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Counting on the Environment

Forest Incomes and the Rural Poor

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June 2004

THE WORLD BANK ENVIRONMENT DEPARTMENT

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Photographs by Paul Vedeld, of Goka Villagers in the Usambara Mountains, Tanzania, 2002.

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Foreword

It is well-known that poor people are often directly dependent on natural resources that are not cultivated. But how important, actually, is income from non-cultivated resources? To what extent can we measure it? What are we missing in our poverty assessments? Indeed, what is "environmental income"? These were some of the questions that inspired this study.

Thanks to the financial support of the Norwegian Government through the Trust Fund for Environmentally and Socially Sustainable Development, and the World Bank's Environment Department, it was possible to launch the analytical work behind this report.

The authors are all associated with the Agricultural University of Norway, and its Noragric Department (Vedeld, Sjaastad, and Berg) or its Department of Economics and Resource Management (Angelsen). Let me extend my sincere thanks to the authors for their diligent and ambitious efforts to compile a broad empirical data base, and transform this diverse raw material into an accessible and succinct product.

This report takes us through an intriguing discussion of the concept of "environmental income" and suggests an operational definition. Through a unique meta-study, it summarizes no less than 54 empirical studies of forest-related environmental income. Many of these studies were not previously easily accessible to a general audience. The results should not be carelessly extrapolated to large populations, but still tell us a story about just how important forest-related environmental income can be for poor people in many parts of the world.

The authors also uncover a methodological terrain that is difficult to navigate. If our understanding of environmental income is to improve, our methods for measuring it must be sharpened. This report gives concrete advice on how to do that. For developing country governments, donors—including the World Bank—academics, NGOs and everyone engaged in poverty reduction, there is a challenge here to better capture environmental income, and ensure that policies and interventions will support sustainable use of these resources.

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Abstract

Environmental income is defined as rent (or value added) captured through consumption, barter, or sale of natural capital within the first link in a market chain, starting from the point at which the natural capital is extracted or appropriated.

The present study, which focuses on forest environmental income, had two main objectives. The first was to investigate the extent to which people in rural areas of developing countries depend on income from forest environmental resources, and how this dependence is conditioned by different political, economic, ecological, and socio-cultural factors. This is accomplished by a meta-analysis of 54 case studies. The second objective was to review research methodology and make recommendations for "best practices" in assessment of forest environmental income.

Although there are substantial variations in methodology and quality of case studies, results indicate that forest environmental income represents a significant income source with an average contribution to household income of some 22 percent in the populations sampled. The main sources of forest environmental incomes are fuelwood, wild foods, and fodder for animals. Forest environmental income has a strong and significant equalizing effect on local income distribution. Cash income constitutes about half of total forest environmental income.

The report recommends the development of research protocols, field methods, and simple analytical models to analyze the role of environmental income in rural livelihoods. More in-depth studies are needed to unravel the roles of local heterogeneity and social differentiation. Extended studies that generate time series data would assist in understanding the role of environmental income in both individual household strategies and in broader development strategies.

The omission of forest environmental income in national statistics and in poverty assessments leads to an underestimation of rural incomes, and a lack of appreciation of the value of environment. In areas where environmental income is important, this omission may also lead to flawed policies and interventions.

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Executive Summary

Understanding the role that environmental income plays in poor people's livelihoods is important for at least two reasons. First, it helps policymakers design and implement effective poverty reduction strategies. Second, the size and nature of environmental income has implications for issues of conservation and sustainable resource use.

There is no generally agreed definition of "environmental income," and this paper discusses different uses of the term. We settled on the following definition: *Environmental income is rent (or value added) captured through consumption, barter, or sale of natural capital within the first link in a market chain, starting from the point at which the natural capital is extracted or appropriated*. Obviously, the level of income will be influenced by the degree of processing that might take place before any transaction. For the economically most important categories of forest environmental income (fuelwood, wild food, fodder), however, the modifications of natural capital will be negligible.

The present study, which focuses on forest environmental income, had two main objectives. The first was to investigate the extent to which people in rural areas of developing countries depend on income from forest environmental resources, and how this dependence is conditioned by different political, economic, ecological, and sociocultural factors. This is accomplished by a meta-analysis of 54 case studies. The second objective was to review research methodology and make recommendations for "best practices" in assessment of forest environmental income.

Note that the many methodological problems and weaknesses identified in the case studies in connection with the second objective significantly reduced the accuracy and robustness of the results arrived at in connection with the first objective. Figures and relationships based on the meta-study of 54 cases must therefore be interpreted and used with caution.

Forest Environmental Income, Income Dependence, Diversification, and Distribution

- The mean annual forest environmental income was US$678 (adjusted for purchasing power parity) per household in our sample, which was equivalent to 22 percent of total household income.
- The median forest environmental income was US$346, equivalent to 19 percent of median total income.
- Although agriculture and off-farm income had higher income shares, forest income represented a significant source of income, which is of particular importance to households living close to the survival line.

- Forest environmental income was of particular significance with respect to "gap-filling" and "safety nets"—that is, as an additional income source in periods of both predictable and unpredictable shortfalls in other livelihood sources.
- Wild food and fuelwood were by far the two most important forest products. Fodder was systematically under-reported, but it was important where reported.
- Cash income constituted about half of total forest environmental income.
- The share earned in cash declined with higher forest environmental income. We also found a negative relationship between the cash share of forest income and total income. Thus, cash forest products were at least as important for communities with low forest environmental and low total household income as for communities that were better-off.
- Forest environmental income increased with total income, both between the cases (communities) and between households within the communities studied. Forest environmental income was thus important not only for poor communities. The elasticity of forest environmental income with respect to total income was close to unity.
- Dependence on forest environmental income, measured as its share of total income, declined with increasing total income when analyzed across households. There was no significant relationship across communities.
- This tendency was even stronger when looking at the income distribution between households: the poor were more dependent on forest environmental income, which had a strong and significant equalizing effect on local income distribution.
- Forest income can be seen as part of rural households' diversification strategies. We found that high total income was associated with less income diversification, indicating that higher income was achieved though a process of specializing in one or a few high-return activities.

Methodological Problems

The studies reviewed displayed a high degree of theoretical and methodological pluralism, and the substantial variability in reporting of specific variables and results is partly explained through such pluralism. This variability must, however, also be attributed to methodological pitfalls and weaknesses observed in many studies.

Few studies analyzed the role of or even distinguished between different types of forest environmental income, although this usually will be necessary in order to devise appropriate policies aimed specifically at the poor.

- Valuation studies reported higher forest environmental incomes than studies focusing on forest environmental income dependence and distribution. This may be due to the inclusion of a wider array of goods in the former type of study, selection of sites with high forest values, or deliberate attempts to inflate the value of conservation. Our data, however, did not permit rigorous investigation of these explanations.
- Double counting, even triple counting, was common.

- Few efforts to define "environmental income" were found, and there was little consistency in measures used across cases.
- The use of flawed price and cost estimates, such as subsistence good values based on world markets, was prevalent.
- Many studies omitted important forest environmental income sources. Unfortunately, some 72 percent of the studies ignored fodder, causing underestimation of income levels.
- Fewer than half the studies considered whether current resource use is sustainable.

Research Recommendations

- First, there is a need to "get the basics right"—to avoid the problems just described—in the individual case studies of environmental income and poverty. Simple research protocols, field methods, and analytical models are needed to understand the role of environmental income in rural livelihoods.
- Second, there is a need for more in-depth studies to understand the role of environmental income, both in individual household strategies and in broader development strategies. Is forest environmental income primarily for gap-filling and safety nets, an employment of last resort, or a pathway out of poverty? Long-term studies with time series data would help answer these questions. Further, very few of the environmental income studies dealt with issues of local heterogeneity and social differentiation.
- Third, there is a need to increase the scope of such studies through larger research projects to get comparable data from different socioeconomic and ecological settings. Our meta-analysis revealed some of the problems of synthesizing case studies with widely differing methodologies and objectives. There is a need to generate a larger sample of case studies that have collected a minimum set of comparable data. This would permit a much higher level of generalization. Moreover, analyzing the impact of meso- and macro-level factors can only be done through a meta-analysis. Achieving this requires a concerted effort by large players in the research field, such as the World Bank or the Center for International Forestry Research.

Policy Recommendations

A main policy message to governments, donors, and international agencies is that leaving forest environmental income out of national statistics and poverty assessments will lead to underestimation of rural incomes. This will depress average and median incomes and also cause overestimation of the numbers of rural poor if such estimates are made from household income levels.

In areas where environmental income is important, these problems may be serious and cause substantial rural-urban, inter-sectoral, inter-regional, and international distortions, with flawed conclusions and policies as a result. Furthermore, environmental policy in particular must be based on understanding how the environment contributes to the livelihoods of the rural poor under changing circumstances.

We also recommend that governments, donors, and international agencies:

- Agree on an operational definition of environmental income that makes income

comparable across cases and across livelihood sources

- Contribute to a worldwide systematic collection of base-line data in the field
- Include important forest environmental income sources in poverty assessments and in Poverty Reduction Strategy Papers, concentrating on the key resources—food, fuel, and fodder
- Develop sets of policies that secure the resource base, increase the possibilities to enhance the environmental values of forests, and address issues of dependence, distribution, and diversification among, in particular, poor households and communities.

1 Setting the Scene

More than 1 billion people depend to varying degrees on forests for their livelihoods. About 60 million indigenous people are almost wholly dependent on forests. Some 350 million people who live within or adjacent to dense forests depend on them to a high degree for subsistence and income. In developing countries about 1.2 billion people rely on agroforestry farming systems that help to sustain agricultural productivity and generate income. Worldwide, forest industries provide employment for 60 million people. Some 1 billion people depend on drugs derived from forest plants for their medical needs. (World Bank, 2001: 15)

Although considerable uncertainty surrounds the figures often cited regarding the number of people dependent on forests, there is no doubt that this natural resource plays an important role in the livelihoods of vast numbers of individuals. Over the last decade or two, numerous studies have documented people's use and dependence on forest resources. These studies share broad objectives but vary substantially in focus and approach.

As developing countries elaborate Poverty Reduction Strategies based on a diagnosis of the nature and extent of poverty, government, donors, and others must start from a correct assessment of the actual level of poverty. If such assessments do not capture important sources of poor people's income, such as forests, the bases for poverty reduction strategies will be flawed.

This study aims to improve knowledge about the level of dependence on forest resources among different groups, as reflected in previous studies. In addition, the report examines the existing literature to identify common methodological pitfalls and shortcomings, and it recommends expedient approaches to future studies of forest resources, poverty, and livelihoods.

Objectives of This Study

To consider the accuracy of estimates of dependence on forests, we looked at existing data from a selection of studies of forest-related environmental income for poor people in developing countries. This should contribute to the policy debate on the role of forest environmental income as a safety net, a gap-filler, and a contribution to long-term poverty reduction. In analyzing how findings were arrived at in other reports, we also hoped to enhance the manner in which data on forest environmental income are gathered and can be incorporated into poverty assessments.

This study thus had two separate objectives:

1. To investigate the extent to which people in developing countries depend on income from forest environmental resources and how this dependence is conditioned by different sociocultural, ecological, economic, and political factors

2. To review and make recommendations on "best practices" for empirical studies of dependence on forests for environmental income, based on both a conceptual discussion and a review of the array of methodological approaches used in studies.

We chose to focus on environmental income from forests for a number of reasons. From a practical view, the time available for the study (three person-months) forced us to focus on one subset of environmental income. Further, there appeared to be more studies on income from forests than from other sources, and forest-related income forms an important part of rural income in many poor regions. This does not mean that environmental income from other sources is less important in individual cases.

This report generally analyzes forest-related environmental incomes, which we have termed *forest environmental incomes* throughout the study. In Chapter 2, where we explore more general and overall perspectives on costs and benefits from the environment, we use the more overall concept of *environmental income*.

Problem Formulations

Dependence on Income from Forest-Related Environmental Resources

In rural household economic research undertaken 20–30 years ago, a key emphasis was placed on agricultural production, neglecting what we now know is crucial to such households: off-farm incomes through wage work, direct employment such as petty trade and transport, self-employment, remittances, pensions, and so on. The inclusion of these sources of income at that time gave a quite different picture of both total and relative incomes from different sources.

Could the same kind of neglect also be true for forest environmental incomes? What would the inclusion of such incomes in poverty assessment efforts mean for policy planning and implementation at large? Forest environmental incomes are particularly important for poor people, presumably because these activities are often easily accessed, require low levels capital and purchased inputs, and offer only low returns to labor, which is not so attractive for well-to-do households. These characteristics thus favor poor households with few other income-generating options. The measurement of levels of dependence for different categories of households and under different external conditions would therefore be important to investigate. The share of incomes relative to total income, how the share enters into subsistence and cash income strategies, and how it relates to other income opportunities in terms of both scale and vulnerability would be important to explore.

People's diversification strategies for survival and livelihood involve forest environmental income. They have to address current needs, and they also face shocks and other types of trouble. They furthermore try to develop strategies to accumulate capital and find their way out of poverty. Forest environmental income may constitute part of this process as well.

Last, it is important to consider if the present resource use patterns are sustainable. Ideally, people's use of and dependence on forest environmental income should constitute a lasting structure, as individuals in principle would have no objective reasons for depleting the renewable resource base on which they depend. This yields a win-win situation in terms of economic growth and the environment. To the extent that people are cutting into stocks,

depleting resources, or degrading their quality, the long-run effects will threaten both biodiversity values and the economic benefits accrued from the resource base. An important question is therefore how robust the resource is in the face of different utilization schemes.

These considerations lead to four research questions relative to the first objective:

1. How large is the forest environmental income?

2. What is the level of dependence on forest environmental incomes?

3. What is the distribution of forest environmental income between different groups of households in the sample?

4. How does the forest environmental income relate to strategies for household diversification?

These issues are analyzed in relation to three dimensions:

1. Forest environmental incomes measured as total, relative, cash, and subsistence levels

2. The impact of household-level variables on forest environmental incomes: wealth, age, tribe/ethnicity/kinship, educational levels, main occupation, access to land and other non-forest capitals, and so on

3. The impact of various contextual factors (community or higher-level variables) on forest environmental incomes: average income levels, market access and conditions, legal frameworks constraining access and use, administrative and organizational frameworks, political frameworks, ecological conditions (such as type of forest or rainfall), and so on.

Best Practices for Empirical Studies of Forest-related Environmental Income

The case studies included in the meta-analysis were heterogeneous and represented an array of practices in terms of the theoretical base and methodological approach, the scientific background of those involved, the purpose of the work, the type of analysis, and so on. The results of the work were most likely influenced by such factors.

In the analysis of cases and comparison between them, consistency was looked for on a number of issues, such as income definitions, clear cost definitions and avoidance of double counting, good differentiation between stocks and flow concepts of natural resources, and a number of other possible pitfalls.

Research and development activities have also increasingly become part of the legitimization of political decisions. To some extent, the development of epistemic communities is evident, in which politicians, bureaucrats, and researchers share common scientific and practical values and norms and depend on each other in their daily work. It could be that the results from forest environmental income studies are flavored by such issues, although this is difficult to document.

Given all this, we formulated three research questions on the second objective on best practices:

1. What are the most common overall theoretical and methodological principles and approaches used to analyze forest environmental incomes?

2. What are common problems in current practices analyzing forest environmental incomes?

3. What are best practices in analyzing forest environmental incomes?

Outline of Report

Chapter 2 addresses theoretical and conceptual issues related to environmental incomes and poverty-environmental income relationships. Chapter 3 briefly outlines the methodology applied for the meta-study. Chapter 4 presents the results from the meta-study, while Chapter 5 deals with common pitfalls found in the studies and outlines best practices in future work in the field. Chapter 6 includes some recommendations for future research, a proposal for including environmental income in poverty assessments, and some tentative policy implications.

2 Forest-Related Environmental Incomes and Poverty

This chapter looks at various theoretical and conceptual issues related to environmental incomes and at the link between poverty and such incomes derived from forest resources.

Toward a Definition of Environmental Income

How much, and in which ways, do environmental incomes contribute to the livelihoods of the rural poor? To answer this question, a clear operational definition of environmental income must be found. A definition is required for internal as well as broad consistency in use of the term—in other words, to ensure that incomes from different environmental goods are measured consistently within a single study and are also comparable across different studies and locations.

In any definition, three issues are of prime importance: the possible sources of environmental income, the appropriate income measure, and the level of "remoteness" from the source—in geographic or economic terms—where environmental income may be captured.

Sources of Environmental Income

With growing concerns about environmental degradation, the concept of natural capital has received increasing attention. And this is a good place to begin an investigation of the environmental income concept in earnest. Could it be that environmental income is simply the flow derived from the stock of natural capital?

In a very limited sense, the answer is yes. Environmental income can be seen as income derived from natural resources, sinks, and processes created by nature rather than by humans—from soils, oils, minerals, trees, fish, game, air and water bodies, and climate regulation.

A strict definition of natural capital is "capital in whose production humans play no part." Defining environmental income in a similar manner is, of course, impossible, since realization of income requires human involvement. On the one hand, practically all income involves the consumption or exchange of goods that ultimately and at least in part are derived from nature. On the other hand, hardly any goods are consumed or exchanged without some human modification.

There is, however, an important distinction between crops from agricultural fields and logs from natural forests. In the latter case it is the natural capital itself, strictly defined, that at some point is modified or harvested, but in the case of crops it is not. And while logs can be seen as "altered trees," it is much more of a stretch to view crops as "altered soil."

Environmental income can be defined as income earned from wild or uncultivated natural resources. In this case, forest plantations, fish

farms, and agricultural fields cannot generate environmental income.

A further point of relevance to this study concerns forest income. While a naturally regenerated tree in an agricultural field may generate environmental income, it will not generate forest income, in contrast to wild grasses and animals found within a forest. This would be in line with the definition of forest used by the U.N. Food and Agriculture Organization (FAO), in which, among other things, an area is not considered forest if the dominant use is agriculture.[1]

Income Measures

Three different income measures are implicitly applied in the measurement of resource values and environmental income: the gross value of extracted goods, value added, and rent.[2] Value added equals gross value minus costs of capital consumption and intermediate inputs. A further subtraction of labor costs and normal profit yields the rent. (See Figure 2.1.)

Use of gross value, characterized by the failure to subtract capital consumption and intermediate input costs, cannot be defended. The discussion here will therefore focus on value added and rent.

The key to realization of rent from a resource is its appropriation—the act of taking the resource from "the wild" and making it your own property. A good deal of economic analysis (including general equilibrium models) ignores this issue, since the starting point is that property rights over all assets are well established.

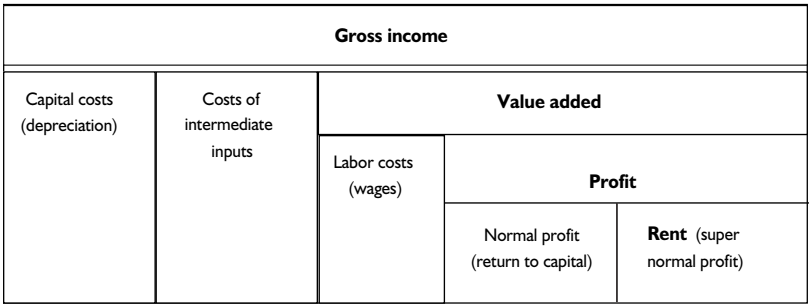
The existence of rent is often thought of as something undesired, indicating distortions and inefficiencies. But the presence of rent at the initial appropriation stage does not imply distortions. In fact, a high resource rent will just be an indication of a valuable resource.

Appropriation will often occur at the point of extraction. But an appropriated resource may of course also be held as capital for some time before "extraction" converts assets into income. Thus, rents related both to holding and to realizing assets can and often will be captured through the appropriation of natural resources.

An alternative to defining environmental income as natural rent is to define it as value added, in line with the way "income" is normally understood in economics and national accounting. Value added can be defined as gross benefit minus the regeneration costs of factors expended during its production. In practical terms, this means gross benefit net the costs of capital consumption and intermediate inputs. In contrast to rent, what would not be subtracted are opportunity costs related to labor (family or wage labor) and normal profits (return to capital).

Which measure is preferable? There is, in our view, no

Figure 2.1 The relationship between different concepts of environmental income



obvious reason to prefer either rent or value added. When alternative investment and employment opportunities do not exist, these figures will be identical. In some scenarios, the costs of capital consumption and intermediate inputs will be trivial, so that even gross value will approximate rent. In reality, though, opportunity costs of use of labor and capital will almost always be above zero, although they may also be very small.

The advantage of using rent is partly conceptual: it measures only income that can be attributed to nature, omitting income from labor that could earn as much in alternative employment. The distinction between marginal and total considerations must, however, be emphasized here. While alternative employment opportunities may exist for any given individual, local economies might fail to absorb the labor made available if the entire natural resource (and thus environmental income opportunities) were to disappear. Estimating the "true" opportunity cost of labor under such counterfactual circumstances is difficult, to say the least, as demonstrated by numerous valuation exercises.

Income earned from processing rather than appropriation and extraction poses particular problems for value added, since a substantial component of "environmental income" will consist of returns to skilled labor. In contrast, natural rent will remain identical. We discuss this further in the next section.

Finally, identification of rent will always permit a simple calculation of value added—for example, for purposes of comparison with other income sources—while the reverse does not apply.

The advantage of using value added is partly practical: when the opportunity cost of labor and capital is difficult to ascertain, as may be the case in many rural areas of developing countries, the use of value added will simplify research. In many cases, revealing the actual labor inputs would also be time-consuming, requiring recording over longer periods of time.

An additional argument for using value added is the fact that it is in line with normal concepts of income used elsewhere and thus provides a basis for direct comparisons.

Location, Production Processes, and Market Chains

While it seems intuitively right to regard at least part of the value of a fish to the fisher as environmental income, it seems equally right not to regard the cash generated in a fancy restaurant in a distant city as also environmental income, even though the star of the meal was that same fish. The key question is: At what point does environmental income turn into something else?

Aspects of location could potentially be used to define the limits of environmental income; such income, for instance, may only be earned by local people living within a certain distance of the resource in question. Alternatively, aspects of the production process could be incorporated into the definition; for example, only consumption or sale of raw materials, not processed goods, could count.

Both of these dimensions—location and production processes—suffer from problems of ambiguity and imprecision, however. How close do you have to live to a resource to qualify as "a local"? Is charcoal a processed good and therefore excluded from the range of goods capable of providing environmental income?

A simple case can be made for limiting the definition of environmental income to that which is earned only through the first link in a potentially extended market chain. That case begins with a consideration of natural rent and competitive equilibria.

After initial appropriation or extraction, and provided markets are competitive, no increases in the value of a good through processing can be attributed to nature; they will appear instead as returns to invested labor and human-made capital. Thus in an economy characterized by competitive markets, rent can be earned only through the initial appropriation of a resource. If costs are properly deducted and there are competitive markets for any already extracted or processed good, environmental income—defined as natural rent—will not rise beyond what is earned through initial appropriation or extraction. This is true regardless of the number of market links and production stages that must be negotiated before an end product emerges.

Then the relevant question is: Under what circumstances is this not true? Upon its extraction, a natural resource may be consumed immediately, sold immediately, or processed or modified by the extractor. In the first case, consumption, there is no problem. But if it is sold immediately, the problem is that rent may be appropriated at later points in the market chain, particularly under imperfect market conditions due to asymmetric information, monopsony (having only one buyer), or price controls. Appropriators may sell extracted resources at a lower price than could have been obtained with perfect information and competitive markets. Thus market distortions in subsequent links in the market chain represent a necessary but not sufficient condition for "natural rent" to be captured by others than initial appropriators.

