

# Economic indicators and their use in sustainable forest management

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**Gary Bull<sup>1</sup>, Olaf Schwab<sup>2</sup>, and Priyangi Jayasinghe<sup>3</sup>**

## Abstract

The economic sustainability literature highlights important theoretical and practical limitations when developing economic indicators to assess sustainable forest management (SFM). Since SFM is multi-disciplinary, no body of theoretical knowledge can embrace all of its dimensions. There is a significant gap between economic theory and management application which will likely remain. For the economic indicators, spatial scales have a very significant impact on the indicator chosen, and there is a danger of not selecting the best indicator simply because there is little or poor-quality data. The use of criteria and indicator frameworks and certification systems is a means to define and assess SFM. However, these frameworks and systems do not address some key conflicts in economic theory. This paper explores these conflicts and their challenges, identifies areas for improvement, and provides some guidance on the use of economic indicators in forest management. The authors conclude that: (1) stakeholder participation is imperative for SFM; (2) all stakeholders need to clearly state their choice of framework before beginning a dialogue on the implementation of economic indicators; (3) new methods for measuring economic sustainability based on the concept of total capital need to be developed; (4) spatial scale must be thoroughly discussed and incorporated into the set of indicators chosen; (5) a selection process needs to be developed to help in balancing the “best” indicators against the “practical” indicators which may not fully address the issues at hand; and (6) the collection and maintenance of appropriate datasets is a priority for the implementation of economic indicators.

**KEYWORDS:** *economic theory, indicators, sustainable forest management.*

## Contact Information

- <sup>1</sup> Associate Professor, University of British Columbia, Faculty of Forestry, 2045–2424 Main Mall, Vancouver, BC V6T 1Z4. Email: [gary.bull@ubc.ca](mailto:gary.bull@ubc.ca)
- <sup>2</sup> PhD Candidate, University of British Columbia, Faculty of Forestry, 2045–2424 Main Mall, Vancouver, BC V6T 1Z4. Email: [oschwab@interchange.ubc.ca](mailto:oschwab@interchange.ubc.ca)
- <sup>3</sup> Masters Student, University of British Columbia, Faculty of Forestry, 2401–2424 Main Mall, Vancouver, BC V6T 1Z4. Email: [priyangi-mind@eureka.lk](mailto:priyangi-mind@eureka.lk)

## Introduction

Sustainable development was defined by the Brundtland Commission as “development that meets the needs of the present generation without compromising the needs of future generations” (Brundtland [editor] 1987). To address the problem of global poverty and inequitable distribution of resources and wealth, the commission identified the need for a new phase of economic growth (Brundtland [editor] 1987). When the concept of sustainable development was formally introduced, a demand for tools to assess and measure progress towards sustainability was created (Milon and Shogren 1995). At roughly the same time, similar ideas were developing to better merge economic ideas with ecology (Archibugi *et al.* 1989; Pearce and Turner 1990; Costanza *et al.* 1991; Swingland 2002; Freeman 2003). The consequence has been a rethinking of how to approach business and the environment in virtually every sector of the economy (Capra and Pauli [editors] 1995; Jenkins and Smith 1999).

In the forest sector, the use of criteria and indicator (C&I) frameworks and certification systems became the means for defining and assessing sustainable forest management (SFM), particularly in developed economies. However, in the context of SFM, these frameworks and systems do not address some key conflicts in economic theory or the controversies over the theory of economic value (Food and Agriculture Organization [FAO] 1998; Vincent and Hartwick 1998; Nordhaus and Kokkelenberg 1999; Mittelsteadt *et al.* 2001; Adamowicz 2003). This paper will explore these conflicts and challenges, identify areas for improvement, and provide some guidance on the use of economic indicators in forest management.

## Background

### Sustainable Development in the Forest Sector

The majority of forest management models traditionally concentrated on sustained yield timber management (Bull and Schwab 2002). The concept of sustainable development brought attention to the limitations of

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these models regarding the long-term sustainability of the natural resources sector. In response, a broad coalition of stakeholders in the forest sector developed the concept of SFM. The concept recognizes a broad array of forest benefits<sup>1</sup>, inappropriate (wasteful) forest uses and user groups, as well as the need for the improvement of tools to assess such benefits and costs (Food and Agriculture Organization 1998). Sustainable forest management poses at least two important challenges to forest economists:

1. new economic theories and models that integrate the SFM concept rather than simply rely on traditional sustained yield theory and neo-classical economic theory; and
2. new multi-stakeholder friendly technical tools to assess the economic sustainability and social acceptability of alternative forest management activities.

