

Introduction

The coastal zone is an extremely complex social-ecological system that changes in relation to its environmental, socio-economic, cultural and governance factors (Diedrich et al., 2010). Integrated coastal zone management (ICZM) is a process that seeks to develop an integrated model for sustainable development, that is based on finding points of convergence among these factors (IOC, 2006; cited Diedrich et al., 2010). Indicators are presented as efficient and descriptive tools of anthropogenic and natural phenomena, which are optimal for ICZM (Diedrich et al., 2010). Indicators are defined as quantitative/qualitative statements or measured/observed parameters that can be used to describe existing situations and measure changes or trends over time (IOC, 2006), also in evaluating an isolated phenomenon (diagnosis) or in a monitoring system to evaluate processes and detect changes (Doménech-Quesada y Sanz-Larruga 2010). In ICZM, sustainability scenarios and indicators are not generic, rather they are specific to sites and restricted by political and local realities (Diedrich et al., 2010). In the context of these realities, the analytical framework used for an assessment helps to determine the variety of indicators that are chosen to communicate the outcomes of that assessment (Gabrielsen & Bosch, 2003). For its assessments of the relations between human activities and the environment, Environmental European Agency (EEA) uses the Driving forces-Pressures-State-Impact-Responses (DPSIR) framework (Figure 1; Gabrielsen & Bosch, 2003) and it has been used in this work.

The main goal of this work has been to show a proposal of sustainable indicators for the tourism and urban development (driving forces) in Gran Canaria. Since both are two important and influential driving forces the Canary Islands coast (Gesplan, 2012) and therefore they should be taken into account in a local ICZM system.

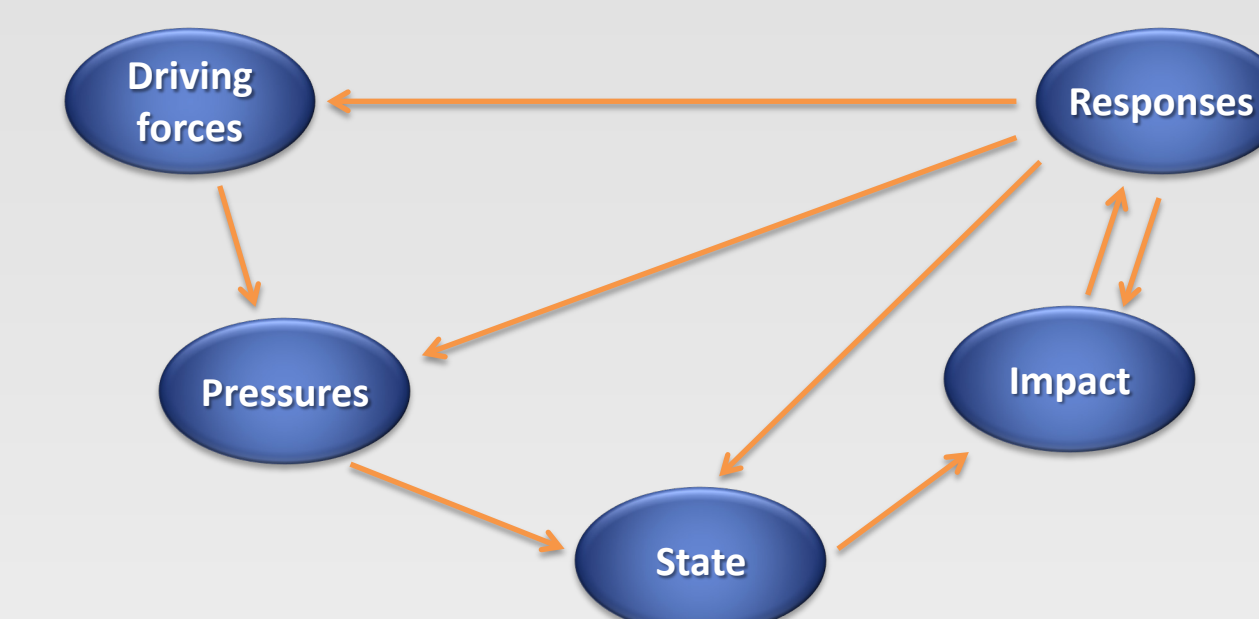


Figure 1. The Driving force, Pressures, State, Impact and Responses (DPSIR) framework scheme.

