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A framework to account for the tourism carbon footprint at island destinations

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HIGHLIGHTS

- A framework is provided to measure the national tourism carbon footprint.
- It is based on the Tourism Satellite Account and the Environmentally Extended Input–Output model.
- Islands may incur half of the tourism carbon footprint outside their territory.

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ABSTRACT

Given concerns over greenhouse gases and the role of tourism in generating such environmental externality, a consistent carbon measurement framework is needed. This paper combines principles derived from production and consumption accounting measures to better allocate the responsibility for carbon emissions. Utilizing a boundary that includes domestic tourism expenditure, inbound tourism expenditure, and local spending associated with outbound travel, this paper (a) proposes a framework to measure the domestic total carbon effect and foreign-sourced effect, and (b) applies the analytical framework to Taiwan. The empirical study indicates that the carbon emissions for domestic tourism industries, international aviation, and imports accounted for 47%, 28% and 25% of the tourism carbon footprint. It is suggested that an island's dependence on both aviation and international trade leads to a larger share of emissions outside their geographic territory with respect to tourism development.

1. Introduction

Evaluation of the tourism carbon footprint has gained prominent attention in recent years as a means to account for the environmental externality of tourism growth. Empirical applications range from the national analysis (Becken & Patterson, 2006; Dwyer, Forsyth, Spurr, & Hoque, 2010; Patterson & McDonald, 2004), to regional scales (Kelly & Williams, 2007; Konan & Chan, 2010; Whittlesea & Owen, 2012), and from targeting a single industry (Becken, 2002) to individual tourism events (Hanandeh, 2013; Jones, 2008). These empirical studies encompass different research scope, and raise questions about which components of tourism demand and operations should be addressed when assessing the full scale of tourism carbon emissions (Munday, Turner, & Jones, 2013).

The most common debate for the carbon research rests on the philosophical question of whether to designate carbon responsibility using the production accounting principle (PAP) or the consumption accounting principle (CAP) (Munksgaard & Pedersen, 2001; Peters, 2008; Turner, Munday, McGregor, & Swales, 2012). The first philosophy, PAP, argues that a region is liable for all the carbon emissions in its local production for which products are sold domestically or exported. This principle is also embraced by the Kyoto Protocol (KP)[1] for determining emission reduction targets among developed nations. For the national tourism carbon estimation, the PAP concept includes local emissions that are associated with internal tourism (domestic and inbound tourism) and transactions related to outbound tourism within the geographic boundary of the departure country. This approach, however, excludes all imported products consumed by visitors or the imported intermediated goods used by the tourism industry directly or indirectly. Furthermore, PAP does not incorporate carbon emissions associated with residents traveling to and at foreign destinations.

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[1] The first commitment period of the Kyoto Protocol started in 2008 and ended in 2012, and the second commitment period is from 2013 to 2020 (UNFCCC, 2013).

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On the other hand, the CAP philosophy attributes carbon emissions to the end consumers for all the products and services consumed, regardless of product origins. Under CAP, national tourism carbon emissions cover domestic tourism consumption and outbound tourism consumption by residents for all products at tourist-generating regions as well as at tourist-hosting regions. Inbound tourism is considered an export, so CAP excludes those emissions. The current tourism carbon studies generally fall between these two extremes of carbon accounting principles (Munday et al., 2013).

Besides CAP versus PAP approach, another common debate is whether to include international aviation and marine transportation in the tourism greenhouse gas (GHG) emission accounting framework (Dwyer et al., 2010). The standard national CO_2 accounting procedures proposed by the Intergovernmental Panel on Climate Change (IPCC) exclude energy uses from international transportation when compiling National Emission Inventories (NEI) (IPCC., 1997). International emissions are excluded because it is difficult to assign jurisdictions to cross-border emissions in a manner that is consistent with the Kyoto Protocol, which assigns responsibility using territorial boundaries (Bureau of Energy, 2011).

Assigning international aviation emissions in the context of tourism is complex. The territorial or KP perspective would completely ignore emissions associated with international bunkers to be in line with the IPCC suggestions. The PAP approach takes a different perspective by including all the emissions produced by national carriers for its inbound, outbound and stop-over services. The CAP approach, on the other hand, traces the emissions of residents' outbound travel to a specific country. The CAP output comprises air pollution emitted from domestic and foreign-registered airlines by a share contributed by its own residents.