Mittelsteadt *et al.* (2001), in addressing the need for new economic theories and models, suggested that sustainable development requires that total capital<sup>2</sup> be non-declining over time, maximizing the overall net benefits to present and future generations. The notion of non-declining may suggest to some that total capital be in a “static equilibrium”; however, in a world of increasing population, sustainability could incorporate a notion of growth in total capital. Other economists have argued that sustainable growth should also include measures of quality of life (Boulding 1991).

For developing economic tools or procedures at the forest management unit level, Veeman (1989) and Mittelsteadt *et al.* (2001) suggest a holistic notion of

<sup>1</sup> Forest resources provide a range of benefits to society. These include both market and non-market goods and services such as: (1) fibre; (2) tangible non-market products (e.g., fruits, mushrooms); (3) less tangible amenities (e.g., existence values for biodiversity); (4) environmental services (e.g., watershed protection); (5) a source and sink for carbon dioxide; (6) land for other purposes; and (7) forest management as an activity that creates demand for inputs such as labour, materials, and human-made capital (Vincent and Hartwick 1998).

<sup>2</sup> Total capital stock includes human-made capital (assets, inventory, etc.), natural capital (forests, soil and subsoil assets, air, water, etc.), and human capital (human skills and ingenuity) (Vincent and Hartwick 1998).

sustainable development that includes three critical elements:

1. a growth element that analyzes the long-run productive capacity of the economy where non-market values and depreciation of environmental assets are incorporated;
2. a distributional element that analyzes the impacts of economic growth on poverty rates and income inequality; and
3. an environmental element that includes the environmental and ecological foundations needed to sustain economic growth over time.

Transforming these elements into economic indicators at the forest management unit level is not without difficulties. The key challenges are finding the appropriate theoretical foundation and a set of appropriate economic indicators.

### Economic Theories

According to neo-classical economic theory, economic development is measured in terms of increased production derived from the utilization of scarce resources (Gregory 1972; Costanza *et al.* 1991; Daly 1991). During the recovery process from the Great Depression in the 1930s, this theory suggested that we should maximize the productivity of the limiting factor of development—human capital—since natural capital and labour were widely perceived to be abundant (Daly 1991). As a result, public policy typically sought to increase the productivity of human-made capital in order to gain economic growth and to provide for the distribution of the environmental goods noted previously. This greatly increased the consumption of natural capital, and productivity became a fundamental determinant of profitability and national standard of living (Veeman and Luckert 2000). In essence, neo-classical economists incorporated the contribution of nature into production functions (Archibugi *et al.* 1989). Those components of nature that were not “productive” were, in most cases, not explicitly identified within the economic models.

Today, some analysts suggest that the limiting factor in production is natural capital, not human-made capital (Boulding 1991; Daly 1991). Other researchers increasingly emphasize the danger of ignoring the role of nature as the life-support system that economies depend on (Archibugi *et al.* 1989; Hardin 1991). Human welfare is no longer entirely determined by increased material

output for consumption, but also includes components of non-marketed, un-priced or poorly-priced, and intangible services from natural resources (Veeman and Luckert 2000). Ecological economics has emerged as an economic sub-discipline that includes the environment more explicitly (Archibugi *et al.* 1989).

To date, few attempts have been made to incorporate ecological economics or related theories into traditional forest management theories (Kant 2003; Lee and Field [editors] 2005). Part of the reluctance lies in limited knowledge of diffuse ecosystem services, causality relationships, and the value of non-market goods (Swingland 2002; Kant 2003; Bull *et al.* 2004). At the forest management unit level, different stakeholder groups are positioning themselves around two major groups of theories. One group focuses on the crisis in natural capital depletion, and suggests that the appropriate theory for SFM is ecological economics. The other group subscribes to neo-classical economic theory, and finds solutions in technological change, changes in consumer preferences, scientific management, and a more “accurate” representation of social valuations for non-market goods and services. The result of this theoretical impasse at the forest management unit level is a standoff over selecting appropriate economic indicators. However, unless we identify a common set of indicators, we will never know if we can bridge this divide and negotiate our way to a set of indicators that both sides can agree on. Once we have explored the possibilities at a more practical level, we may create a new theory and change our current ways of thinking.

