a substitute for the admission prices for the recreational site or activity. It estimates the demand curve for a non-priced recreational good through the observed behavior. Visitors to sites are surveyed to determine their cost of travel and their socio-economic characteristics. Then regression analysis is used to estimate a demand function that relates the travel costs as a function of the number of visits.

Hedonic pricing models use statistics or econometrics to estimate the increase in property values based on the benefits from identified environmental attributes. This assumes that environmental amenities and problems affect the price of a piece of property. Thus the land price is determined by the value or the flow of future benefits or services on the specific tract. A large sample of landowners and land prices and environmental attributes are collected for the analysis. By holding other factors constant, a statistical model can estimate the contribution of an environmental benefit to the land's total value. Hedonic wage models also have been used to statistically estimate the value of a life. Hopefully this application is less relevant in forestry project analyses;

however, the value of statistical life might apply to high risk operations such as logging or sawmill jobs.

Stated Preference Methods. Stated preference methods, or attitudinal surveys, are a type of willingness to pay method that relies on people's ability to value relative benefits. In stated preference approaches, individuals are asked to place values or ranks in response to carefully worded survey questions. Answers may be provided in the terms of monetary amounts, choices among attributes, or ratings. These may be scaled with appropriate model of preferences in order to estimate a willingness to pay value. Many kinds of goods, including water quality, recreation, hunting, and sports stadiums have been valued with contingent valuation (CV) surveys, also termed the contingent valuation method (CVM). Valuing the use or potential use of goods with CV is relatively accepted. Valuing passive use or non-use with CV is more controversial.

Contingent valuation is by far the most widely used stated preference method for valuing nonmarket goods and services. It represents a relatively new approach for determining the public's willingness to pay for public goods that have no direct markets. Some debate exists about the accuracy and reliability of asking people about willingness to pay in surveys compared to what they would actually do in a real-life situation. For this reason, as mentioned earlier, most economists tend to prefer revealed preference methods, if they are possible for the good or service in question. However, advocates contend that contingent valuation, if undertaken with state-of-the-art methodology, can be as accurate as other available methods.

Benefit Transfer

The difficulty and large cost in estimating nonmarket values suggests that most analyses of forestry projects will not perform primary research on nonmarket valuation. Thus most analyses will rely on prior research estimates of nonmarket values. This use of prior research or other studies and applications is sometimes termed "benefit transfer techniques." That is, analysts use the prices for the project being analyzed based on the results from other studies. Benefit transfer is a procedure for taking the estimates of the economic benefits gathered from one site in applying them to another. The study site is where the initial, detailed estimate of value is made, which is then applied to the policy site (Brouwer 2000, Plummer 2009). Analyses might make ad hoc estimates of nonmarket values, such as an opportunity costs to protect forests as being equal to the value in another higher and better use. However, the estimation, benefit transfer, shadow pricing, and application must be performed carefully and transparently.

Theoretically, these benefit transfer approaches may not be well substantiated and should be used with caution. Recent global, national, and local forestry projects often aspire to pay forestry communities and landowners for nonmarket benefits. Wunder (2005) and Engel et al. (2008) provide reviews of the opportunities for payments for environmental services. Contemporary efforts try to pay for forest services such as biodiversity, watersheds, and carbon focus on nonmarket values. In the arena of ecosystem valuation "benefit transfer" methods have been summarized by King and Mazatta (2012) in a handy review available at http://www.ecosystemvaluation.org/benefit_transfer.htm).

Plummer (2009) provides a contemporary review assessing benefit transfer for the valuation of ecosystem services. He begins with an example of the misapplication of benefits transfer from an isolated case of extremely high benefits for wastewater treatment for a wetland that is extended to all wetlands. He then points out that the transfer of benefits from one case to a more general case must involve like ecosystem characteristics and social contexts. His example is used not to dismiss the merits of benefits transfer, but rather to caution that it must be used appropriately.

Plummer (2009) notes that a proper benefit transfer should consist of three steps. First, the analyst must carefully describe the policy site in the proposed policy actions. This should include the important biological and physical characteristics of the site and how humans are expected to use it, or are connected to it in non-use ways, such as for endangered species. Second, the analyst must select suitable existing studies to provide a basis for benefit transfer. The study sites should have similar types of biophysical and social characteristics, as well as similar types and extents of project changes. The study site and the policy site must have a large amount of correspondence, in order to ensure the accuracy of benefit transfer. Third, an economic value on a per unit basis is taken for one or more studies and expressed as an average or range. This average is multiplied by the projected quantity or area of use at the policy site or by the number of people connected to the site. An alternate (and preferred) approach is to use a benefit function which can relate the value from a study site physical and demographic characteristics and then be applied to the policy site.

Brouwer (2000) also outlines a number of steps for good practice in benefit transfer. First, the analyst must define the environmental goods and services clearly. This includes the identification of the relevant ecological functions underlying the goods and services and the importance of these functions for sustaining ecosystems and human systems. Second, the stakeholders must be identified, and third, so must their values. Fourth, forest stakeholders should be involved in determining the validity of monetary environmental valuation. Fifth, relevant studies must be selected for transfer, with similar biophysical and social characteristics. Sixth, the analyst must account for the effect of the different methods of estimation on the values. Last, stakeholders should be involved in the value aggregation. Box 3 lists some references that provide estimates for benefit transfer, but note that analysts may need to develop their own estimates or find other sources.

Box 3: References for Benefit Transfer Data

Wilson and Hoehn (2006) listed several online databases designed to support the empirical practice of benefit transfer. Those databases (and their current web sites) included the Environmental Valuation Reference Inventory (https://www.evri.ca/Global/Splash.aspx), summarizing at least 1500 valuation studies, the Envalue database, now covering about 1700 studies (http://www.environment.nsw.gov.au/envalueapp/), the Ecosystem Services (now Natural Capital) database (http://www.naturalcapitalproject.org/database.html covering 300 studies then, and the Review of Externality database (http://www.isis-it.net/red/) with about 200 studies.

The World Wildlife Fund has recently developed a web-based tool to estimate environmental benefits directly based on site characteristics, which is part of the natural capital project (http://www.naturalcapitalproject.org/toolbox.html). These ecosystem valuation and benefit transfer data web sites stem from the broader principles of payments for ecosystem services, which not only value those services, but also seek to develop payments for them. There is a burgeoning literature and practice regarding payments for environmental services; a handy internet reference and networking site is maintained by the Katoomba Group (http://www.katoombagroup.org/).

Mullan and Kontoleon (2008) performed an extensive global review on nontimber forest products (NTFPs) and nonmarket valuation studies that included many performed in Latin

America, as excerpted in Appendix A. These included the Adger et al (1995) study and one other for Mexico, which estimated that NTFPs values of $US 330 and $US 116 per ha per year, respectively. The Adger et al. research estimated low values for recreation in Mexico ($US 1/ha/yr), which was much less than the studies found by others in Costa Rica, of up $US 160/ha/yr or more. The ranges for tropical biodiversity were extremely wide, from as little as $US 0.20/ha/yr to as much as $9177/ha/yr. Their review reported indirect use values in Latin America ranging from negligible to $100/ha/yr. And the estimated non-use values also ranged from negligible to $43/ha/yr. These values could be considered for use in benefit transfer, as long as one employed the caveats for good practice suggested by Brower (2000) and Plummer (2009).

Develop Physical and Cash Flow Tables

The estimates of the physical production processes and their inputs and outputs can be used to develop a physical flow table that describes when each activity will occur in terms of the quantity of the inputs required or the output produced.

