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Inventory analysis and carbon footprint of coastland-hotel services: A Spanish case study

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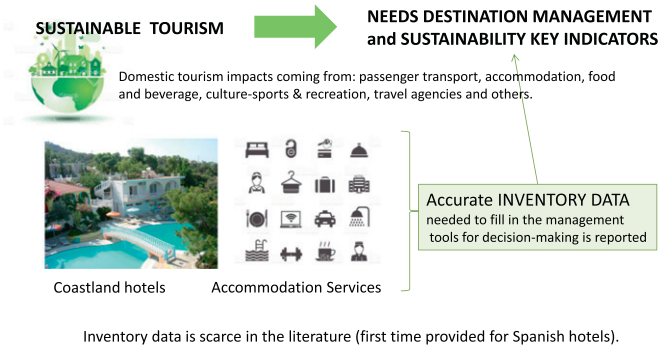
HIGHLIGHTS

- Energy and resource use of Spanish coastland hotels through 14 on-site surveys.
- Average inventory per hotel category (from 2 to 5 star categories).
- Results comparison with literature after a state of the art review of LCA studies on tourism.
- Variability of inventory data mainly affected by the occupancy rate of the hotel.
- Implementation of environmental management systems in hotels promotes them having more detailed and accurate data.

GRAPHICAL ABSTRACT



Hotels with Environmental management systems (i.e. EMAS) collect more detailed and accurate data, which is a necessary step to reduce impacts.

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ABSTRACT

Tourism is a key industry in the Spanish economy. Spain was in the World top three ranking by international tourist arrivals and by income in 2015. The development of the tourism industry is essential to maintain the established economic system. However, if the environmental requirements were not taken into account, the country would face a negative effect on depletion of local environmental resources from which tourism depends. This case study evaluates, through a life cycle perspective, the average carbon footprint of an overnight stay in a Spanish coastland hotel by analyzing 14 two-to-five-stars hotels. Inventory and impact data are analyzed and presented both for resource use and greenhouse gases emissions, with the intention of helping in the environmental decision-making process. The main identified potential hotspots are electricity and fuels consumption (6 to 30 kWh/overnight stay and 24 to 127 MJ/overnight stay respectively), which are proportional to the number of stars and unoccupancy rate and they produce more than 75% of the impact. It is also revealed that voluntary implementation of environmental monitoring systems (like EMAS regulation) promotes collection of more detailed and accurate data, which helps in a more efficient use of resources. A literature review on LCA and tourism is also discussed. Spanish hotels inventory data presented here for the first time will be useful for tourism related managers (destination managers, policy makers and hotel managers among others) to calculate sustainability key indicators, which can lead to achieve real sustainable-tourism goals. Further data collection will be needed in future projects to gather representative data from more hotels, other accommodation facilities and also

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other products/services offered by tourist sector in Spain (like transport of tourists, food and beverage, culture-sports & recreation and others).

1. Introduction

Tourism industry, which is responsible for 5% of global emission of CO_2 (UNWTO, 2008), is one of the two largest sectors of Spanish economy in terms of employment and economic activity. Spain ranked second in 2014 and third in 2015 in income from international tourism worldwide with 65 billion and 56.5 billion US$ respectively; and third in arrivals both in 2014 and 2015 with 65 and 68.2 million overnight visitors (UNWTO, 2015; UNWTO, 2016). Particular attention should be paid to resource consumption and CO_2 emissions of tourism industry, considering its significant growth (Cerutti et al., 2016). In Spain, tourist population is often concentrated in coastal regions, where local natural environment is a key factor of tourist attraction. Although the increase of tourist arrivals in these areas is essential to maintain the established economic system, the increment of tourist population may significantly increase the depletion of local natural resources and may cause deterioration of the local ecosystem due to construction of new infrastructure and continuous pollution, unless an accurate design of the activity pays the needed attention to the environmental requirements (Köberl et al., 2016). Environmental concerns for the natural and economic environments place emphasis on the inclusion of sustainability in the tourism sector and on accurate identification and assessment of the environmental impacts.

