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Application of a comparative multidimensional life cycle analysis in solid waste management policy: the case of soft drink containers

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Abstract

The paper describes the application of a multidimensional life cycle analysis (LCA) for packaging soft drinks in Israel. The suggested approach combines the conventional product LCA, vertical summation of all environmental burdens along the chain of production, use and disposal activities, and horizontal comparison of different products and disposal options, such as recycling, incineration or landfilling. The paper attempts to show that the most effective, as well as transparent, means of comparing packaging alternatives, is to place them on a commensurate basis, the most appropriate one being a monetary basis. Taking into account limitations and drawbacks of monetary valuation of non-market assets (namely, environmental assets), the study derived estimates of environmental benefits and damages associated with each alternative. The production of soft drinks containers in Israel, used here as an example for the above mentioned considerations, is based mainly on imported materials, since natural resources such as oil or bauxite do not exist in Israel. Locally, only direct production and pollution abatement costs are incorporated in the final bill, while global environmental burdens are excluded. Countries extracting and producing raw material for the packaging industry, in effect, grant an environmental subsidy to the final users, in this case — the Israeli user. The paper suggests that only by globalization of externalities and fully internalizing environmental costs into the price of the final product (the packaging material or the packaged product), an equitable full environmental accounting can be designed. This mechanism can be even accompanied by global trading in the relevant environmental credits. Decisions will, consequently, follow a sustainable path, in both importing and exporting countries.

Keywords: Life cycle analysis; Solid waste; Environmental policy; Soft drink bottles

1. Introduction

In recent years, many countries have adopted product-related policies and targeted packages as one of the key issues in waste management. The Ministry of the Environment in Israel is considering a packaging law that will tax non-recyclable and non-recycled packages and will subsidize recycled ones.

The concern about the environmental impacts of packages has been dealt using several approaches in environmental management, such as risk assessment, environmental impact assessment, environmental auditing, substance flow analysis, energy analysis, material flow analysis and life cycle analysis (LCA) (Finnveden, 1998). LCA is a tool used to evaluate the environmental impacts associated with a product over its entire life-cycle, from the manufacturing processes to the final waste disposal stages (Schaltegger, 1996; Curran, 1996).

Individual LCAs are modified to fit the specific objectives of individual analyses. Generally, a producer

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should use LCA to compare alternatives involving environmental externalities at any stage of production, use and disposal of intermediate and final goods. The classic product LCA (Fig. 1a) is based on a vertical summation of all environmental inputs associated with a product, "from cradle to grave" (Hunt et. al., 1992).

Horizontal LCA (Fig. 1b) is widely used by waste managers, local authorities or the central government, to compare waste management alternatives such as recycling, incineration or landfill (White et al., 1995; Thoreneloe et al., 1998).

The possibility of taking into account the availability of alternative options at different stages of product life cycle is rather limited in the approaches described above. A comprehensive approach requires, however, consideration of alternative inputs, production and disposal processes or outputs in a multidimensional, expanded space. We suggest a matrix of a vertical LCA, examining different raw materials and production processes, as well as a horizontal comparison of different waste treatment options (Fig. 1c), in order to choose the alternative in which costs and environmental burdens are minimized. In other words, decisions would need to relate to the preferred type of the packaging material overall, as well as the selection of waste management for each packaging material.

Usually, the results of an LCA are evaluated according to pre-determined sets of priorities, including such items as mitigation of greenhouse gases, ozone depletion, water pollution or the effects on the marine environment (i.e., UNEP, 1996). The ISO 14040ff standards address specifically the normalization, grouping and weighting of the LCA inventory analysis (SETAC, 1998) but, yet, different individuals, organizations, and societies may have different values, therefore, different parties will reach different weighting results based on the same indicator results. Similarly, as will be shown, different decisions, based on LCA, will be made by different countries, depending on their participation along the production line of a given product.

The concern about environmental burdens, as well as the misperception of the weight of these burdens has led to mistakes, some of them very costly (e.g., the first years of the packaging ordinance in Germany, see Bilitewski and Copeland, 1997). Therefore, there is a need to put these figures into perspective and to analyze their relative importance. Due to the fact that direct costs are given in monetary terms, it is reasonable to assign monetary values to the environmental damages as well, and the optimal solution will be chosen according to cost-benefit analysis or economic efficiency (Tietenberg, 1992; Turner et al., 1994). It is important to note, however, that there is neither a perfect way to assign monetary values to environmental issues nor an agreed ultimate method to price 'nature' and resources scarcity.

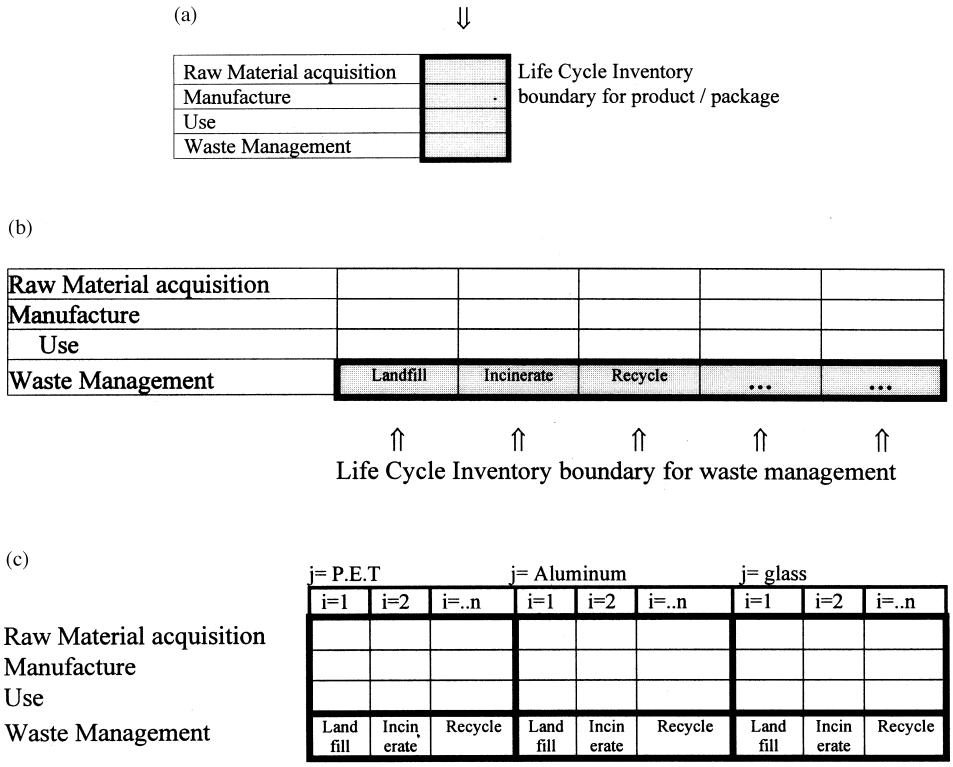

Fig. 1. (a) Vertical life cycle inventory (adopted from White et al., 1995). (b) Horizontal life cycle inventory (adopted from White et al., 1995). (c) Multidimensional life cycle inventory.