A financial cash flow table should be developed for each entity or organization involved in the project. A typical cash flow table would display the costs, returns, net annual returns on the left hand side of the table, the years that each activity occurs across the top of the table, any actual costs or returns for each year in the table contents. This table would lay out the expenses and returns expected by each entity for every year of the project investment.

An economic cash flow table also should be prepared for each project participant. This cash flow table would be constructed in the same manner, but the costs and benefits entered in the table would be based on the economic valuation methods described above. Thus the economic cash flow table would exclude transfer payments, and include the estimates of shadow prices for wages, nonmarket values and benefits, as developed for this project or transferred from other studies.

Quantitative Capital Budgeting Criteria

Economists use capital budgeting criteria as their principal standards for evaluating projects. Farmers and community forest landowners probably are not familiar with these criteria, and use more intuitive accounting or social criteria for making decisions, such as net returns, annual profits, or community capacity building. Capital budgeting measures account for the value of money invested over time (Table 4). For example, simple interest tells investors how much funds invested today will be worth in the future at a given interest rate. On the other hand, a simple discount rate will tell investors how much income earned in the future will be worth in the present or today.

Table 4. Quantitative Capital Budgeting Criteria Formulas

Value of a present investment in the future in year n

$V_n = V_0 (1+i)^n$ (1)

Value of a future return at the present, or in year 0

$V_0 = V_n / (1+i)^n$ (2)

Simple internal rate of return

$i = (V_n/V_0)^{1/n} - 1$ (3)

Where: V_0 = value in year 0; V_n = Value in the future, year n; n = year; i = the discount (interest) rate

Net Present Value (*NPV*), Land Expectation Value (*LEV*), and Internal Rate of Return (*IRR*)

$$NPV = \sum_{n=0}^{N} B_n / (1+i)^n - \sum_{n=0}^{N} C_n / (1+i)^n \quad (4)$$

$$LEV = NPV + \left(\sum_{n=0}^{N} B_n / (1+i)^n - \sum_{n=0}^{N} C_n / (1+i)^n \right) / ((1+i)^N - 1) \quad (5)$$

$$LEV = NPV + NPV / ((1+i)^N - 1) \quad (6)$$

where:

B_n = benefit in year n; C_n = cost in year n; *i* = annual discount rate; n = year; *N* = project or rotation length

$$IRR = i \text{ such that } \sum_{n=0}^{N} B_n / (1+i)^n = \sum_{n=0}^{N} C_n / (1+i)^n \quad (7)$$

Benefit:Cost Ratio

$$B{:}C \text{ ratio} = \sum_{n=0}^{N} B_n / (1+i)^n \; / \; \sum_{n=0}^{N} C_n / (1+i)^n \quad (8)$$

Annual Equivalent Value (AEV)

$$AEV = LEV * i \quad (9)$$

Cost-Price: the future value where Price*Quantity $= \sum_{n=0}^{N} C_n * (1+i)^n$ (10)

The Net Present Value (*NPV)* converts a series of periodic cost and income flows to a single number that can be used to compare mutually exclusive investment alternatives over the same investment horizon at a given discount rate (cost of capital). For single investment decisions, one would accept an investment that has a positive NPV if enough capital were available. This would imply that the rate of return on the project (per unit of land) is higher than the cost of the capital. However, one might reject on financial grounds a project that has a positive NPV if an alternative project has a greater NPV. In order to compare NPVs of repeatable projects (rotations) of different lengths, one would have to convert all those investments to the same time horizon, such as the least common denominator of all time horizons.

For a community forestry project, NPV could be used to evaluate the financial returns to the investment of any project funds, and help provide a benchmark to see how well that investment performs compared to other similar production processes, or in other communities or in other parts of the country or world. Similarly, it could be used to analyze how different components of an integrated project are performing, and if they could be improved.

The Land Expectation Value (*LEV)* was developed to solve the problem of comparing unequal time periods for alternative forestry investments. The LEV calculates the present value of an infinite series of projects (rotations). Utilizing LEV as a decision tool does not imply a commitment to forever manage a piece of land under the same regime. Rather, LEV provides a simple means to convert investments with different time horizons to one simple common time frame for comparison.

LEV is applied just like NPV in making investment decisions, with positive LEVs inferring investment acceptability, and negative LEVs suggesting project rejection. LEV also is termed the soil expectation value (SEV), bare land value (BLV), or Faustmann formula. The inference with all of these terms is that the value provides an estimate of what one could pay for bare land, grow an infinite number of identical forest rotations, and earn the given discount rate.

However, one seldom starts a forestry investment with bare land, so the term is more comparative than absolute. In comparing different possible rotations on the same area, one could find the maximum LEV, and that would be the optimal rotation. The LEV will of course be greater than the NPV for any positive NPV, and less for any negative NPV. But this is not meant to just present more optimistic results; it is important for comparing different investments on the same area, not just to inflate present values.

The Annual Equivalent Value (*AEV*) is simply the payment, which if received annually, would be the equivalent of the LEV at the given discount rate. AEV is useful for comparison to other investments that have an annual return, such as agricultural crops. To be equivalent, one must be careful that these other alternatives also are based on a discounted cash flow analysis, not just an annual accounting returns basis.

The Internal rate of Return (*IRR*) is defined as the discount rate that makes the present value of the benefits of a project exactly equal to the present value of the costs of a project. Thus the NPV would equal 0 if the IRR were used as the discount rate, and the B:C ratio would equal 1.0. IRR indicates the annual rate of return that an investment would generate. For individual investments, the IRR is usually compared with some given alternative rate of return (which may be the same as the discount rate), hurdle rate, or with other potential investments. Projects with IRRs greater than the hurdle rate or other potential alternative rates of return are considered acceptable given adequate capital. Projects could be ranked in priority based on their IRRs in capital budgeting decisions.

The *Benefit:Cost ratio* is used to compare total discounted benefits with total discounted costs. It should not be confused with cost-benefit analysis (CBA), which has grown to mean a general financial and economic approach for project analysis that we discuss here. For now, we will use it in a narrow capital budgeting context of the ratio of benefits to costs. The criterion for B:C ratio application is simply that the ratio must be greater than 1.0 for project to be acceptable. Projects with B:C ratios of less than 1.0 indicate that the costs are greater than the benefits; projects with ratios greater than 1.0 indicate that discounted benefits exceed discounted costs. The criterion termed *Cost-Price* is based on the sum of a project's compounded expenses to calculate what amount of return (price times quantity) that would be required to earn a specific interest rate for the compounded value of all costs of an initial investment.

Most investment or project decisions compare multiple investments with a limited capital budget or constraint. For selecting among many exclusive projects, one would choose the maximum NPV or LEV, or largest IRR or B:C ratio.

The Discount Rate

The discount rate is crucial in determining if a project is acceptable or not. It represents the tradeoff between receiving income in the present versus delaying and receiving income in the future. The capital budgeting criteria determine a present (or future) value of an investment at the given discount rate. That means that a positive present value indicates the investment received the rate of return equal to the discount rate, plus the positive quantity of value calculated per the project or per area.

The appropriate discount rate is a controversial subject, but in principle it should represent an individual's, organization's, or government's opportunity cost of capital for an investment. For private firms or investors, this implies the alternative rate of return (ARR) that the investor could receive in some other investment of similar risk. This is often calculated as the weighted average of cost of capital (WACC), which includes debt (loans) and equity (stock) for private firms or individuals. For public organizations, the cost of capital is usually determined by the government or by an international lending agency. It too should represent some average of debt financing such as the cost of government borrowing. The government rate should reflect some type of social time preference for consumption by society today versus society tomorrow. Discount rates may be expressed in nominal terms—including inflation—or real terms—excluding inflation. Real discount rates are usually recommended for project analyses, and for the costs and prices used in a forestry project, since inflation if difficult to estimate far into the future.