Note, however, that if a definition of environmental income includes "rent attributable to nature" realized through later links in the market chain, there would be no good reason not to include incomes from agricultural processing, fancy restaurants, or any productive activity that for some reason and at some point involved the acquisition of inputs at prices below the competitive market equivalent. Market distortions may shift the capture of natural rent away from extractors, but this rent is then realized precisely because of these market distortions, not because of the resource itself.

The problem in the third case, when the resource is processed or modified by the extractor, is that part of the rent captured by appropriators and extractors may be attributable to factors other than "nature." In two otherwise identical settings, an entrepreneur who lives in an area with labor market failures may capture more rent than one who does not. And while the monopsony rent earned by carpenters who extract their own raw materials would count as environmental income, that earned by carpenters who purchase these materials would not.

How common are such conditions? There is no problem when markets for processed goods and labor are competitive, but market failures are prevalent in developing countries, particularly in rural areas. The problems only appear when incomes are compared across rather than within cases and study sites. Also, labor wages among poor people in comparable rural areas are small in any case and unlikely to differ much in absolute terms. What of monopsony rent for processors? In most cases, the measurement of environmental income is much easier when the entire first link is considered; that is, it is easier

to measure directly the income accruing to carpenters or charcoal burners than the income attributable only to the natural inputs they use. Only when processing by extractors is common, and monopsony rent is prevalent in one locality but not another, can a case be made for limiting environmental income only to rent earned from non-processed goods.

The problem is more serious when value added is used to measure environmental income. If processing is common, simple differences in the division of labor—some processors extract their own raw materials while others purchase them—may generate substantial variation in environmental income. And this will apply even when markets are competitive.

Income earned through "the first link in a potentially extended market chain" refers to income earned by the extractor through consumption or exchange of the extracted good. But the first link in the market chain in this context refers to the first link involving consumption or transformation of the natural capital. Thus multiple sales of the same forest or fishing right, or the acquisition of licenses for timber harvesting and fishing, do not represent links in this chain. In some countries, gate receipts from national park visitations are gathered centrally by government before being partially redistributed to communities located adjacent to the park. This is environmental income. But the wages paid to the tour guide or the waiters at the park lodge are not.

Competitive markets may provide a theoretical justification for limiting the concept of environmental income to rent realized through the first link of a market chain only. But the advantages of such a delineation lie in the resulting linking of environmental income to only those who have direct access to natural capital and in the ease of measurement that this entails.

Costs

Natural resources not only provide income, they can also generate costs. A typical example is when wild animals cause damage to crops or livestock. Although the damage affects agricultural or pastoral activities, its source is natural capital and the costs should properly be deducted from environmental income.

More generally, conflicting interests with respect to the use of natural resources may mean that one person's revenue is another person's cost. In a typical case, tree cutting by local inhabitants may significantly reduce the value of a forest environment to visiting tourists or of the water available to downstream users. Should such "costs" also be deducted? No, they should not, because they arise through the absence of the natural capital rather than its presence. The same logic applies to rights and their absence. Costs should not be deducted simply because of an absence of rights to use natural capital—whether such a lack of rights is due to the establishment of a national park or the imposition of fishing quotas.

On the other hand, the imposition of duties, such as compulsory fencing, will lead to relevant costs. In all cases, the relevant question is: What are the costs and benefits attributable to the presence of the natural capital compared with a situation where it does not exist?

In this regard, a particular problem arises when the presence of natural capital and environmental goods deprives locals of alternative livelihoods. An obvious example of this is when protected forest areas preclude conversion to agriculture or pasture. Under

many circumstances, forests may in fact represent a net loss of wealth for local populations. The counterfactual here—an absence of forest and instead an alternative land use—will most often be impossible to measure with any accuracy, although numerous valuations make the attempt. The problem of natural capital as an obstacle rather than as a source of benefits must, however, always be kept in mind.

Finally, any attempt at limiting environmental income to that which is earned sustainably would be meaningless. This is not because of the measurement problems involved in separating sustainable and non-sustainable components of natural resource extractions. Rather, as noted above, the relevant comparison is with a situation where the natural capital is absent, not a situation where it is used or managed sustainably.[3]

The Definitions

Based on the above deliberations, a definition of environmental income as rent is as follows:

Environmental income is rent captured through exchange or consumption of natural capital within the first link in a market chain, starting from the point at which the natural capital is extracted or appropriated.

The corresponding definition of environmental income as value added is very similar:

Environmental income is the capture of value added in exchange or consumption of natural capital within the first link in a market chain, starting from the point at which the natural capital is extracted or appropriated.

Neither these nor any other definitions will be "perfect" or optimal under all circumstances. Since the use of the value added definition may entail substantial variations in income estimates simply through minor and random differences in production processes and supply chains, *as a default we recommend the use of the rent definition*.

Use of value added may, however, be warranted under certain circumstances: when a lack of labor markets renders the measurement of labor costs impractical or when production processes, supply chains, and the division of labor in processing are largely homogenous across the population being studied.

The Forest-Related Environmental Income and Poverty Link

It has long been argued that environmental income is relatively more important for the poor, and—as a corollary—that overuse and degradation will hurt the poor more than other groups. A second and more controversial corollary is that the poor might be hurt more by strict environmental conservation as well.[4]

In the case of non-timber forest products (NTFPs), Neumann and Hirsch (2000) note the "overwhelming evidence that the poorest segments of the societies around the world are the populations principally engaged in NTFP extraction." The apparently close association between environmental income and poverty needs to be considered, however, in terms of types of environmental income, absolute or relative dependence, the relation to household and contextual factors, and more generally the role of environmental income in livelihood strategies. For the purposes of this paper, the focus in this section is on forest income.

Types of Benefits and Stakeholders

Forests provide a wide range of benefits to poor people (see Table 2.1) .

Table 2.1 describes four major types of benefits. First, converting forests (temporarily or permanently) to agricultural land can be one of the most valued benefits locally. Shifting cultivation represents an intermediate case between permanent conversion and conventional forest products, where soil recuperation and fertilization through biomass burning and decay are essential forest services. Forests also can provide other non-land inputs to agriculture such as arboreal fodder and forage, as well as non-consumptive inputs such as shade, windbreaks, and contour vegetation.

The case studies we reviewed focused, however, on the more direct forest products—the second and third categories in the table. NTFPs cover a wide range of products from fruits and wild meat for subsistence uses to commercial products such as rubber and para nuts. The timber category covers everything from small-scale timber (such as poles and building material) to industrial timber. The indirect benefits of the final category—on-site ecological services (excluding payment for off-site ecological services)—can be important, but little is known about their magnitude.

Table 2.1 Importance of different forest benefits to various groups of beneficiaries

	Types of economic benefits			
User groups	*Agricultural land and other inputs in agricultural production*	*NTFPs*	*Timber*	*On-site ecological services*
Forest dwellers				
Hunters and gatherers	Minor benefit	Main benefit	Supplementary if transport access exists	Variable, but normally important
Shifting cultivators	Main benefit	Important supplement		
Farmers living adjacent to forests				
Smallholders	Major "land reserve"	Supplementary	Supplementary if transport access exists	Variable
Landless	Not important	Important supplement		
Commercial users				
Artisans, traders, small entrepreneurs	None	Important	Important	None
Employees in forest industries	None	Supplementary	Main benefit	None
Consumers of forest products				
Urban poor	None	Some "pro-poor" products	Variable	None

Source: Angelsen and Wunder (2003), with user groups based on the classification of Byron and Arnold (1999) and with the addition of the "consumers of forest products" category.

Forest dwellers depend directly on a wide range of forest products for their existence. For the farmers living adjacent to forests, who are the focus of most of the case studies, forests provide a major agricultural land reserve. They depend on various forest products such as firewood, construction material, medicinal plants, and so on; forests often provide a food reserve to be drawn on in periods of crisis or during seasonal food shortages (before the agricultural harvest). And commercial forest products sometimes also provide an important source of cash. We discuss these uses later.

A third user group consists of those whose main occupation is based on forest products, either small-scale operators (such as artisans and carpenters) or those employed in timber extraction for downstream activities. Under the definition of environmental income in the previous section, most of the income of these groups should not be classified as forest income. This, combined with the limited focus given to these individuals in the studies reviewed, meant that we did not deal much with these beneficiaries. The last group, poor urban consumers who depend on forest products such as firewood and charcoal, is also not dealt with much here.

Roles of Forest Income in Rural Livelihoods

Income diversification is a distinguishing feature of rural livelihood strategies in poor countries (Ellis 2000: 4). Most households thus manage a broad portfolio of activities and income sources. Subsistence and cash incomes from "non-cultivated forest-related resources" complement other sources, with a continuum running from households that depend almost entirely on these incomes to those that basically do not depend on them at all.

The reasons for diversification are several, and their relative importance is controversial. The standard argument of diversification as a risk-reducing strategy is questioned by Dercon (2000). First, income diversification will tend to reduce expected income; second, because fluctuations in income sources tend to be covariant, diversification is not a very effective risk-reduction means. Thus relatively little income smoothing is achieved at the price of reduced mean incomes. Diversification should instead be understood in terms of the constraints poor households face. No single activity is sufficient, so people have to get involved in "whatever is there" to make it add up to a reasonable living. Following this line of argument, income growth due to the emergence of one or a few high-return activities should result in less diversification.

Diversification should further be understood in term of the seasonality of different activities. Further, the absence of well-functioning markets also necessitates "diversification": the high transaction costs (purchase and sales price wedges) mean farmers try to achieve self-sufficiency in food production, and thereby more diversification. On the other hand, the absence of labor markets will shut down one possible avenue of income diversification for households and can make environmental income-generating activities become more interesting.

One lesson from this is that environmental income must be assessed in light of the role it plays in the total portfolio of activities. Following Cavendish (2003), we might distinguish between three different functions of forest income in rural livelihoods:

- *Safety nets:* Forest products are used to overcome unexpected income shortfalls or cash needs.

- *Support of current consumption:* Forest products are important to maintain the current level of consumption and prevent the household from falling into (deeper) poverty. This role would largely correspond with the term "coping strategy."
- *A pathway out of poverty:* Forest products provide a way to increase household income sustainably (poverty reduction) either through a "stepping out" strategy (accumulation of capital to move into other activities) or a "stepping up" strategy (intensification and specialization in existing activities) (cf. Dorward and Anderson 2002).

These three roles are of course interlinked, and particular products can serve the three functions simultaneously. The distinction is, however, useful to clarify the role environmental incomes can and do play in poverty alleviation. The functions and descriptions of the three roles are provided in Table 2.2.

Safety Net

The safety net function refers to the role forests can play during periods of hardship. We choose a rather narrow definition of safety nets and relate it to the more unpredictable and irregular events that cause a temporary need for extra income (either shortfall of other incomes or extraordinary cash needs). Examples of such emergency events include family illness or death, natural disasters, economic crisis, and civil war.

We do not use this term for the normal seasonal gap-filling functions that forests products often play, in particular before the main agricultural harvest. A third common usage of forests, which we also do not classify as safety net in this paper, is as a more regular income source for the

Table 2.2 Direct roles of forests in household livelihood strategies

Poverty aspects	*Function*	*Description*
Safety net	Insurance	Food and cash income in periods of unexpected food and income shortfall
Support current consumption	Gap-filling	Regular (seasonal, for example) shortfall of food and income
	Regular subsistence uses	Fuelwood, wild meat, medicinal plants, and so on
	Low-return cash activities	A wide range of extractive or "soft management" activities, normally in economies with low market integration
Poverty reduction	Diversified forest strategies	Forest activities that are maintained in economies with high market integration
	Specialized forest strategies	Forest activities that form the majority of the cash income in local economies with high market integration
	Payment for environmental services	Direct transfers to local communities from off-site beneficiaries

Source: Classification based on Arnold (2001), Kaimowitz (2002), Angelsen and Wunder (2003), and Belcher, Ruiz-Perez, and Achdiawan (2003).

poor who otherwise have few alternatives. It saves them from being even poorer.

The role of forests as a safety net depends on the household's vulnerability—that is, both the probabilities of being exposed to such events and the existence of other safety nets. Many forest-dependent people have little access to credit and limited options in terms of formal sector employment. In these cases, forest products can be an important "natural insurance" against, for example, agricultural shocks (Pattanayak and Sills, 2001).

Measuring the role of forests as a safety net raises several difficult issues. Using average annual income (absolute or share of total household income) will not fully capture this role of environmental income. Availability and timing are key for assessing the safety net role. Ultimately, safety nets help people survive. Further, forest income can be used to accumulate capital and build up other safety nets (as well as income sources), such as buying cattle or sending a son to the city to work.

Support of Current Consumption

The second function of forest income in rural livelihoods is its regular uses in support of current consumption, but with no or limited scope of lifting people out of poverty. Three different sets of activities can be distinguished in this case.

Seasonal Gap-Filling
Forest products are most extensively used to overcome seasonal food shortfalls—that is, before the main harvest. "The importance of forest product income is usually more in the way it fills gap and complements other income than in its absolute magnitude or share of overall household income," note Byron and Arnold (1999: 792). Also, on the subsistence-use side, the authors note that "forest products seldom provide the staple, bulk items that people eat" (1999: 792).

The gap-filling function is distinguished from the safety net function by its regularity and higher predictability. For example, some forest fruits are harvested each year in the months between staple harvests. They fill a gap in the sense that they provide a periodic and reasonably predictable contribution to food security, serving as a "seasonal buffer."

The gap-filling function raises measurement problems. Ideally, any valuation should take into account that during slack seasons the opportunity costs of labor are lower and the value of extra income is higher than in the rest of the year.

Regular Subsistence Uses
Moving a step further, the category of "regular subsistence uses" includes forest uses that are done more or less continuously throughout the year. Most forest products are consumed directly. This is not included in official statistics and has therefore been referred to as the "hidden harvest." It is particularly important with regards to firewood, fodder, wild food (including meat), and medicinal plants. In some areas with good forest access, the contribution can be as high as 30–40 percent of total income (cash and subsistence).

FAO estimated that in the mid-1990s some 2 billion people used fuelwood (firewood and charcoal) as their main or sole source of domestic energy.[5] Although not all of this comes from forests, fuelwood is probably the forest product with the largest number of direct users. This subject received some attention following alarming reports in the 1970s about a global fuelwood crisis, but governments, private firms, and donors have largely ignored fuelwood since then. Yet it continues to be important to the bulk

of rural households in developing countries, and an increasing number of them face fuelwood shortages.

A recent literature survey by Arnold and others (2003) shows that fuelwood's commercial role can also be significant. In peri-urban areas of Sub-Saharan Africa, tens of thousands of poor farmers and small traders supplement their incomes by selling fuelwood. Sometimes this activity even becomes their main source of cash. Notably, this includes also the poorest of the poor; for instance, many rural landless people are among those specializing in fuelwood production.

The wild food used regularly includes literally thousands of different species: fruits, roots and tubers, mushrooms, and so on. These provide important vitamins and complement regular staples such as rice or maize. Wildlife also provides a large share of the calories and protein of rural households, particularly in Central and West Africa, the Amazon, and Southeast Asia. In more than 60 countries, wildlife and fish contribute more than 20 percent of the animal protein in rural diets.

In the early 1980s (the most recent data available), the World Health Organization estimated that 80 percent of people in developing countries met their primary health needs through traditional medicine, mainly with some 10,000–20,000 different medicinal plants. The role of these plants, a large share of which comes from forests, has been ignored in the international debate on health and poverty, probably reflecting western "scientific" approaches to health and ignoring indigenous knowledge and use of these resources.

Low-Return Cash Activities

As noted, rural households are normally involved in several activities, and forest products play an important role in such diversified livelihood strategies. Many of the forest activities (collection of honey, meat, nuts, and so on) are, however, low-return activities. Why? There are two sets of answers to that question. The first one deals with why poor people get involved in such activities; this is addressed in the next sub-section.

The second answer deals with why many (if not most) forest activities yield low returns. Natural forests are often economically inferior production environments (Angelsen and Wunder 2003). Low per-hectare densities of commercially valuable species imply that extraction tends to be spread over large areas, triggering high costs and low net returns. There are also characteristics of the products, especially extractive products, that put producers at a disadvantage. They are commonly collected in de facto open access situations. There are sharp seasonal and other fluctuations in supply due to the phenology of plants, migration patterns of animals, or fluctuating climatic conditions. Many have heterogeneous quality and are highly perishable.

Further, forest product trade is often characterized by monopsonies and exploitative marketing chains. The heterogeneity and quality differences of some products, combined with a lack of well-defined standards, encourage intransparencies and manipulations. Perhaps most important, the remoteness of many forest communities reduces their level of information about changing end-use prices and their bargaining power in relation to the few traders who are commercializing low volumes. Finally, limited growth in the demand for many NTFPs, both over time and with rising income levels, restricts the options for expanding producer incomes. If producers increase supply, the

downward pressure on the price might actually reduce their combined income.

Poverty Reduction

The third function of forest income in rural livelihoods is poverty reduction. Again, three different sets of activities can be distinguished.

Diversified Forest (cash income) Strategies
Although most forest activities yield low returns, and therefore are more significant for poverty prevention than poverty reduction, some forest products—given favorable conditions—can provide a means of socioeconomic advancement. The Center for International Forestry Research (CIFOR) has done a worldwide comparison of 61 cases of commercial NTFP production and use. The cases were then broadly classified, based on two dimensions (Belcher, Ruiz-Perez, and Achdiawan, 2003): the importance of the product in local livelihoods (the income from the product in percent of total household cash and subsistence income) and the degree of integration into the cash economy (the percentage of total household income earned in cash).[6]

Using a cut-off line of 50 percent for both dimensions, three categories emerged:[7] The first category is *the subsistence economy*, with low product contribution and low integration in the cash economy. (This is not a subsistence economy in the conventional sense, as all cases have some cash income from the forest product and possibly also other sources.) This would to some extent overlap with the category we have discussed already—low-return cash activities. In terms of geographical distribution, the subsistence strategies are associated with Sub-Saharan Africa. In general, they have lower trade volumes and less income, but also growing populations and market demand that are increasing pressure on the resource.

The second category is *the diversified economy*, with low product contribution and high integration. In this case, forest activities are maintained even in situations with a high degree of market integration (more than 50 percent of the total income is in cash, and forest cash income is one among several cash sources). This suggests that the forest activities are able to compete with other cash income-generating activities. The diversified economies are found in Latin America.

The third category is *the specialized economy*, with high product contribution and high integration, as discussed in the next section. The specialized strategies are associated with Asia.

Specialized Forest (cash income) Strategies
In the specialized economy, households have focused on one particular forest product. The CIFOR study shows that the average income for such households is significantly higher (34 percent) than the average local income (there is no significant difference in the two other categories). This indicates that forest product specialization can be a pathway for poverty reduction.

The specialized economy is further associated with a number of favorable conditions: a high value-weight ratio for the product, stable product market and household involvement in NTFP production, less product adulteration, stable populations of target species, and—interestingly—a lower incidence of customary rules. It is also associated with more intensive management, but this can either be by domestication (plantation) or from managed forests. Plantation products are found in only

one-third of the specialized cases, but they are associated with higher prices and productivity.

Payment for Environmental Services

Forests provide important services to both local on-site forest dwellers (clean drinking water, for example) and off-site beneficiaries, such as regional users (downstream water benefits, for instance), national users (urban tourists), and global stakeholders (through valuing the existence of endemic biodiversity). Probably the highest poverty reduction potential is through payments for the off-site benefits enjoyed at the regional, national, or global levels. Currently, most off-site beneficiaries are "free-riders": they don't pay. Hence a poor forest community that owns a forest has no incentive to take this service provision actively into account in its land use decisions. Thus when land becomes scarce, the service may eventually be lost.

Compensation mechanisms are relevant in at least four areas: carbon storage and sequestration, biodiversity conservation, hydrological services, and forest-based tourism. We will not go into details for these, but refer to overviews such as that by Landell-Mills and Porras (2002).

Generally, there is ground for some optimism that forest-service payments can help reduce rural poverty. Not only do they offer an additional flow of income, the flow will also tend to be more stable over time than the ones it is designed to replace, such as the fluctuating prices of timber and cash crops. In addition, the introduction of payments can also help induce indirect benefits, follow-up investments, and external assistance, such as training, improved community organization, better knowledge about forest management, improved environmental quality, better understanding about urban markets for other products, and so on. Finally, international markets for ecological services provide a mechanism for long-term investment flows from the North to the South. Even when the direct payment recipients are larger landholders, the transfer can eventually also provide indirect benefits that trickle down to the poor (Angelsen and Wunder 2003).

A key question is to what extent poor people will be able to compete in emerging service markets. Two comparative disadvantages of the poor are their insecure land tenure and the high transaction costs generated by small communities, poor infrastructure, and imperfect markets. Additional constraints for poor people can arise if there are entry costs into the schemes or if agreements imply long-term, inflexible land use commitments (Pagiola, Bishop, and Landell-Mills 2002: 282–84).

The Poverty–Forest Dependence Connection: A Two-Edged Sword?

Poor households often display "forced diversification," with multiple occupations. Activities typically include low-income forest-based actions such as wildlife hunting, charcoal production, fish smoking, tobacco curing, and the gathering of fuelwood, poles, fruits, vegetables, and so on. These prove to be "low skill and open access activities" with low returns. That poor people take them on may relate to asset stakes, barriers to entry in certain factor markets, lack of access to resources, and more general rights issues. Forest-based activities thus attract poor households. "Ease of access to the resource and low skill and capital thresholds to commercial forest product activities means that these can be very important in coping strategies of the very poor," notes Arnold (2001: 3). There is overwhelming evidence that the poorest households depend

relatively more on these low-return forest activities, as will be shown in Chapter 5.[8]

What is the causal link? Are they forest-dependent because they are poor, or poor because they are forest-dependent? We would argue that the causality runs mainly in the first direction: low-return activities—in forestry or other sectors—become an employment of last resort for poor people.[9] Forest dependence is a function of their poverty: the poor do not have access to more lucrative income opportunities, and low-return activities become the best possible use of their labor. For the better-off, on the other hand, low-return activities are not attractive.[10]

Based on this, it can be argued that the prime importance of forest products is with respect to providing a safety net and a means to maintain current levels of income, not a pathway out of poverty. There might, in fact, be a tradeoff between these roles. According to Angelsen and Wunder: "A key insight for the forestry-poverty discussion from the literature is the ambiguous role of NTFPs. The very same characteristics that make them important and attractive to the poor in the first place also limit the potential for further income increases" (2003: 25).

The authors also point out that efforts to increase the value of NTFPs that the poor depend on might be counterproductive: more valuable resources might be captured by the rich, scarcity can cause internal differentiation and development of individualized rights that exclude the poorest of the poor, higher value might lead to overexploitation, and domestication and synthetic products might be stimulated and replace collection from the wild.

Even if NTFPs do not provide a major way out of poverty, they should not be understood as the activities that generate poverty. People seek these activities because they do not have many other options; as such, the activities are important for poor people's survival and livelihood. Thus NTFPs should not be seen as a poverty trap, unless "alternative development options actually exist but . . . policies, donor projects or other external interventions seek to maintain people in their low yield forest extraction activities" (Angelsen and Wunder 2003: 24).