Methods

First, a shortlist of indicators was obtained according to the references, based on the established framework (DPSIR model) and the following four criteria: relevance, data availability, regular updating and ease of interpretation (criteria used by the public bank of environmental indicators of Ministry of Agriculture, Food and the Environment, MAGRAMA). Second, a DELPHI analysis was performed with four specialists in tourism and two in urban development, in order to decrease the number of preselected indicators. Third, the final weight of indicators was estimated by an Analytic Hierarchy Process (AHP; Saaty 1980). It was conducted in the two driving forces by the experts considered according to three criteria: relevance, data availability and ease of interpretation.

Results and discussion

The AHP set 32 (tourism) and 33 (urban development) indicators initially, divided into DPSIR categories. The experts observed the importance granted in parentheses to the criteria of suitability (63%), data availability (26%) and ease of interpretation (11%). In driving force category of tourism, it was given a 40% to "socioeconomic" and a 60% to "eco-efficiency". Besides in responses category of tourism it was given a 40% to "material and percent" and a 60% to "habitats and biodiversity". In driving force category of urban development, it was given a 80% to population and activities and a 20% to natural resources. Besides, in response category of urban development, it was given a 52% to "urban ordination", a 20% to "energy efficiency", a 20% to "transport system" and a 8% to "governance". There is not specific indicators to State category in urban development.

The information described above was combined with the comparative of indicators that are part of the AHP, and the resulting normalized weights (0 to 1) are observed in the Figures 2 (tourism) and 3 (urban development). The names of most relevant indicators appear in the Table 1 (tourism) and the Table 2 (urban development). This outcome has been delivered from the work agreed among the expert team of OMARCOST project (OMARCOST, 2014).

Notwithstanding DPSIR possess some drawbacks, the fact that the method is still in use more than three decades after its creation also attests to its robustness, and it has been concluded that the DPSIR framework is a useful tool that can still be refined (Gari et al., 2015). It links cause-effect relationships among the five categories of the framework (Figure 1) and has been used for analyzing and assessing the social and ecological problems of aquatic systems subject to anthropogenic influence. and it has been used to develop ICZM (Gari et al., 2015). We believe that DPSIR has successfully guided the selection of indicators for the drivers evaluated.

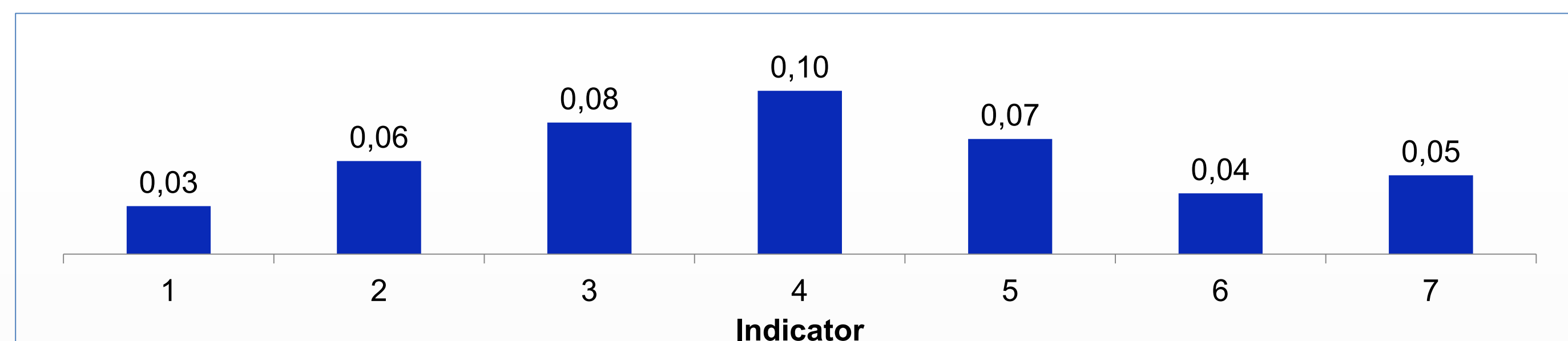


Figure 2. Normalized weights resulting from the Analytic Hierarchy Process (AHP) in tourism. (these include a 42% of the total weight of all DPSIR categories).