### Economic Indicators in Sustainable Forest Management

Defining policy goals is important, but it is equally important to evaluate the progress towards the goals. Indicators can play an important role in evaluating the effectiveness of policy mechanisms and inform public policy decisions (Milon and Shogren 1995). For example, well known indicators such as the gross national product (GNP) were developed during the Great Depression to inform public policy decisions (Archibugi *et al.* 1989). With sustainable development, indicators such as GNP and gross domestic product (GDP) are limited since they ignore the contribution of nature to production, and thus do not fully capture the impacts of current production activities on future income or economic welfare (Food and Agriculture Organization 1998). New indicators, such as green gross domestic product (Green

TABLE 1. Criterion for sustainable forest management (Canadian Council of Forest Ministers 2004)

Criterion	Description	Emphasis
Criterion 1	Conservation of biological diversity	Environment
Criterion 2	Maintenance and enhancement of forest ecosystem condition and productivity	Environment
Criterion 3	Conservation of soil and water resource	Environment
Criterion 4	Forest ecosystem contributions to global ecological cycles	Environment
Criterion 5	Multiple benefits of forests to society <sup>a</sup>	Economic and Social
Criterion 6	Accepting society's responsibility for sustainable development	Social

<sup>a</sup> These benefits include: productive capacity, competitiveness of resource industries, contribution to the national economy, and non-timber values.

GDP), have been proposed as replacements (Ahmad *et al.* [editors] 1989; Vincent and Hartwick 1998; Nordhaus and Kokkelenberg 1999).

Certification and C&I frameworks are now a popular means for government and business to assess progress toward SFM. In 1994, Canada adopted C&I under the Montreal Process, and in 1995 the Canadian Council of Forest Ministers (CCFM) developed it at the national level. An examination of the six CCFM criteria (Table 1) shows that only one criterion places an emphasis on economic aspects, while four criteria emphasize environmental issues. The most explicit indicators associated with Criterion 5—multiple benefits of forests to society—include productive capacity, competitiveness of resource industries, contribution to the national economy, and non-timber values.

In order to assess SFM indicators for the C&I system, the CCFM (2004) approved four key attributes:

*Relevance:* Each indicator must relate clearly to a particular criterion, and should represent significant information about the values embodied by the criterion. An indicator must be sensitive and responsive to change because management actions and other forces can readily influence its behaviour.

*Measurability:* An indicator should be based on available or easily obtainable, scientifically valid, empirical measurements that can be consistently repeated

to observe trends. Obtaining indicator data must be practical and fiscally feasible.

*Understandability:* Indicators must be understandable not only to resource (forest) managers but also to the informed public, especially if public interests are to be incorporated into planning exercises. Simplicity and clarity are other relevant characteristics.

*Predictability:* Future behaviour of indicators should be predictable with reasonable accuracy if they are to guide management or policy decisions. Given certain management actions, policies, or other factors, it must be possible to assess future indicator behaviour.

Others have added assessment criteria such as economic welfare (Mittelsteadt *et al.* 2001) and reference values<sup>3</sup>(British Columbia Ministry of Forests and Range 2004). Forest certification systems have also struggled to find the most appropriate attributes for assessing indicators (Bull and Schwab 2001; Auld and Bull 2003; Hickey *et al.* 2005). It seems that in the national and provincial C&I frameworks and various certification systems, the key attributes to assess economic indicators are yet to be determined.

## Analysis

The literature on economic sustainability and indicators identifies several theoretical and empirical challenges (Vincent and Hartwick 1998; Nordhaus and

<sup>3</sup> Reference values include historic baselines, scientific thresholds, and desired targets which provide a context for the assessment of states and trends.

Kokkelenberg 1999; Mittelsteadt *et al.* 2001; Adamowicz 2003; Kant 2003). This section highlights four key challenges in developing SFM economic indicators.

### Difficulties with the Theory of Economic Value

Moving towards ecological economics and sustainable forest management involves incorporating timber (or private) goods and services and non-timber (or public) values of forests into economic models, and developing appropriate indicators that assess the sustainability of these values against the other two pillars of C&I approaches—environment and social benefits.