This does not mean that all forest activities are low-return ones with poor prospects for socioeconomic advancement. Some activities are different, and where the right conditions are in place (resource base, skills, market access, and so on), specialization strategies can make households better-off (Belcher, Ruiz-Perez, and Achdiawan, 2003). Further, well-to-do households do diversify by incorporating environmental incomes in their portfolios. The products sought and the level of division of labor achieved in their pursuit does, however, tend to be much greater. Such environmental activities could include semilegal timber extraction and trade, pole production, and intermediary activities for NTFPs.

It may thus be possible to identify poverty prevention strategies as those of less well-to-do households, where motives related to insurance, gap-filling, and coping strategies prevail. For those better-off, the strategies would be seen as various types of more and less specialized forest strategies, enterprise, and industrial activities (Angelsen and Wunder 2003).

Other Conditioning Factors of Forest Dependence

A number of factors at household and community level and beyond may have an

impact on the role of environmental incomes for rural households. (Appendix A considers how these variables, and others, can be applied in measuring and explaining variations in environmental income levels and dependence.)

Household-Level Factors

Age can affect forest dependence in several ways. Many studies document that young people depend more on forest resources. Collection of valuable forest products can be part of an accumulation strategy to establish a household. Young households can also be clearing more forest to build up a sufficient amount of cropping or pasture land. Older households may have less time and physical strength for forest work. At the same time, our experience is that some young people consider forest collection old-fashioned. They may also lack the necessary skills.

Education is expected to be negatively correlated with forest dependence, for similar reasons as poverty (income level). Better-educated households have access to a wider range of income opportunities and would therefore not find it sufficiently rewarding to get involved in forest activities. It might also be a cultural factor, as with age: Going to the forest is considered backward and not for the well-educated.

Ethnicity and place of origin can be important determinants of forest dependence, but not in a straightforward manner. In some contexts, migrants do not have access to forests or they lack the necessary skills, experience, and tradition of forest product collection. In others, they might be restricted from other opportunities (use of arable land, in particular) and may therefore resort to forest products as "employment of last resort."

A general finding in rural household surveys is that female-headed households are poorer than male-headed ones. It is worth noting, however, that female heads of household in most cultures are widowed or divorced, or their husbands are working far away. Thus the adult labor force is typically smaller. In a study from Malawi, for example, Botha (2003) finds that the average income of female-headed households is significantly lower. In a regression analysis, however, controlling for other household factors, the dummy variable for sex of household head was no longer significant.

Community-Level and Contextual Factors

Beyond the individual and household level, a number of factors at the village, district, or even national level are important determinants of forest dependence. In total, these establish how interested households are in environmental income opportunities and thereby their dependence on them. Such broader issues must be considered for any meaningful description and explanation of adaptations concerning environmental income at individual and household level. Unfortunately, many studies are done in only a few villages and do not have sufficient variation to allow for a useful analysis of these variables.

The availability of forest and environmental resources will vary substantially, for instance, defining the potential production possibility set for the household. There is obviously a big difference in resource access in montane moist forests in Nepal or Tanzania compared with suburban areas around Khartoum, Sudan, in terms of both types and amounts of products. Furthermore, the ecological variation also defines the agroecological conditions that have an impact on income possibilities in agriculture

and therefore the need to resort to forest products.

Having good access to markets has ambiguous effects on forest dependence and is also correlated with other factors such as forest availability and population density. In general, we would hypothesize that good market access implies less forest dependence, as alternative income opportunities are better and forest availability lower. But in some cases the opposite might be true, as exemplified by the specialization strategy discussed above. Specialization in high-value forest products requires good access to markets.

The population-environment nexus and the Boserup versus Malthus debate are important topics in the environmental arena. In high population density areas, fewer resources per capita are likely to be available from which environmental incomes can be drawn. Further, high-density areas can be expected to have better infrastructure and market access as well as a greater number of other income-generating activities, also pulling in the direction of lower environmental income dependence.

There is an extreme variation in legal frameworks regulating access, withdrawal, maintenance, monitoring, and control rights over environmental income resources.

Communities close to protected areas are in quite different positions for generating environmental incomes than communities close to forest plantations or those with access to common property resources (CPR) or to open access areas. Tenurial rights and degree of landlessness have an impact on the level of dependence on forest resources. Because of poor people's particular dependence on environmental incomes, the management of CPRs seems to hold an important role in Poverty Reduction Strategy Papers.[11]

Countries have different administrative, policy, and legal frameworks that affect access to resources. Concessions rights, the degree of local participation, and the amount of land under different types of protection all have implications for levels of and dependence on environmental income.

Local social institutions regulate access and possibilities to generate environmental incomes to some extent. Furthermore, knowledge about possibilities for environmental incomes often varies among local ethnic groups. It is observed that groups "emanating from the forest" tend to have a much broader array of products and interests in the forest than agricultural people living in the lowlands, as can be seen, for example, in a study from Tanzania (Sjaastad and others 2003).

3 Methodology of Meta-Study

This chapter looks at various methodological challenges related to the two objectives of this study, including sources of information, the selection of cases, representativity, and the use of models.

Sources of Information

Within the limitations provided by the selection of cases criteria below, the general approach was to include studies that could contribute quantitatively to our understanding of dependence on forest-related income in developing countries. We selected 28 studies from various international research institutions. Twenty studies were theses written at the Agricultural University of Norway (NLH). And we have included three consultancy reports. We do not pretend to have made a complete review of all quantitative studies done outside NLH.

The studies were found through various Internet sources and databases, including Tropag and Rural, ISI Web of Science, CAB Abstracts, Eldis, World Bank, FAO, and the Overseas Development Institute. We have also used Internet search engines such as Google. And we used the 2,680 Fulltext journals subscribed to by NLH when searching by means of keywords such as environmental incomes, forest environmental incomes, and dependence on forest environmental resources. Getting access to and overview of potential cases in this way was thus a first step in the final selection of cases.

Selection of Cases

Generally, we used the following criteria for the case study selection:

- The case had to include registered household environmental income and preferably also incomes from other sources.
- The case had to have registered other aspects relevant to the households' productive capacity, such as assets, factors of production, and sociocultural information.
- The case had to have some information about contextual variables of various types, as described in Chapter 2.

Due to one of the main objectives of this report, we also wanted a mix of different types of research, theses, and consultancy work. We needed variations on type of study—economic valuation studies or different types of household adaptation studies. We also wanted a focus on studies from Africa, but with some cases from both Latin America and Asia.

These efforts and criteria gave us the sample of cases included in this study (see Appendix B).

Description of Sample

Our meta-analysis is based on 54 case studies from 17 countries. The cases display great

variation in terms of ecological, sociocultural, demographic, political, and economic environments. The sample is dominated by African cases: 15 are from East Africa, 18 from Southern Africa, 14 from Asia, and 7 from Latin America. This African dominance should be kept in mind when interpreting the results. The cases are about evenly drawn from wet, semi-wet, and dry forests (see Table 3.1).

Some key household characteristics and contextual properties of the cases are presented in Table 3.2. The communities and households in our meta-study were generally rural dwellers, mostly farmers with some access to forests. Most of them were poor in terms of income levels; they had low education levels and hardly any access to capital. The households in our cases had on average 5.5 years of schooling, a typical feature of rural dwellers in poor countries. Enrolment rates in secondary and post-secondary education were low, with 26 percent of households attaining secondary education and only 4 percent attaining post-secondary education. Low education levels typically indicate that the households are excluded from large segments of the labor market.

The average household size for the cases was 5.9 people, also a typical level for poor rural countries. The average annual income for these households was US$3,043 (adjusted for purchasing power parity (PPP)), which gives a per capita income of US$513. This compares to the average US$675 for the countries represented in the survey (simple average). Together with the fact that most of the environmental incomes were not included in the overall figures, this suggests that communities included in the samples had average incomes well below the national averages.

The average land holding was 1.8 hectares. Small plots constrain households in crop and livestock production and make other alternatives more attractive, including exploitation of forest environmental resources.

Livestock numbers were reported to be low, with an average of 4.3 tropical livestock units per household but with large variations in the sample. The low number is puzzling, given that many rural poor commonly depend heavily on livestock production. It could indicate that livestock represent a significant investment outside the reach of many poor households. Our results still indicated that livestock contribute significantly to total household income.[12]

As a result of having little land and low levels of capital and education, the sample households were more likely to allocate labor to enterprises

Table 3.1 Distribution of cases by region and forest type

	Region				
Type of forest	*East Africa*	*South Africa*	*Asia*	*Latin America*	*Total*
Wet forests	4	2	7	5	18
Semi wet forests	7	4	3	0	14
Dry forests	4	10	2	0	16
Not specified	0	2	2	2	6
Total	15	18	14	7	54

Table 3.2 Household characteristics and external factors in sample

Household and external characteristics	*Total sample*	*Studies included*
Age	40.7 years old	14
Size of household	5.9 persons	41
Education level	5.5 years of school	26
Livestock	4.3 tropical livestock units	9
Land size	1.8 hectares	20
Total income	US$3,043	48
Cash income	US$1,633	18
Gross domestic product of country	US$684	51
Elevation	1,219 meters above sea level	30
Precipitation	1,062 millimeters per year	34
Distance to market	19.5 kilometers	13

such as forestry, fisheries, and unskilled wage work. These have small barriers to entry and may not require much education or high levels of capital inputs—that is, they have some of the "employment of last resort" characteristics discussed earlier.

The households in our case studies reported that they allocate their resources to crop production, livestock rearing, forest environmental activities, and off-farm work. Off-farm activities included retail trade, wage labor, brewing, and tailoring. Forest environmental activities typically included animal hunting; grazing; gold panning; gathering a number of products such as firewood, thatching grass, wild fruits, vegetables, rattan, wild medicine, insects, timber, and poles; and making baskets, mats, and crafts.

Representativity and Sources of Bias

The meta-analysis should be broadly relevant for poor rural populations in developing countries living adjacent to forests who rely on these for some but not all of their livelihood. Obviously, however, even within this category there will still be substantial variations in the relationship to the forest as well as other socioeconomic variables. Indeed, one purpose of the study was to investigate how forest-related income depends on these variables.

For the first objective of the study, the selection of cases may have an impact on the "levels of dependence" on forest-related incomes. There may be biases relative to continents, countries, or ecological zones. This problem can be controlled through the use of contextual variables whenever these are available. Within each case there may also be substantial biases.

Given the broad sampling of cases, several sorts of bias are possible. Of course, we had no control over the locations that writers chose to concentrate on, and this may naturally have caused a geographical bias within a country or region. There may also have been a tendency among researchers to select study areas in which NTFPs or other forest goods are of particular importance, and this may bias results

toward high levels of environmental income and dependence. Thus it is not appropriate to claim that the findings are representative of "rural areas in developing countries." In addition, there were the numerous flaws committed during field work or analysis within the studies themselves, which may bias results; these are discussed in detail in Chapter 5.

The variability is also reflected within the meta-sample in the means arrived at in the separate cases. While the sample averages for annual income earned from agriculture and off-farm activities were US$1,499 and US$1,038 respectively, several studies reported no such income. Although sample average household size was 5.9, it ranged from 3.8 to 8.5. Sample average farm size was 1.8 hectares, but this ranged from 0.2 to 3.7 hectares, with a standard deviation of 0.9.

Given the high variability in sociocultural and socioeconomic conditions, results from tests that rely solely on variability across cases rather than within them must be treated with caution.

Another type of bias lies in the selection done by the case study authors themselves. If the purpose was to investigate the role of forest-related income, or even to prove that environmental income is important to poor people, it is likely to be a selection bias in favor of communities where this is important. Again, the findings are therefore not representative of "rural areas in developing countries."

For the second objective of this study, the selection of cases could be biased relative to the totality of studies and the approaches selected in the "worldwide portfolio of studies." The composition of studies from different types of research and development environments and the types of approaches was most likely somewhat biased in favor of university and research work compared with consultancies and donor-funded assignments. It was hoped that some of the typical research biases and faults are less frequent in the former types of studies, but they are certainly still around and they deserve attention.

Methodology

The variables used (see Appendix C) were selected through a perusal of the cases as well as other meta-studies, in particular the one by CIFOR described in Belcher and Ruiz-Perez (2001). The final set of variables represents, to a large extent, an amalgamation of those found in the different cases. As objectives and approaches vary between studies, the degree to which each case will supply information on the selected variables differs considerably. In some cases, such as rainfall, it was possible to find missing information through other means or through calculation based on existing information. In most cases, however, we were left with missing observations for some of the variables, even for quite crucial information. This was a serious problem in the present study, as it is for most meta-studies of this type.

We also looked at what we have called contextual factors. These are beyond the immediate control of households but may influence levels of total income, environmental income, and dependence on the latter.

In order to approach our second objective of making recommendations on "best practices" for empirical studies on this subject, we had to identify variables that would describe the type of theoretical and methodological framework used in a particular study and that might influence the quality of results and analysis. These issues are discussed in more detail in

Chapter 5, where we present some of the factors we tentatively expect to be important.

Researchers from different disciplines are doing research on the economic importance of natural resources on people's livelihoods. We thus found studies on "dependence on environmental income" to be a meeting ground for a variety of methods, with no consensus on how to approach estimates and analysis of environmental usage and income. Meta-studies therefore have to deal with research conducted under different scientific frameworks. In addition to more overarching considerations, there are also a number of methodological issues where studies will differ.

Models and Statistical Analyses

Possible measures and procedures for use in analysis of forest-related income and dependence on such incomes are presented in Appendix A. Most of these, however, are more relevant to case studies where households are the unit of analysis, rather than to meta-analyses such as ours, where cases—communities or regions—have been the focus.

A meta-analysis is, at a fundamental level, more attuned to study differences across communities than differences within them. For an analysis of the latter to be possible, the cases on which the meta-study is based must provide indicators and aggregate variables that permit comparisons of intra-case variations. Examples of such indicators—diversification indicators and income inequality measures, for instance—are also described in Appendix A.

Some of these variables are of such basic importance that we would expect them to be present in the vast majority of cases. Unfortunately, this is not the case. In addition to pointing up fundamental flaws in the methodology applied, however, this may also create problems for meta-analysis of the type conducted in this study. As the range of variables supplied by each case will vary, each test will be based on different samples. Thus, for example, a test of how environmental income dependence is influenced by overall income levels may be based on a different sample than an analysis of the role of income inequality. This is particularly a problem when some cases contain values that represent "outliers" for some variables. This needs to be borne in mind when interpreting the results, and we also keep this problem in mind in the analysis in Chapter 4.

The statistical analyses have been done using SAS/JPM and Stata.

4 Income from Forest Environmental Resources

This chapter presents the results of the meta-analysis. The first section looks at the magnitude of forest environmental incomes and the dependence on them, and how these are conditioned by household specific variables (averages for cases) and contextual variables. The second section considers the distribution of forest environmental incomes, both between cases and between households. The final section looks at the relationship between forest environmental income and degree of diversification.

What is the Level of and Variation in Forest Environmental Income?

This section looks at forest environmental income compared with overall income, at the key sources of the former, and at how income varies with household characteristics and with factors beyond the control of the households, such as ecological variations, economic factors, legal status of areas, and different geographical regions.

Level of Forest Environmental Income

Table 4.1 gives average shares of total incomes derived from different sectors of production. For the cases studied, agriculture (including livestock) contributed 37 percent, forest environmental activities accounted for 22 percent, while 38 percent was derived from off-farm activities, making these the three main livelihood strategies.[13]

The mentioned activities provided households with both subsistence and cash income, and the

Table 4.1 Average contribution to total and cash income, by sector

	Total sectoral income					*Cash sectoral income*	
Sectors	*US$-PPP (%)*[a]	*Standard deviation*	*Minimum value*	*Maximum value*	*N*	*US$ PPP (%)*	*N*
Agriculture (crop and livestock)	1,499 (37%)	1,792	0	6,455	28	271 (31%)	15
Forest environmental incomes	678 (22%)	791	1	3,459	51	202 (24%)	17
Off-farm activities	1,038 (38%)	1,424	0	6,129	24	176 (43%)	8

Note: [a] The figures represent average household income/year for the cases reporting to have the particular income. Figures in parenthesis are percentage contribution to total income for the samples reporting that income. Thus the percentages do not add up to 100. We have not corrected for the sample size because we do not know if the study excluded income from, for example, off-farm activities because it was small, zero, or outside the focus of the study.

contribution to cash income for these activities is also shown in Table 4.1. Note that the forest environmental income is close to the average of other rural income sources in terms of its subsistence-cash ratio (although some care is needed in comparing these figures—22 versus 24 percent—as the sample for the latter is much smaller).

The households in our sampled cases did acquire substantial forest environmental incomes. As seen from Table 4.1, the average household derived around US$678 per year (PPP adjusted) as forest environmental income out of a total average income of US$3,043—around 22 percent. Removing the three cases with forest environmental income above US$2,000 gives a new mean of US$533, or 19.5 percent of total income. And removing all cases with forest environmental income above US$1,500 gives a mean of US$401, but this was still 20 percent of total income.

There were substantial variations in the level of forest environmental income. The maximum level was US$3,460 per household and year while the minimum was US$1.30. The distribution was quite skewed, with the mean income (US$678) almost twice that of the median (US$346), rendering a skewedness measure of 1.78. The median share of forest environmental income was 18.9 percent, much closer to the average, with the cases ranging from 0.4 to 60.4 percent.

Relationship between Total Income and Forest Environmental Income

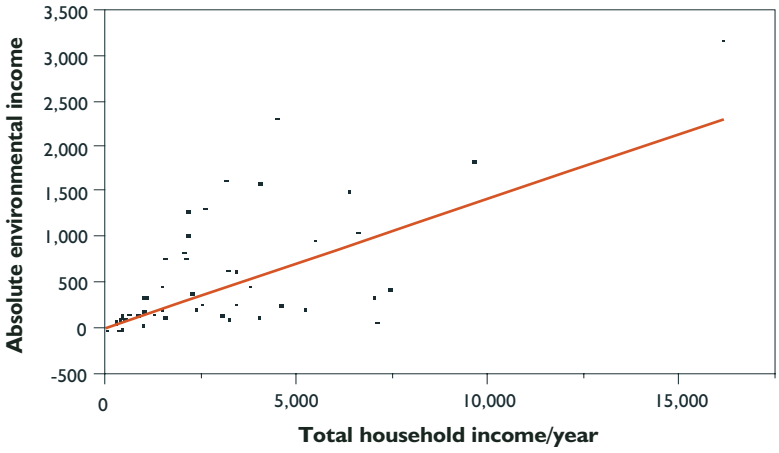
Forest environmental income is closely and positively related to total income. We found that the forest environmental income (AFI) increased with increasing total income (AI). A simple regression analysis (using a log-log model, which gave the best fit) produced the following results (t-values in parentheses):

$$\ln AFI = \underset{(-1.68)}{-1.823} + \underset{(6.93)}{0.987} \ln AI$$

$$R^2 \text{ (adj)} = 0.5005; N = 48$$

Thus the elasticity of forest environmental income with respect to total income was close to unity (see also the next section, on distribution). Inclusion of control variables (region, forest type) did not yield significant coefficients and did not improve the overall fit of the model (adjusted R^2). Omitting the outliers for total income did not change signs or significance. The plot and regression line are found in Figure 4.1.

Figure 4.1 The relationship between total and forest environmental income



Key Sources of Forest Environmental Income

What are the key sources of forest environmental incomes? Wild foods, fuel, fodder, and thatch grass were the economically important resources (see Table 4.2). As discussed earlier, there are

Table 4.2 Distribution of forest environmental income, by source

Source of forest environmental income	*Forest environmental income for cases reporting that source (USD PPP-adj.)*	*Share of total sample income*[a]	*Standard deviation*	*Maximum value*	*Minimum value*	*N*
Wild foods	286.5	38.3	584.4	2,589.4	2.3	20
Fuelwood	215.5	31.7	283.8	1,036.7	1.4	22
Fodder	123.5	5.8	292.9	786.0	0	7
Timber	28.0	2.3	41.6	155.0	0	12
Grass/Thatch	82.5	5.0	76.7	250.0	0	9
Wild medicine	46.5	3.7	78.1	257.3	0	12
Gold panning	6.2	0.2	10.9	26.7	0	6
Others	128.9	13.0	72.6	970.0	0	15
Total[b]	677.9	100.0	791.0	3,460.0	1.3	51

Notes: [a] The share of total sample income is calculated by multiplying mean income (based only on cases reporting the source) with the number of such cases (N), and dividing by the total number of cases (with breakdown into different sources) (51). This is correct if "not reporting" an income source means that it is zero. [b] The total sample income is calculated by multiplying mean income (based only on cases reporting the source) with the number of such cases (N), and dividing by the total number of cases.

good reasons to believe that there was substantial underreporting for a number of sources, including timber, fodder, and environmental services. By adjusting the mean incomes for the number of cases where the different activities were reported, the relative importance of wild foods, fuelwood, and "other sources" increased. Our impression from the review is that many of the studies focused on a limited set of forest environmental goods while neglecting others. The mean income from a particular source, averaged out over only those studies that reported it, may therefore be a more realistic measure of its relative importance than the sample mean (which assumes a failure to report the source is a result of its irrelevance).

Source of forest environmental income Forest environmental income for cases reporting that source (USD PPP-adj.) Share of total sample

Household Characteristics and Forest Environmental Income

How do household characteristics (case averages) correlate with variations in forest environmental income? Gaps in the data prevented thorough econometric analyses. We therefore divided the total sample into three groups of equal size according to the absolute level of forest environmental income—high, medium, and low—and compared them in terms of household characteristics. The characteristics included age of head of household, his or her education level, household livestock units, land size, total income, and cash income. Only the latter two were significantly different for the groups (as described later).

The importance of household characteristics would be better answered by a household-level

analysis than a meta-analysis of cases. While the latter in essence compares averages between different communities, the former will be able to capture intra-community variations, which is surely the more important objective when analyzing household characteristics.

Contextual Factors and Forest Environmental Income

Chapter 2 discussed a number of factors beyond the direct control of households that may influence their willingness and ability to take part in forest environmental income-generating activities. These relate to physical, political, and social constraints to resource access.

Again, the sample was divided into low, medium, and high forest environmental income groups of equal size. Contextual factors considered included forest availability, ecological conditions, market access, overall economic conditions, and demographic conditions (see Table 4.3). The sample data did not permit analysis of legal frameworks and sociocultural conditions.

Only economic and geographical conditions were found to be significantly different between the three groups. A particular note must be attached to market distance, where increasing forest environmental income was found to imply greater distance to markets. This result

Table 4.3 Forest environmental income and household external factors

External factors	*Low forest env. income*	*Med. forest env. income*	*High forest env. income*	*Sample mean*	*Anova test Prob>F*	*N*
Mean forest env. income (USD)	101.6	354.3	1577.8	677.9	0.001	51
Total income (USD)	1,501	3,053	4,905	3,043	0.005	48
Relative forest environmental income	13.9	17.3	37.7	22.0	0.001	48
Elevation (masl)	1,355	1,205	1,103	1,219	ns[a]	30
Precipitation (mm)	1,057	1,063	1,073	1,062	ns[a]	34
Wet forest	6	4	6	18	ns[a]	45
Semi-wet forest	3	6	5	13		
Dry forest	8	5	2	16		
Gross domestic product of country (US$)	459	456	1,147	684	0.0079	51
Distance to market (km)	1.7	19.0	33.5	19.5	ns[b] 1 out; 0.003	13
Human-to-forest ratio	173	86	100	123	ns[b]	17
East Africa	9	5	1	14	[a]Likelihood ratio	51
South Africa	4	6	5	18	prob > chi.sq.	
Asia	4	5	5	14	0.008	
Latin America	0	1	6	7	Pearson > chi.sq. 0.015	

Notes: [a] The chi.sq. test is questionable, as many cells have fewer than 5 counts. [b] Substantial variations and outliers.

was, however, only significant if an outlier was removed, and was based on only 13 observations. The results are discussed in more detail in the next section.