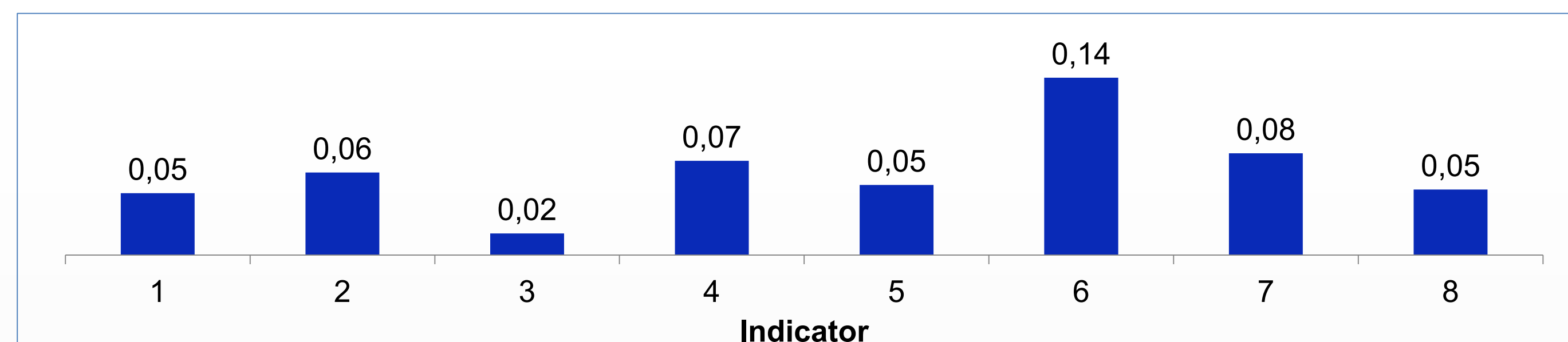


Figure 3. Normalized weights resulting from the Analytic Hierarchy Process (AHP) in urban development. (these include a 52% of the total weight of all DPSIR categories).

Table 1. Names of the 7 indicators as a result of the Analytic Hierarchy Process (AHP).

INDICATORS OF TOURISM
1. Number of tourists entering in the period (driving force-socioeconomic)
2. Water consumption per night (driving force-eco efficiency)
3. Percentage of intertidal occupied by tourist infrastructure (pressure)
4. Percentage of beaches comply with the law quality of bathing water (state about tourism)
5. Number of negative references about the coastal environment carried out by intermediary organizations or representatives of companies that provide tourist services at a tourism unit (impact)
6. Percentage of treated and reused wastewater (response, material and percent)
7. Percentage coastal marine area under some form of conservation (response-habitats and biodiversity-)

Table 2. Names of the 8 indicators as a result of the Analytic Hierarchy Process (AHP).

INDICATORS OF URBAN DEVELOPMENT
1. Resident and floating population per local government (driving force-population and activities-)
2. Urbanization index (driving forces-population and activities)
3. Energy consumption per inhabitant on household and accommodation units (driving forces-natural resources-)
4. Annual increase of urban land in hectares / year (pressure)
5. Mass of solid waste/inhabitant/year per local government (by type) (pressure)
6. Number of complaints and denunciations per year by local perceived impacts due to wastewater treatment plants, local and water pollution (impact)
7. Percentage of new buildings licences on old buildings over all residential building permits in a year (response- urban ordination)
8. Indicator of inefficiency in the use of urban and urbanized land (depending on soil type) (response-urban ordination-)

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Acknowledgments

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