Often the real discount rate is set by the lending agency, such as 12%, which is frequently used by the World Bank. Discount rates commonly vary from as little as 2% to 10% in forestry literature, but are often as much as 6% to 15% or more in practice. The low discount rates will favor investments such as forestry that occur over a long time, since they will not decrease future values as much as high discount rates. Low discount rates may be considered appropriate for public goods and investments because they place relatively more value on returns for future generations. However, obtaining market loans at such low discount rates is often not possible, and many poor persons and communities may have very high discount rates—they need funds and income much more in the present than in the future. Thus the higher discount rates common in the market reflect the cost of capital for private goods and services.

Some forestry and natural resource analysts and researchers have argued for lower rates such as 4% (Row et al. 1981). In fact, some recent research has contended that we should use duration dependent discount rates, which are generally less for longer investments. The textbook on Cost–Benefit Analysis (Boardman et al. 2005) argues that the discount rate should be 3.5% per year. Other analysts have suggested the “hyperbolic” discount rates bring higher short term rates and lower long term rates to a common, lower average rate for extended natural resource investments (e.g., Newell and Pizer 2004, Wagner 2012). As a general rule, analysts must use the discount rate mandated by the agency requesting the analysis. Most forestry investments will have much better NPVs, LEVs, and B:C ratios with lower discount rates.

One can also determine the optimal rotation length as the age at which the percentage increase in the value of the stand is exactly equal the discount rate. The percentage increase in the value of the stand represents the marginal value product of a timber investment. The year in which the marginal change in timber value for a stand is exactly equal to the interest rate is the optimal rotation age (Hyde et al. 1991).

Inflation also must be considered in selection of the discount rate. It is generally easiest to use real discount rates, not including inflation. A 4% real discount rate would probably also have some additional inflation factor, say 4% per year, which would lead to a nominal discount rate of 8%. As noted, if all costs and prices have the same inflation rate, the results of an analysis will be the same whether one uses a real discount rate or a nominal discount rate. If inflation affects costs and prices differently, perhaps nominal discount rates and nominal input and output costs should be used. However, nominal prices often confuse the analysis, especially with long run investments such as forestry. Thus it is usually better to use real costs, prices, and discount rates for financial and benefit cost analyses. Nominal costs, prices, and discount rates are needed for actual cash flow and conventional accounting and tax reporting, however.

Taxes and Subsidies

Taxes also influence forest investments and discount rates. One can calculate a before and after tax discount rate, which then can be used accordingly to apply to before and after tax cash flows. Taxes are complex and vary considerably among countries or even states, provinces, and municipalities. Taxes include property taxes, income taxes, value added taxes, social insurance taxes, import and export taxes, and others. In some parts of the world, forest management qualifies for reduced tax rates relative to other land uses.

Subsidies or incentives can exist as direct payments for performing forest practices or forest protection, the provision of services such as fire and insect disease control, or payments for provision/protection of environmental services (pagos de servicios ambientales, PSAs). These direct or indirect subsidies also should be quantified and considered in the financial and economic analyses.

For simplicity, we suggest just using the tax costs as negative cash flows in a project assessment, and any tax reductions or direct government subsidies as a positive cash flow in the year received. One could also compute before and after tax discount rates in more complex analyses.

Forest Products Examples: Yerba Mate and Ponderosa Pine

To provide a compact example of a financial analysis that can be shown in its entirety, we used a moderate length investment analysis for yerba mate (*Ilex paragurariensis*), a nontimber forest product in South America, using a 8% discount rate. This is a short investment time period of 9 years, which provides a simple example of how one could use the methods discussed here. The yerba mate input production activities, outputs, prices, and costs are shown in Table 5.

Table 5. Inputs, outputs, costs, and prices for growing Yerba Mate in South America, 2006

Activity	**Year(s)**	**Quantity**	**Cost/Price**
Planting seedlings	0	2222 / ha at a 3 m by 1.5 m	$600/ha for site preparation, seedlings, planting
Cleaning, herbicide	1-9	Ha	$200
Tax, administration	0-8	Ha	$20
Leaf collection	3-9	Ha	100
Leaf sale	3-9	Yr 3 – 3,000 kg/ha Yr 4 – 5,000 kg/ha Yr 5 – 7,000 kg/ha Yr 6 – 10,000 kg/ha Yr 7 – 12,000 kg/ha Yr 8 – 13,500 kg/ha Yr 9 – 14,500 kg/ha	$US 0.08/kg

The inputs, outputs, costs, and prices would then be calculated and entered into a cash flow and capital budgeting table, as summarized in Table 6. The table would be summarized in a computer spreadsheet, probably with more detail, but in a similar format. We have developed and will provide spreadsheet templates examples of these approaches that are available on request.

At the given discount rate of 8% the yerba mate project would be considered acceptable—earning that rate of return plus $US 653/ha in NPV, and $US 1307/ha in LEV. All present value measures are greater than zero, the B:C ratio is greater than one, and the internal rate of return is about 16%. Obviously, the 16% rate of return exceeds the discount rate or the alternative rate of return of 8%. The land expectation value of $US 1307 per hectare indicates the approximate price one could pay for land and break even growing yerba mate at the 8% discount rate. Lower discount rates would generate greater NPVs and LEVs, and vice versa.

Table 6. Cash Flow Table and Capital Budgeting Analysis for Yerba Mate per Ha, 8% Discount Rate

Activity/Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	- - - - - - - - - - - - - U.S. dollars / ha - - - - - - - - - - - - -									
Costs										
Site Prep/Plant	600									
Clean/Herbicide		200	200	200	200	200	200	200	200	200
Tax/Admin	20	20	20	20	20	20	20	20	20	20
Leaf collection				100	100	100	100	100	100	100
Returns										
Gross revenue	0	0	0	240	400	560	800	960	1080	1160
Net and Discounted Revenues										
Net Annual Cash Flow	-620	-220	-220	-80	80	240	480	640	760	840
Total of Annual Discounted Costs	620	204	189	254	235	218	212	187	173	160
Sum of All Discounted Costs	2441									
Total of Annual Discounted Benefits	0	0	0	191	294	381	504	560	583	580
Sum of All Discounted Benefits	3094									
Capital Budgeting Criteria										
NPV ($/ha)	653									
LEV ($/ha)	1307									
AEV ($/ha)	105									
B:C Ratio	1.27									
IRR (%)	16.2									

In addition, we computed a similar financial discounted cash flow analysis for an extended ponderosa pine regime, assuming a longer rotation of 80 years at a medium site index, based on growth and yield from Meyer (1938). This may be more typical of an extended timber rotation such as in Northern Mexico or the Intermountain region of the United States. At an average growth rate of 3 m^3/ha/yr, the financial returns for ponderosa pine would be much less than the yerba mate example. At the 8% discount rate, the LEV would be -$347 per ha, and the Benefit:Cost Ratio only 0.08. The IRR would be 3.1% (Table 7).

The low rates of return and negative NPV and LEV for ponderosa pine are unfortunately common for long term timber investments in natural forests with slow growth and any management costs. This helps explain the reasons for forest land losses to more profitable uses, and the reason that forestry enterprises prefer lower discount rates for their analyses. Many community forestry enterprises in Mexico also make payments to the communities from their timber income, which further reduces the financial returns.