Market Access and Overall Economic Conditions

The mean gross domestic product (GDP) value in the high forest environmental income group was substantially higher than for the other two groups. The causal link may of course run both ways here, but living in a generally vibrant economy will of course imply benefits related to a number of factors such as infrastructure, marketing, credit, and prices.

Forest environmental income seemed to increase with distance to markets. The normal expectation would be that superior market access would improve incomes from forest resources. But other factors correlated with market access were apparently more important. A remote location generally means both more abundance of forest resources and fewer alternative income opportunities. Again, however, this result must be interpreted with caution, given the caveats mentioned earlier.

Demographic Conditions

We had expected that increasing population density would yield lower forest environmental incomes per household. However, the number of people, the area size from which resources are drawn, and the combined human-to-forest environmental ratio did not show any significant variation across the income groups. Three of the studies were done in urban areas with extremely high population densities, but removing these did not yield significant differences.

Forest Availability and Ecological Conditions

Low, medium, and high forest environmental income was not significantly related to the type of forest or woodland studied (wet, intermediate, or dry). We also divided the sample into three different groups based on these types of forest, and we compared overall income, forest environmental income, and forest environmental income dependence between the groups. Only overall income, however, was significantly different, with incomes generally increasing with "humidity." Forest environmental income was not significantly different, while the level of dependence was virtually identical for the three groups.

Possible explanations for these results are that wet forest environments may be systematically associated with more severe restrictions on use, that drier forests may be more accessible, and that major product groups such as fuelwood and fodder may just as easily be harvested from dry environments. Note also the probable underestimation of timber values—which we would expect to be much greater in humid forests—in many of the sampled cases.

Legal and Political Frameworks

The institutional framework is an important conditioning factor for the role of forest environmental income in local communities and also for the income's distribution among households and communities. Many studies reveal ways in which rules and regulations may restrict or facilitate access to forest resources (see Box 4.1).

Our data did not, however, permit any rigorous analysis of legal and political frameworks. In terms of both property and management regimes, only a few cases reported these

Box 4.1
Establishment of Mt. Elgon National Park and the Effect on the Access of Local People to Resources

In 1993, the Government of Uganda decided to convert Mt. Elgon Central Forest Reserve to a National Park. This was part of a larger, donor-supported effort to transform seven of the most valuable forest reserves in Uganda into national parks. With the transfer of this area from the Ministry of Forests to the Ministry of Tourism and Wildlife, rules and regulations for access to forest-related resources changed, as did the authority, goals, and competence of field officers.

A study by Gosamalang (2003) indicates that the conversion had substantial impact on local people's access to forest resources. Important economic activities such as livestock grazing, hunting, and timber harvesting were banned. Gosamalang found that the number of households using the forest decreased from 72 to 30 percent, while the number of households involved in cash income-generating activities declined from 14 to 2 percent. The number of livestock held by local people was reduced by some 50 percent. No initial compensation was offered. Collaborative models are now being tried out to reduce the effects of the change.

contextual variables, and there was too little variation within the regimes being reported.

Region as a Composite Contextual Variable

As seen from Table 4.3, chi square tests between forest environmental income groups (low, medium, high) and region (East Africa, South Africa, Asia, Latin America) yielded significant results, with relatively more cases from East Africa being found among the low-income category, with cases from Latin America tending toward the high-income category, and with the two remaining regions evenly distributed across forest income groups. These results were confirmed when cases were grouped according to region and both total income and forest environmental income were compared (see Table 4.4).

Moreover, Latin American communities were found also to be significantly more dependent on forest environmental income. This result may be due to selection bias in our sample. The Latin American sample was biased toward studies of indigenous people (by Godoy and collaborators, see chapter 5), while the *colonos* (forest clearing in-migrants)—a dominant forest-margin-dwelling group—were not represented in the sample.

Table 4.4 Incomes by Region (number of cases in parentheses)

Variable	*East Africa*	*South Africa*	*Asia*	*Latin America*	*Kruskal-Wallis test (p-value)*
Total income (US$, PPP)	1,697 (15)	2,010 (12)	4,055 (14)	5,676 (7)	0.0017
Forest environmental income (US$, PPP)	219 (15)	766 (15)	573 (14)	1,681 (7)	0.0012
Relative forest environmental Income	16% (15)	25% (12)	18% (14)	35% (7)	0.0168

Note: Regions as follows: East Africa—Uganda, Kenya, Tanzania, Sudan, and Ethiopia; Southern Africa—Zimbabwe, Malawi, Zambia, and South Africa; Asia—India, Nepal, Sri Lanka, and Lao PDR; Latin America—Peru, Bolivia, Honduras, and Nicaragua.

A Closer Look at Forest Environmental Income Dependence

Dependence on forest environmental income can be measured by the share of total income (see Appendix A) or by relative forest environmental income, here denoted RFI. We ranked the cases according to this share and divided them into three equally sized groups: low RFI, medium RFI, and high RFI.

As reported earlier, the relative forest environmental income was 22 percent, while the median was 19.5 percent. Even if the variation between cases was substantial, this finding indicates that there is every reason to take incomes from the environment seriously in research, policymaking, and development planning activities.

The pattern emerging from Table 4.5 is that the low RFI cases were characterized—not surprisingly—by low absolute forest environmental income, but also by above average total incomes. The medium RFI group appeared to be the "most fortunate," in that they had above average forest environmental and also total income. And a large share of their income was in cash. They were also on average located much closer to markets than the other two groups. The high RFI group, who derived some 42 percent of their total income from forest environmental resources, were characterized by much lower total income levels than the two other groups. They also scored lower on household capital indicators such as education and livestock ownership and were on average the group that was furthest from markets. It can also be noted that the medium and high RFI groups did not have very different forest environmental incomes; it was the total income that differed between the two groups.

This pattern could be related to the different strategies discussed in Chapter 2. The medium RFI resembles the diversified forest strategies. Forest environmental activities were maintained in a situation with high incomes but did not constitute the major source of income. The high RFI, on the other hand, could more appropriately be considered belonging to one or more of the three strategies identified as "supporting current consumption."

We also estimated various regression models on the relationships between forest environmental dependence and total income and other household level and contextual variables, but we did not find any statistically significant relationships. The statistically insignificant link between relative forest environmental income and total income should be no surprise. We earlier found the elasticity of total forest environmental income with respect to total income to be close to unity, meaning that the elasticity for relative forest environmental income should be close to zero.

Among household characteristics reported for the samples, only education was significant. Communities with low dependence on forest environmental income had a significantly higher educational level than those with medium or high dependence. This association between high forest environmental dependence and low educational levels was also confirmed when looking at differences between the households (not just cases): several of the case studies found that households with low education tend to depend more on forests than those with higher education levels (see, for example, Aryal 2002, Fisher 2002, and Stoian 2003).

In terms of contextual factors, also provided in Table 4.5, we found surprisingly few statistically

Table 4.5 Distribution of relative forest environmental income, by case characteristics

Characteristics	*Low RFI*	*Medium RFI*	*High RFI*	*Anova test Prob>F*	*N*
Relative forest environmental income (%)	5	19	42	0.001	48
Forest environmental income (US$, PPP)	173	743	837	0.008	48
Total income (US$, PPP)	3,339	3,945	1,846	ns[a]	48
Cash income (US$, PPP)	555	2,861	692	ns[a]	18
Education level (years)	6.4	4.8	4.4	0.09	25
Elevation (meters above sea level)	1,430	1,187	990	ns[a]	28
Precipitation (millimeters/year)	1,386	858	998	ns[a]	31
Wet forests	8	3	5	ns[a]	45
Semi-wet forest	4	4	4		
Dry forests	4	5	5		
Gross domestic product per capita. (US$, PPP)	429	692	497	0.008	48
Distance to market (kilometers)	22	7.9	34.7	ns[a] ; removed 1 case and got 0.002	13
Man-to-forest ratio (people/km$^{2)}$	227	73	87	ns[a] 0.1	17
East Africa	7	5	3	Likelihood Ratio	48
South Africa	1	5	6	prob>chi.sq. 0.02	
Asia	8	3	3		
Latin America	0	3	4	Pearson>chi.sq.0.05	
N	16	16	16		48

Notes: RFI = Relative Forest Environmental Income (forest environmental income as share of total income). [a] Substantial variations and outliers.

significant relationships. Concerning forest types and RFI, we found no significant patterns or even trends. We would expect that communities close to wet forests with high environmental values would tend to depend relatively more on environmental income, but we did not see this in our sample. The economic conditions seemed to affect the dependence on forest environmental incomes. Both the high and low dependence groups were associated with low GDPs. Long distance to markets also seemed to be associated with high levels of dependence. There was a tendency of low RFIs being associated with East Africa and Asia, whereas Latin America and also Southern Africa were associated with higher RFIs.

Population density did not seem to have much impact on the levels of dependence, even if we see that the low dependence group had significantly higher population density, in line with what we would expect.

In a cross tabulation with region and forest type, for the Latin American cases close to 41 percent of the income was derived from forest resources (see Table 4.6). The forest dependence was also higher than average in the Southern African cases. Furthermore, there were smaller differences across forest types than between regions.

The dependence on environmental incomes was generally high and it also varied considerably among cases. Communities with high dependence tended to have lower overall incomes, they were further from markets, they had lower population densities, and Latin America and Southern Africa were over-represented among them. How representative our average findings are for developing countries in general is, however, hard to tell. There are reasons to believe that the sites for many of our cases were selected precisely because forest environmental goods were assumed to be important. We take this discussion a step further in Chapter 5.

What is the Distribution of Forest Environmental Income?

How does forest environmental dependence change with total income? We analyzed this at two levels. First we conducted an inter-community analysis—that is, we compared and analyzed the cases (communities) to identify distributional patterns in forest environmental dependence between them. Then we conducted an intra-community analysis, where we investigated the same questions at the household level: What can the studies tell about the variations in dependence between different groups of households within each community?

Forest Environmental Income and Income Distribution Between the Cases

In Table 4.7, the sample cases have been divided into quintiles based on total income. The total forest environmental income increased as we move from the bottom to the top quintile. There is, however, an interesting pattern emerging when it comes to the relative forest environmental income: the relationship appears to be bell-shaped, with the highest share for the middle-income quintile.

To test the bell-shaped relationship, we applied a quadratic regression model with relative forest

Table 4.6 Relative forest environmental income, by Region and forest type (number of cases in parentheses)

	Forest type			*Total (N)*
Region	*Wet*	*Semi-wet*	*Dry*	
Eastern Africa	18.8 (4)	17.2 (7)	14.4 (4)	16.9 (15)
Southern Africa	—	25.7 (2)	25.0 (8)	25.2 (10)
Asia	7.0 (7)	25.0 (3)	26.7 (2)	14.7 (12)
Latin America	40.9 (5)	—	—	40.9 (5)
Total	20.5 (16)	20.6 (12)	22.2 (14)	21.1 (42)

Table 4.7 Forest environmental income for quintiles of cases (standard deviation in parentheses)[a]

	Income quintiles					
Variable	*Lowest 20%*	*20–40%*	*40–60%*	*60–80%*	*Top 20 %*	*Total*
Total income (US$ PPP)	*381 (157)*	*1,195 (263)*	*2,301 (394)*	*3,647 (457)*	*7,568 (3,325)*	*3,043 (2,984)*
Forest env. income (US$ PPP)	*90 (67)*	*305 (218)*	*654 (471)*	*876 (787)*	*997 (974)*	*584 (678)*
Forest env. income share (%)	*21.9 (14.6)*	*24.4 (13.8)*	*29.0 (20.6)*	*23.4 (19.5)*	*11.9 (8.2)*	*22.0 (16.3)*

Note: [a] The sample consists of 48 cases from 12 different studies; not all studies had information for all quintiles, which affected the estimations of total average income as well as the forest environmental income share.

environmental income as the dependent variable and total income as the independent variable. It did not yield any statistically significant results using either the basic model, which included various control variables, or a model where some of the extremely high-income cases were excluded. Thus the regression analysis could not confirm the bell-shaped relationship illustrated in the table.

But the alternative approach used in Table 4.7 still demonstrates that the poorest and richest groups have a significantly lower dependence on forest environmental income than the intermediate group.

Distribution of Forest Environmental Income Within the Cases

To look at what the cases tell about the differences in forest environmental income among households at different income levels, we focused on three measures—the Gini coefficient, income quintiles, and the Kuznets ratios (see Appendix A). The central question is: Do poor households within communities depend more on the forest environment as a source of income than wealthier households do?

Only a few of the cases reported on the intra-community distribution related to forest environmental income. Table 4.8 summarizes the seven recent studies that reported the Gini coefficients for household income both with and without forest environmental income. An additional six studies calculated the Gini coefficient for one of the income measures.

Forest environmental income reduced income inequality between households significantly. Although there were only a few cases, the results were clear and in line with what others have observed and with the discussion in Chapter 2. On average, the Gini coefficient increased from 0.41 to 0.51 when forest environmental income was excluded from the calculations. Only in one case (from India) did income inequality decrease slightly when forest environmental income was excluded.

Some of the case studies did carry out more detailed analyses of dependence on forest environmental income across different income groups. Table 4.9 shows that absolute forest environmental income was highest for the richest income group, but the differences were smaller than perhaps could have been expected. We need, however, to take into account the fact that the sample is small, particularly for the very rich and very poor groups. We further see that forest environmental income share decreased with increasing total income, also in line with what we hypothesized.

Table 4.8 Gini coefficients with and without forest environmental income

Study	*Gini for total income*	*Gini without forest env. income*	*Change (units)*
Aryal (2002)	0.55	0.61	(0.06)
Botha (2003)	0.41	0.54	(0.13)
Fisher (2002)	0.49	0.56	(0.07)
Shaanker et al. (2003b)	0.23	0.43	(0.20)
Shaanker et al. (2003a)	0.56	0.76	(0.20)
Shaanker et al. (2003c)	0.36	0.34	0.02
Stoian (2003)	0.26	0.34	(0.08)
Average	0.41	0.51	(0.10)
Sharma (1999)		0.35	
Cavendish (1999a)	0.29		
Cavendish (1999b)	0.39		
Muderis (1998)	0.36		
Nsubuga (1998)	0.25		
Nyland (1998)	0.17		
Average total	0.36	0.49	(0.13)

Table 4.9 Income distribution within cases and forest environmental income

Income category	*Mean forest environmental income (US$, PPP)*	*Relative forest environmental income (%)*	*Standard deviation*	*Minimum*	*Maximum*	*N*
Very rich	897.40	16.85	10.25	7.0	28.3	6
Rich	516.00	17.90	14.30	0.5	35.7	12
Average	476.00	20.57	12.72	4.4	39.3	11
Poor	497.40	32.43	20.60	5.0	79.0	12
Very poor	376.30	31.96	14.28	6.6	50.0	7

In Appendix A we suggest using the Environment Kuznets Ratio (EKR) as a measure of the poverty profile of forest environmental income. We can differentiate between the absolute and relative EKR. The absolute ratio (AEKR) measures the relationship between the average incomes of the richest and the poorest segments. It is thus a measure of the forest

environmental income disparity within the communities. The relative ratio (REKR) measures the average forest environmental income share of these two segments. It is thus a measure of the forest environmental income dependence disparity within the communities.

From Table 4.9 we find that the average REKR was about 0.59, using the six cases that reported the income shares for the very rich/very poor ratio. Comparing the income shares for the richest and poorest (for which we have more observations) yielded a similar value. Thus, the poorest households were close to twice as dependent on forest environmental income as the richest.

Our statistical analysis further demonstrated a positive correlation between REKR and forest environmental income (both absolute and relative). In other words, lower forest environmental incomes were associated with the poor having a high dependency on the forest environmental incomes (low REKR). This result is in line with what would be expected from our "employment of last resort" model in Chapter 2: low forest environmental incomes indicate that they are low-return activities, making them attractive for only the poorest groups.

To summarize, for inter-household differences there is a relatively clear pro-poor profile for forest environmental incomes. This tendency is much weaker for the inter-community comparison, where the link between relative forest environmental and total incomes is weak. The methodological problems involved in an inter-community analysis notwithstanding, our findings thus suggest that the pro-poor profile of forest environmental income is important primarily within communities rather than across communities.

How is Forest Environmental Income Used in Household Diversification Strategies?

We looked at relationships between levels of total and forest environmental household incomes and households' diversification strategies. Rural households pursue a wide range of economic activities to secure a living. These can have different motivations involving safety nets, insurance, consumption support, income maximization, and capital accumulation. Diversification is thus an important feature of rural life, and incomes from the forest enter into complex relationships with other household activities. In this section we look first at different sources of household incomes, then we look at the relationship between number of activities and income levels, and finally we look at diversification strategies to secure cash incomes.

Diversification and Main Economic Activities

Most of the people in households in the selected cases were agriculturalists with varying involvement in crop production, livestock production, forest environment-related activities, and off-farm engagements of different types. Earlier we looked at levels of income acquired from different sources and found that in most cases agriculture was the key income generator, followed by off-farm activities and forest environmental incomes. Income levels from different activities constitute a simple measure of diversification.

We constructed a "strategy variable" where, for each case, we set up a ranked list of activities according to their economic importance in the cases, with 1 as the most important activity. The main income strategy was agriculture, followed by off-farm activities (see Table 4.10). Forest

environmental activities were ranked as the third most important strategy for those cases where it was reported. We note that forest environmental incomes were roughly at the same level as off-farm activities and livestock.

Number of Activities and Income Levels

Do household incomes increase with diversification? To get a measure of the degree of diversification in terms of number of activities, we used a diversification index, DITI (see Appendix A), in which a value of 0 represents no diversification (a single source) and a value of 1 represents maximum diversification (an infinite number of sources of equal size).

There was substantial variation in the degree of diversification among the 22 cases reporting on livelihood sources, ranging from less than 0.1 to almost 0.9. The majority of cases (15), however, fell between 0.5 and 0.7.

It is possible, of course, to discuss the direction in which causality between income and diversification will go. We ran a regression with absolute income, denoted AI, as the independent variable, using a quadratic function. The plot and regression line are presented in Figure 4.2. The sample of 22 is quite small. Nevertheless, the regression yielded a function suggesting that diversification is reduced when income levels increase:

$$DITI = 0.62256 - 0.0001\ AI - 8.13E^{-9}\ AI^2$$
$$(5.96) \quad (-0.20) \quad (-0.9)$$

$$R^2\ (adj) = 0.36;\ N = 22;\ Prob>F = 0.0052$$

Related to our discussion in Chapter 2, this result may support the claim that diversification comes at the expense of higher income or that in some types of diversification rural dwellers must make do with whatever is available at any given time. Higher income, then, seems to be associated with some specialization in one or a few higher return activities.

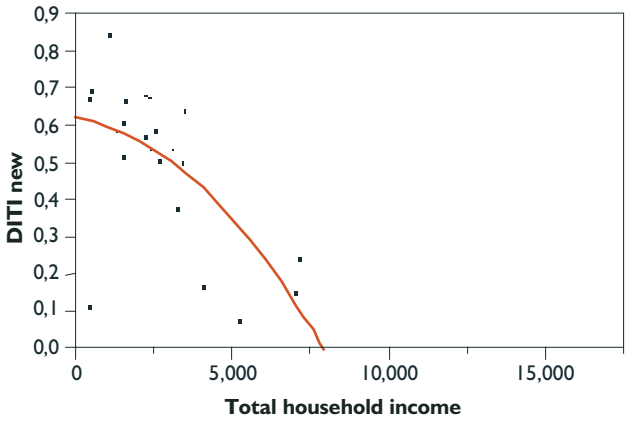
What is the relationship between diversification and forest environmental incomes? The test yielded a rather weak but statistically significant relationship, in that the total forest environmental income increased with increasing diversification up to a certain point. Beyond this point, diversification decreased again. However, we also ran the test for relative forest environmental income and found a similar but much more significant relationship (see Figure 4.3). The sample is still small and interpretations can easily become speculative. However, we see that samples with low forest income dependence diversified less than households with medium forest income dependence.

Table 4.10 Importance of various income sources

Activity	*Average*[a]	*Standard deviation*	*Minimum*	*Maximum*	*N*
Crop	1.9	0.93	1	4	41
Off-farm	2.4	1.08	1	4	27
Forest	2.6	1.31	1	6	38
Livestock	2.8	1.47	1	5	28
Wage work	3.3	1.49	1	5	12
Remittances	3.4	0.89	3	5	5
Others	3.6	0.89	2	4	5

Note: [a] For the *N* cases where this type of income is reported.

Figure 4.2 Total income and diversification



$$DITI = 0.17381 + 3.25347\ RFI - 4.57824\ RFI^2$$
$$(3.33) \quad (6.19) \quad (-5.00)$$

R^2 *(adj.) = 0.70; N = 22; Prob>F 0.001*

It would have been relevant also to investigate the relationship between cash income (forest environmental and total) and diversification, but we did not have sufficient data for a meaningful test of these relationships.

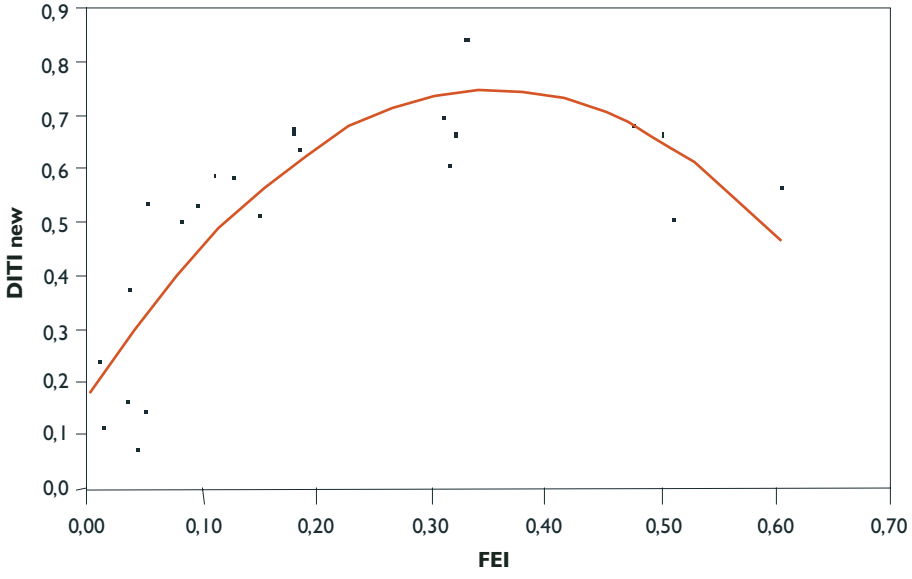
Cash Forest Environmental Income Strategies

Rural households have strategies for total income generation and also for cash incomes. Cash is needed both for consumption of goods and services as well as for various investments and inputs in production.

We would generally expect that cash income, as well as the cash share of income, increases with overall incomes. Well-to-do households (and communities) will typically be more integrated in market economies (the causal link probably runs both ways). We did observe this in our sample. The purpose here, however, is to investigate whether this is true also for absolute forest environmental cash income (ACFI): does it increase with total forest environmental income?

