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Ecological Footprint and Life Cycle Assessment in the sustainability assessment of tourism activities

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ABSTRACT

Within the recent debate about the needs for improving Ecological Footprint (EF) method, Kitzes and colleagues highlighted the necessity of standardised and detailed Life Cycle Assessment (LCA) studies to support the calculation of specific impacts accounted in EF. As EF has been identified as a useful method for the evaluation of sustainability of tourism activities, this article presents a comparative study about sustainability evaluation of tourism activities, including LCA of a holiday and a hotel structure. The methodology for a joint use of the two methods was expected to provide more robust and detailed sustainability assessment as LCA is more comprehensive in terms of coverage of impact categories but disregard the carrying capacity of the system/limit of resource assessed by EF. The methodology was applied to two case studies in Northern Italy. The case studies showed that there is a correlation between the results of the two assessments, due to the relevance of energy and fossil fuel consumption as main drivers of impact.

1. Introduction

Sustainability assessment of human activities, such as tourism, requires integrating as much as possible tools and methodologies in order to achieve a comprehensive assessment of impacts, both environmental and socio-economic (Castellani and Sala, 2010). Amongst tools and methodologies to assess sustainability, Ecological Footprint (EF) and Life Cycle Assessment (LCA) are of specific interest as they evaluate environmental impacts from different perspectives and assumptions that may be integrated. In a recent debate (Kitzes et al., 2009) on means for improving EF methodology has been highlighted the necessity of standardised and detailed Life Cycle Assessment (LCA) studies to support the calculation of specific impacts accounted for within the EF. Thereby, as for other sectors, the evaluation of tourism activities performed using both methods could provide more extensive and comprehensive results and could lead to a more reliable evaluation of the system providing better support for decision making (Wiedmann and Barrett, 2010). Moreover, practitioners of both EF (Kitzes et al., 2009; Marchettini et al., 2007) and LCA (Huijbregts et al., 2008; Udo de Haes et al., 2004; Hofstetter et al., 2002) have highlighted the necessity to integrate several instruments for sustainability evaluation, each one addressing different research questions within the sustainability science framework (Castellani, 2010; Wiedmann and Barrett, 2010).

Therefore, the aim of this study is to compare the results of the two approaches and to investigate the possibility of using the two methods for sustainability assessments of tourism activities. The joint use of the two methods is expected to provide a more robust and detailed assessment of various issues related to sustainability of tourism activities, from the holiday (travel and accommodation) to building and maintenance of the hospitality's structure.

1.1. EF and LCA: strengths and weaknesses

An overview of the current debate on strengthens and weakness of both EF and LCA is necessary to understand how to better integrate the two methodologies. Starting from critics to EF (Ecotec, 2001; Moffatt, 2000; van Den Bergh and Verbruggen, 1998), the main issues at stake are related to: comprehensiveness of environmental impacts; specific assumptions related to land use and ability of considering the carrying capacity of the earth system.

1.1.1. Comprehensiveness of impact assessment

EF does not capture the full range of environmental impacts, such as those arising from acidification, eutrophication, ecotoxicity, human toxicity, etc. Those impacts imply processes that may irreversibly damage bioproductive capacity (e.g. by reducing ecosystem services, affecting nutrient cycles, impacting biodiversity). Hence, the integrated environmental assessment performed

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with the LCA is more comprehensive than that performed by EF, even if Life Cycle Impact Assessment methodologies still require further development, especially at the endpoint level (EC, 2010; Finnveden et al., 2009).

1.1.2. Assumption related to land use

EF does not distinguish between sustainable and unsustainable land use, but considers only the absolute quantity (i.e. area) of land used (see Fiala, 2008), without taking into account the possibility of recovery after the end of its useful life. For instance, in the case of a camp site, the amount of land occupied is relatively high, although not completely built up. After the dismantling, the camp site area could recover more easily compare to an area with another hospitality structure (e.g. a hotel). In contrast, the LCA allows for the definition of end-of-life scenarios where such issues can be considered. In the inventory, data on land use and land transformation have to be collected and then, in the impact assessment phase, various methods address the transformation of land use, assigning a specific impact factor (Milà et al., 2007). Furthermore, the EF calculation does not account for the possibility of multiple functions of an ecosystem (e.g. it does not allow land to simultaneously provide biodiversity, timber and carbon sequestration) and this may result in a larger area of land being shown as required for the activities under evaluation than is actually necessary.