In valuing non-marketable public benefits, many economists translate them into market analogues and value the consumption of these goods and services (Adamowicz 2003). While there is consensus that accurate valuation is highly important, especially in the context of ecological economics, there is little agreement on which valuation method—economic and non-economic—to use (Food and Agriculture Organization 1998; Vincent and Hartwick 1998; Nordhaus and Kokkelenberg 1999).

Researchers have identified difficulties and concerns in valuing the wide range of non-market benefits from forests. Kant (2003) analyzes the problems by assigning market prices to non-timber values that can be characterized as public goods and services. He argues that certain forest values, such as spiritual and ecological ones, cannot be translated into monetary values because they are complementary rather than substitutable values. Furthermore, certain benefits from forests are difficult to value in terms of market analogues since no market reference data exists (Food and Agriculture Organization 1998; Vincent and Hartwick 1998; Kant 2003). Adamowicz (2003) points out that even if non-market forest values could be translated to market analogues, they often depend on the spatial scale where they are applied (e.g., recreation site), making it problematic to make direct comparisons of these values between countries, regions, and specific sites.

Clearly there are challenges in defining what to value, how to value it, and what methodology to use for trade-off analysis. Thus, impasses are common in the selection of economic indicators at the forest management unit level. Kant (2003) suggests that resolving the issues and problems in economic valuation and trade-offs depends on multi-stakeholder decision-making processes such as British Columbia's Land and Resource

Management Plan or Watershed Unit Planning processes (British Columbia Integrated Land Management Bureau 2007).

### Gaps Between Economic Theory and SFM Indicators

Adamowicz (2003) argues that the gap separating ecological and economic characteristics largely exists because of the integration complexities and inconsistencies between the current indicators and ecological economic theory. The gap challenge also applies to the SFM framework since economic sustainability indicators should build upon knowledge of the biophysical dynamics of the natural capital (Boulding 1991; Food and Agriculture Organization 1998; Vincent and Hartwick 1998; Nordhaus and Kokkelenberg 1999).

Adamowicz (2003) further argues that a gap also exists between the conceptual notion of economic well-being and the indicators used in C&I systems. The indicators used to measure well-being, such as employment, economic diversity, two-income households, and debt loads may not be suitable to detect a decline in well-being, especially when both market and non-market values are considered. The development of new indicators such as a green national net product (Green NNP) has frequently been proposed as a solution (Onuma 1999; Cairns 2000; Adamowicz 2003; Aronsson *et al.* 2004; Endress *et al.* 2005). However, Aaheim and Nyborg (1995) and Aronsson (1998) argue that measures such as a Green NNP will not necessarily provide any relevant information for policy makers.

The gap between economic theory and SFM indicators is a significant challenge. Sustainable forest management combines a host of theories from many disciplines and strives to recognize the diversity of market preferences and non-market mechanisms across communities, time, and generations (Bernhard *et al.* 2003; Kant 2003). Instead of closing the gap, Barthod (1998) argues that the use of C&I frameworks can be viewed as an attempt to avoid the pitfall of overly disciplinary theoretical approaches that seek to specify abstract conditions for sustainable management. The C&I framework contains complex concepts where technical-scientific and political-cultural consensus or compromise is needed (Barthod 1998; Lee and Field [editors] 2005). As a result, economists may have to accept and adopt a multi-disciplinary theoretical foundation.

### Scale of Indicator

It is recognized that the definition of sustainability depends on the spatial scale at which it is applied (Boulding 1991; Food and Agriculture Organization 1998; Vincent and Hartwick 1998; Nordhaus and Kokkelenberg 1999; Mittelsteadt *et al.* 2001). The measures of sustainability—indicators—often differ for countries, regions, and communities, thereby limiting their transferability across spatial scales.

Where they do exist, the linkage between smaller and larger scales illustrates important interdependencies (Mittelsteadt *et al.* 2001). Many larger-scale environmental, social, and economic decisions are influenced by decisions made at community levels. Conversely, community-level decisions can stem from larger regional- or national-level initiatives. Therefore, Mittelsteadt *et al.* (2001) suggest that standardized measurements that enable comparisons among different scales are preferable. While this would be the ideal solution, the authors feel this is unrealistic since there are no studies that could support this goal. For example, non-timber forest products and services indicators, a particularly difficult set of indicators to develop, are very sensitive to spatial scale (Adamowicz 2003). Many non-timber forest products, which are frequently non-priced, may represent an insignificant portion in national scales; however, at the household or community level, the economic significance of such products could be high (Mittelsteadt *et al.* 2001; Kant 2003). Limiting acceptable indicators to ones that are significant at all scales would therefore substantially constrain the informational value of the entire C&I system for assessing economic sustainability.