The cash forest environmental income was reported in only 17 cases, with an average of US$202 per household. For these 17 cases, the total forest environmental income was slightly (but not statistically significantly) higher than the average for the full sample: US$691 compared with US$678. The distribution was quite skewed—with a large number of cases with no or very low cash income levels, while one case reported incomes above US$1,000.

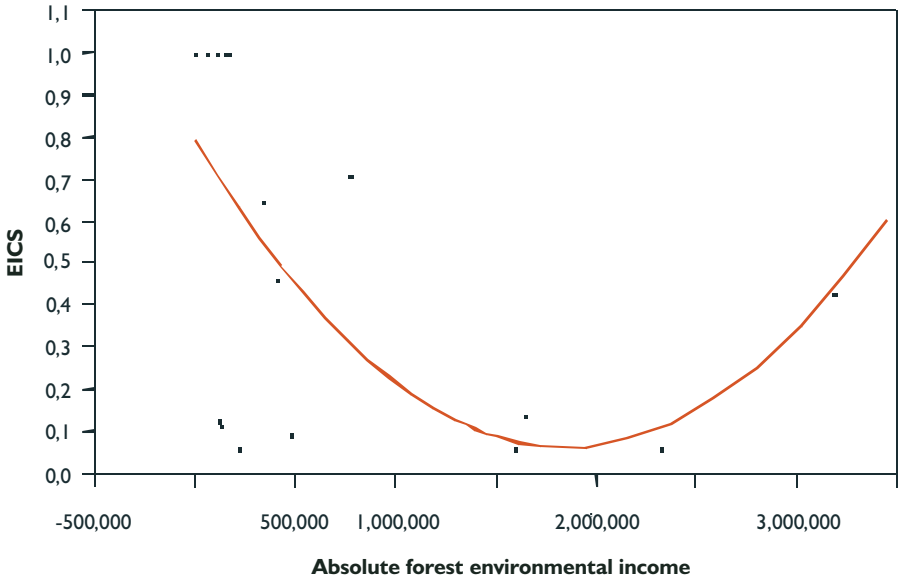
Figure 4.3 Relative forest environmental income and diversification



The average cash share was 53 percent for forest environmental income. Some cases reported 100 percent cash incomes. This was probably due to the

objective of the particular study (a focus on cash incomes) rather than the households in the sample not engaging in subsistence forest environmental activities. We also suspect that cash income was reported only in cases where it was important and that the cash share of 53 percent therefore was not representative for the full sample.

Figure 4.4 Relationship between cash share and total forest environmental income



We earlier asked how forest environmental cash income changes with both forest environmental and total income. We considered how the forest environmental income cash share (FICS, which is forest environmental cash income divided by all forest environmental income) changes with total forest environmental income in the communities.

In Table 4.11 the average FICS is computed for the three groups of cases, based on level of forest environmental income. The results are surprisingly clear: communities with low forest environmental income had a much higher cash share than those with medium and high levels: 78 percent compared with 32 percent and 28 percent for the latter groups. In absolute terms, however, we did find—quite naturally—that the high forest environmental income groups also had the highest forest environmental cash income.

The link between forest environmental income and the cash share can also be studied by a regression analysis. A quadratic regression where the FICS is explained by total forest environmental income (AFI) yielded the following (and see Figure 4.4).

Table 4.11 Cash forest environmental income share, by household income groups

Income source and share	*Low env. income (standard deviation)*	*Medium env. income (standard deviation)*	*High env. income (standard deviation)*	*Anova test Prob>F*	*N*
Forest environmental cash income	65.9 (103.3)	119.8 (146.1)	484.4 (130.7)	Rsquare = 0.32 Prob>F 0.063	17
Forest environmental income cash share	0.78 (0.12)	0.32 (0.17)	0.28 (0.16)	Rsquare 0.36 Prob>F 0.042	17

$$FICS = 0.79416 - 0.00078\ AFI + 2.11E^{-7}\ AFI^2$$
$$(6.16) \quad (-2.38) \quad (1.86)$$

R^2 *(adj.) = 0.27; N = 17; Prob>F 0.0442*

A U-shaped curve gives the best fit, with both coefficients significant at the 0.10 level. Thus the cash share appeared to be highest for cases where total forest environmental incomes were either very high or very low. With medium-level forest environmental incomes, the cash share was low. As can readily be seen from the Figure, the result is sensitive to the outlier with high forest environmental income and high cash share. Removing this yields forest environmental income cash share as a globally declining function of total forest environmental income.

These results are surprising. It is commonly assumed that at low levels of forest environmental income the activities are mainly for subsistence, while higher levels are associated with a high cash share. After all, there are limits to how much wild food a person can eat and how much firewood can be burned. The figure shows that for most cases the cash share was low, but there were a few cases with both high cash shares and low levels of total forest environmental income.

In short, cash income and market access are also important for communities at low levels of forest environmental income. In fact, they are relatively more important for these communities. We also analyzed the relationship between the FICS and total income levels and found a similar, but weaker, relationship.

We should again note, however, the reservations that attend these results, given the small number of cases and potential biases in the sample.

5 Best Practices in Forest Environmental Income Studies

This chapter looks at problems generally found in research on environmental income and at the particular problems in the case studies we looked at. It also provides guidelines on best practices in each problem area identified.

Theoretical and Methodological Pluralism

Our review of different cases revealed a high degree of theoretical and methodological pluralism. All studies contained sections dealing with forest environmental income. The studies were, however, undertaken for different practical reasons, for different scientific purposes, by people with very different scientific backgrounds and proficiency levels, and with quite different budgets and ambition levels.

Differences in the Purpose of the Study

The studies reflected a variety of research objectives, and we categorized them along certain key purpose categories: valuation studies, studies of environmental income dependence, and socioeconomic studies focusing more on internal distribution of incomes within local communities. A study aiming to explain rapid forest conversion will primarily focus on comparing per-hectare profitability of sustainable forest extraction and agriculture and might not look for data describing forest environmental income dependence within the communities. In a study considering the effects of the creation of a national park on a local population, on the other hand, such data will be crucial. Practically all valuation studies of non-timber forest products measure the absolute value of forest extractions by local populations and were thus of interest for our study at a basic level. But surprisingly few studies concerned themselves with levels of dependence and the internal distribution of incomes within communities. This made it difficult to ascertain the relative importance of the forest-related environmental incomes.

Differences in focus may, however, also affect estimated forest environmental income levels. While valuation studies often aim to ascertain the socioeconomic value of forests at the national or even global level, other studies might try to examine the private economic value of resources for a community or for individual households. The decision to include environmental services is discussed further later.

The stated purpose of the case studies was classified as overall forest values, dependence on forest environmental income, distribution of forest environmental income, or a combination of these three. Table 5.1 shows that most of the cases were socioeconomic studies about dependence on forest environmental incomes or valuation studies; only a few went into detail on distribution of the forest environmental income.

Table 5.1 Purpose of study, by total and relative forest environmental income

Forest income	*Valuation studies (standard deviation)*	*Dependence on env. income studies*	*Distribution of env. income studies*	*Combination of purposes*	*Anova test Prob>F*	*N*
Total forest env. income (US$/household/year)	1,405 (1,050) N= 14	525 (505) N=26	152 (111) N=5	230 (149) N=9	R square 0.35 Prob>F 0.001	54
Relative forest env. income	32% (175) N=11	21% (136) N=23	26% (293) N=5	19% (218) N=9	R square 0.02 Prob>F 0.02	48

Purposes affect results. We found a rather strong correlation between the purpose of the study and total forest environmental income: valuation studies systematically reported almost three times higher total forest environmental incomes than the environmental dependence studies did. "Distribution" studies tended to report very small numbers. The large difference is partly explained by the fact that five of the seven studies from Latin America, which has a much higher average income than other regions, were valuation studies. But for Southern Africa, with five valuation studies included, the cases also yielded estimates of forest environmental income about twice the average for all studies from that region.

This finding is interesting. One possible explanation is the inclusion of public goods and global values in valuation studies, even if we are not able to document this in our study (as discussed later). It could also relate to the difference between potential and actual use values. Moreover, valuation studies might systematically seek areas with very high biodiversity and existence values, which seems like a reasonable explanation. More dubious attempts to consciously inflate values in valuation studies cannot be discounted, however.

Relative forest environmental income followed the same pattern as total income, but the explanatory power of the test was weaker there.

Types of Studies

The particular scientific approach used and even the proficiency levels of researchers can also have an impact on results. The sample included research articles, theses works, and consultancy reports. Differences in the type of study might affect results through associated variations in time, funding, ambition levels, and proficiency.

We tested and found significant differences between theses and research studies (see Table 5.2). Theses systematically reported lower total forest environmental incomes than the research works.

A number of underlying factors may be affecting this result: there were more thesis studies from low-income countries in Africa, they were based on shorter fieldwork, they had less funds, and they typically focused on household dependence and distribution.

Methodological Approach

The studies reflected different methodological and conceptual approaches: household

Table 5.2 Type of study by total and relative forest environmental income

Forest income	*Thesis (stand. dev.)*	*Research (stand. dev.)*	*Consultancy (stand. dev.)*	*Anova test Prob>F*	*N*
Total forest env. income (US$/household /year)	314.7 (288) N=20	988.2 (937) N=28	202.7 (67.9) N=3	R square 0.19 Prob>F 0.006	51
Relative forest env. income	17% (14) N=20	28% (17) N=25	8% (3) N=3	R square 0.16 Prob>F 0.02	48

economic approaches, stakeholder approaches, and broader valuation studies. Even among the studies with a household economic approach, however, surprisingly few focused explicitly on more "sophisticated issues" around poverty, local heterogeneity, entitlements, and distribution. Just seven studies involved the use of Gini-coefficients, and we were only able to generate Kuznets ratios for 12 studies. Thus only a small number looked at the community internal distribution between groups of households for forest environmental incomes. Hardly any studies identified or focused on different forest environmental income functions and strategies or disaggregate forest income to capture variations depending on different goods or categories of goods.

Measures related to forest income dependence were also mostly very crude, although still useful. The most common approach was to look at the share of forest environmental income relative to total income.

Last, few studies linked forest environmental incomes to broader contextual factors beyond the household level. Households' access to resources under different legal, economic, political, and ecological conditions—and how access affects the ability and willingness to generate forest environmental income—was generally neglected.

Other Factors

Researchers from different disciplines investigate the importance of environmental resources and people's livelihoods.

An epistemic framework is characterized by particular common values, norms, and ways to address research problems (Knorr-Cetina 1981). Especially in such a young and heterogeneous applied field as environmental income, it may be that the more diffuse and intractable problem of researcher bias with respect to achieving some more or less hidden objectives is particularly present. Sheil and Wunder (2002) state that some researchers inflate numbers in order to make their work more interesting for other researchers and for funding agencies. They accuse Peters, Gentry, and Mendelsohn (1989), authors of a well-known valuation study from the Amazon, of producing inflated values for NTFPs. According to Panayotou and Ashton (1992), the study by Peters, Gentry, and Mendelsohn sought and found an audience that wanted NTFP extraction from tropical forests to be economically competitive. It was not possible, however, to rigorously investigate this type of problem in a meta-study like ours.

Even if we were not able to assess this in detail, most of the reviewed cases had a disciplinary core. Some cases were dominated by economists, ecologists, foresters, or

anthropologists; other studies were more interdisciplinary. It could well be that the disciplinary focus of a case affected the results. An ecologist, for example, might find or identify more and higher biodiversity values on account of his or her knowledge. An anthropologist might detect more use-values because of an inclination to listen and talk to local people and to observe through participation. Time unfortunately did not allow for interviews with involved researchers to clarify the origin of "dominating researchers" for each case.

Last, the level of research and resource input can have a direct impact on results. Long-term studies with substantial fieldwork inputs might lead to the discovery and registration of more sources of environmental income, and thus higher income levels. And the precision of data and possibilities to correct for contextual variables of different types could also increase with the resource input.

To sum up, a meta-study like ours must use whatever data are available in the cases examined. The wide disparity in the range and detail of variables reported in these cases does not necessarily signify glaring omissions or poor quality. Instead, the disparity may reflect variation in why, how, by whom, and for whom the study was carried out.

Best Practices

Most of the problems just described were not primarily due to flaws in technique or methodology but instead linked to differences in the purpose of the study, the specific competence of the investigators, or the scope and methodology applied. Since most of these problems were given at the outset, it is difficult to recommend a set of "best practices."

Some general points can, however, be outlined:

- The findings imply a need for researchers to be self-critical of and self-reflective about their theoretical approaches and methodological practices.
- Use the information contained in the data collected to its fullest extent; environmental income measures will generally be based on aggregation of measures for different goods, so the reverse process—disaggregation—should not pose any difficulties. And the dependency, distribution, and diversification implications for a good such as timber may be very different from those for wildlife or medicinal plants.
- From a research user perspective, it is important to note that results might be affected by the way the TOR is formulated, the objectives defined, the time and resources allocated, and the disciplinary background of researchers.

Economic Concepts and Bookkeeping

Price and Cost Estimates

In terms of price and cost estimates, unrealistic assumptions are often made using, for example, national minimum wages or world market prices as proxies for the absent local equivalents. Estimating the actual opportunity costs of labor in the presence of substantial market distortions can often be difficult and resource-demanding.

The studies usually used local market prices when markets existed. When markets are imperfect or missing, problems may arise. In some cases researchers omitted goods that were not bartered or traded locally, such as wild

fruits, thatching grass, and wild animals. This implies that forest environmental incomes were underestimated.

Other studies used shadow prices for estimation. Godoy, Brokaw, and Wilkie (1995) used the contingent valuation method. This might create an upward bias. A few studies used local prices from the nearest markets, which may give biased results depending on the characteristics of the market. Some studies (such as Cavendish 2000) used substitute prices. One problem with this method is to find close substitutes.

In some cases, prices used to value all crafts were the prices paid by tourists, which are usually higher than the local prices.

In general, average prices rather than marginal prices were used; this is understandable, given the difficulties generally associated with determination of the latter.

Best Practices:

- For goods that are sold, the actual price and income obtained by the household should be determined; differences in market access across households may be important.

- For goods consumed, the average forest gate price for all households should be used; use of world market or even local market prices may lead to significant distortions.

External Factors

Many external factors affect the possibility and willingness of actors to acquire forest environmental incomes, such as legal frameworks and rights of access for different groups; political, administrative, and social institutions; and other sociocultural factors affecting access. One problem was that many studies only looked at potential economic values, as stated by Sheil and Wunder (2002): "Social obstacles to realization of potential forest values were generally ignored."

We found good reasons to stress the access issue—not only in the difference between potential and realizable economic values, but even more so in dependence, distribution, and diversification studies. The often socially constrained access of some groups to particular types of forest products is a key reason why some households but not others can use the forest as a way out of poverty.

Best Practices:

- Collect and use data on important exogenous variables related to climate, ecology, economy, law, and other institutions. These may inform general levels of environmental income dependence, and their omission from subsequent data analysis might, if local variations are present, lead to significant bias in results and interpretations.

Processed Goods

A more subtle problem concerns the definition of environmental income in terms of its location in the market chain. While in one case goods endlessly processed and exchanged are included as long as these processes take place locally, in others only raw materials are considered. This does not necessarily represent a problem for the particular study itself, as long as a consistent and conscious choice is made. But this is not always the case.

Table 5.3 Inclusion of processed goods in valuations of forest environmental income

Forest income	*Value processed goods (standard deviation)*	*Do not value processed goods (standard deviation)*	*Anova test Prob>F*	*N*
Total forest env. income (US$/household/year)	1,262.6 (1,133) N=15	434.3 (415) N=36	R square 0.23 Prob>F 0.0003	51
Relative forest env. income	31% (12) N=12	19% (16) N=36	R square 0.12 Prob>F 0.02	48

Table 5.3 indicates that the inclusion of processed goods as forest environmental income affected estimates for such earnings. It yielded an average of US$1,263 per household per year compared with US$434 for studies that did not include processed goods. We also found that the relative environmental income was different in the two sub-samples, with 31 percent for the cases including processed goods compared with 19 percent without valued processed goods. Both findings indicate inconsistency in the ways the term "forest environmental income" was defined and used by different authors. It constitutes an important problem and calls for caution when comparing cases.

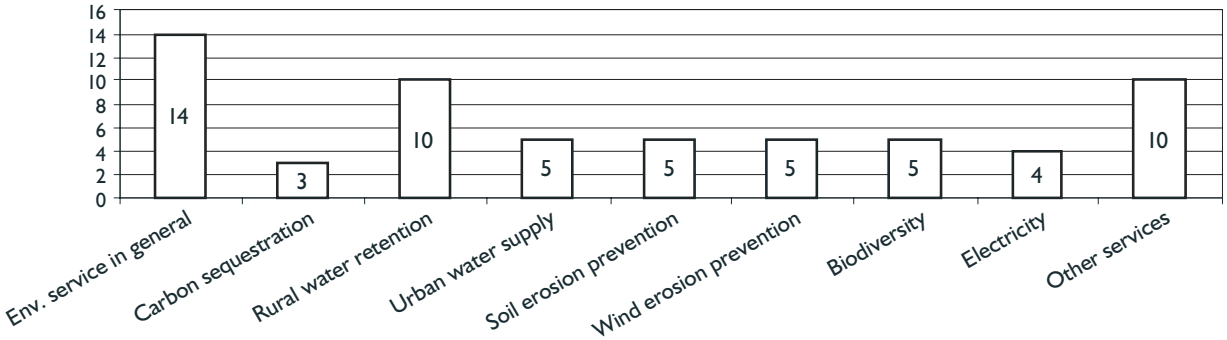
Best Practices:

- Use a definition of environmental income based on rent realized in the first link of the market chain.
- If particular circumstances merit the use of an alternative definition, it is important that this alternative definition is clearly stated and applied throughout.

Environmental Services

Many studies neglected the role of forest environmental services in local communities in, for example, the form of erosion control and stabilization of water flows. Again, the intended scale of the study is of relevance here; but researchers, when investigating the value of a resource at community or household level, may fail to examine not only spillovers or downstream effects of environmental services but also the significance of these services to local people. The more traditional non-use values are of less significance to local communities.

Figure 5.1 Types of forest environmental services included in the studies



The results presented in Figure 5.1 indicate that many researchers neglected the roles that forest environmental services play not only at national and community levels, but even at individual household levels. Many of these studies were carried out to find the dependence on forest environmental activities and should therefore have included forest environmental services.

Out of the 54 cases studied, only 26 percent discussed some kind of forest environmental services, mainly stressing water retention. Few included important services like erosion protection and clean water. And only one study attempted to quantify incomes from forest services (Sjaastad and others 2003).

This supports the argument that reported forest income estimates often represent a lower bound of actual values, all other factors apart.

Best Practices:

- Establish, at an early stage, the environmental services that are of importance to the local population.
- Gauge the degree to which environmental service values will vary across households.
- For important services with homogenous values across households, broader community-wide estimates are sufficient; acceptable approximations may be available in the literature.
- For important services with variable values across households, a separate household-level valuation will be necessary.

Double Counting

The double or even triple counting of benefits is a common problem in many studies. This can occur in numerous ways, including the following:

- The benefits of tourism are added to benefit estimates of biodiversity, where the value of tourism already is partially included.
- Government revenue is added on top of valuation estimates (although it is "just" a transfer of income).
- Replacement costs for wells or pumps needed to counter lower groundwater levels are added to afforestation costs.
- Costs of livestock lost to wild animals are often computed both directly, in terms of stock value, and as a loss of present and future income flows—a failure to distinguish between stocks and flows.
- The value of fodder harvested from the forest may sometimes be included as a benefit in calculations, but not subsequently subtracted as an input cost into livestock production, escalating the household income estimates.

The first two examples are mainly associated with more large-scale valuations and thus of limited relevance to our meta-study. The two latter problems, though, are common in cases of the type considered here.

Best Practices:

- Focus on end products and goods and work backwards. For example, loss of clean drinking water may be countered through afforestation, drilling of boreholes, sinking of wells, or municipal plants. Are all measures required or just one, and in the latter case, at what cost?

- Focus on production processes. Does one particular forest good enter into the production process of another forest benefit, as in the case of fodder and livestock production?

Stocks, Flows, and Sustainability

A problem of particular importance for valuations is the existence of alternative measures of the goods contained within forests. Batagoda and others (2000) distinguished four different measures:

- The value of the stock, or inventory
- The value of maximum sustainable yield, or maximum potential flows
- The value of maximum potential flows as constrained by access (legal or physical)
- The value of actual extraction.

Stock values and different measures of flows may yield widely disparate figures. Godoy, Lubowski, and Markandya (1993) assert that: "For most purposes, the value of the inventory is a meaningless concept related neither to present or to sustainable use." Stock value may be of interest in studies of rapid forest conversion and strategies related to such conversion, but it has no direct bearing on forest income estimates.

The third category, while rarely applied in valuations, again highlights a wider problem: the necessity of considering law, conventions, and other social institutions and constraints when analyzing and explaining resource values and their distribution.

The main point, however, is that researchers should be aware of the different options and should carefully specify the type of measure that is targeted. This is often not the case, as both Batagoda and others (2000) and Godoy, Lubowski, and Markandya (1993) point out.

A related problem concerns sustainability of extraction. Regrettably, assumptions about the sustainability of actual extraction are often made beforehand, with no subsequent investigation of whether these hold. Thus a standard practice is to measure actual extraction and treat this as if the values derived could be perpetuated automatically. This could create problems, especially when calculating net present values of forest incomes.

In many cases, however, there is a genuine lack of knowledge about sustainable yield levels, as with medicinal plants, bamboo shoots, rats, caterpillars, and butterflies, so the omission may often be for a reason.

Finally, the question of the extent to which use, potential or actual, is efficient (in the conventional economic sense of equalizing marginal costs and benefits) is very rarely considered.

In Chapter 2 we noted that many studies did not fully take into account whether present use is sustainable. Net present value calculations assuming that present use can go on "forever" without considering whether present use is cutting into stocks will in general tend to overrate forest environmental income estimations.

Many of the studies that did address sustainability issues did it based primarily on interviews with local people and not on detailed field-level ecological studies, which are more appropriate.

Table 5.4 Inclusion of sustainability issues, by total forest environmental income

Variable	*Total forest env. income (US$/household/year)*	*Standard deviation*	*N*	*Anova test Prob>F*
Included sustainability issues	882.9	949.2	29	R square 0.09
Neglected sustainability issues	407.7	392.4	22	Prob>F 0.03

Around half the studies we reviewed did not address sustainability issues at all (see Table 5.4). We found that studies that took sustainability into account seemed to have higher forest environmental incomes than those that did not.

By using the interview material, we furthermore found a strong positive correlation between local people stating that there was a sufficient sustainable supply of resources and the level of forest environmental income (see Table 5.5).

Again, ideally the studies should address sustainability through elaborate ecological field investigations, preferably over time, and also following the different types of key resources in question. Very few studies did this.

These results underline the importance of considering sustainability.

Best Practices:

- Be clear and consistent in the choice of measures across different forest goods—maximum sustainable yield values, access-constrained values, or values based on current extraction.
- Unless reliable data on the sustainability of current extractive practices are available, avoid present value estimates based on discounted periodical measures; instead, focus on periodical estimates only.

