Valuation of Ecological Goods and Services in Canada's Natural Resources Sectors Executive Summary[1]

This report describes a new method developed to estimate the "natural subsidy" value of ecological goods and services (EG&S) in the production of various nature-related economic products. The analysis summarized here is an exploratory work to support evolving understanding of how most effectively to recognize the economic, ecological, and social significance of biodiversity and ecosystem services. It has raised many questions for further examination by experts.

The term "ecological goods and services," or "ecosystem services," as defined by the UN Millennium Ecosystem Assessment (MA 2005) refers to the benefits that humans receive from the natural processes and functions of healthy ecosystems. The MA categorizes these benefits in terms of four types of services: provisioning, regulating, supporting, and cultural. Provisioning services, or "goods", include water, food, fuels, fibres, medicines, and genetic resources that are "provided" by nature. Most of these goods have been assigned a "market value" by human societies, wherein they are traded as economic products using monetary or other forms of exchange.

Ecosystem services of the other three types however, are not typically considered to have a market value, and their benefits to humans are often taken for granted. Regulating services include pollination, air and water purification, and natural regulation of climate, disease, water, pests, and soil erosion. Supporting services include soil formation, nutrient cycling, and primary production (the basis of the food chain). Finally, cultural services involve non-material benefits: spiritual and religious, recreation and ecotourism, aesthetic, inspiration, education, sense of place, and cultural heritage. Some of these services provide fundamental life support, and others are central to human well-being and quality of life.

Statistics Canada regularly collects economic statistics for nature-related products (plant crops, livestock, timber, fish, etc.) from the agriculture, forestry and fisheries sectors and includes them in Canada's System of National Accounts. The valuation of the products themselves is part of the routine statistical methodology employed by Statistics Canada based on market prices.

When EG&S provide inputs (water, soil, pollination, etc.) that influence the yield of marketed products, these inputs are not normally factored into calculations of economic activity for the resource-based economic sectors, nor are they considered in Canada's national accounting system.

This analysis was commissioned to determine the economic value of EG&S that act as "natural subsidies" to Canada's natural resources sectors in order to clarify their significance and support efforts to recognize the values of ecosystem services.

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Objectives of this analysis were to:

1. demonstrate how rigorous estimates of the value of natural subsidies can be practically derived by combining conventional economic statistics with appropriate ecological data;

2. produce estimates of the economic value of these natural subsidies;

3. discuss the economic significance of nature-related goods in the Canadian economy and the contribution of natural subsidies to this economic output;

4. show how these results can be used for policy analysis; and

5. communicate to decision-makers and the public the importance in giving due consideration to these natural subsidies when making economic and environmental policy decisions.

Deriving reliable quantitative estimates of these contributions is a major challenge. The authors of this analysis take the position that economic valuation can be undertaken by applying economic theory and principles in combination with ecological understanding. Several economic methods are available for use in this context, each with strengths and limitations. While numerous metrics exist for working with ecosystems, the authors contend that there are significant gaps in the available ecological data to support this kind of analysis, in particular related to the characterization of EG&S inputs, units of measure, basic statistics for each and their functional relationship with economic products (i.e., their impact coefficients). The authors recommend that filling these gaps should be a major priority and this valuation method provides a good foundation for addressing this challenge.

The production function method is characteristically used in conventional welfare economics, and its logic imposes limitations on the kinds of data that can be integrated for the present analysis. As a result, a different classification of ecosystem services was considered, one developed by Boyd and Banzhaf (2006:8) who propose an Ecosystem Services Index designed to provide a consistent measure of ecosystem services to human wellbeing. They define ecosystem services as "…components of nature, directly enjoyed, consumed, or used to yield human well-being." An important aspect of this definition is that ecosystem services are confined to "things" and not functions or processes.

According to this view, functions and processes are important intermediate products that contribute to the supply of end products but their value is embodied in the value of the end product and should not be double counted. As a result, the types of ecosystem services that could be assessed using the modified production function method include: pollination, soil quality, nutrient supply, water supply, primary productivity, water quality, and critical habitat.

This report demonstrates how economic methods can derive reasonable measures of ecosystem services input values. It describes an innovative approach using a modified version of the Cobb-Douglas model of production function methodology, and presents the results of this approach. These results are consistent with the requirements of cost-benefit analysis, a primary public policy analysis technique. The report shows how the method can be applied, provides initial estimates of the magnitude of values for a

selection of these inputs in Canada, and discusses the relevance of the method to future policy analyses.

To demonstrate the application of this modified production function method, economic value estimates were calculated for products from three sectors and three ecosystem services inputs:

- A 50% reduction in wild pollination would result in annual loss in the value of Canadian fruit production of est. $53 million, with net loss $84 million consumer surplus
- A 50% reduction in water supply would result in annual loss in the value of Canadian wood harvest of est. $375 million, with corresponding net loss of $500 million consumer surplus
- A 50% reduction in primary productivity would result in annual loss of $5.8 million in the economic surplus associated with the fish harvest, and corresponding net loss of $7.5 million in consumer surplus

The authors indicate that methodological strengths of this approach are:

- Ecological metrics grounded in the natural sciences;
- Ease of updating economic and ecological data sets independently;
- Ease of communication;
- Economic and theoretical rigor;
- Compatibility with conventional economic measures;
- Scale independent;
- Useful for diverse applications; and,
- Reduced risk of "double counting".

The authors also noted methodological limitations of this approach are:

- Generic limitations of economic valuation, e.g. skewed market prices will result in skewed prices for EG&S;
- Limited understanding of the impact of changes in EG&S supplies on economic output of various nature-related products;
- Assumed partial equilibrium – lack of consideration of how a shift in the equilibrium price for a single product will ripple through the economy;
- Lack of accounting for ecosystem services substitutes, e.g., domesticated bees can be used to provide pollination services if wild pollinators decline; and,
- Lack of accounting for economic impacts beyond the primary production stage, e.g., on value of processed goods.

The authors of this analysis provide recommendations addressing applications for policy analysis and priorities for refinement, for example to reflect values of aggregated products.