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Life Cycle Thinking used for assessing the environmental impacts of tourism activity for a Greek tourism destination

Alexandra V. Michailidou [a, *], Christos Vlachokostas [a, b], Nicolas Moussiopoulos [a], Dimitra Maleka [a]

[a] Laboratory of Heat Transfer and Environmental Engineering, Aristotle University, Thessaloniki, Box 483, 54124 Thessaloniki, Greece
[b] MECO P.C., Technopolis Thessaloniki ICT Business Park, 55535 Pylaia, Greece

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ABSTRACT

This work puts forward a generic methodological scheme, based on Life Cycle Assessment (LCA) principles, in order to estimate the environmental load in areas of considerable tourism activity. The possibility of combing LCA with Ecological Footprint Analysis (EFA), Environmental Indicators (EIs) and Multi-criteria analysis (MCA) is also discussed. The methodology is demonstrated for Chalkidiki, an area with considerable tourism activity in Greece and one of the prevalent destinations in the Balkan peninsula. A comparative assessment is realized for characteristic hotel categories. Their respective contribution to environmental burden attributed to tourists' transport and accommodation services is assessed. Up-market hotels impose larger absolute impacts on the environment (6–10 times), especially in the consumption of resources, when transport (and especially air one) is taken into account. As far as operational use of all hotels is concerned, HVAC systems are the most energy intensive “end-users”. It is noted that some up-market hotels with the largest absolute carbon footprint have already been nominated with the Green Key in the area under study. Based on the results of this study, policy making should primarily put forward incentives in order to maximize the penetration of: (i) Renewable Energy Sources (RES) in hotels in the area, (ii) vehicles with biofuels in the hotels' fleet and (ii) local products in dining sector. This work adds up to the low number of respective LCA implementations found in the literature and extents the scope of LCA application to a new tourism destination. The adopted approach and the results presented herein add scientific value, since they provide the basis for the identification of environmental “hot spots” in order to highlight processes with considerable environmental impacts and promote the implementation of effective mitigation measures by hoteliers and public authorities. The work clearly depicts the fact that LCA can play a crucial role in decreasing the complexity in the strategic planning of tourism, especially in local-to-regional areas of concentrated tourism activities. The holistic approach presented provides a basis for policy insights that can lead to robust policy modeling and reliable national strategic governance.

1. Introduction

Tourism is a dynamic and competitive industry with direct effects on the social, cultural, educational and economic aspects of communities, thus a key driver for socio-economic progress. International tourist arrivals grew by 5% in 2013, reaching a record of 1087 million arrivals and international tourism receipts reached 1159 billion US$ (UNWTO, 2014). According to the World Travel & Tourism Council, the Travel & Tourism (T&T) sector accounts for 9% of direct global Gross Domestic Product (GDP) offering 120 million direct jobs and another 125 million indirect jobs worldwide. On the other hand, tourism is associated with environmental impacts and contributes to the climate change phenomenon. Tourism can affect detrimentally the natural environment in local as well global scale, through transport, accommodation and relevant activities (Gössling, 2002). On this basis, it is important for the tourism industry to consider its environmental impacts since it is largely dependent on the natural environment (clean water, clean air, pleasant weather, ecosystem quality). Over the last years, the scientific community has focused on the impacts of climate change on

* Corresponding author. Tel.: +30 2310 994181; fax: +30 2310 996012.
E-mail address: amichail@aix.meng.auth.gr (A.V. Michailidou).

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tourism and the tourism industry response to climate change (e.g. Becken, 2013; Filimonau et al., 2011a; Gössling, 2010; Peeters and Dubois, 2010; Scott et al., 2008; Amelung et al., 2007). Furthermore, many experts underlined the importance of accurate quantification of tourism's environmental impacts (e.g. Gössling et al., 2005; Patterson and McDonald, 2004).

An in-depth analysis of environmental impacts of tourism can be found analytically elsewhere (Gössling, 2002). Attempts to systematically evaluate them are mainly limited to a small number of environmental assessment tools (Filimonau et al., 2011a), i.e. Ecological Footprint Analysis (EFA) (e.g. Hunter and Shaw, 2007), Environmental Impact Assessment (EIA) (e.g. Geneletti and Dawa, 2009), Life Cycle Assessment (LCA) (e.g. De Camillis et al., 2008) and Environmental Indicators (EI) (e.g. Michailidou et al., 2015). These approaches possess different strengths and weaknesses depending on the scale of application (global or local), the characteristics of the tourism destinations, the objective and the accuracy of the assessment (Schianetz et al., 2007). The application of LCA in tourism has recently gained acceptance by the scientific community (De Camillis et al., 2010). According to available scientific literature, amongst other environmental performance tools for tourism, LCA is crucial, since it holistically evaluates environmental impacts from different perspectives and assumptions (e.g. Castellani and Sala, 2012; De Camillis et al., 2010). LCA is a holistic approach to assess potential impacts associated with a product, process, or service, by compiling an inventory of relevant energy, material inputs and environmental releases and interpreting the results to help a decision-maker to make a better informed decision (Curran, 2012).

