METHOD FACTSHEET

Production function approach

Introduction

The production function approach (PFA) can be used in situations where a marketed good or service is produced with both man-made and ecosystem inputs. For example, many agricultural crops are dependent on insect pollination and the value of increased pollination can be estimated from the increased revenues from higher yields or improved crop quality associated with higher level of pollination by insects. The PFA is therefore a method designed to value indirect use values. The challenges involved in its application are that data on the relationships between the services (regulation and provision services) and on other non-environmental inputs are often difficult to obtain. The method is therefore not often used, despite its great potential for illustrating the value of taking an ecosystem services approach. However, it has been used to value e.g. water quality improvements resulting in reduced costs of water purification, increased agricultural productivity due to better pollination and increasing soil carbon stocks. A caveat related to the use of this methodology is that the researcher needs to account for inputs other than those from ecosystems. The production of marketed products requires both man-made input as labour and machinery, as well as land and ecosystem based processes. Not accounting for this can lead to the criticism that the valuation is exaggerating ecosystem service values.

Keywords

Production functions; Indirect use values; Valuation of ecological processes

Why would I chose this approach?

The methodology is particularly useful in an ecosystem service context to illustrate the invisible value of ecosystem processes. The value of insect pollination securing provision of some agricultural crops is a well-known example. It relies on the functional relationship between ecosystem service, man-made input factors and the production of marketed products. With this information the methodology can be used to raise awareness of the economic rationale for investing in healthy ecosystems to support the production of marketed products.

The spatial scale at which PFA works best is often relatively fine scale e.g. the field scale in relation to agricultural products. Most studies therefore rely on plot data to estimate the functional relationships. Such plot data can be based on long-term field trials or intensive sampling in agricultural fields across many plots. Obtaining this kind of data is therefore the main obstacle to the use of this methodology. In terms of the valuation, the approach is simple as it relies on prices in the market which are directly observable. The approach has been used for awareness raising of the general public, with farmers to help them include this aspect into their farm management, and as a rationale for developing subsidy schemes to improve the sustainability of farming practises.

What are the main advantages of the approach?

- Recognised and established approach;

- Draws on scientific data on the relationships between ecosystem properties and production of marketed goods;
- When the underlying data is rich, uncertainties in the linkages can be addressed;
- The method can provide public policy rationales for providing ecosystem services and can be linked directly to land management initiatives and policies.

What are the constraints/limitations of the approach?

- Requires collection of large field data sets (cross-sections or time-series) on environmental conditions and inputs to production which can be a constraint for the application to individual case studies;
- Requires modelling competences, which can also be prohibitive.

What types of value can the approach help me understand?

The production function approach is highly appropriate to capture ecological and monetary values, as well as anthropocentric instrumental values, including both direct and indirect use values. It is not appropriate to elicit sociocultural values and intrinsic values of nature. It also has serious limits when used to grasp bequest and existence values.

How does the approach address uncertainty?

The production function methods address uncertainty in a very direct way, as it enables analysis of the value implications of the uncertainty about the relationship between ecological processes. Functional relationships between ecosystem processes are most often highly uncertain and the production function approach allows an explicit analysis of how the range of the strengths in the ecological relationships translates into economic value ranges.

How do I apply the approach?

The flowchart below (Figure 1) gives a short description of the steps involved in applying the production function approach. The steps can roughly be divided in two parts. The first analytical part (steps 1-3) organises the data, conducts the statistical analysis and estimates a production frontier model. The second application part (steps 4-5) will vary depending on the decision context. In the flowchart below the steps relate to using the method for evaluating the consequences of alternative policies e.g. giving subsidies to farmers to plant flower strips to support pollination or schemes to promote management activities to increase carbon stocks in soils, partially to increase long-term productivity of soils.

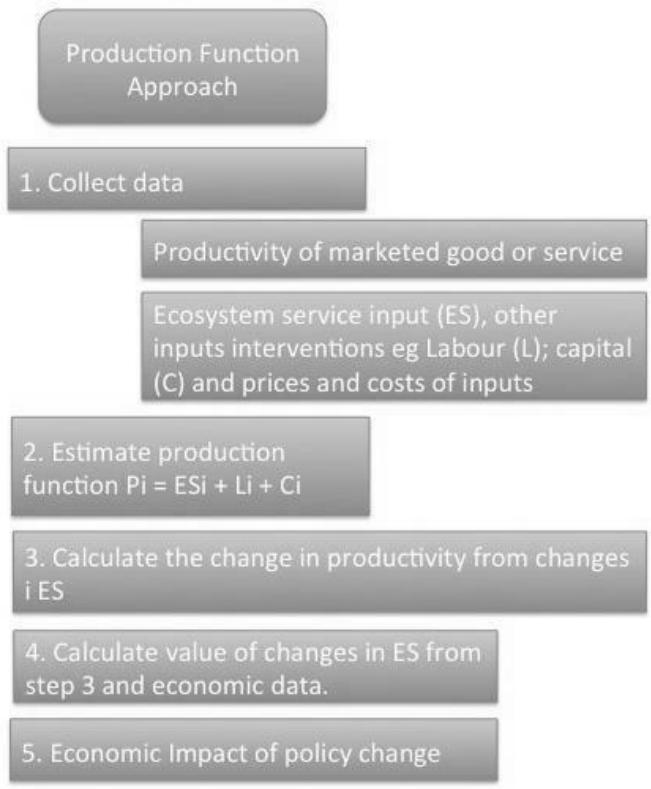

Figure 1. Steps involved in applying the production function approach.

Requirements

Requirements		Comments
Data collection requirement	· Data is available □ Need to collect some new data (e.g. participatory valuation) **X Need to collect lots of new data (e.g. valuation based on surveys)**	
Type of data required	**X Quantitative** □ Qualitative	Time series for single plots and/or plots of a representative sample of variation in land-use conditions
Expertise and production of knowledge needed	□ Working with researchers within your own field **X Working with researchers from other fields** □ Working of non-academic stakeholders	Experts in the production technology in question (e.g. agronomists, hydrologists, ecologists)
Software requirements	**X Freely available** □ License required □ Advanced software knowledge required	Any statistics package
Time requirements	□ Short-term (less than 1 year) □ Medium-term (1-2 years) **X Long-term (more than 2 years)**	If the data is not available from a previous study
Economic resources	□ Low-demanding (less than 6 PMs) X **Medium-demanding (6-12 PMs)** □ High-demanding (more than 12 PMs)	For the analysis assuming the data have been collected

Other requirements	

Where do I go for more information?

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