1.1.3. Carrying capacity of the environmental system

One of the main features of EF is the ability of present directly the result accounting to a specific physical threshold (amount of land on the earth). Generally, Life Cycle Impact Assessment (LCIA) methods do not take into account the concept of limited resources and the carrying capacity of the earth's ecosystems. Conversely, these concepts represent the fundamental assumptions of EF and are crucial aspects that differentiate sustainability evaluation from the environmental assessment of single issues (Global Footprint Network, 2007; Kates, 2001; Meadows et al., 2004). It also affects the evaluation of impacts related to the use of renewable resources (e.g. wood), that risk being considered sustainable *a priori*, without taking into account their rate of renewal, i.e. the carrying capacity of the ecosystems that provide them (Cornelissen and Hirs, 2002; Cummings and Seager, 2008).

In addition, results of LCA studies can be difficult to translate into easily understandable and usable policy indicators (De Camillis et al., 2010; Zamagni et al., 2008), whereas EF methodology has been designed specifically to provide a picture of the sustainability or un-sustainability of consumption patterns in terms of resource availability and also to help decision makers identify the activities responsible for the most relevant impacts in terms of resource consumption and land use.

1.2. EF and LCA for sustainability assessment of tourism

EF has been identified as a useful method for the evaluation of sustainability of tourism activities (Hunter and Shaw, 2007), even if in practice this sector remains quite unexplored, except from few specific studies (see Bagliani et al., 2004; Gössling et al., 2002; Hunter, 2002; Li and Yang, 2007; Martın-Cejas and Ramırez Sanchez, 2010; Patterson et al., 2007, 2008; WWF – UK, 2002).

Furthermore, when EF is calculated at sub-national level, the availability of site-specific or sector-specific studies becomes crucial for obtaining reliable input data and hence significant results (as for any other sustainability indicator method) (Ko, 2005; Reed et al., 2006; Twining-Ward and Butler, 2002). In the past, sub-national footprints have been calculated through process-based approaches, using LCA data to provide conversion factors for locally collected (or approximated) consumption data. Inconsistent methodologies and differences in data availability resulted in difficulties in comparing the outputs of these studies. The general consensus amongst practitioners, which has been formalised in the published Ecological Footprint Standards (Global Footprint Network, 2009), is that the national footprint should be taken as a starting point for sub-national footprints (Risk and Policy Analysts Ltd., 2007). Nevertheless, in the case of EF calculations relating to a specific sector of activities (such as tourism systems), the lack of availability of specific data may result in significant difficulties in deriving data from national accounts and therefore to highly uncertain results. Lack of site-specific data and difficulties in correctly allocating consumption between origin and destination areas affect the capability of deriving accurate EF of tourism and this sector remains incompletely implemented in National Footprint Accounts (Kitzes et al., 2009). Hence, the bottom-up calculation seems to be a more suitable approach for a site-specific and sector-specific evaluation of tourism sustainability through EF. Hunter and Shaw (2007), pointed out that collecting primary data from specific LCA studies of each consumption activity is the crucial for ensuring robustness of EF.

2. Methodology

2.1. Conceptual model for the sustainability assessment of tourism

The conceptual model of tourism systems and their sustainability evaluation upon which this study is based consists of two sections (Fig. 1):

a) breakdown of tourism activities and their related decision making process, being supported trough the sustainability assessment (Fig. 1a) and
b) proposal of a potential combined use of LCA and the bottom-up calculations of the EF (Fig. 1b).

The first part of the model (Fig. 1a) analyses the three main areas of activity within the tourism sector: the construction of tourism facilities consisting mainly of hospitality structures; the holiday itself that includes the activities that tourists do at the determined destination; and the travel involved in getting to and from the tourist destination. Each activity is related to specific stakeholders and their related decision-making process: local administrators play an important role in defining spatial planning, selecting potential building areas and giving permission for the construction of hospitality structures and facilities; entrepreneurs (directly or indirectly involved in tourism activities) determine the type of tourist services available, thereby influencing the opportunities for tourists to make sustainable consumption choices; the tourists themselves make consumption choices that are not only related to their own behaviour but are also limited by the actual availability of sustainable products and services, and are determined by their own level of environmental awareness and sense of responsibility. Indeed, the choice of the model of development for a tourism destination, (e.g. the level of urbanisation, the prevailing type of hospitality structure, the available infrastructures and tourist facilities) affects the ability of tourists to make sustainable consumption choices. For example, if the number of beds available in less impacting structures (such as B&B and agriturismo accommodation) is limited, then the number of tourists that spend their holiday in less sustainable types of accommodation will be, necessarily, higher. In the same way, if public transport in an area is not efficient, then it would be difficult to persuade tourists to leave their private cars at home.

The second part of the model (Fig. 1b) explores the possibility of combining LCA and EF methodologies. The application of LCA