The first application of LCA in the tourism sector provided an environmental assessment of a package holiday in the Seychelles offered by British Airways Holidays (Sisman, 1993), followed by a holiday package in St. Lucia offered by the same provider (UK SEED, 1998). Rosenblum et al. (2000) used LCA to trace direct and indirect supply chain environmental effects of hotel service sector in the USA. Chambers (2004) assessed two package holidays in Bulgaria (one mass tourism package and one responsible tourism package), whereas Sára et al. (2004) applied LCA to hotels in Italy. König et al. (2007) performed LCA of hotel buildings under development in Portugal. De Camillis et al. (2008) assessed the environmental performance of accommodation services in a 3-star hotel in Italy. Kuo et al. studied a package holiday in Kinmen Island, Taiwan (2008) and a package holiday in Penghu Island, Taiwan (2009). Filimonau and colleagues applied LCA to provide linkages with the carbon footprint of two hotels in Poole, Dorset, UK (2011a) and for climate change impact assessment related to tourism (2011b). Castellani and Sala (2012) used LCA to assess impacts generated by one tourist during one week in a spa resort and of impacts of a hospitality structure (a 2-star hotel) in Northern Italy. Kuo et al. (2012) used LCA to explore energy use and Carbon Dioxide (CO_2) emissions in three Taiwanese islands (Penghu, Kinmen and Green islands). Filimonau et al. assessed the carbon impact of short-haul tourism from London to Marseille considering five different travel scenarios (2013) and of an all-inclusive holiday package tour from UK to Portugal (2013), using a hybrid method of LCA, the DEFRA-LCA. El Hanandeh (2013) applied LCA to assess the Global Warming Potential (GWP) during Hajj (the pilgrimage to Mecca).

The present study aims to promote a generic methodological scheme, based on LCA principles, in order to estimate the environmental burden in areas of considerable tourism activity. The methodology is demonstrated for Chalkidiki, an area with considerable tourism activity in Greece. Apart from economic development, tourism activity in the area causes considerable environmental deterioration, increased energy and water consumption, as well as waste generation. A comparative assessment for characteristic hotel categories and their respective contribution to environmental burden for numerous impacts is analytically realized for hotel operation and both for road and air transport that can be attributed to tourism activity. The approach is leading to a reliable and holistic assessment of damage that can be attributed to tourists' transport, and accommodation services. This work adds up to the low number of respective LCA implementations found in the literature (De Camillis et al., 2010) and provides evidence on the way LCA can be used in the context of Greece, since such a methodological framework is implemented for the first time in Greece, at least up to the authors' knowledge. On this basis, the work herein extents the scope of LCA application to a new destination. In addition, the adopted approach and the results presented herein add value, since they provide the basis for the identification of environmental “hot spots” in order to highlight processes with considerable environmental impacts and promote the implementation of effective mitigation measures that can be adopted by hoteliers and public authorities. To amplify this purpose the possibility of integration with other environmental impact assessment and management tools is discussed in an extended methodological framework. Thus, the work provides a holistic approach for the area under study and gives a basis for policy insights that can lead to robust policy modeling and reliable national strategic governance.

2. Materials and methods

2.1. The significance of LCA in the tourism sector

LCA is useful in quantifying the extraction of resources and emissions of a product system or process to air, water and land and their associated impacts, enabling the identification of “hot-spots” in the life cycle and therefore identifies opportunities for improvements and optimization of environmental aspects and processes at all stages of their lifecycle (Muthu, 2014). It has the ability to highlight processes and/or flows that have the highest resource consumption and the highest environmental burden in an effort to accurately assess environmental impacts (De Camillis et al., 2012). In parallel, it estimates also the “indirect” environmental impacts (Berners-Lee et al., 2011 and Frischknecht et al., 2007), which is one of the competitive advantages of LCA over other environmental assessment tools. In addition, LCA allows the definition of end-to-life scenarios for products and services as well as multiple functions of an ecosystem (UNEP, 2014). The comprehensiveness of LCA makes it an appealing stand-alone tool among Ecological Footprint Analysis (EFA), Environmental Indicators (EIs) and Multi-criteria analysis (MCA). According to literature review these tools are employed in order to assess environmental deterioration in the tourism sector. Literature review also reveals that the EFA, EIs and MCA have been employed in combination with LCA due to its advantages. According to Finnveden and Moberg (2005), LCA integration/combination with other environmental tools puts forward a holistic analysis that can lead to realistic strategies toward environmental sustainability.

Ecological Footprint is a synthetic indicator used to estimate a population's impact on the environment due to its consumption. It quantifies the land use required for population activities taking place on the biosphere while considering the prevailing technology and resource management for a specific year (Borucke et al., 2013; Bastianoni et al., 2012). EFA accounts for energy (including transport), raw materials, water, foodstuff use, waste production (including CO_2 from fossil fuels) and the loss of productive land associated with buildings, roads and other aspects of the built environment. EFA takes into account the concept of limited resources and the carrying capacity of the earth's ecosystems, which is useful for understanding resource use in relation to availability.

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