

Chapter 4.9

Construction of Agri– Environmental Data Using Computational Methods: The Case of Life Cycle Inventories for Agricultural Production Systems

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ABSTRACT

Increased public focus on agri-environmental issues and recent policies on agricultural sustainability have necessitated the construction of a life cycle inventory (LCI) database for agricultural production systems. However, the current progress of LCI database construction is far from being complete in both developed and developing countries. In this chapter, an integrated view for a data-construction methodology for agri-envi-

mental assessment is proposed. The applications of computational methods to the construction processes are also proposed, with a special focus on Japanese case studies. After discussing the methods for construction, the implications of LCI construction are presented, which includes the following issues: how to make a transition to sustainability, and how to achieve informed and science-based policy decisions by increasing the applicability of life cycle assessment and the level of preparedness. The Japanese case studies should support assessment and decisions in developed and developing countries.

DOI: 10.4018/978-1-60960-472-1.ch409

INTRODUCTION

Global food trends—such as intensified food–fuel competition and deforestation due to the increase in biofuel production—have necessitated informed decision making based on environmental and economic assessments. These include, for example, life cycle assessment (LCA), life cycle costing (LCC), environmental impact assessment (EIA) and strategic environmental assessment (SEA). The construction of a database is the first step towards achieving informed decision making processes, and mathematical models and computational methods are expected to play an important role.

However, at present, the life cycle inventory (LCI) data for agricultural production systems, which constitute a representative database for environmental assessment and are necessary for conducting LCAs of agricultural products, are generally inadequate, both quantitatively and qualitatively. This is applicable to Japan as well as to other countries. The reason for the inadequacy of LCI data is related to the characteristics of agricultural production, including the diversity of cultivation practices and the existence of a variety of statistical datasets.

In this chapter, we propose an integrated view of a data-construction methodology for agri-

environmental assessment. Special attention is focused on the classification and characteristics of the computational methods for each stage of data construction and database development. The methods are broadly classified according to the degree of computation, as shown in Figure 1. Individual methods can be selected from Figure 1, or methods can often be combined depending on the data sources. The details of the application of such computational methods are described in the following subchapters. The following topics are discussed in terms of data construction: (a) life cycle assessment and life-cycle inventories, (b) foreground system data for agricultural production, (c) background system data for agricultural production and (d) LCI database management and development. Japanese cases are largely studied as instances of data construction in a country where systematized datasets in terms of agricultural production are not well established.

BACKGROUND

As an analysis method, LCA has attracted considerable attention in recent years; it is regarded as the most comprehensive technique for quantitatively evaluating the environmental load associated with a product or project. It covers all the

Figure 1. Classification and characteristics of computational methods in LCI construction (Extracted from Hayashi, 2008)

Classification of computational method	Major data source	Data processing	Processing tool
Calculation	Field data Experimental data	Simple calculation	Calculator
Estimation	Government statistics Experimental data	Statistical processing	Spread sheet on computer
Simulation	Various	Construction or application of simulation model	Software for simulation or modeling

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