Cash Versus Subsistence Income

Many studies failed to separate cash income and consumption, or—even worse—studies counted only cash income as income. This problem may take many forms, but the most common is the simple omission of consumption in reported income estimates.

In the cases reviewed, six studies defined total income as cash income. This problem was identified both in student theses and other types of work. As can be seen in Table 5.6, studies that defined cash income as total income tended to underestimate both forest environmental incomes and forest environmental income dependence.

Table 5.7 shows that only 17 studies (31.5 percent) explicitly recorded cash forest incomes at all. Testing for the difference relative to total forest environmental incomes, however, did not

Table 5.5 Perceptions of change in resource supply, by total forest environmental income

Variable	*Total forest env. income (US$/household/year)*	*Standard deviation*	*N*	*Anova test Prob>F*
Insufficient resource supply	511.9	570.7	22	R square 0.0.49
Same as before	2,021.9	747.1	5	Prob>F 0.0001
Sufficient resource supply	2,117.9	1,897.2	2	

Table 5.6 Inclusion of cash and/or subsistence and forest environmental incomes

Variable		*Forest env. income (US$/household/ year)*	*Standard deviation*	*Minimum*	*Maximum*	*N*
Total forest environmental income **Prob>F 0.048*	Included both cash and subsistence as income	757.3	809.7	1.3	3,459.4	45
	Cash as total income	82.4	71.6	2.9	164.7	6
Relative forest environmental income *Prob>F 0.15;ns.*	Included both cash and subsistence as income	0.23	0.17	0.003	0.60	42
	Cash as total income	0.13	0.10	0.01	0.26	6

Table 5.7 Non-inclusion of cash incomes by total forest environmental income

Variable	*Total forest env. income (US$/household/ year)*	*Standard deviation*	*Minimum*	*Maximum*	*N*
Cash income not included	671.2	723.8	1.3	3459.5	34
Cash income included	691.2	935.3	2.9	3186.5	17

yield statistical significant differences. We found the same non-significant trend for relative forest environmental income.

Omission of cash incomes will not necessarily lead to underestimation; the problem is common, for example, in studies where the only methodology applied is enumeration of goods removed from the forest and the subsequent multiplication of these with general prices. There may be valid reasons for not recording cash incomes, but the omission will also severely limit the range of feasible data analyses.

Best Practices:

- Valuate cash and subsistence income separately (see also the section on price and cost estimates and Appendix A).

Omitted Variables

Omitted variables commonly pose a problem. Godoy, Lubowski, and Markandya (1993), for instance, in reviewing some of the early literature on valuation of NTFPs, identified a tendency to examine either flora or fauna but not both.

They also mentioned the neglect of labor costs. Given that forest environmental income can be defined in terms of both rent and value added, the "neglect" of labor costs may simply represent the application of a different definition of income. This does not represent a problem as long as the study explicitly outlines the reasons behind the choice and as long as all incomes, if compared, are treated in the same way.

Other important costs may also be omitted, however, including capital costs, intermediate input costs, marketing and other transaction costs, and taxes. There are also potential costs of living close to forest resources in terms of weed infestation, wildfire spillovers, health risks, and pests such as predators preying on livestock or crops that should be included in a comprehensive assessment of net forest benefits.

In our review of cases, we focused on labor costs and fodder income.

Labor Costs

We found that some studies consistently omitted or forgot costs involved in production; 56 percent of the cases did not include labor production costs while estimating the forest environmental income, implying an overestimation of that income and of dependence (according to the "economic rent" definition of forest environmental income). This was particularly so if labor costs were taken into account for other household production activities (see Table 5.8).

We checked if there was a systematic difference in forest environmental income when labor costs were included but did not find any significant difference. The same applies for relative incomes. In fact, total incomes were somewhat higher in studies where labor costs were included. This would, first of all, seem to indicate that labor costs, as expected, are calculated to be very low in the case studies considered. Second, it may just be that those cases where labor costs have been included have also been more diligent in terms of identifying and valuing all potential sources of environmental income.

Fodder Income

Most of the households reported having livestock of different types, but few of the studies actually valued fodder. This would mean a substantial underestimation of forest environmental incomes and dependence, but generally not of total household income, as the value of fodder for domestic use should enter as a cost in livestock production. In studies where fodder was included, it competed with fuelwood and wild food in terms of economic importance, so the omission can be a serious flaw in forest environmental income estimates. The issue becomes even more problematic for assessment of forest environmental dependence if fodder costs are not deducted from livestock incomes.

A test of its impact across our cases revealed no significant differences, even for relative incomes. The mean was actually somewhat lower for the households that included fodder. It is hard to explain this finding; one possibility is that more of the studies in drier forests with lower total forest environmental incomes would have included fodder.

Table 5.8 Labor cost inclusion and total forest income in the sample

Variable	*Total forest envir. income (US$/household/year)*	*Standard deviation*	*Minimum*	*Maximum*	*N*
Labor costs not included	653.8	737.8	1.3	3459.5	30
Labor costs included	712.3	879.1	2.9	3186.5	21

Best Practices:

- At the pilot stage of an investigation, all factors that may possibly contribute to higher or lower environmental income should be mapped out and their relative importance assessed.
- If variables are intentionally omitted, this should be clearly stated and explained.
- In general, studies should aim to include all the most important goods, which will generally involve fuelwood, wild food, fodder, and timber-related goods.

Representativeness and Data Collection

Representativeness

This study has emphasized the importance or influence of contextual variables on forest environmental incomes. If individual cases purport to represent province-wide, nationwide, or even regional trends, the cases would have to control for a substantial amount of potential variation, such as ecological conditions of climate, soils, and vegetation as well as economic, legal, sociocultural, political, and administrative conditions of various types. This would clearly be beyond the scope of most studies looked into here.

Many cases we looked at did not at all take into consideration how representative their samples are. Some cases were too small to be representative of a population's variability. Nyland (1998), for example, had a sample of only 20, implying that it would be incorrect to interpret his findings in relation to even the local population of the study area.

Others, however, took into consideration certain issues such as wealth groups, market access, and type of management of the forest while selecting the sample. Fisher's (2002) sample selection covered three forest management types and the issue of market access by including representative villages. The size of area and variation in ecological parameter are also issues that should be realistically represented in the studies relative to the objectives of the study.

The impact of contextual variables is analyzed in Chapter 4. Although we document surprisingly few statistically significant relationships, a key message is that it is important to be cautious when concluding and making policy recommendations based on findings from a very limited sample of households.

Data Collection

Turner and others (2002), in the context of valuations, offer the general observation that there is a shortage of studies that consider both before and after conditions with respect to environmental change, although such studies are perhaps the most useful and reliable. Note also that time series are important for observing whether forest environmental income risk functions primarily relate to safety nets (an ex ante condition) or gap filling (ex post). There is also a lack of systematic historical studies that could have looked into how people de facto used forest environmental incomes to cope in periods of natural, social, and economic hardships. Finally, extended data collection might be necessary simply to catch the seasonal and annual variations that often attend extraction of forest resources.

Only three of our studies contained time series data. Thus, meaningful tests of the implications of such data were not possible.

Care must be taken in generalizing about how a lack of time series studies could bias forest environmental incomes. It seems reasonable, however, to assume that more times series would improve the quality of our knowledge concerning diverse household strategies in a constantly changing environment. Times series would also allow for more in-depth studies of people's relationship to potential forest environmental incomes, and in that sense they could possibly also lead to the discovery of new and other sources of forest environmental incomes that are not detected in short-term surveys and consultancy work.

An "optimal information gathering strategy" is, in any case, impossible to define, as it will depend on a variety of factors: purpose of study, social and natural given conditions of the area, economic and social resources at hand, and so on.

A general observation, however, is that reliance on a single method of data collection most often will be insufficient. The two most common approaches found in the case studies involved household questionnaire surveys and enumeration of extracted forest goods on the forest perimeter. The first of these methods will often be found wanting in terms of identification of the range of sources of forest income and the accuracy of amounts extracted; the second will fail to capture environmental services and costs, and also animal grazing within the forest, and will be unable to distinguish between cash and subsistence income.

In addition to the above two methods, literature reviews, informal talks with key informants, and more advanced valuation methods may be required. Again, there is no general, universal methodology that will work for all cases in all contexts.

Summary on Best Practices

Much of the "secret" of conducting a proper analysis of forest environmental income and its significance—in terms of dependence, distribution, and diversification—for local populations lies in the apparently simple task of not forgetting several important factors: appropriate price estimates, the entire range of important goods supplied, the risk of double counting, focusing on flows and not stocks in income calculations, and so on. Some of the problems discussed, and their possible positive or negative effects on total and relative forest environmental income, are summarized in Table 5.9, and Box 5.1 provides an example of the impact of the combined effect on studies.

Information is expensive. There will always be a trade-off between the purpose of a study, the financial and human resources available, and the expected utility of increased information. A conscious practice should include assessing the importance of information relative to the costs of acquisition.

For the benefit of the wider research and policy community, it is important that the measures of forest environmental income used are comparable to other types of incomes. The representativeness of the study is equally crucial.

Given this study's conclusion regarding the importance of forest environmental incomes for rural households, leaving such incomes out of national statistics and poverty assessments will contribute to the underestimation of total incomes among rural dwellers. It could also affect estimates of numbers of rural poor if such figures are derived from household income levels. For people living close to the poverty line, even small income additions are crucial, and the neglect of something in the range of

Table 5.9 Factors affecting total and relative forest environmental income

Factor to consider	*Anticipated impact on total env. income estimates*	*Anticipated impact on relative env. income estimates*
Purposive sampling of high forest value study sites	+	+
Lack of resources or proficiency	-	+/-
Use of world or regional market prices	+	+/-
Neglect of external factors	+/-	+/-
Inclusion of all local processed goods	+	+
Neglect of environmental services	-	-
Double counting	+	+
Neglect of sustainability issues	+	+
Failure to include subsistence income	-	-
Omitted costs	+	+
Omitted sources of income	-	-

Box 5.1
Waiting for Godoy

The meta-study includes five case studies undertaken by Godoy and collaborators from Latin America. The average annual forest environmental income in these studies was some US$1,922 per year—three times the average for our total sample. The average share of environmental income was 41 percent, or almost twice our sample average. The average total income was around US$5,981 per year, more than twice the average for the overall sample.

Why were the figures so high? The studies were from Nicaragua, Honduras, and Bolivia, countries with generally high GDPs. They were from tropical rain forest areas, with high precipitation rates (2500 mm per year), and from areas where we would expect the production of forest values to be high. The studies, commendably, encompassed both valuation and livelihoods objectives and involved very close field investigations of different types of use. The average time spent for the studies was 24 months, well above the sample average. The cases were from areas where local people have good access to environmental resources. They included a large number of environmental goods, such as processed timber. Family labor costs were not included. No explicit assessments were made about the sustainability of present use.

We do, of course, not accuse Godoy and others of consciously inflating figures. On the contrary, the studies were carefully planned and much effort went into avoiding many of the common pitfalls. They also referred to studies by others that have produced higher overall figures. The point here is that for a variety of reasons—both naturally given and because of theoretical and methodological choices—the figures were high compared with the averages in our sample.

one-fifth of household income may have wide statistical and political connotations. The World Bank, other donors, and the countries with which they cooperate thus have compelling reasons to include forest environmental income in the surveys on which many important policy decisions are based. In addition to providing more accurate data for policy use, this would

have the added benefit of testing and refining methodologies described here.

We recommend the following:

- Develop a set of concepts, tools, procedures, best practice methodology, and recommendations on the inclusion of forest environmental incomes in poverty assessments.
- Agree on an operational definition of forest environmental income that makes it comparable with other sources of household incomes.
- Concentrate on a few simple, key resources such as food, fuel, and fodder.
- Contribute to a worldwide systematic collection of base-line data in the field.
- Include important forest environmental incomes in poverty assessments and in development programs designed to reduce poverty.

6 Conclusions and Recommendations

How important is environmental income to the rural poor in developing countries? While we have a number of case studies demonstrating that it can be quite significant for poor people and communities, we still lack a good overall picture. Knowing more about the significance of environmental income is important for at least two reasons. Obviously, a good description and understanding of actual livelihood sources for the poor is needed in order to design effective poverty reduction strategies and targeted policies and programs. But knowledge about the significance of environmental income is also important to the environmental conservation debate. If a substantial share of the poor's income is derived from the natural environment, there might be less of a tradeoff between poverty alleviation and conservation objectives than some people claim.

Most developing countries experience degradation of their natural resource bases; forest areas in particular are vulnerable to both decimation and degradation, especially through conversion of forestland to agriculture, but also through unsustainable use of the existing remaining resources. From an economic point of view, some of this conversion of natural capital into other forms of capital could be efficient and contribute to overall economic development at household, community, and national levels. However, documenting environmental income can demonstrate some important costs of this process. If we use some notion of an optimal level of conversion and cut into stocks of natural resources, documenting present uses must enter into the calculus. A particular policy concern is that the poorest segments tend to depend more on environmental income.

This report has focused both on studies that looked into forest environmental incomes and on typical problems related to such studies. This chapter sums up key findings in this respect. We furthermore make some recommendations for further research along with some more-operational policy recommendations that we think can be drawn from the lessons of this study.

Key Findings on Forest Environmental Income and Poverty

The meta-study synthesized results from 54 case studies on forest environmental income. These represented a heterogeneous sample, with highly varying forest environmental incomes and degrees of forest dependence as the common denominator. There were, as documented, several gaps and potential biases in the cases and, therefore, in the meta-analysis. The findings thus need to be interpreted with care. Caveats notwithstanding, several major conclusions emerged from our meta-analysis:

- Forest environmental income constituted an average of about 22 percent of the household income in our sample. Even

though agriculture and off-farm income had higher income shares, forest environmental income represented a significant source of income. In absolute terms, the mean annual forest environmental income was about US$678 (PPP-adjusted) per household in the sample, while the median income was US$346, representing about 19 percent of total income. This indicates a skewed distribution, with some cases of very high forest incomes (US$3,460 was the highest). Removing the eight studies with forest environmental incomes above US$1,500, forest environmental income was still around 20 percent of total income, with the average household forest environmental income of US$401. Thus the broad conclusion from our limited amount of cases is that forest environmental income represents about one-fifth to the total income of rural households.

- Even if encumbered with substantial uncertainties and variations, the figures suggest that forest environmental incomes contribute significantly to the economic production of goods and services and to welfare levels in these societies. Even contributions that are relatively "small" may be of utmost importance to families living close to the survival line. Omitting such incomes from calculations of national economic statistics and poverty assessments will create biases in the base-line data. If such data are then used in development strategies and programs and in policymaking focusing on livelihoods and poverty, inefficient resource use may occur.

- There is probably a selection bias in the sense that communities with high forest dependence were selected for study in many of the cases. This points to the need to include environmental income estimates into poverty and livelihoods surveys. On the other hand, the studies focused only on a set of environmental benefits, namely those from the forest. Moreover, the values of forest environmental (both forest and non-forest) services are difficult to quantify, and almost all studies concentrated on products only. This lack of valuation of benefits created an estimation bias in the other direction. It implies that the figures cited, all other factors constant, represent a lower limit for environmental incomes in the cases.

- Wild food and fuelwood were by far the two most important forest products for the households in the sample, accounting for an average of 70 percent of all forest income. We suspect that some products were underreported, such as fodder, which was reported in only seven cases but still had the third highest value for these cases. Cutting trees for timber got surprisingly low figures.

- Forest income was higher in Latin America, while East Africa had the lowest figures. There was a weak tendency of higher income from wet forests, but the variation across regions was stronger than the variation across forest types.

- Forest environmental income tended to increase with distance to market—that is, more-remote communities had higher forest environmental incomes. This probably reflects both forest abundance and lack of other income opportunities. Few of the other contextual factors were found to have a statistically significant impact on forest environmental income, including tenure and legal status.

- About half of the forest environmental income was earned in cash (only about a

third of the cases distinguished between cash and subsistence income). A surprising finding was that the share earned in cash declined with higher forest environmental income. We also found a negative but weaker relationship between the cash share and total income. Thus cash forest products and market access were at least as important for communities with low forest and low total income as they were for better-off communities.

- Forest environmental incomes were particularly important for poor people. Dependence is measured by relative forest income (percent of total income). The sample was divided into three groups: low, medium, and high forest dependence, with relative forest incomes of 5, 19, and 42 percent, respectively. The difference between these groups was striking. The high forest dependence group had on average only half the total income of the two other groups. This group also scored lower on household capital indicators such as education and livestock ownership, and they lived in more-remote locations.

- As expected, there was a strong positive association between forest environmental income and total income. Forest environmental income was important not only for poor communities. But in terms of forest dependence (income share), the opposite was true: we found a weak but not statistically significant trend of declining forest environmental income share as total income increased.

- Only about a quarter of the studies explicitly addressed the question of the distribution of forest income within the communities studied. Yet the picture that emerged was clear: the poor were more dependent on forest income, and forest income had a strong equalizing effect on local income distribution. The pro-poor profile of forest environmental income was much stronger when looking at inter-household differences than inter-community differences.

- In the seven studies that calculated Gini coefficients (a measure between 0 and 1 of the degree of inequality), the coefficient on average increased from 0.41 to 0.51 when forest income was excluded from the calculations.

- The forest income share for the poor was about twice the share for the rich households in the communities, about 32 and 17 percent, respectively. Still, the absolute level of forest income was higher for the richest households.

- Forest income can be seen as part of rural households' diversification strategies. We found that high total income was associated with less income diversification, indicating that higher income was achieved though a process of specializing in one or a few high-return activities. Interestingly, we found a bell-shaped relationship between diversification and forest environmental income. This result, however, was sensitive to a few outliers in the data.

- Many studies found that forest environmental incomes most typically serve as income supplements and important safety net in times of hardship. Only rarely do they provide a pathway out of poverty. The present study cannot provide any rigorous analysis of strategies, but our findings are consistent with this observation.

As stated throughout the report, it is difficult to determine how representative these findings are for developing countries in general, for African, Latin American or for Asian countries, for communities close to or far away from forests, for rich and poor developing countries, for dry and humid climates, and so on. Caution is called for in drawing conclusions and using the findings.

Methodological Experiences and Common Pitfalls

The studies reviewed displayed a high degree of theoretical and methodological pluralism. Many of the case studies were also marred by methodological and interpretive flaws and weaknesses.

The objectives of the studies differed, and they were classified as valuation studies, forest environmental income dependency studies, or studies focusing on the distribution of forest environmental income. The estimates of this income varied systematically in these three categories, with valuation studies estimating much higher values (US$1,405/household/year) than those dealing with dependence (US$525) or distribution (US$152). One reason could be that many of the valuation studies had a social benefit perspective, which implies a broader set of forest benefits. A second reason could relate to methodology—using contingent valuation methods , spending more time in the field, and so on. Sites for the individual cases may also have been chosen because high forest income made them an attractive target for such studies. A more speculative explanation is that the valuation studies may more often have hidden agendas on generating high biodiversity land values in order to generate arguments for increased conservation. This phenomenon has not been investigated further in this study, but it is mentioned and discussed by other researchers (such as Sheil and Wunder 2002).

Economic concepts of incomes and costs were treated differently in the studies, and this has implications for the estimates. At the most fundamental level, the studies differed with respect to the definition of forest environmental income: some meant gross income and others value added (gross income minus costs of capital depreciation and intermediate inputs), while some authors used economic rent (value added minus opportunity costs of labor and capital). A related problem concerns cut-off points with respect to proximity to resource, processing, and market chains. Furthermore, in cases with missing or imperfect markets, the application of various types of shadow prices and opportunity cost principles can be problematic.

Reviewing the studies, we found the following possible sources of problems:

- Labor costs for generating forest environmental incomes were not included in almost 60 percent of the studies, indicating that some concept of value added had been used. This could create biases in estimation of forest environmental income and in environmental dependency, although we did not find any significant differences between those that included labor costs and the others.
- Some 70 percent of the studies did not include processed goods. This will easily create a bias in the estimation of forest environmental income. The studies that included processed goods as forest environmental income had much higher estimates for forest environmental income than the other studies.

- Some studies registered only cash income as "income." Subsistence forest incomes were not valued at all in six studies. This leads to an underestimation of the economic value of forest environmental income and income dependency. Furthermore, a majority (68 percent) of the studies did not distinguish between cash and subsistence incomes, something that constrains the analysis of the role of forest environmental income in the household and rural economy.

An important weakness in many of the studies was related to the range of forest environmental products and services that were included—that is, the completeness:

- Only 26 percent of the studies included some discussion of forest environmental services, and only one included a value estimate for these. This means that most of the household studies did not deal with such services as water retention and soil erosion control—which clearly may have household-level economic impacts but are difficult to measure and value.

- Around 72 percent of the studies did not include fodder as income or as costs in production of livestock, even though animal husbandry is prevalent in most of the areas under consideration. This will create a serious bias in the estimate of forest environmental incomes and forest environmental income dependency.

Few studies seriously analyzed distribution aspects in any detail. Only 13 percent estimated Gini-coefficients. Hardly any study focused on forest environmental income relative to various types of household strategies.

In addition to the handling of economic costs and benefits, we also looked at how the studies considered the issue of sustainable resource use. More than half of them did not consider whether the current resource use was sustainable. Some studies calculated net present values, simply assuming that present levels of exploitation could continue unabated for ever. Most of the studies that addressed the issue did not carry out detailed field-level ecological studies but based their assessments on interviews with local people and key informants. We found that:

- Studies that included sustainability issues had, on average, twice the forest environmental income of studies of other studies.

- In studies where people reported insufficient resource supplies from the forest, the forest environmental incomes were on average one-quarter of the incomes reported in the rest of the studies.

Other important conclusions from the review of methodologies include:

- Only 5.5 percent of the studies used time series data. Thus few studies were able to deal directly with important issues such as the role of forests in countering income fluctuations and the impact of policy changes on forest environmental incomes.

- Many studies tended to overrate the representativeness of their findings. Local variations in ecological, economic, social, and political issues are the rule in case studies—not the exception. Caution should thus be shown when research projects are planned and launched and in making projections or generalizations based on the findings. The research is often based on small samples in confined areas. The selection criteria for study sites may in

addition unfortunately often reflect resource constraints and practical problems in the field rather than representativeness.

Recommendations on Research and Best Practices

As a point of departure, there is a need to "get the basics right" in individual case studies on forest environmental income and poverty. There is a need for more in-depth studies to understand the role of forest environmental income in individual household and in broader development strategies. There is also a need to increase the scope of such studies through larger research projects that get comparable data from different socioeconomic and ecological settings.

"Getting the Basics Right" in Individual Case Studies

Some of the recommendations at the end of Chapter 5 are simply conventional good research practices. We will not dwell on these here. Also, there are guidelines on how to carry out forest valuation, in particular those presented in the edited volume by Campbell and Luckert (2002). There are a number of common pitfalls, omissions (and inclusions), unclear definitions, and myriad models and practical approaches that are partly compatible and partly not. Many shortcomings found in the studies could easily have been avoided. We have a few specific recommendations:

- Increased cooperation should be promoted in clarifying definitions and concepts, standardizing ways of measuring forest environmental income, and using measures to assess the role of forest environmental income for different social groups concerning dependence, distribution, and diversification.
- Although information on different types of forest goods and their uses—by whom, for what, and with what rewards—is often available, it is seldom used analytically. Determining the various ways that different groups, in different seasons, benefit from forest goods is important from policy perspectives related to both poverty reduction and environmental conservation.
- The standard measure of importance of forest environmental income has been either absolute income or income share. But a key role of forest income is to fill gaps and serve as a safety net, thus helping people survive and secure their livelihoods during difficult periods when other sources fail or are unavailable. We need to develop better ways to assess this dynamic role of forest environmental income and other functions of incomes in the livelihood diversification strategies of rural households.
- There is a strong need to develop simple field methods to assess if present uses of particular resources are sustainable and to take this into account when estimating forest environmental incomes.