Table 7. Cash Flow Table and Capital Budgeting Analysis for Ponderosa Pine per Ha, 8% Discount Rate

Activity/Year	**0**	**20**	**40**	**60**	**80**	**0-80**
	- - - - - - - - - - - - - U.S. dollars / ha - - - - - - - - - - - - -					
Costs						
Site Prep/Burn	100					
Prescribed Burn		20	20	20	20	
Tax/Admin						20
Returns						
Thinning/Clearcut	0	0	200	900	6200	
Net Annual Cash Flow	-120	-40	180	880	6180	- - -
Total of Annual Discounted Costs	120	8.58	1.84	0.40	0.04	- - -
Sum of All Discounted Costs	377					
Total of Annual Discounted Benefits	0	0	9.21	8.89	13.14	- - -
Sum of All Discounted Benefits	31					
NPV ($/ha)	-346					
LEV ($/ha)	-347					
AEV ($/ha)	-28					
B:C Ratio	0.08					
IRR (%)	3.09					

The low financial returns for slow growing, long rotation timber investments motivate the need for payments for environmental services (PES) to make retaining forests more attractive. Similarly, the calculation of broader measures of Total Economic Value (TEV) may make management of natural forests more economically attractive. This might involve economic values and payments for the environmental services such as carbon storage, biodiversity, watersheds, or other services, such as those reviewed above by Mullan and Kontoleon (2008), and summarized at various web sites. The World Bank and other investment projects in developing countries seek to increase the economic and financial viability of community forestry enterprises through capturing more commercial market opportunities—such as through forest certification—and gain more economic values from payments for environmental services.

To illustrate how economic values can be added to such a financial analysis as in the yerba mate and ponderosa pine examples, Box 4 restates the economic analysis performed as part of the second Mexico community forestry project. This indicates the types of values that might make low financial rates of return still acceptable in economic terms. However, these economic benefits would need to be valued accurately to be credible.

Coconut Plantation, Mexico

Pinus taeda, Santa Catarina, Brazil

Forestry Demonstration, Asunción, Paraguay

Pinus taeda and Hereford Cattle, Uruguay

Pictures: Forests and Investments, Latin America

Box 4: Illustration - Mexico Second Community Forestry Project

The recent Second Community Forestry Project in Mexico (World Bank 2009) illustrates the differences and applications of financial and economic analyses. The World Bank loaned an amount of $US 21.3 million to the United Mexican States for the project. The government of Mexico then used those funds for a wealth of community forestry enterprise projects, which were quantified by specific project indicators. These indicators included criteria such as:

- a 20% increase in the net value of forest goods and services produced by assisted communities and ejidos
- a 30% increase in the jobs available in assisted communities vs. control
- a significant increase in social capital in assisted communities
- nine payments for environmental services schemes in place
- 118 feasibility studies completed
- $US 2.3 million invested in nontimber forest products
- 800,000 ha of forest area under improved forest management/certification

These indicators could be measured with either financial or economic analyses, or both, depending on whether there were clear market prices and outputs for each component. The 20% increase in value of goods and (market) services, as well the $US 2.3 million invested in nontimber forest products, seem amenable to financial analyses, since there should be clear market prices and project costs for these two components.

However, increases in social capital and feasibility studies have no direct market prices and benefits, so must be assessed with economic analyses that develop proxy values for their benefits. In the subsequent economic analysis of this project used a benefit transfer value of $US 34.23 per ha per year for not converting forest land into agriculture land as its benefits for most of the economic analyses. Against this perhaps too optimistic economic valuation metric, all of the project indicators were quite large, with internal rates of return ranging from 14% to 44% per year. These economic rates of return would be considered pretty spectacular. However, the financial internal rates of return, as measured by market prices, would be much less or negative since some of the benefits such as an increase in social capital have no market values.

Global Forest Investment Benchmarks

The financial analysis shown above had a high rate of return for yerba mate and low rate of return for ponderosa pine. In fact, mate may be one of the most promising forest crops for small farms in South America barring a glut of investors, although many consider it closer to agriculture than forestry. However, native forests in the Americas commonly do not have high rates of return. Conversely, large scale industrial forest plantations of exotic, or sometimes native species, in the Americas have had high rates of return in last decade.

Cubbage et al. (2007, 2010) estimated these returns for timber investments without including the price of land, which would be similar for many community forests or private landowners who are not apt to sell forest land, although it might be converted to another use. These returns are summarized in Appendix B. They provide a benchmark for other current forestry sector investments, which might temper undue optimism by analysts and communities for forests, which remain a less developed and less profitable land use.

Cubbage et al. (2007) estimated timber investment returns without land costs for the principal exotic and selected native species in the Southern Cone of Latin America and in the Southern United States. Exotic eucalyptus plantations in South America were most profitable, with internal rates of returns (IRRs) ranging from 13% to 23%, followed by exotic loblolly pine, with IRRs from 9% to 17%. Average loblolly pine plantation returns in the U.S. South were less profitable, with an IRR of about 9.5%, and natural forest management in the South had IRRs of 4% to 8%. Subtropical native species plantations of the best *Araucaria* and *Nothofagus* species had reasonable financial returns, with IRRs ranging from 5% to 13%. Subtropical or tropical native forests had fewer commercial timber species, and had much lower growth rates and returns. Their IRRs were less than 4%, or even negative for unmanaged stands. State subsidy payments for forest plantations or for timber stand improvements increased IRRs somewhat and reserving areas for environmental protection reduced their IRRs slightly. Including land costs in the cash flows decreased these internal rates of return substantially. Natural stand returns in Latin America were much less than those of plantations, but management of those stands offered better rates of return than only holding the land.

In a recent update, Cubbage et al. (2010, 2012) examined a broader data set of financial returns in 2008 and 2011 for more global timber plantation species and countries. They added many other countries, including China, Colombia, Paraguay, Costa Rica, and Mexico, and found similar results. *Pinus gregii*, a native species in Mexico had excellent returns, with about a 13% IRR, and exotic plantations of *Eucalyptus grandis* in Mexico and *Gmelina* in Costa Rica had returns exceeding an 18% IRR. Land costs and environmental regulations reduced the investment returns for all countries, but usually decreased returns most in Latin America, although their net returns remained greater than in temperate forests. Investment risk also was analyzed, and tended to favor more developed OECD countries, but many Latin American countries had increased their investment ranking significantly in the last six years.

For comparison, Humphries et al. (2012) estimated rates of return for natural forest management in three community forest enterprises in the Brazilian Amazon, and found that the returns were 12%, 2%, and -48%. They compared these results with other literature on natural forest management in the tropics, which found rates of return ranging from 20% to 81%, with one exception of -54%. Humphries et al. (2012) noted that the rates of return they found are smaller than most of these other studies. However, many of those other studies excluded potentially large costs, such as administration, machinery depreciation, vehicles, fuel, and infrastructure. In general, such high rates of return exceeding those calculated by Cubbage et al. and Humphries et al. are not likely if all costs are accounted for, particularly in the long run. Otherwise, there would be a rush of investors into tropical forestry to gain these exceptional profits, which has not occurred.

The results from Cubbage et al. (2005, 2010) and Humphries et al. (2012) demonstrate the care required for accurate financial and economic analysis. Cubbage et al. (2007) found that intensive forest plantations with fast growth rates made by large scale owners had much greater rates of return than natural forest management with slow growth rates by small owners. Humphries et al. (2012) findings supports the low natural stand management returns, although they noted that previous literature usually had found natural forest management rates of return in excess of 20%.

The high variability of estimated returns to natural forests is most likely due to assumptions about the forest stand. A standing natural forest that begins with a large standing stock of commercially-valuable timber can provide significant returns in the short run as stands are harvested, although they may not be managed sustainably, even as investments are made in timber stand improvement (thinning, building roads, etc.). However, it is probably much more common to find natural forests in Latin America either that have been high-graded over time, meaning there is very little valuable timber remaining; or that are extremely remote from mills and markets, meaning much of the potential profits are consumed by the costs of transportation.

