Boletín de la Asociación de Geógrafos Españoles N.º 57 - 2011, págs. 421-425
I.S.S.N.: 0212-9426

ECOLOGICAL FOOTPRINT AND SOCIAL-ENVIRONMENTAL TOURISM PRESSURE. APPLICATION TO THE CANARY ISLANDS

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I. INTRODUCTION

This article intends to establish an approach on the social-environmental pressures of tourism in the Canary Islands, through a series of indicators related to consumption of natural resources and tourist density. The first goal is to calculate the Ecological Footprint of the Canary Islands. The second goal is to develop a simple indicator of tourist density concerning the territory and its population.

II. METHODOLOGY

II.1. Ecological Footprint of the Canary Islands

The Ecological Footprint quantifies the per capita area demand for productive land needed to generate material and energy resources consumed. The methodology and factors used in this work are based on the estimation of the Ecological Footprint in Andalusia (Calvo & Sancho, 2001), and the study conducted in 1997 on the Ecological Footprint of nations (Wackernagel, Onisto, Callejas, Mendez, Suarez, & Suárez, 1997). The method for estimating the Ecological Footprint of the Canary Islands is a composite method, based on the analysis of trade flows and energy consumption (Chambers, Simmons, & Wackernagel, 2003). The consumption of resources is estimated from statistics on trade flows and production of goods using the following expression (Rees & Wackernagel. 1996):

$$\text{Apparent consumption} = \text{Production} - \text{Exportation} + \text{Importation} \quad (1)$$

The Energetic Ecological Footprint of the Canary Islands is determined by the direct consumption of various energy sources and by the indirect energy associated to various consumer goods. The Ecological Footprint per capita for each category (ha/capita) is

obtained by dividing the productive surface demand of each consumption category by the population. The ecological deficit corresponds to the difference resulting from the supply of productive areas of the territory - biocapacity - and the demand for equivalent productive areas (Ecological Footprint).

There is an approach carried out for each Island to estimate their biocapacity or their available standard production area, as well as their own Energetic Ecological Footprint from their consumption of petroleum products, and energetic ecological deficit. This indicator aims to measure the difference between the biocapacity and energetic ecological footprint and it also represents how energy consumption exceeds a territory's productive biocapacity.

II.2. Social-environmental tourism pressure

The social-environmental tourism pressure is analyzed in successive steps. A first step is to make an approximation of the unregulated equivalent population using the available data concerning waste generation and tourism beds from the Canary Islands Integrated Waste Plan 2000-2006 (PIRCAN is Spanish). We proceed to estimate the waste generation rates of accommodation establishments using the available data on environmental claims by EMAS certified establishments, Communitarian Eco-Management and Eco-Audit System, as well as national data from the National Statistics Institute (INE in Spanish) concerning waste generation and overnight stays. We also include a compilation of various studies as references that indicate density values of tourism beds related to population and land area. We generate a synthetic indicator for tourism pressure called social-environmental tourism pressure index (PresTur). This indicator is based on a geometric mean (product) of normalized values of its two variables. The normalized value for each variable x for item i (xi) = (xi - minimum value) / (maximum-minimum) and takes values between zero and one. The first variable of the rate, PresTur TFT, attempts to measure the potential pressure of tourism on the local population, the second variable, PresTur Plazas/km^2, attempts to quantify the potential pressure of tourism on the territory, in a first approximation.

Social-environmental tourism pressure index PresTur = PresTur TFT x PresTur beds/km^2 x 1000

Social-environmental tourism pressure index PresTur = (Observed TFT_i – TFT Minimum Value) x (TFT Maximun Value – Minimum Value TFT) x (observed Beds/km^2_i –Minimum Value Beds/km^2) x (Maximun Value Beds/km^2 - Minimum Value Beds/km^2) x 1000

Being TFT the tourism rate established by Defert in 1967: number of hotel beds and extra-hotel beds for every 100 inhabitants. Tourism beds: hotel and extra-hotel beds.

TFT Minimum Value = 0. Tourism beds/km^2 Minimum Value = 0. TFT Maximum Value = 1000.

Tourism beds/km^2 Maximum Value = 3000.