Treatment of these two above-mentioned issues has important implications for measuring the tourism carbon emissions at island destinations. This type of economy is generally located in isolated area, with a small industrialization scale, limited natural resources and a relatively small population on the island (McElroy & Parry, 2010). These natural characteristics dictate aviation as the primary method for cross-border movement of people and goods, and require island-nations to engage in large-scale international trade for critical supplies of energy and products. It is also probable that the inbound visitor volume will be disproportionately higher than domestic and outbound travel. The decision to include the overwhelming inbound consumption by the PAP concept versus to account for the outbound spending in the CAP concept is itself a challenge in tourism carbon calibration.

The purpose of this study is first to provide a calibration framework for a national tourism CO_2 account. We argue that a country's tourism carbon footprint (CF) should be addressed in line with the Tourism Satellite Account (TSA) concept. In essence, we attempt to estimate the energy use and carbon emissions that support the tourism economic activities reported within a geographic boundary. The framework equally addresses the following question: Without these tourism economic activities reported in the TSA, how much will the carbon footprint be reduced domestically and globally?

The second purpose is to present a case study, Taiwan, under the proposed framework to demonstrate the pattern of tourism carbon emissions for an island destination. The carbon footprint of Taiwan's tourism consumption is calibrated using the Tourism Satellite Account (TSA) and the Environmentally Extended Input–Output (EEIO) model, which links to 16 different energy sources employed in Taiwan. This rich dataset allows us to estimate a more complete and accurate energy use and carbon emissions pattern, instead of using a general greenhouse gas coefficient for tourism industries. Emissions associated with imported products and air transportation will be emphasized to contrast the differences when these aspects are not addressed.

This paper is structured as follows: the literature review section presents recent tourism carbon studies with a detailed comparison of their analytical processes and research scopes. This information helps to identify a general pattern that was employed by the previous tourism carbon applications. The third section presents the recommended accounting boundary and framework for calibrating the national tourism carbon footprint. This is followed by the case study of Taiwan for 2007, the latest year for which detailed industry GHG emissions and TSA data are available. The final sections elaborate the empirical results and conclude with discussion.

2. Literature

The literature section first provides information on major articles related to GHG estimations in tourism applications. Based on our observations, the tourism carbon study is a relatively new research area, so the publications referenced in this review are generally published after 2006. We limit our focus on destination-oriented GHG studies where Table 1 presents the national tourism research and Table 2 addresses the regional cases. Papers that discuss individual tourism events, such as Jones (2008), Collins, Flynn, Munday, and Roberts (2007), and Andersson & Lundberg (2013) or single-industries [the aviation sector in Becken (2002)] are not included in this review. It is important to note that the carbon estimations in Tables 1and 2 are not directly comparable across studies because their analytical approaches, assumptions, timeframes and the research scopes are different, yielding an inconsistent basis for comparison. Next, we address the analysis method and the research scope that each study employed.

2.1. Analysis method

There are two main approaches for accounting for CO_2 emissions from tourism: a bottom-up analysis involving tourism end-user behaviors and energy use, and a top-down analysis using environmental accounting and the Tourism Satellite Account, which were both first applied by Becken and Patterson (2006).[2] The bottom-up analysis computes energy use and GHG emissions based on information related to energy end-uses for typical tourism industries and tourist behavior. In the example of New Zealand, Becken and Patterson (2006) first sampled transportation, accommodation and attraction businesses to calibrate the average energy efficiency and coefficients with respect to per dollar sales (industry analysis). They then combined these results with tourist travel behavior (transportation mode, accommodation type or recreational activity) and visitor volume (tourist analysis) to estimate total energy use in the tourism sector.

Using this bottom-up approach, detailed energy information can be gathered through business surveys to reflect the regional differences in the production function and carbon intensity by detailed sub-sectors. For example, transportation can be differentiated by domestic air, private air, rental car, coach, train, motorcycle, charter bus, or ferry, to name a few, depending on the transportation modes that are best utilized in the area. Supplemented with visitor surveys, tourists can then be segmented into coach tourists, visiting friends or relatives (VFR), auto tourists, backpackers, or campers, for

[2] The other approaches to address the environmental impact of tourism development are the ecological footprint analysis, which measure the area required to support a certain type of development (Gössling, Hansson, Hörstmeier, & Saggel, 2002; Hunter & Shaw, 2007), and life cycle assessment (Filimonau, Dickinson, Robbins, & Reddy, 2011).