On the other hand, based on more than 80 case studies, Hoch et al. (2012) found that plantations seldom prospered with small land owners in the Amazon, and had largely small or negative rates of return, or were complete failures. Natural forest management was much better. The small owners' practice of complementary tree growing in conjunction with agricultural activities and managing natural regeneration of timber and NTFP products was more attractive because of its low input requirements, no need for subsidies, high flexibility in risky environments, and financial returns comparable to well functioning plantations for several naturally regenerated products. These conflicting results illustrate the need for exacting analysis of the economic, biological, social, and market context of an investment to be sure that its promise can be realized, whether for the benefits of planted or natural forest stands, or processing of those timber and nontimber forest products.

Other Project Factors and Analyses

Risk, Uncertainty, and Qualitative Factors

Risk is generally considered to be a measure of uncertainty that can be quantified or has a known probability distribution. Some of the input costs or output prices from forestry projects may have quantifiable risks. However, this is not common, particularly at the smaller local scale that most forestry projects will occur. Most of these projects are new to that local area and thus by definition the quantifiable risk is unknown. Even when risk has been quantified in other areas, the probability distribution of those returns is moot. And incorporating risk and probability distributions into cash flow analyses is not practical for most forestry projects.

Uncertainty is defined as the possibility of an event occurring whose probability is unknown or that cannot be measured. Events such as hurricanes, insect attacks, forest fires, or changes in government policy are generally considered uncertain. The general approach for dealing with uncertainty in project analyses is to examine the potential for such small to catastrophic events through the use of sensitivity analysis as described above.

Qualitative factors often affect project decisions. These could include employment, subjective estimates of risk, benefits for the local community, education, safety, emigration, or other factors. Governments often seek to build institutional and community capacity. These efforts were instrumental in the community forestry enterprise project in Mexico. Community members were trained in development and marketing of nontimber forest products, in developing forest management plans for timber, and in obtaining forest certification to ensure sustainable forest management. These factors often are as important as quantitative factors in project development and selection. They should be explicitly stated and discussed in project analyses.

Sensitivity Analyses

Production functions, input costs, output prices, nonmarket valuation, benefit transfer, discount rates, and economic and valuation are not precise, and subject to considerable inherent variability as well as measurement difficulty. As noted, individual projects are subject to investment risk and each country also has inherent macroeconomic risk levels that differ considerably. There are some published measures of country risk, but not of specific project financial risk, cost and production variability, or measurement error. Distributions of the variation in production or returns are not usually available.

Thus the analyst should perform sensitivity analyses on how changes in the key components of the project will affect the project financial and economic returns. A project evaluation also should consider the possibility of a range of input costs and output prices of 10% to 25% or more variation. As noted, nonmarket valuations are not likely to be more accurate than widely variable market prices, so they too should be examined in sensitivity analyses, at 25% variations at least. A variety of qualitative methods may be used to deal with financial and economic risk, which are usually complex and require hard to obtain historical data on a project level. So perhaps sensitivity analysis, country risk ratings, and objective descriptions are best used for risk considerations as well.

Joint Production of Multiple Outputs

Just as most production systems require multiple inputs (land, labor, water, various capital inputs), many of them also produce multiple outputs. In fact, production of multiple outputs is more likely the rule than the exception (Baumgärtner et al. 2001). In some instances, only one of the outputs generates financial returns, while the others are non-market outputs, but in other situations, more than one output may be bought and sold on markets. Joint production of one market and other non-market outputs may be the most common scenario, and these non-market outputs may include negative outputs, such as water or air contamination.

Forests provide numerous joint market outputs, which are not mutually exclusive, and forests generally are considered to produce significant non-market benefits. For instance, a forested area may produce timber and non-timber forest products such as materials for crafts or botanical herbs, as well as ensure a supply of water for a bottling facility; while at the same time absorbing carbon dioxide – which may or may not be compensated.

If production of one output impacts production of another, then one should try to include all linked productive activities in a single financial/economic analysis. This is most clear when the multiple outputs are from one production process—such as lumber and sawdust. Less simple may be when the two outputs are linked through biological processes, for instance, if increasing timber output would lead to a decrease in carbon credits from the same stand. It is not necessary to know the exact biological trade-off function to be able to conduct a financial or economic analysis. However, knowledge of this relationship would allow a firm to produce the exact proportion of outputs that maximizes profits; this is known as *allocative efficiency*.

On the other hand, if each output is managed independently—that is, they are produced from separate plots of land, with labor and capital inputs that are easily identifiable as contributing to the production of only one or the other of the outputs—it may be possible to estimate financial returns for one product without considering other outputs. This might be the case, for example, if timber is produced on some stands, while payments for environmental services are produced on others (i.e., no timber harvest is allowed on stands enrolled in a payment for environmental service (PES) program).

Employment, Income, and Welfare Considerations

Many projects are justified based on their supposed economic contributions to employment, income, industrial output, or value added. Others may be justified based on their contributions to community or social welfare. Quantifying the benefit, of greater employment, however, is difficult, so is probably better discussed in the project reports rather than developing a specific price. In cost-benefit analysis of public projects, Boardman et al. (2005) caution against the use of typical income and value added measures, as well as employment benefits. Similarly, Gittinger (1982) notes that while welfare, equity, and distribution of benefits obviously affect forestry projects, it would be better for an analyst to discuss social welfare and income distribution impacts for a project rather than arbitrarily choosing what weights to use.

Incremental Cost Analysis

Incremental cost analysis compares project financial (or economic) costs and benefits under multiple scenarios, each of which provides a different amount of the non-valued good or service. For instance, incremental cost analysis may show that it would cost the project (in the form of reduced profits) $20,000 to generate 5 additional jobs, $50,000 to generate 8 additional jobs, and $100,000 to generate 10 additional jobs. If generation of employment is a goal of the project, this incremental cost analysis will help the decision-makers determine the most appropriate level of support for this goal.

Reports and Recommendations

An economic analysis of forestry projects must have thorough and well documented reports. Gittinger (1982) includes a substantial appendix providing guidelines for project reports. These include a preface with summary and conclusions, a background, the project rationale, the project area, the project, organization and management, and production markets and financial results. Essentially the project report summarizes the objectives, background, project and analysis in the same fashion as our guidelines for economic analysis have done here.

Table 8 summarizes possible report components for reference, adapted from Gittinger (1982), the World Bank (2008) Forests Sourcebook, and the World Bank (2012) Project Appraisal Document (PAD). A project report should consider the components from Table 8 as relevant for local project or for the funding agency. The Project Appraisal Document is likely to be required for most World Bank forestry projects regardless. The Gittinger and Forests Sourcebook guidelines are supplemental components that should be considered as relevant for other organizations.