PresTur can vary from zero (lowest social-environmental tourism pressure) and 1000 (theoretical maximum value that can be reached).

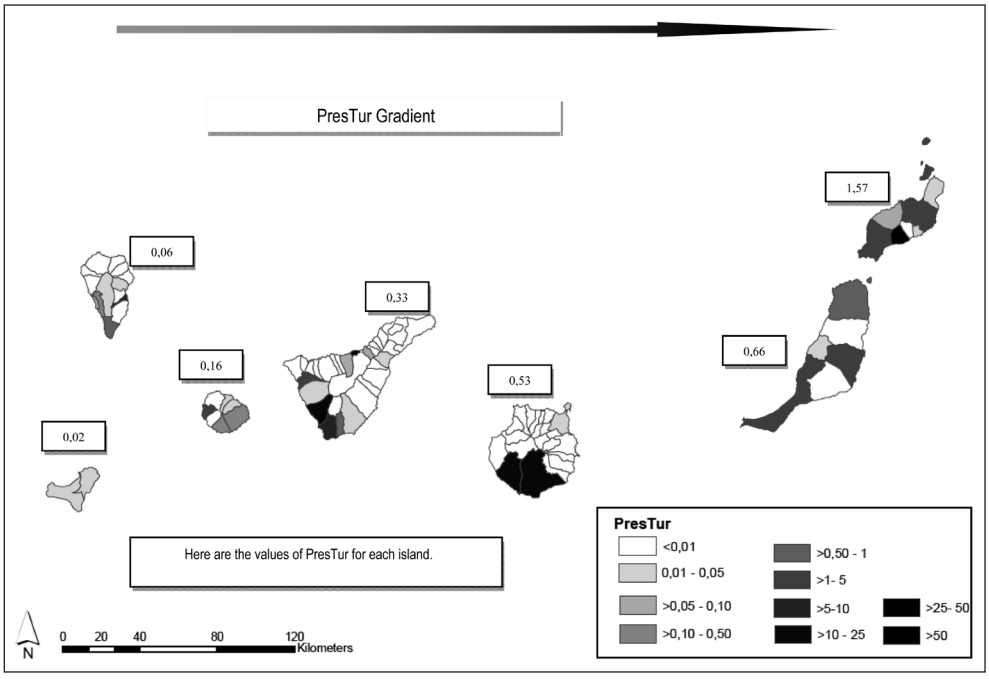
The proposed maximum and minimum values are defined by calculating the tourism rate (TFT) and the value of the territorial pressure indicator of the tourism beds per km^2 concerning the 924 municipalities that make up the regions of the Canary and Balearic Islands and Andalusia. The results of these variables have also been considered in other empirical studies which we have collected. Finally, we analyze the statistical correlations of the Energetic Ecological Footprints of the islands with the PresTur indicator and its components.

III. RESULTS

3.1. Ecological Fooprint and biocapacity of Canarias

The Canary Islands's Ecological Footprint (6.52 gha per capita) exceeds the world average ecological footprint (2.30 gha per person on the planet). It's Biocapacity (0.24 gha per capita) is far below the global average (1.70). As a result, the archipelago's ecological deficit is much higher than the Earth's. The relationship between the Ecological Footprint of the Canary Islands and the standard productive land available is 26.94, which means that the Canary Islands consume 26.94 times more territory than what they have available in the year of this study (2000). Consequently, if the world population would follow the same rate of consumption as the Canary Islands, 3.84 planets would be necessary to support its demand.

Figure 1
SPATIAL DISTRIBUTION OF TOURISM SOCIO-ENVIRONMENTAL PRESSURE, BY APPLYING PRESTUR INDICATOR (2008)