### Data Availability for Indicators

The availability of data represents a significant challenge in working with SFM indicators. Relevant data for economic indicators that value unmarketable/non-timber forest products and services, and indirect/induced employment from forests were difficult, or sometimes impossible, to obtain. For example, the technical supplement for CCFM criteria and indicators states that indicators—such as *contribution of non-timber forest products and forest-based services to the gross domestic product* and *value of unmarketed non-timber forest products and forest-based services*—do not have readily available data from reliable sources (Canadian Council of Forest Ministers 2004). Nordhaus and Kokkelenberg (1999) describe how the measurement of quantities for non-market goods and services, especially ones with

characteristics of public goods, suffer from insufficient data. Mittelsteadt *et al.* (2001) also found that there is a lack of available data for economic indicators relating to income distribution.

Trade-offs are necessary in indicator selection, and the lack of available data is a serious impediment in the process (Hickey *et al.* 2005). For example, some available indicators do not measure economic sustainability (Mittelsteadt *et al.* 2001), while others that measure economic sustainability have no data. Nordhaus and Kokkelenberg (1999) propose mounting central federal efforts to identify “green” data needed for measuring economic changes. The technical supplement of CCFM criteria and indicators warns that the weakness of data for the non-timber sectors of the forest economy is unlikely to change unless data collection is encouraged at the provincial level (Canadian Council of Forest Ministers 2004). Similar efforts could also be useful at regional or local levels. In other words, government and industry investments in the acquisition of relevant economic data and data co-ordination could improve the selection of economic indicators used in defining sustainable forest management.

### Conclusions

Identifying and using appropriate economic indicators for SFM still present formidable challenges at the theoretical and managerial level. We have reached the following conclusions:

1. Stakeholder participation is imperative for SFM since different forest values are perceived and valued differently by different stakeholders. Researchers increasingly emphasize the limitations of neo-classical economic frameworks in assessing SFM. The literature suggests moving towards integrated economic frameworks while recognizing the fundamental challenges of the theory of economic value.
2. Since both the neo-classical and the ecological economic frameworks are theoretically valid, stakeholders in the resource planning process (government, industry, community, and non-government organizations) need to clearly state their choice of framework before beginning a dialogue on the implementation of economic indicators.
3. The gap between economic theory and application is pronounced and, perhaps, it should remain so. Nevertheless, for decision-making processes, new methods for measuring economic sustainability based on the concept of total capital still need to be developed.



Future research must address such information gaps in helping to develop integrated economic indicators to assess SFM.

4. Spatial scale must be thoroughly discussed and incorporated into the indicators chosen because not all economic indicators are relevant at all spatial scales. One stakeholder group should not dismiss another group working at a different scale since the context is often different.
5. Because the “best” indicators—which are relevant, measurable, understandable, and predictable (Canadian Council of Forest Ministers 2004)—often have incomplete datasets to support them, a selection process needs to be developed to balance them with the “practical” indicators which may not fully address the issues at hand. The key attributes identified by the CCFM should be applied to ensure the selection of good indicators.
6. The collection and maintenance of appropriate datasets is a priority for the implementation of economic indicators based on either theoretical framework.

Addressing the challenges of selecting appropriate economic indicators does not have to be limited to the traditional social sciences. New methodologies in economics and analytical techniques from a range of academic disciplines such as the biological sciences and the humanities, could advance the use of economic indicators in management decision making.

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## Test Your Knowledge . . .

### *Economic indicators and their use in sustainable forest management*

How well can you recall some of the main messages in the preceding Discussion Paper? Test your knowledge by answering the following questions. Answers are at the bottom of the page.

1. According to ecological economic theory, substitution is allowed between:
  - A) Natural capital and human-made capital
  - B) Natural capital and human capital
  - C) All of the above
  - D) None of the above
  
2. Market analogues can be used to value non-marketed goods if:
  - A) They are complements
  - B) They are private rather than public goods
  - C) Market reference data exists
  
3. The majority of economic indicators for SFM are:
  - A) Sensitive to spatial scale
  - B) Insensitive to spatial scale

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**ANSWERS**

1. D 2. C 3. A