Project Scoping Meeting, Guadalajara, Mexico

Data Collection Meeting, Los Bajitos, Mexico

Field Visit and Orientation, Cali, Colombia

Project Records and Files, Corrientes, Argentina

Pictures: Project Preparation, Implementation, and Reporting

Table 8. Components of a project preparation report and project appraisal document, per Gittinger (1982) and the World Bank (2008, 2012)

Component	Gittinger (1982)	World Bank (2008[a], 2012)
Summary and conclusions		
Introduction		
Background	Current economic situation	Country Context
	The agriculture and forestry sector	Sectoral and institutional context
	Development and social objectives	Higher level objectives to which the project contributes
	Income distribution and poverty	
	Institutions	
Project rationale		Project Development Objectives
		Project beneficiaries
		Project level results indicators
The project area	Physical features	
	Economic base	
	Social aspects	
	Infrastructure	
	Institutions	
The project	Project description	Project components
	Detailed features	
	Project phasing and disbursement period	
	Cost estimates	Project cost[a,] and financing
	Financing	Lending instrument
	Procurement	
	Environmental impact	
Organization, management, and implementation	Credit administration	Institutional and implementation arrangements
	Marketing structure	
	Supply of inputs	
	Land reform and tenure	
	Research, extension	
	Cooperatives	
	Farmer organization and participation	
		Sustainability
		Key risks and mitigation measures
Production, markets, and financial results	Production	Cost-Benefit Analysis[a]
	Availability of markets	Market analysis[a]
	Farm income	
	Processing industries and marketing agencies	
	Government agencies or project authorities	
	Cost recovery	
		Policy incentive framework[a]

Benefits and justification	Social benefits	Public Goods: environmental services & potential payments[a]
	Economic benefit	Fiscal impact analysis[a]
		Poverty impact analysis[a]
Monitoring		Results monitoring and evaluation
		Economic monitoring[a]
Appraisal Summary		Economic and financial analyses
		Technical
		Financial management
		Procurement
		Social (including safeguards)
		Environmental (including safeguards)
Outstanding issues		
Annexes		

Note: World Bank 2008 denoted with an [a]; World Bank 2012 as listed in Project Appraisal Document (PAD)

Implementation, Monitoring, and Evaluation

Projects should begin with a financial and economic analysis, which can form the basis for subsequent implementation, measuring, and monitoring. All World Bank projects wil use a Project Analaysis Document (PAD), as noted above. Most will also have an economic analysis developed as a scoping component of the project. Appendix C shows a sample Terms of Reference for a financial and economic scoping document for a forestry project.

Project implementation and monitoring are keys to eventual success. Projects may appear to be desirable on paper and indeed may be desirable in practice, but only if implemented well. The role of analyst of course is not that of implementation. However, the project that is analyzed well and has the steps in the project determined and explained well will be off to a good start. The analyst may often contribute to project definition, clarity, and execution through the art and process of making the project assessment, and can provide implementers with appropriate decision-making tools. This can involve the identification and clarification of the objectives; collecting data on production functions, costs and prices, of market and nonmarket goods and services; and talking with participants in the eventual project. Summarizing this information, analyzing the financial and economic impacts, and discussing the results that decision-makers need should help lead to selection of good projects and clarify which ones are best.

Monitoring can assess the individual project and its conformance to the plans outlined in the economic analysis, and identify problems in implementation. Monitoring can track progress toward quantifiable project objectives, and identify when management adjustments and continuous improvement should take place. Project monitoring also can examine an individual project or set of projects that have received funds (the factual or with case) and compare them with other forestry activities or communities that have not received funds (a proxy for the counterfactual or without case).

Implementation and monitoring will require collection of appropriate data about the production functions, costs, and returns of the forestry project. The type of data needed will vary depending on the type of forestry project. For traditional timber investment projects, data will be needed on growth and yield, annual timber harvests and volumes, management costs, and prices received. These data will help track if the economic analysis inputs and costs were accurate. If any of the assumptions differ substantially, new management approaches, different rotations, new markets, or other adaptations should be sought. For nonmarket valuation or benefit transfer, tracking the ecological production functions, estimating the quantity of the effects, and estimating values must occur.

Conclusions

This report reviews the financial and economic analysis of forestry projects for market and nonmarket goods and services with an application to community forestry projects in Mexico and Latin America. The methods and applications are general, however, and could be extended to forestry projects for communities and other owners throughout much of the world.

The financial and economic analyses reviewed here can help international donors, community forestry enterprises, and technical assistance groups understand and apply economic principles better. They can help these interests estimate financial and economic returns for entire forestry projects and for the separable components of those projects. This can help determine if forestry projects are meeting the required alternative rates of return for external investors and communities. The estimates also can be used to benchmark rates of return and costs among communities and other organizations, to determine how competitive production may be in one region versus others, or in the world. In addition, the techniques presented here can be used to identify components of production—production functions, costs, or prices—that could be improved so that the community can improve profitability and competitiveness. By comparing the results of the financial and economic analyses to other estimates, communities can identify activities that should become more efficient to compete locally and globally.

As our example of ponderosa pine and some of the benchmarking literature indicates, natural forests are not likely to have high financial rates of return, although some studies found exceptions to this generalization. Regardless, in order to encourage the retention of native forests, more of their nonmarket services need to be recognized, and the owners need to receive payments for those values. The literature has found mixed rates of return for natural and planted forests depending at least on the types of ownership and perhaps on the costs included in economic analyses. Thus we can be hopeful that natural forest management of timber and nontimber forest products can be financially attractive, and particularly for small community forest holders. However, we encourage careful analysis and full cost accounting of each project as outlined in this primer to be sure that promise can be realized. It still seems likely that long term forest management cannot produce sustainable harvests and enduring high financial rates of return, or we would not have problems with tropical deforestation.

The factors that influence economic analysis of forestry projects in Latin America have changed dramatically in the last two decades. Community forestry enterprises and small and medium size owners have become more important, sharing more power and authority in forest resource management with governments. Sustainable Forest Management and forest certification have institutionalized economic, environmental, and social principles for forest management. Globalization has internationalized forest goods and services, ranging from timber to biodiversity to tourism to carbon storage, including reduced emissions from deforestation and forest degradation

(REDD) to mitigate climate change. REDD+ extends REDD and carbon storage payments to cover improved forest management enhancement of carbon stocks (Kaimowitz 2008). In fact, valuing and monetizing ecosystem services and creating new markets have been proposed as an important new policy tool to encourage retention and restoration of native forests.

The increasing recognition and valuation of the nonmarket values of forests has drastically changed economic assessments and public policies for forestry. Economic analyses can assess the merits of new forest goods and services, such as forest carbon, biodiversity, water quality, and scenic beauty. Furthermore, they can help identify which of those elusive benefits are most valuable to society and to local communities, and still contribute to allocating similarly scarce payments for the most valuable ecosystem services. The current ecosystem and benefit transfer web sites and the review by Mullan and Kontoleon (2008) provide a source for some of these values, or they can be calculated with original data for an economic analysis.

This promise of analyzing and realizing more commercial value from nonmarket forest benefits, however, is difficult. Estimating production functions, prices, and the magnitude of price changes due to a project is difficult even in a financial analysis. Yields and productivity of workers is uncertain, costs and prices vary substantially in short and long time periods, supply and demand curves are extremely difficult to estimate, and seldom even used in the financial analyses. The public sources and web sites can be used for estimating total economic values and for benefit transfer. However, compared to financial analyses, which are based on (hard to find) market prices, the level of uncertainty and lack of accuracy in nonmarket economic analyses should be greater.

The applications of financial analyses and economic analyses differ. Financial analyses are intended to determine if individual entities will maximize their profits or present values based on the cash flow of costs and returns during a project. Economic analyses are intended to take the broader perspective of the costs and benefits of a project from the point of view of a community, country, or society as a whole. Not every individual may benefit due to an economic project, but it is presumed that society as a whole will, and indeed that most individuals will benefit from the project. The difference between the net returns in an economic analysis and the profits from a financial analysis indicates either the cost that the government is bearing or the subsidy that forest owners must receive for project to be acceptable. Alternately, it may be viewed as the amount that must be received in alternative income sources, such as payments for environmental services.

We hope that this review will be a bridge between theoretical forest economics literature and cost-benefit analysis and practical economic assessments of forestry projects. We also have developed spreadsheet templates in English and Spanish for financial and economic analyses that are based on the principles and procedures discussed above, and used those for the yerba mate and ponderosa pine examples. They are available at no charge from the authors as well. Cubbage et al. (2011) also published a slightly briefer Spanish version of these guidelines for Mexico. We hope that these guidelines and associated analytical tools also will have opportunities for adaptive management, and will be pleased to receive feedback and suggestions for better presentation and content of the report.