Ideas for Future Research on Forest Environmental Income

There is a clear need for studies that go beyond the simple measurement of forest environmental income and its contribution to total income for different groups.

- We need to understand better why forest environmental income is particularly important for the poor. To what extent is the

income contextually and politically determined, and to what extent is it a function of some inherent characteristics of forests often being an "employment of last resort"?

- We need to investigate the extent to which forest environmental income can provide a way out of poverty. This requires panel data, and very few studies to date have been able to address the more dynamic aspects of poverty-forest interactions.

- Many studies do not address how legal, ecological, economic, political, and sociocultural factors outside the control of households affect ability and willingness to become involved in forest environmental income strategies, or how these factors affect levels and shares of forest environmental income. A more complete and rigorous consideration of control variables is necessary.

- Very few forest environmental income studies deal with issues of local heterogeneity and social differentiation.· A more rigorous focus on differences in user profiles is necessary.

- Although there is a growing literature on forest environmental income, far fewer studies focus on other natural resources. More studies on other types of environmental incomes, in both rural and urban settings, are needed.

Policy Implications

Policies to Enhance Forest Environmental Values and Incomes

We found that forest environmental income constitutes an important share of total household income in the cases studied. In most national accounts and even poverty assessments, these values are often omitted or underreported. We strongly recommend identifying ways to include environmental values in these. Focusing on the key resources of food, fuel, and fodder would facilitate such inclusion.

Policies to enhance the environmental income of the poor must be pursued along several lines. First, it is important to design and implement policies to secure and enhance the resource base on which these incomes are drawn.

Second, improved systems for poor people's access to and control of the resource base are needed. Forest environmental resources are typically not privately owned but are under varying degrees of state or communal ownership. At the national level, the planning and management authority of forest environmental resources generally rests with three often competing departments: agriculture, forestry, and nature conservation. These departments have different mandates and responsibilities as well as different structures, legal frameworks, and management practices regarding local people.

At the local level, ownership of forest environmental resources is often contested. The status can range from a total lack of access and a ban on resource withdrawal in many national parks and conservation areas to forest reserves and communal lands with a myriad of formal and informal usufruct rights.

Elements of a policy to enhance forest environmental values and incomes could thus:

- Improve formal systems for mapping and registration of environmental values

- Clarify structures, rights, and responsibilities between involved public bodies at national, regional, and local levels
- Establish systems of user agreements with participatory monitoring and control systems to secure and enhance the natural resource base.

Policies That Address Dependence, Distribution, and Diversification

Policy interventions should not only concentrate on maximizing aggregate values from the environmental resources but should also be given a poverty focus.

The studies on which this report is based tell us clearly that these incomes are important for poor people and that deprivation of access and withdrawal of resources have serious impacts on rural livelihoods—both in terms of consumption and in cash income-generating strategies. It still seems unlikely that incomes from the environment in most cases can be the principal solution for poverty reduction within rural development efforts. Forest environmental incomes primarily serve as a necessary supplement and as an important safety net in times of household hardships or when society at large goes through general crises (war, drought, economic recessions, and so on). Only in a few cases do they provide, on their own, the pathway out of poverty.

This does not mean that forest environmental income is unimportant on the poverty agenda. But it must be understood within the overall livelihood strategies of households and communities. People prepare for and reduce potential effects of crises in advance through "risk management." They also have to handle the effects of crises through risk coping strategies. Forest environmental incomes form part of such complex processes.

In many of the studies forest income was derived from areas under of protection, which often meant that part of the income was illegally acquired The number and size of protected areas in the world is likely to increase in the future following international agreements and conventions (such as the Convention on Biological Diversity). Conflicts over access and use rights are sure to escalate. In many African countries, donors and international forest environmental NGOs still promote the conversion of forest reserves that local people have traditionally had access to into national parks and other types of legal status where biodiversity control is stricter and where local people are more often given no access.

Many countries are now developing community-based forest management systems. There is a substantial devolution of powers to lower levels of governance and even to local communities to manage the forest resources. Decentralization may, however, easily result in local elites capturing the lion's share of the benefits.

A policy to address dependence, distribution, and diversification could:

- Secure direct but controlled access and withdrawal rights to and duties regarding crucial forest environmental resources for poor people within local communities through negotiated resource use agreements with other actors
- Secure dynamic and flexible agreements that can cater for both ecological variations and variations in social and economic conditions over time

- Develop local capacity and competence to harvest and process products and to increase local value added
- Improve the functioning of forest and non-forest product markets and reduce the role of inefficient intermediaries.

Policies to Secure the Biodiversity Base

The old "fortress approach" to conservation, including the alienation of local people from natural resources, has not worked and is no longer politically acceptable. Policies must have a broader focus than just conservation. The more recent social forestry approaches, joint forest management, and other participatory approaches also have problems, however: biodiversity is often less than adequately protected, and local benefits, in particular for the poor, are less than expected (see, for example, Hulme and Murphree 2001, Barrow and Murphree 2001, Vedeld 2002).

Conserving biodiversity resources will in many cases be difficult to reconcile with local participation. We need a better approach that combines the ambitions of biodiversity conservation with rural development, value generation, and distribution concerns. There are no blueprint models for this.

A revised policy could:

- Develop simple operational field methods to assess if current uses of particular resources are sustainable
- Secure the biodiversity resource base through zoning and multiple use arrangements, using local institutions and knowledge
- Develop transparent and reciprocal systems to secure congruence between provision and appropriation of natural resources
- Secure harmonization of external public bodies of management, monitoring, and control.

Concluding Remarks

The forest resources from which environmental incomes are drawn are under tremendous pressure in most of the developing world. Converting forest to agricultural land can be economically sensible and may in many cases be seen as part of a reasonable development process. But with the growing scarcity of forest resources, remaining forestlands increase in value, and the additional land converted to agriculture is typically less productive for agricultural purposes. The conversion processes would nevertheless typically continue, partly because they often entail a transfer of ownership from state or communal to private property and partly because many of the benefits from standing forests are local or global public goods in contrast to private agricultural products.

In this larger picture of forest incomes and development, we need a better database on forest environmental values and incomes. Reaching some consensus on best research practices is a common goal for both researchers and policymakers. Heterogeneity of study objectives and methodologies and the substantial variations in results unfortunately yield a field riddled with uncertainties. In a situation where political decisions increasingly are based on—or legitimized by—research findings, research works increasingly become involved in politics.

The assessment of the economic importance of forest resource use involves individuals with conflicting interests, such as conservationists, timber traders, medicine plant merchants, and agriculturalists. This has strong political implications—a fact well acknowledged by researchers themselves, by bureaucrats, and by politicians. Different stakeholders will find supporters within various parts of the research community. In this context we believe that transparency, integrated and unified research methods, and increased awareness about the strategic dimensions of research are important.

Appendix A — Measures and Tests Relevant to Forest Environmental Income

Basic Measures of Forest Environmental Income and Dependence

Several basic measures are relevant to the analyses of forest environmental income and its link to poverty. The first and most obvious, using simple syntax, is

AI = absolute total income

which would involve a household's income, in both subsistence (direct consumption) and cash form, from all available sources. A further measure is

ACI = absolute cash income

which would involve cash income from all available sources. A final measure related to absolute income from all sources would then be

ASI = absolute subsistence income

where AI = ACI + ASI. The two latter can also be measured in terms of their relative rather than absolute contribution to total income. That is,

RCI = relative cash income = ACI/AI

and

RSI = relative subsistence income = ASI/AI

Each of the above has a counterpart for forest environmental income. The simplest is

AFI = absolute forest environmental income

which is forest environmental income, in both consumption and cash form, from all environmental income sources and products. Furthermore,

ACFI = absolute cash forest environmental income

which is the cash component of AFI and

ASFI = absolute subsistence forest environmental income

which is the consumption component of AFI. Again, these two latter measures can be expressed in terms of their relative rather than absolute contribution to absolute forest environmental income, so that

FICS = forest environmental income cash share = ACFI/AFI

and

FISS = forest environmental income subsistence share = ASFI/AFI

Just as important as the two latter, however, are measures relating environmental income to income from all sources. First,

RFI = relative forest environmental income = AFI/AI

which measures absolute forest environmental income as a share of absolute income from all sources and is thus a simple but important

measure of reliance, or dependence, on forest environmental income. The equivalent for cash income is

RCFI = relative cash forest environmental income = ACFI/ACI

which measures cash forest environmental income as a share of cash income from all sources, while

RSFI = relative subsistence forest environmental income = ASFI/ASI

which measures subsistence forest environmental income as a share of subsistence income from all sources.

Simple Tests on Role of Forest Environmental Income in Different Households

If the above measures are available, a number of simple tests and procedures can be carried out that shed light on the role of environmental income in poverty alleviation. In the following, unless otherwise indicated, it is assumed that tests are carried out with households as the unit of observation.

Forest environmental income will, of course, depend on numerous endogenous and exogenous variables, as discussed in Chapter 2. In general, therefore, all available explanatory variables of possible relevance should be included in the regression equations. For simplicity, however, we here specify the key relationship only and leave out the control variables. These relationships generally would be non-linear, which should be considered in the model specification.

1. Research question: (How) does total income level influence forest environmental income level?

This is the simplest test, asking basically whether total income contributes to higher forest environmental incomes or not:

$$AFI = f(AI) \quad (1)$$

There is, however, a potential endogeneity problem in this model, since forest environmental income will tend to contribute to higher overall income. In many cases, in fact, the reverse specification may be the relevant one.

2. Research question: Does total income level influence the dependence on forest environmental income?

This question looks at how dependence varies with overall income. Using RFI as a proxy for dependence, the model appears as

$$RFI = f(AI) \quad (2)$$

This model may also directly relate to questions regarding forest environmental Kuznets curves, discussed later.

3. Research question: Does cash/consumption realized from forest environmental income increase with absolute forest environmental income?

These tests simply look at whether forest environmental cash income or forest environmental subsistence income increase with total forest environmental income. The test may reveal whether increases in forest environmental income primarily contribute to cash income or consumption, with implications for the role of forest environmental income as a safety net, as support for consumption, or as a pathway out of poverty.

$$FICS = f(AFI) \quad (3a)$$

$$FISS = f(AFI) \quad (3b)$$

Note, however, that both of these tests may suffer from the same endogeneity problem as that which potentially afflicts (1).

4. Research question: Do "poor people" depend more on the environment as a source of cash than the wealthy do?

The following specifications are relevant:

$$ACFI = f(AI) \quad (4a)$$

$$RCFI = f(AI) \quad (4b)$$

The first of these looks at absolute cash forest environmental income as a function of absolute total income, while in the second the dependent variable is cash forest environmental income as a share of cash income from all sources.

In specifications where absolute total income enters as an independent variable and where problems of endogeneity crop up, a wealth indicator—based on households' aggregate possession of productive and exchangable assets—may usefully be substituted. Wealth indicators have the advantage over absolute income of being a more reliable proxy precisely for wealth, which is usually the more interesting explanatory variable, and are at the same time much less sensitive to the endogeneity problems.

Each of these questions, and the attendant specifications, have dealt with forest environmental income in general. It may, however, be useful to consider groups of environmental goods—or even individual goods—separately. We might, for example, wish to look at dependence on timber, NTFPs, and environmental services—and at how these vary with wealth—separately, since such an analysis will reveal more accurately the nature of dependence and the sustainability of environmental use for different social groups. Or, following up on the discussion in Chapter 2, we could test the hypothesis that certain low-return forest activities are an "employment of last resort" for the poor, while the rich are able to monopolize high-return activities.

Thus, for example, model (2) could be changed into:

$$RFI_i = f(AI) \quad (5)$$

where *i* denotes the specific good or group of goods under consideration.

A "Forest Environmental Income Kuznets Curve"?

The manner in which forest environmental income, and dependence on it, varies with income or wealth may be neither strictly increasing or decreasing, and more flexible models may be necessary. One example of this could be a slightly reinterpreted environmental Kuznets Curve, where instead of looking at pollution or resource degradation we look at forest environmental income levels and dependence and postulate U-shaped relations between these and total income.

The logic underlying the forest environmental income Kuznets curve (FIKC) is that there is some trajectory of environmental degradation as the income of societies increases, which could then also be applied to environmental income. If the unit of analysis is households, it could similarly be argued that there is an FIKC-like trajectory that households pass through as income increases (cf. Bulte and van Soest 2001).

The following model could be useful to test this relationship:

$$AFI = a(AI) + b(AI)^2 + u \quad (6)$$

which can be transformed into a linear relationship by dividing both sides of the equation with AI:

$$AFI/AI = a + b(AI) + u/AI \quad (7)$$

which in turn equals:

$$RFI = a + b(AI) + u/AI \quad (8)$$

In investigations of dependence, RFI may be substituted for AFI in equations (6) and (7).

Note that (8), apart from the error term, is equivalent to (2). Ideally, given the weighted error term, the estimators should here be transformed through the standard generalized least squares procedure.

The assumption here is that degradation is proportional to use or extraction, which in turn is proportional to forest environmental income. While the latter may seem quite unproblematic, the former assumption neglects sustainability thresholds.

The model can (and should) also be used to examine how income from and dependence on specific environmental goods or groups of goods vary with income and wealth levels within communities:

$$AFI_i = a(AI) + b(AI)^2 + u \quad (9)$$

where AFI_i is income from environmental good i (or group i). And, again, a wealth indicator may profitably be substituted for absolute total income.

Income Inequality and Distribution

Many of the regression models suggested, including the FIKC, aim at finding out how environmental dependence differs among income groups. This sub-section suggests other complementary measures of income inequality and how they can be used in the analysis of environmental dependence.

Gini Coefficients

The Gini coefficient can be calculated as

$$G_{AI} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}\left|AI_i - AI_j\right|}{2n^2\mu}$$

where n is the sample size and m is the sample average. So the Gini coefficient for income inequality is simply the relative mean difference between all possible income pairs *i* and *j* in the sample. For small samples, the expression should be multiplied with n/(n – 1) to provide an unbiased estimator.

If we construct a new variable for "absolute non-environmental income"—that is, absolute income from all sources other than the environment—such that

$$ANI = AI - AFI$$

then we can calculate a Gini coefficient for absolute incomes excluding forest environmental income:

$$G_{ANI} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}\left|ANI_i - ANI_j\right|}{2n^2\mu}$$

A comparison of these two Gini coefficients will reveal whether, and to what extent, forest environmental incomes contribute to reducing inequality. For example, Aryal (2002) finds that the Gini coefficient in his study area of Budongo, Uganda, increases from an already relatively high level of 0.55 to 0.61 when forest income is excluded.

Kuznets Ratios

Comparisons of forest environmental income and dependence between the rich and the poor are of interest in general, regardless of the specific nature of the relationship. The Kuznets ratio (not to be confused with Kuznets curves) is the ratio between the average income of the richest x percent with the poorest y percent. ('How many times richer are the richest x percent compared with the poorest y percent?') We extend the definitions of the Kuznets ratio by distinguishing between the absolute and relative ones, and we also apply them to forest environmental income.

In the following, values for the richest and poorest 20 percent will be used, since separation into quintiles is common, but other percentages may be used (typically some have used the bottom 40 percent).

The "absolute Kuznets ratio," in terms of total income, can be defined as:

$$AKR = \frac{mean \cdot AI(wealthiest \cdot 20\%)}{mean \cdot AI(poorest \cdot 20\%)}$$

The corresponding "absolute environmental Kuznets ratio" can then be defined as:

$$AEKR = \frac{mean \cdot AFI(wealthiest \cdot 20\%)}{mean \cdot AFI(poorest \cdot 20\%)}$$

Relative Kuznets ratios specify the share of mean absolute income attributable to different sources. The "relative environmental Kuznets ratio" can thus be defined as:

$$REKR = \frac{mean \cdot RFI(wealthiest \cdot 20\%)}{mean \cdot RFI(poorest \cdot 20\%)}$$

While AEKR measures the ratio of absolute forest environmental income among the wealthy to that of the poor, the REKR expresses the ratio of dependence among the wealthy to that of the poor. Thus it is entirely plausible, as Cavendish (2003) hypothesizes, that while the wealthy will have absolute forest environmental incomes exceeding those of the poor (AEKR > 1), the poor will be more dependent on forest environmental incomes (REKR < 1). This was indeed observed by Aryal (2002) and Botha (2003) in Uganda and Malawi, respectively.

Kuznets ratios can also be used as explanatory variables when analyzing forest environmental income in meta-studies. Relevant tests could, for example, be:

$$\text{mean AFI} = f(\text{AKR}) \quad (10)$$

or

$$\text{mean RFI} = f(\text{AKR}) \quad (11)$$

These would, respectively, analyze absolute forest environmental income and dependence on forest environmental income as a function of total income inequality.

If data permit, meta-studies might also usefully employ pairwise t-tests or ANOVAs to analyze absolute forest environmental income and income dependency as a function of income group (such as wealthiest and poorest 20 percents) across cases.

More generally, the Kuznets ratios can also be applied to income from and dependence on specific environmental goods or groups of goods, for example:

$$AEKR_i = \frac{mean \cdot AFI_i(wealthiest \cdot 20\%)}{mean \cdot AFI_i(poorest \cdot 20\%)}$$

where AFI_i is forest environmental income from good i (or group i), or

$$REKR_i = \frac{mean \cdot RFI_i(wealthiest \cdot 20\%)}{mean \cdot RFI_i(poorest \cdot 20\%)}$$

where RFI_i is forest environmental income from good i (or group i).

Diversification

Diversification of income sources is central to analysis of the role of forest environmental income in rural livelihoods. The simplest indicator would be a digit indicating the number of different income sources in a household.

Two relevant diversification indexes, based on the same logic as the Simpson Index for field fragmentation, would be:

Diversification index, total income =

$$DITI = 1 - \text{å}(I_i/AI)^2$$

where I_i is income (consumption + cash) from source i.

Diversification index, cash income =

$$DICI = 1 - \text{å}(CI_i/ACI)^2$$

where CI_i is cash income from source i.

These indexes, like the simple digits, may suffer from problems related to the specific manner in which incomes are classified. For example, should forest environmental income constitute one category, or should it be divided into income from timber, NTFPs, and environmental services? The specific purpose of the analysis, and experimentation, may reveal the most expedient classification. But the comparison of cases presumes that a similar level of aggregation has been used in defining the income categories.

Diversification indexes can be used to test a number of hypotheses, such as:

Total income increases with total income diversification:

$$AI = f(DITI) \quad (12)$$

Cash income increases with cash income diversification:

$$ACI = f(DICI) \quad (13)$$

Forest environmental income is important for income diversification:

$$DITI = f(AFI) \quad (14)$$

Forest environmental cash income is important for cash income diversification:

$$DICI = f(ACFI) \quad (15)$$

The implied causality in the above tests can, of course, be discussed. Tests incorporating exogenous variables are, again, recommended.

Forest Environmental Income Fluctuations

Fluctuations in forest environmental income are of general interest, since they may reveal the extent to which the resource functions as a "bank account"—to be tapped only when other sources of income decline or fail—or represents a stable source of income for consumption or sale, which in turn may illuminate questions related to the types of risk (idiosyncratic or covariant) faced by households, the coping strategies they use, and the role of forest environmental income in poverty reduction or avoidance.

To investigate this, time series are necessary, and these are unfortunately but understandably rare. When time series data—and in particular panel data—are available, however, variances and standard deviations in forest environmental income (also from different goods, and as cash or consumption) for each household over time may be computed. These, in turn, can be compared across different income, wealth, or social groupings.

Panel data may also permit procedures explaining forest environmental income fluctuations, for example:

$$AFI_{t+1} - AFI_t = f(ANI_{t+1} - ANI_t, DITI_{t+1} - DITI_t) \quad (16)$$

where t is time period (1…..n). This would attempt to explain fluctuations in absolute forest environmental income as a function of fluctuations in non-forest environmental income and income diversification.