Life cycle assessment (LCA) is a widely accepted methodology that has proven its efficiency on figuring out environmental performance improvement opportunities and definition of sustainability strategies for many industries including tourism and individual tourism events (El Hanandeh, 2013; Michailidou et al., 2016). As stated by UNEP/SETAC Life Cycle Initiative (UNEP/SETAC, 2012): "If the green economy is to bring the necessary changes to guarantee a future for life on Earth, decision making on product sustainability, investment, and policy must be made using life cycle thinking and operationalized through life cycle management, approaches, and tools". A life cycle approach to impact assessment enables product and services designers, service providers, companies, government agencies and individuals to make choices for the longer term, by considering impacts on all environmental media (i.e. air, water, land) in a systemic and holistic way.

A fully-fledged LCA is not always needed but a Life Cycle Management (Rebitzer et al., 2001) point of view is essential to assess systems' impact, if environmental shifting is to be avoided (Fullana-i-Palmer et al., 2011). The carbon footprint (CF) of a product or service is one of the impact categories evaluated through a LCA study, although it has its own specific standards, such as ISO 14067 (ISO 14067, 2013), and sometimes is used as a proxy for the whole set of impact categories (Bala et al., 2010). A CF-LCA approach could be a scientific supporting tool for environmental communication and education of tourists and an objective instrument for a more responsible consumption, by measuring the environmental burdens and provide a reliable assessment of greenhouse gas emissions associated with tourist accommodation (Michailidou et al., 2016, De Camillis et al., 2010).

Our research aims to provide inventory data regarding one overnight stay in Spanish coastland hotels with different star ratings (the standard quality classification indicator for hotels), and propose resource consumption averages that can be useful to establish best practices to promote hotels' environmental performance.

Inventory data presented in this paper has an added value since, to our knowledge, default values for Spanish hotels were provided for the first time. In addition, this is in line with the Sustainable Tourism Program (of the 10-Year Framework of Programs on Sustainable Consumption and Production Patterns) and where the UNEP/SETAC life cycle initiative strives to identify key performance indicators for a sustainable tourism private sector (UNEP, 2017). The relative size of the global tourism sector, its scale of consumption and level of impacts on the environment needs an urgent and imperative response. Sustainable tourism indicators were also considered part of an early warning system for destination managers and a key tool for measuring and monitoring change. The main impacts due to consumptions in domestic tourism are (OECD, 2016): passenger transport (22%), accommodation (18%), food and beverage (17%), culture-sports & recreation (7%), travel agencies (4%) and others (32%). Publishing inventory data is really necessary because inventory (not impacts) is what is needed and can be introduced in either tool or model for sustainability tourism management. Destination managers and policy makers need urgently tools to evaluate and improve the sustainability of tourism in an area (Blancas et al., 2011) and these tools need to be filled with inventory data, as much accurate as possible. This paper will contribute to Spanish sustainability of tourism by providing inventory data on hotel-accommodation which was not previously found in the literature.

This project is a preliminary step to make a contribution to the existing knowledge. Further analysis of more detailed and wider inventory will be investigated in the next phase of our work.

2. Literature review: life cycle assessment & tourism

In the last 15 years, an increasing number of studies on applications of LCA methodology in the field of tourism at different geographical locations with various system boundaries such as an island (Sun, 2014), a country (Perch-Nielsen et al., 2010), alternative travel choices (Filimonau et al., 2014), services provided in a holiday package (Filimonau et al., 2013) or individual hotel case studies (Hu et al., 2015) by adopting various flow references have been developed. Several approaches have been taken on the identification and evaluation of the environmental impacts of tourism sector. In this section, the published papers were classified in 5 different subsections to facilitate a complete overview: environmental impact assessment of tourism sector (where the more general LCA studies with different scopes can be found), environmental impact assessment of holiday packages (where specific touristic packages are evaluated), energy audits in hotel buildings (where energy consumption is audited and improved, but no other impacts are evaluated), life cycle energy analysis (where, not only the energy during the use phase of the hotel is considered, but also the embodied energy due to materials use for hotel construction and demolition) and, finally, environmental impact of food consumption (where the impacts due to the production of the consumed food are taken into account, which is rarely done otherwise).

2.1. Environmental impact assessment of tourism sector

A life cycle assessment case study was conducted to evaluate the environmental performance of accommodation services in order to identify hot spots of the service provided by two Italian hotels and introduce life cycle thinking into the decision making process (Balázs et al., 2004; De Camillis et al., 2008; Raggi et al., 2005). The functional unit was defined as an overnight stay of one guest for all case studies. Life cycle inventory data was collected on-site from two participating hotels, regarding accommodation services, transport of guests to the hotels and wastes produced by hotels. Authors implemented both normalization and weighting phases to the impact assessment. Nevertheless the