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Appendix A. Selected Benefits Reported in the Literature for Nontimber Forest Products and Nonmarket Values in Latin America Countries (Mullan and Kontoleon 2008)

Table A1. Estimated Values of Nontimber Forest Products (NTFPs)

Location	Value of NTFPs ($/ha/year)	Reference
Guatemala (stock of goods)	$787, gross	Ammour et al (2000)
Peru (stock of goods)	$700, gross; $420, net	Peters et al (1998)
Brazil (potential flow)	$20, net	Pinedo-Vasques et al (1992)
Ecuador (potential flow)	$200, net	Myers (1988)
Global	$50, gross	Godoy et al (1993)
Guatemala	$30, net	Ammour et al (2000)
Venezuela	$15, net	Melnyk and Bell (1996)
Ecuador	$77-180, net	Grimes et al (1994)
Belize	$41-188, net	Balickc and Mendelsohn (1992)
Mexico	$330 net	Adger et al (1995)
Mexico	$116, net	Alcorn (1989)
Brazil	$79, gross	Anderson and Ioris (1992)
Brazil	$97, gross	Mori (1992)
Venezuela	$1, net	Thorbjarnson (1991)
Peru	$67/ha/year	Smith et al (1997)
Peru	$18-24, net	Padoch and de Jong (1989)

Table A2. Estimated Values of Recreation for Tropical Forests

Location	Value ($/ha/year)	Value ($/trip or $/household)	Reference
Costa Rica (foreign and local tourists)		WTP for '1 level' increase in scenic beauty: Costa Ricans - $2.93/year ; Foreign tourists - $3.28	Bienabe and Hearne (2006)
Costa Rica, Two forested parks (foreign and local tourists)	$950 and $2305 (two sites).	$11 and $13 per local visitor, and $23 and $14 per foreign visitor.	Shultz, Pinazzo and Cifuentes (1998)
Costa Rica, 3 national parks (foreign tourists)		$21-25 per visitor	Chase et al (1998)
Costa Rica (foreign tourists)	$160		Tobias and Mendelsohn (1991)
Costa Rica (foreign and local tourists)		$60/visit (current fees $30/visit)	Baldares et al (1990)
Bolivia (foreign tourists)	$2.4-2.8/ha/year	Mean WTP: $72 (CB); $35 (CV)	Ellingson and Seidl (2007)
Mexico	$1		Adger et al (1995)
Brazil, Atlantic Coastal Forest		WTP for new parks: $23-$89/person WTP for protection of half of remaining forest: $9/person	Holmes et al (1998)

Table A3. Estimated Values of Biodiversity for Tropical Forests

Location	Value ($/ha/year)	Reference
Biodiversity hotspots	Random search, locations with highest biodiversity: Value for bioprospecting: $1.09 - $265/ha depending on parameters used in model. Ordered search, most promising locations: Value for bioprospecting: $12-$58/ha	Costello and Ward (2006)
Biodiversity hotspots	Range from $0.2 per hectare in California Floristic Province to $20.6 per hectare in Western Ecuador.	Simpson et al (1996)
Biodiversity hotspots	Range from $29 per hectare in California Floristic Province to $2888 per hectare in Western Ecuador.	Craft and Simpson (1996)
Biodiversity hotspots	Range from $0 per hectare in California Floristic Province to $9177 per hectare in Western Ecuador.	Rausser and Small (1998)
Mexico	$6.4/ha/year	Adger et al (1995)

Table A4. Estimated Values of Indirect Use Values for Tropical Forests

What is being valued	Location	Value ($/ha/year)	Reference
Cost of soil replacement and preventing soil loss.	Guatemala	Negligible for soil loss; $12/ha for nutrient loss; $30/ha for NTFPs and ecosystem services.	Ammour et al (2000)
Sedimentation effects on infrastructure	Mexico	Negligible	Adger et al (1995)
Carbon sequestration	Costa Rica	$105/ha/year	Bulte et al (2002)

Table A5. Estimated Non-use Values for Tropical Forests for Tropical Forests

What is being valued	Location	Value ($/ha/year)	Value ($/household/year)	Reference
Existence value of tropical rainforests for US citizens	Global	$4.6/ha/year (Pearce and Pearce, 2000)	Payment card: $31 per year; Dichotomous choice: $21 per year.	Kramer and Mercer (1997)
WTP for increased biodiversity protection	Costa Rica		WTP for '1 level' increase in biodiversity protection: Costa 52ican residents - $3.87; Foreign tourists - $6.62	Bienabe and Hearne (2006)
WTP of UK and Italian citizens for protection of Brazilian Amazon	Brazil	Mean WTP for protection of 5% more of the Brazilian Amazon: $43/ha/year	Mean WTP for protection of 5% more of the Brazilian Amazon in the UK and Italy: $42/hh/year	Horton et al (2003)
Existence value of Mexican forests	Mexico	$0.03-10/ha/year		Adger et al (1995)

Appendix B: Timber Investment Financial Returns in the Americas, 2005

Table B1. Forest Management Regimes for Selected Exotic Plantations and Native Species in the Americas, 2005

Country	**Species**	**Rotation (year)**	**Thinnings and Harvests (years)**	**Growth (m^3/ha/yr)**	**Total Yield per Rotation (m^3)**
Argentina	*Pinus taeda* - Misiones	20	5, 8, 12, 20	30	600
	Pinus taeda - Corrientes	20	7, 12, 20	35	700
	Eucalyptus grandis	14	5, 9, 14	40	560
	Araucaria angustifolia	28	10,15,20,25	15	420
	Native forest unmanaged	80	20,40,60,80	1	80
	Native forest best management	80	20,40,60,80	2	160
Brazil	*Pinus taeda*	18	18	30	540
	Eucalypytus grandis	15	7,11,15	40	600
	Eucalyptus dunnii	7	7	43	301
	Araucaria angustifolia	25	10, 16, 21, 25	18	450
	Ilex paragurariensis (yerba mate)	10	leaves, all	Na	Na
Chile	*Pinus radiate*	22	7,11,15,22	22	484
	Nothofagus dombeyi	30	10, 15, 22, 30	18	540
	Nothofagus nervosa	35	12, 18, 26, 35	16	560
Mexico (2011)	*Eucalyptus grandis*	8	8	30	240
	Pinus gregii	20	6,12,20	15	300
Uruguay	*Pinus taeda*	22	11,15,22	20	440
	Eucalyptus grandis	16	6,11,16	30	480
	Eucalyptus globulus	10	10	18	180
Subtropical Optimal	Native forest optimal management	80	20,38,50,65,80	4	320
U.S.A.	*Pinus taeda* planted	30	17,24,30	12	360
	Pinus taeda natural	40	25,33,40	7.4	300
	Pinus palustris	80	38,50,65,80	4	320
	Hardwood sp.	80	38,50,65,80	4	320

Source: Cubbage et al. 2007, 2011

Table B2. Financial Returns to Exotic and Native Forest Plantations and Stands in the Americas by Capital Budgeting Criteria with a 8% Discount Rate, 2005