Appendix B — Case Studies

Author	*Project topic*	*Year of fieldwork*	*Country*	*Citation*
Adhikary, R. K. (2001)	Contribution of Agroforestry to Farm-Household Income and Community Forestry Management	2000–2001	Nepal	M.Sc. thesis, Noragic, NLH
Akitanda, P. (1994)	Local People's Participation in the Management and Utilization of Catchment Forest Reserves. A Case Study of Kilimanjaro Catchment Forest Reserve, Tanzania	1993–1994	Tanzania	M.Sc. thesis, Noragri, NLH
Aryal, B. (2002)	Are Trees for the Poor? A Study from Budongo Forest, Uganda	2001–2002	Uganda	M.Sc. thesis, Dept. of Economics and Social Science, NLH
Ayele, A. A. (1998)	The Role of Livestock in Smallholder Household Economy in the Mixed Crop-Livestock Framing System of Ethiopia	1997–1989	Ethiopia	M.Sc. thesis, Noragric, NLH
Balachander, G. (1993)	Extraction of Non-Timber Forest Products, Including Fodder and Fuelwood, in Mudumalai, India	1990	India	*Economic Botany* 47(3): 268–274
Bogahawatte, C. (1997a)	Forest Policy, Non Timber Forest Products and the Rural Economy in the Wet Zone Forests in Kandy, Sri Lanka, Dept of Agricultural Economics, Faculty of Agriculture, University of Peradeniya, Sri Lanka	1996–1997	Sri Lanka	Report submitted to Environmental Economics and Policy Studies, Economy and Environment Program for South East Asia, Singapore, November 1997
Bogahawatte, C. (1997b)	Forest Policy, Non Timber Forest Products and the Rural Economy in the Wet Zone Forests in Matara, Sri Lanka	1996–1997	Sri Lanka	Report submitted to Environmental Economics and Policy Studies, Economy and Environment Program for South East Asia, Singapore, November 1997
Bogahawatte, C. (1997c)	Forest Policy, Non Timber Forest Products and the Rural Economy in the Wet Zone Forests in Ratnapura, Sri Lanka	1996–1997	Sri Lanka	Report submitted to Environmental Economics and Policy Studies, Economy and Environment Program for South East Asia, Singapore, November 1997

Author	*Project topic*	*Year of fieldwork*	*Country*	*Citation*
Botha.N. B. (2003)	Looking for a Path Out of Poverty: The Study of Chimaliro Forestry Reserve, Malawi	2002	Malawi	M.Sc. thesis, Dept. of Economics and Social Science, NLH
Campbell, B. M., J. Clarke, M. Luckert, M. Maatose, F. Musvoto, and I. Scoones (1999a)	Local-Level Economic Valuation of Savanna Woodland Resources: Village Cases (Jinga Village) from Zimbabwe	1995	Zimbabwe	Hot Springs Working Group. *Research Series* Vol. 3, No.2, International Institute for Environment and Development
Campbell, B.M., J. Clarke, M. Luckert, M. Maatose, F. Musvoto, and I. Scoones (1999b)	Local-Level Economic Valuation of Savanna Woodland Resources: Village Cases (Matendeudze Village) from Zimbabwe	1995	Zimbabwe	Hot Springs Working Group. *Research Series* Vol. 3, No.2, International Institute for Environment and Development
Campbell, B. M., S. Jeffrey, W. Kozanayi, M. Luckert, M. Mutamba, and C. Zindi (2002)	*Household Livelihoods in Semi-Arid Regions: Options and Constraints*	1999–2000	Zimbabwe	Book published by CIFOR, Jakarta, Indonesia
Campbell, B. M., M. Luckert, and I. Scoones (1997a)	Local Level Valuation of Savannah Resources: A Case Study of Chimanimani, Zimbabwe	1993	Zimbabwe	*Economic Botany* 51(1): 59–77
Campbell, B. M., M. Luckert, and I. Scoones (1997b)	Local Level Valuation of Savannah Resources: A Case Study of Matale, Zimbabwe	1993	Zimbabwe	*Economic Botany* 51(1): 59–77
Cavendish, W. (1999a)	Empirical Regularities in the Poverty Environment Relationship of African Rural Households, 1993–1994	1993–1994	Zimbabwe	Working paper Series 99-21, Imperial College, London
Cavendish, W. (1999b)	Empirical Regularities in the Poverty Environment Relationship of African Rural Households, 1996–1997	1996–1997	Zimbabwe	Working paper Series 99-21, Imperial College, London
Coomes, Oliver T., Bradford L. Barham, and Yoshito Takasaki (2001)	When Poor People Depend on Biodiverse Environments: Rain Forest Use and Reliance Among Amazonian Peasants in the Pacaya-Samira National Reserve Area, Peru	1996	Peru	Draft paper for submission to NEUDC Conference

Author	*Project topic*	*Year of fieldwork*	*Country*	*Citation*
Dovie, D., C. Shackleton, and E. Witowski (2001)	Valuing Non-Timber Forest Products—Indicators for Interplays Between Poverty, Livelihoods and the Environment. Case from South Africa	2001	South Africa	Symposium Paper, Open meeting of GEC Research Community, Rio de Janeiro, 2001
Eknes, M., and K. Holtermann (1989a)	Settled Nomads and Nomadic Settlers; A Social and Economic Case Study from Central Turkana, Lodwar Town, Kenya. 1. Case	1989	Kenya	M.Sc. thesis, Noragric, NLH
Eknes, M. and K. Holtermann (1989b)	Settled Nomads and Nomadic Settlers; A Social and Economic Case Study from Central Turkana, Lodwar Town, Kenya. 2 Case.	1989	Kenya	M.Sc. thesis, Noragric, NLH
Fisher, M. (2002)	Household Welfare and Forest Dependence in Rural Malawi	1999–2000	Malawi	Unpublished working paper
Godoy, R., N. Brokaw, and D. Wilkie (1995)	The Effect of Income on the Extraction of Non-Timber Tropical Forest Products: Model, Hypotheses, and Preliminary Findings from the Sumu Indians of Nicaragua	1992	Nicaragua	*Human Ecology* 23 (1)
Godoy, R., H. Overman, J. Demmer, L. Apaza, E. Byron, T. Huanca, W. Leonard, E. Pérez, V. Reyes-García, and V. Vadez (2002a)	Local Financial Benefits of Rain Forests, 1999–2000	1999–2000	Bolivia	*Ecological Economics* 40: 397–409
Godoy, R., H. Overman, J. Demmer, L. Apaza, E. Byron, T. Huanca, W. Leonard, E. Pérez, V. Reyes-García, and V. Vadez (2002b)	Local Financial Benefits of Rain Forests, 1999–2001	1999–2001	Bolivia	*Ecological Economics* 40: 397–409

Author	*Project topic*	*Year of fieldwork*	*Country*	*Citation*
Godoy, R., H. Overman, J. Demmer, L. Apaza, E. Byron, T. Huanca, W. Leonard, E. Pérez, V. Reyes-García, and V. Vadez (2002c)	Local Financial Benefits of Rain Forests, 1995–1996	1995–1996	Honduras	*Ecological Economics* 40: 397–409
Godoy, R., H. Overman, J. Demmer, L. Apaza, E. Byron, T. Huanca, W. Leonard, E. Pérez, V. Reyes-García, and V. Vadez (2002d)	Local Financial Benefits of Rain Forests, 1995–1997	1995–1997	Honduras	*Ecological Economics* 40: 397–409
Gosalamang, D. (2003)	Changing Legal Status of Mount Elgon Forest Reserve, Uganda—Impacts on Local People's Livelihoods	2003	Uganda	M.Sc. thesis, Noragric, NLH
Gunatilake, H. M., D. Senaratne, and P. Abeygunawardea (1993)	Role of Non-Timber Forest Products in the Economy of Peripheral Communities of Knuckles National Wilderness Area of Sri Lanka: A Farming Systems Approach	1993	Sri Lanka	*Economic Botany* 47(3): 275–281
Hegde, R., S. Suryaprakash, L. Achoth, and K. S. Bawa (1996)	Extraction Of Non-Timber Forest Products In The Forests Of Biligiri Rangan Hills, Billigirirangaswamy Temple Wildlife (BRT) - Exterior Block, India. 1. Contribution To Rural Income	1993	India	*Economic Botany* 50(3): 243–251
Hegde, R., S. Suryaprakash, L. Achoth, and K. S. Bawa (1996)	Extraction Of Non-Timber Forest Products In The Forests Of Biligiri Rangan Hills, Billigirirangaswamy Temple Wildlife (BRT) – Interior Block, India. 1. Contribution To Rural Income	1993	India	*Economic Botany* 50(3): 243–251

Author	*Project topic*	*Year of fieldwork*	*Country*	*Citation*
Kiyingi , I. (1999)	The Contribution of Non-Timber Forest Products to Household Incomes in Goma Sub County, Mukono District.	1999	Uganda	BSc. diss., Fac. of Agriculture and Forestry, Makerere University
Maskey, Y. (2001)	Fund of Community Forest: Consent and Satisfaction. A Case Study of Aakase and Kattikepakha CFUGs of Ramechhap District, Nepal	2000–2001	Nepal	M.Sc. thesis, Noragric, NLH
Mbarouk, A. A. (1996)	Economic Analysis of National Park Establishment. A Case of Jozani-Chwaka Bay Forest—Zanzibar, Tanzania	1995–1996	Tanzania	M.Sc. thesis, Noragric, NLH
Muderis, A. M. (1998)	Resource Deprivation and Socio-Economic Changes Among Pastoral Households. The Case of Karayu and Itu Pastoralists in the Middle Awash Valley of Ethiopia	1998–1999	Ethiopia	M.Sc. thesis, Noragric, NLH
Nasser, S. (1994)	Socio-Economic and Ecological Study of Mangrove Forest Management in Zanzibar, Tanzania	1994	Tanzania	M.Sc. thesis, Noragic, NLH
Nsubuga, N. G. (1998)	Social-Economic and Political Factors for Sustainable Forest Resource Use and Management	1997–1998	Uganda	M.Sc. thesis, Noragric, NLH
Nyland, T. (1998)	Local People's Use of Land and Natural Resources	1997–1998	Lao PDR	Candidate agric. thesis Dept of Economics and Social Science, NLH
Sætre, D. V. (1993)	People and Grasses, A Case Study from the Royal Bardia National Park, Nepal	1992–1993	Nepal	M.Sc. thesis, Noragric, NLH
Salih, A. H. (1989)	Agro-Ecological and Socio-Economical Constraints on Increased Sorghum Productivity Among Small Scale Mechanized Rainfed Farmers in Gedarif District, Sudan, The Case of Azaza Area	1989	Sudan	M.Sc. thesis, Noragric, NLH

Author	*Project topic*	*Year of fieldwork*	*Country*	*Citation*
Shaanker, U. R., K. N. Ganeshaiah, S. Krishnan, R. Ramya, C. Meera, N. A. Aravind, A. Kumar, D. Rao, G. Vanraj, J. Ramachandra, R. Gauthier, J. Ghazoul, N. Poole, and B. V. Chinnappa Reddy (2003a)	Livelihood Gains and Ecological Costs of NTFP Dependence Assessing the Roles of Dependence, Ecological Knowledge and Market Structure in Three Contrasting Human and Ecological Settings in South India (Biligirirangan Swamy Temple Wildlife Sanctuary)	2001	India	International Conference on Rural Livelihoods, Forest and Biodiversity, Bonn, Germany, May 20–23
Shaanker, U. R., K. N. Ganeshaiah, S. Krishnan, R. Ramya, C. Meera, N. A. Aravind, A. Kumar, D. Rao, G. Vanraj, J. Ramachandra, R. Gauthier, J. Ghazoul, N. Poole, and B. V. Chinnappa Reddy (2003b)	Livelihood Gains and Ecological Costs of NTFP Dependence Assessing the Roles of Dependence, Ecological Knowledge and Market Structure in Three Contrasting Human and Ecological Settings in South India (Malai Mahadeshwara Hills)	2001	India	International Conference on Rural Livelihoods, Forest and Biodiversity, Bonn, Germany, May 20–23
Shaanker, U. R., K. N. Ganeshaiah, S. Krishnan, R. Ramya, C. Meera, N. A. Aravind, A. Kumar, D. Rao, G. Vanraj, J. Ramachandra, R. Gauthier, J. Ghazoul, N. Poole, and B. V. Chinnappa Reddy (2003c)	Livelihood Gains and Ecological Costs of NTFP Dependence Assessing the Roles of Dependence, Ecological Knowledge and Market Structure in Three Contrasting Human and Ecological Settings in South India (Rajiv Gandhi National Park)	2001	India	International Conference on Rural Livelihoods, Forest and Biodiversity, Bonn, Germany, May 20–23

Author	*Project topic*	*Year of fieldwork*	*Country*	*Citation*
Shackleton, S., C. Shackelton, T. Netshiluvhi, B.Geach, and A. Ballance (1999a)	How Valuable Are Our Woodlands for Sustainable Rural Livelihoods? Local Level Valuation of Woodland Resources from Ha-Gondo in South Africa	1999	South Africa	Presented at "Towards Sustainable Management Based On Scientific Understanding Of Forest And Woodlands," Pretoria, South Africa
Shackleton, S., C. Shackleton, T. Netshiluvhi, B.Geach, and A. Ballance (1999b)	How Valuable Are Our Woodlands for Sustainable Rural Livelihoods? Local Level Valuation of Woodland Resources from Kwajobe in South Africa	1999	South Africa	Presented at "Towards Sustainable Management Based On Scientific Understanding Of Forest And Woodlands," Pretoria, South Africa
Shackleton, S., C. Shackelton, T. Netshiluvhi, B.Geach, and A. Ballance (1999c)	How Valuable Are Our Woodlands for Sustainable Rural Livelihoods? Local Level Valuation of Woodland Resources from Mogano in South Africa	1999	South Africa	Presented at "Towards Sustainable Management Based On Scientific Understanding Of Forest And Woodlands," Pretoria, South Africa
Sharma, N. T. (1999)	Community Forestry and Its Impact on Socio-Economic Status of the People in Nepal	1999	Nepal	M.Sc. thesis, Noragric, NLH
Shoko, T. (2000)	Assessment of the Contribution of Agriculture, Non Agricultural Activities and Indigenous Woodlands Towards Household Security	1999–2000	Zimbabwe	M.Sc. thesis, Noragric, NLH
Siame, D. (2001)	The Impact of Participatory Forest Management on Peoples Livelihoods in Kapiri-Mposhi District in Central Zambia	2000–2001	Zambia	M.Sc. thesis, Noragric, NLH
Sjaastad, E., P. Vedeld, K. Magnussen, Y. Ngaga, S. Chamshama, and G. Monela (2003)	Economic Valuation of Catchment Forests in Arusha District—Tanzania	2002	Tanzania	Noragric, report to MNRT, Tanzania
Sjaastad, E., P. Vedeld, K. Magnussen, Y. Ngaga, S. Chamshama, and G. Monela (2003)	Valuation of Catchment Forests in Kilimanjaro District—Tanzania	2002	Tanzania	Noragric, report to MNRT, Tanzania

Author	*Project topic*	*Year of fieldwork*	*Country*	*Citation*
Sjaastad, E., P. Vedeld, K. Magnussen, Y. Ngaga, S. Chamshama, and G. Monela (2003)	Valuation of Catchment Forests in Tanga District—Tanzania	2002	Tanzania	Noragric, report to MNRT, Tanzania
Stoian, D. (2003)	Making the Best of Two Worlds: Rural and Peri-Urban Livelihood Options Sustained by Non-Timber Forest Products from the Bolivian Amazon	1998	Bolivia	International Conference on Rural Livelihoods, Forest and Biodiversity, Bonn, Germany, May 20–23
Vithanage, P. R. (1999)	Evaluation of the Sustainability of Different Land-Use Systems Using Avian Community as a Bio-Indicator	1997	Sri Lanka	M.Sc. thesis, Noragric, NLH
Yadama, G. N., B. R. Pragada, and R. R. Pragada (1997)	Forest Dependent Survival Strategies of Tribal Women: Implications for Joint Forest Management, Andhra Pradesh, India	1995–1996	India	Book published by FAO, Bangkok, Thailand

Appendix C — Variables in the Meta-Analysis

Background to the Case Study

1. Year of data

2. Purpose of original study (academic research, rural development, conservation report, or consulting report)

3. Duration of the study in months

4. Objective of the study

5. Sample size in the study

6. Methodology used (household survey, other method or both)

7. Locality of the study area – Province

8. District

9. Study site

10. Country

Geographic Characteristics

11. Size of the study area (km^2)

12. Number of people living in the study area

13. Population density (persons per km^2)

14. Human population growth trend - Has the human population in the study area increased, remained stable, or decreased over the past 10 years (including changes due to migrations)?

15. Mean elevation of the study area (m)

16. Average precipitation of the study area (mm/year)

17. Soil type

18. Forest type

19. Major land uses in the study area in percentages by the following categories:

20. Rainfed crop production (%)

21. Irrigated crop production (%)

22. Non-cultivated land (%)

23. Grassland (%)

24. Pasture (savannahs/woodlands that are used for grazing) (%)

25. Swidden fallow (%)

26. Forest (%)

27. Settled area (%)

28. Marshy/swampy area (%)

29. Other (%)

Characteristics of Environmental Products

30. Use of the environmental products:

31. Wild animal (own consumption, sale, or both)

32. Wild fruits (own consumption, sale, or both)

33. Wild vegetables (own consumption, sale, or both)

34. Wild insects (own consumption, sale, or both)

35. Other wild foods (mushroom, birds, mice, honey, spices) (own consumption, sale, or both)

36. Wild medicine (own consumption, sale, or both)

37. Timber (own use, sale, or both)

38. Timber (used as a production input)

39. Firewood (own use, sale, or both)

40. Thatching grass (own use, sale, or both)

41. Woven goods (sleeping mats, baskets, brooms, hats) (own use, sale, or both)

42. Leaf litter (own use, sale, or both)

43. Pottery clays (own use, sale, or both)

44. Termite mounds (own use, sale, or both)

45. Livestock fodder (own use, sale, or both)

46. Ornamental/aesthetic/fashion (own use, sale, or both)

47. Tourism (own use, sale, or both)

48. Charcoal (own use, sale, or both)

49. Resin (own use, sale, or both)

50. Rattan (own use, sale, or both)

51. Fish (own use, sale, or both)

52. Gold (own use, sale, or both)

Characteristics of the Environmental Area

53. Type of land tenure system of the resource area:

54. Private land

55. State land

56. Communal land

57. Open access

58. Type of management of the environmental resource:

59. Strict nature reserve

60. National park

61. Habitat management area

62. Protected landscape

63. Managed resource protected area

Socioeconomic Characteristics

64. Socioeconomic characteristics:

65. Average household size

66. Average number of people involved in environmental production per producer household

67. Average age of the household head

68. Average number of years in school

69. percentage of households with no education

70. percentage of households with primary education

71. percentage of households with secondary education

72. percentage of households with post-secondary education

73. Average annual household income (US$)

74. Average annual cash income (US$)

75. Share of cash income (%)

76. Income share according to sectors

77. Crop production

78. Livestock

79. Wage labor

80. Off-farm activities

81. Remittances

82. Forest activities

83. Fishing

84. Other

85. percentage income that is earned in cash according to sources as follows:

86. Crop income (%)

87. Livestock income (%)

88. Off-farm (%)

89. Forests (%)

90. Average annual forest environmental income (US$)

91. Average forest environmental income by sources:

92. Average timber income (US$)

93. Average fodder income (US$)

94. Average fodder income (US$)

95. Average firewood income (US$)

96. Average gold panning income (US$)

97. Average wild food income (US$)

98. Average wild medicine income (US$)

99. Average thatching grass income (US$)

100. Other income (US$)

101. Average annual cash forest environmental income (US$):

102. Average timber income (US$)

103. Average fodder income (US$)

104. Average fodder income (US$)

105. Average firewood income (US$)

106. Average gold panning income (US$)

107. Average wild food income (US$)

108. Average wild medicine income (US$)

109. Average thatching grass income (US$)

110. Other income (US$)

111. Relative forest environmental income

112. Relative cash forest environmental income

113. Does the study indicate costs incurred in production?

114. Costs incurred in crop production (labor, seeds, fertilizers, draft…)

115. Costs incurred in livestock production (labor, fodder, cattle purchases...)

116. Costs incurred in forest production (labor, machinery, transport.)

117. Domestic expenses

118. Other expenses

119. Total expenses

120. Net income (US$)

121. Has fodder been valued?

122. Gini coefficient without forest income

123. Gini coefficient with forest income

124. Degree of forest dependency (percentage of total households dependent on forests):

125. Not dependent (percentage of total households with 0% share of forest environmental income)

126. Weakly dependent (percentage of total households with <=20% share of forest environmental income)

127. Dependent (percentage of total households with between 20 and 40% of forest environmental income)

128. Strongly dependent (percentage of total households with more than 40% of forest environmental income)

129. percentage of total households involved at all in forest environmental income activities

130. Local labor rate - Average daily wage for labor (US$)

131. Proportion (%) of households involved in forest environmental production

132. Proportion (%) of households involved in processing of environmental goods

133. Proportion (%) of households involved in marketing of environmental goods

134. Average household income of producer households per year (US$)

135. Proportion of men having forest income (%)

136. Proportion of women having forest income (%)

137. Average land holding (ha)

138. Average livestock holding (TLU)

139. Classification of household according to wealth:

140. Very rich (%)

141. Rich (%)

142. Average (%)

143. Poor (%)

144. Very poor (%)

145. Degree of forest dependency according to different income groups (role of forest products in total household production)

146. Cash forest share according to different wealth groups

147. Livelihood strategies adopted, ranking:

148. Crop production

149. Livestock

150. Wage labor

151. Off farm activities

152. Remittance

153. Industrial worker

154. Forest activities

155. Transfers

156. Fishing

157. Other

158. What is the percentage of households with formal employment?

Characteristics of the Market

159. Are there any organizations securing transport, marketing, and sales of produce: private, cooperative, state, and projects?

160. Age of organization

161. Is the organizational structure efficient?

Institutional Characteristics

162. Customary rules governing forest/product use:

163. Does the community respect customary laws

164. Are the rules effectively enforced? (Yes or No)

165. Are there government regulations affecting resource exploitation?

166. If yes, what is the effect of regulations on exploitation of the resource? (positive would mean resource exploitation is tending toward sustainable)

167. What is the effect of government regulations on promoting equitable access to the resource? ((positive means equitability is promoted)

168. Is there government investment to support, encourage, or develop environmental production?

169. If yes, what is the effect of investment on exploitation of the resource? (positive would mean resource exploitation is tending toward sustainable)

170. What is the effect of investment on promoting equitable access to the resource? (positive means equitability is promoted)

171. Do households have recognized legal right to harvest the product for trade?

172. Do households have recognized legal right to change the land use to another production system?

173. Have the legal rights of households to harvest the environmental products for commercial purposes changed in the past 10 years?

174. Are households generally aware of the nature of their legal rights to harvest the product for commercial purposes?

175. Have there been any official claims by households to increase land/resource rights over the last 10 years?

176. Are state laws and traditional rules conflicting regarding exploitation of environmental products?

177. What is the walking distance in km from the environment production area to the market?

178. What is the mode of travel?

179. Does the study indicate any external support?

180. Has external support from donors or NGOs been targeted to:

181. Raw material producers

182. Traders

183. Processing/manufacturing industry

184. Retail/export industry

185. What is the main source of external support? (local/national NGO, international NGO, international donors, national private sector, or international private sector)

186. Does the study take into consideration environmental services?:

187. Does the study account for carbon sequestration? (Yes or No)

188. Does the study account for water retention?

189. Does the study account for soil erosion prevention?

190. Does the study account for electricity?

191. Does the study account for wind erosion?

192. Does the study account for biodiversity?

193. Does the study include other resources other than forestry?:

194. Does the study include fish resources?

195. Does the study include grasslands?

196. Does the study include freshwater wetlands?

197. Does the study include coastal wetlands and mangroves?

198. Does the study include freshwater bodies?

199. Does the study include salt-water bodies?

200. Does the study include others?

201. Does the study include the value of processed goods, e.g., woodcarvings?

202. Does the study include subsistence income in estimation of total income?

203. Does the study consider sustainability? (local perceptions regarding trends in resource supply)

Notes

1. The FAO definition of a forest includes a minimum area size of 0.5 ha, a minimum tree canopy cover of 10 percent, and the dominant use not being agriculture or urban; cf. FAO (2001).

2. A fourth possible measure is profit, which equals value added minus labor costs. There does not, however, seem to be any good reason to omit labor costs while at the same time retaining normal profit. Also, of course, in rural areas of poor countries, normal profit will often be insignificant.

3. Environmental services provided by forests are numerous, including carbon sequestration, water flow stabilization, erosion control, and biodiversity protection. Vast populations in faraway locations may in some way benefit from forest resources without ever realizing it. The focus here, however, is on the rural poor.

4. The first part of this section draws on Angelsen and Wunder (2003).

5. See Kaimowitz (2002) for sources and full references for the figures provided in this sub-section.

6. The study used a much larger number of dimensions to categorize the cases (Belcher and Ruiz-Perez 2001): geographic setting; characteristics of the product; production system; ecological implications of production; socioeconomic characteristics of raw material production area; processing industry and trade; institutional characteristics of producers and government policies; and external interventions.

7. The distribution between these categories was 18, 28, and 15, although this should not be given much weight, as the cases were not selected randomly.

8. See Neumann and Hirsh (2000), Kaimowitz (2002), and Angelsen and Wunder (2003) and the references therein.

9. The model is elaborated in Angelsen and Wunder (2003: 22).

10. Wealthy households also realize substantial income from the forest but will more often engage in high-return activities that require capital (animals, machinery) that is unavailable to the poorest.

11. In brief, "Poverty Reduction Strategy Papers (PRSPs) describe a country's macroeconomic, structural and social policies and programs to promote growth and reduce poverty, as well as associated external financing needs. PRSPs are prepared by governments through a participatory process involving civil society and development partners, including the World Bank and the International Monetary

Fund (IMF)." (See www.worldbank.org/poverty/strategies.)

12. Only 9 studies presented data on livestock ownership, while 28 cases presented data on livestock income. The results thus most likely underestimate livestock ownership. The omission could partly also be a result of different objectives of the cases. Quite a number of studies were furthermore concerned about livelihood strategies and presented data on incomes rather than ownership.

13. In comparing incomes across countries, we used the purchasing power parity (PPP) conversions to account for price level differences. We used the ratio between countries' PPP GDP and nominal GDP found in World Bank Development reports for the year of the study.

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