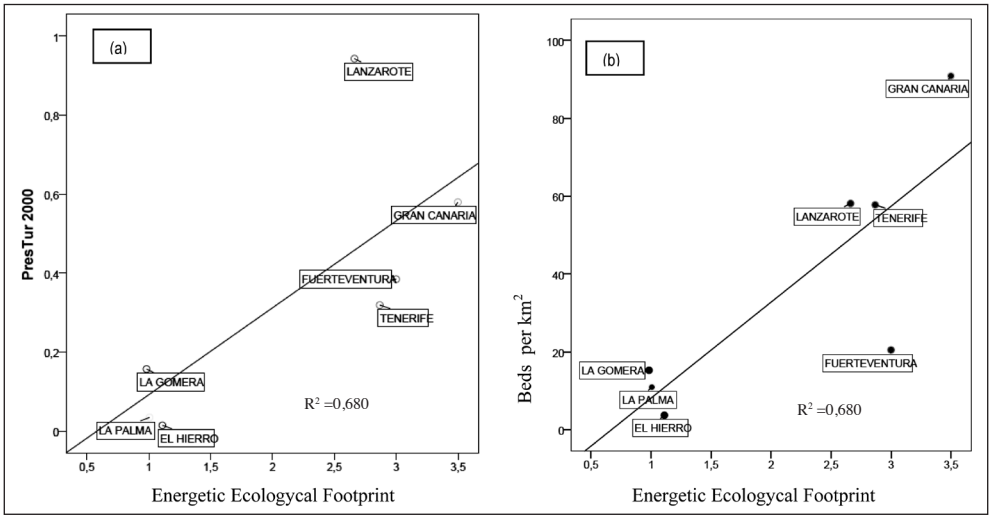
Source: Authors. Population data (LBS). Hotel and Extra-hotel beds (Department of Tourism).

3.3. Social-environmental tourism pressure

Of the collected studies, the case of Biescas in the Pyrenees, with a value of 788 tourism beds/100 inhabitants, is exceptional. The maximum values obtained in the Canary Islands, Balearic Islands and Andalusia are around 1300 tourism beds per km^2 (Fuengirola and Torremolinos). The municipality of Puerto de la Cruz in Tenerife (Canary Islands) represents an extreme value, around 2700, far off the group of municipalities which have been studied. There is a gradient in the island social-environmental tourism pressure index PresTur, which goes from west to east.

Direct high correlations can be observed between the Energetic Ecological Footprint and the Social-environmental tourism pressure index (PresTur) as well as between the Energetic Ecological Footprint with PresTur tourism beds/km^2. From the PresTur variables and the population density we obtain a multiple regression model, which explains 71% of the variance of the Energetic Ecological Footprint.

Figure 2
RELATIONSHIP BETWEEN THE ENERGETIC ECOLOGICAL FOOTPRINT AND PRESTUR INDICATOR COMPONENTS



Source: Authors. (a): p=0.067. (b): p=0.023.

IV. DISCUSSION

General Planning and Tourism Management Guidelines of the Canary Islands establish regulatory measures to contain the accommodation availability of the Islands. However, the pressure of the formal accommodation offer is not the only pressure which needs to be controlled. The development of different forms of residential tourism, immigration flows and even the natural growth of the Canary Islands population affect resource consumption and therefore the Ecological Footprint. The high value of this indicator is the logical consequence

of the remoteness of the Canary Islands, and of its high Energetic Ecological Footprint. The Energetic Ecological Footprint seems to be closely linked to tourism development, considering its high correlation with the social-environmental tourism pressure index PresTur. Tracking the evolution of legal tourism beds is an easy and operational tool. However, the use of indirect social-environmental criptopressure indicators, such as municipal solid waste generation and the islands Energetic Ecological Footprint helps to demonstrate the global pressure exerted on the territorial system.

V. CONCLUSIONS

The results show a significant social-environmental tourism pressure in the Canary Islands, evidenced by the high Ecological Footprint of the Archipelago, the high Energetic Ecological Footprint and PresTur indicator values. There is a distinct spatial behavior between the Western Isles, which are less developed tourism wise and present a lesser degree of social-environmental pressure, and the Eastern Isles, with a much higher development of tourism. The central capital islands have high population densities, high Energetic Ecological Footprints and reduced Biocapacity. All Canary Islands present an energetic ecological deficit, with the exception of the western islands of El Hierro and La Gomera. On a municipal level, considering the high density these towns posses, Puerto de la Cruz (Island of Tenerife) and Tias (Island of Lanzarote) stand out by the high values that this indicator reaches respectively.