Country	**Species**	**Net Present Value ($/ha)**	**Land Expectation Value ($/ha)**	**Annual Equivalent Value ($/ha)**	**Benefit: Cost Ratio**	**Internal Rate of Return (%)**
Argentina	*Pinus taeda* - Misiones	1148	1462	117	1.73	12.9
	Pinus teada - Corrientes	370	471	38	1.42	10.5
	E. grandis	819	1241	99	1.77	13.8
	Araucaria a.	-169	-215	-12	0.85	7.2
	Native forest unmanaged	-97	-19	-11	-22	<0
	Native forest best mgt.	-91	-111	-9	0.47	1.7
Brazil	*Pinus taeda*	1870	2495	200	3.25	16.0
	E. grandis	3716	5427	434	4.99	22.7
	E. dunnii	1196	2872	230	2.31	22.9
	Ilex p.	1061	1976	158	1.41	19.0
	Araucaria a.	823	963	77	1.96	12.4
Chile	*Pinus radiata*	2729	3345	268	3.57	16.9
	N. dombeyi	1581	2012	161	2.82	13.6
	N. nervosa	792	1009	81	1.91	10.9
Mexico (in 2011)	*Eucalyptus grandis*	901	1961	157	1.86	18.4
	Pinus gregii	1638	2137	170	2.13	13.2
Uruguay	*Pinus taeda*	1634	2003	160	2.90	15.1
	E. grandis	2890	4081	327	5.15	21.9
	E. globulus	319	593	47	1.49	12.8
Subtropical Optimal	Native species Optimal mgt	-113	-138	-11	0.25	3.6
U.S.A.	*Pinus taeda* planted	333	408	33	1.39	9.5
	Pinus taeda natural	-25	-31	-2	0.94	7.8
	Pinus palustris	-413	-507	-41	0.16	4.3
	Hardwood sp.	-270	-331	-27	0.14	3.6

Source: Cubbage et al. 2007, 2011

Appendix C: Example Terms of Reference for an Economic Evaluation of a Project:

Adapted from a Sustainable Land Management Project in Chile

Background

The work to be conducted is in support of the development of a Sustainable Land Management (SLM) Project in Chile. The SLM project's main objective is to develop a national system to promote practices for combating land degradation, conserving biodiversity of global importance and protecting forest carbon assets. The project aims to achieve this objective primarily through developing, testing, and improving the design of a national system for sustainable land management. SLM is defined as a knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management (including input and output externalities) to meet rising food and fiber demands while sustaining ecosystem services and livelihoods.[1] It requires the maintenance of the following key components of the environment: biodiversity, ecological integrity, and natural capital. The system would coordinate existing yet discrete programs to mainstream sustainable land management, biodiversity conservation, and climate change mitigation in priority regions of Chile, including four globally and nationally-recognized eco-regions, some of which cover parts of the Chilean hotspot. The project would bring about sustainable land management by improved coordination of many ongoing government and private initiatives in the forestry and agriculture sectors (native and plantation forestry, soil conservation, and irrigation).

Expected impacts include: (i) a National System for Sustainable Land Management developed for national and sub-national levels; (ii) reduced degradation and biodiversity loss, and increased carbon stock in target areas of priority ecosystems; (iii) monitoring system established for land-degradation, (iv) capacities developed in national and regional governments, civil society, and producers to reduce land degradation, promote ecosystem services, mitigate climate change, and reduce biodiversity loss. The proposed project would aim for the following impacts:

• Development of an effective framework and roadmap for a national program to mitigate land degradation, conserve biodiversity, and protect vital carbon assets.

• Reduced land degradation and increased carbon stocks in 5 target areas for landscape restoration and SLM practices.

• Improved capacity to monitor impacts and results through the development of an effective monitoring and early warning system for SLM.

• Increased management and coordination capacity for the application of a program to mainstream SLM.

Work to be conducted

The analyst will conduct a financial and economic evaluation of the proposed project. The evaluation should show the situation both *with*/*without* and *before/after* the project, and include the following aspects:

[1] The World Bank (2006). Sustainable Land Management, CHALLENGES, OPPORTUNITIES, AND TRADE-OFFS.

(i) **Project Plans, Components, and Scoping.—**Meet with the key project organizations, leaders, stakeholders, affected communities, or other interest groups to clarify the project objectives, components, activities, and participants and to define the specific SLM activities/investments and geographic regions to include in the financial and economic analysis. The SLM activities include but are not limited to: plantation forestry, native forest management, restoration of degraded lands, agriculture with conservation practices, physical works for erosion control, conservation set asides, restoration of wetlands (bofedales), etc. Develop thorough lists of the project components that will be performed from these meetings.

(ii) **Production and Cost Summary.—**For each project component, identify and list the project inputs, participants, processes, outputs anticipated by year that they will occur and the quantity needed. For each of these activities, summarize the market costs of the inputs, for labor, management, equipment fixed and operating costs, land, loans, or other relevant expenses. Similarly, estimate the value of the products produced by each component at market prices.

(iii) **Financial Analysis.—**Based on the production and cost summary, calculate financial returns for each project component based on market costs and prices using cash flow analyses and capital budgeting criteria, such as New Present Value (NPV), Land Expectation Value (LEV), Financial Internal Rate of Return (IRR), and Benefit-Cost Ratio (B:C ratio).

(iv) **Economic Valuation.—**From the preceding list of project components or activities that do not have market prices or values, identify the best qualitative or quantitative means to value their outputs. At a minimum, describe the anticipated benefits from each project and preferred metrics to measure their success (e.g., number of personnel trained in an activity, number of ha treated, etc.). To the extent possible, based on other literature or valuation studies, estimate the values of nonmarket goods and services, such as nontimber forest products, recreation, water quality, local consumption of forest outputs, ecosystem services, aesthetic values, or benefits of conservation or preservation. These values may be approximated using revealed preference methods such as travel cost or hedonic pricing; stated preference methods such as willingness to pay, contingent valuation, or stated choice; or from benefit transfer from other studies.

(v) **Economic Analysis.—**Given the lists of economic components and financial and economic values, calculate integrated financial and economic returns for each project component based on market costs and prices where available and the economic values where market costs and prices are lacking. Use the same cash flow analyses and capital budgeting criteria, such as New Present Value (NPV), Land Expectation Value (LEV), Economic Internal Rate of Return (IRR), and Benefit-Cost Ratio (B:C ratio).

(vi) **Economic vs. Financial Analysis.—**Compare the results of the financial analysis with the economic analysis, noting the important differences between returns that can be calculated (financial vs. economic NPV, LEV, IRR, B:C) and the important project components and benefits that cannot be quantified. Note the problems associated with estimating economic benefits; the importance of not-quantifiable project components, and the likely impact on the economic analysis. Estimate the magnitude of the differences between the financial and economic analysis, and the amount of funds required through subsidies or government transfers to encourage SLM in the projects.

(vii) **Project Implementation.—**Summarize the components of the project that were identified in the scoping process; the financial and economic returns for those components; and the likely profits, subsidies, payments, or transfers associated with each component. Identify activities, costs, or prices that lacked good information for financial and economic analyses, and their possible impact. Finally identify crucial components in each project component that will determine project success or failure, and should be monitored during project implementation.

Products for Delivery

Develop a detailed report of the financial and economic evaluation for the proposed project, including summary of methods, tables showing results, and references. For each of the seven items listed above, prepare a section that summarizes that analysis and results for that section, and then write any concluding remarks, identification of project components with the best or worst returns, or suggestions for project implementation, based on the initial scoping and financial and economic analyses.

SLM Project Investment Activities

The following activities are possible SLM activities that will be performed by this overall project. The analyst will identify and perform the financial and economic analysis on those that are deemed most appropriate and likely to be implemented by the project organization and leaders.

1. On farm investment activities

   • Land-use plans for farms to support sustainable land management

   • Technical assistance to farmers for improving production and conservation

   • Sustainable land management, which may include plantation forestry, native forest management, restoration of degraded lands, agriculture with conservation practices, physical works for erosion control, conservation set asides, restoration of wetlands (bofedales), etc.

2. Non-farm investment activities

   • Defining and implementing conservation districts

   • Developing and implementing a monitoring system for degraded lands and SLM

   • Training of technicians and producers

   • Program Development for Sustainable Land Management