COASTAL SUSTAINABILITY INDICATORS. A PROPOSAL FOR AGRICULTURE AND LIVESTOCK DEVELOPMENT WITHIN THE FRAMEWORK DPSIR (GRAN CANARIA, SPAIN).

Pérez-G., Y*[1]., Bilbao A[1]. González, M[2]., Cedeño, V[2]., Suárez, B[2]., González-Lorenzo, G[3]., Tello, O[4]., González-Gil, S[4]., Jiménez, S[3]., Santamaría, M.T.G[3]., Betancort, J[5]. & Pavón N[1].

[1] GMR Canarias S.A.U. c/Los Cactus 68, Polígono Industrial de Arinaga, 35118, Agüimes, Islas Canarias, Spain. *veraypg@gmrcanarias.com
[2] Departamento de Análisis Económico Aplicado. Campus de Tafira, Universidad de Las Palmas de Gran Canaria, Las Palmas de Gran Canaria. Spain.
[3] Instituto Español de Oceanografía (IEO). Centro Costero de Canarias. Vía Espaldón, Dársena Pesquera PCL 8, 38180. Santa Cruz de Tenerife. Spain.
[4] IEO. Sede Central. Corazón de María 8, 28002. Madrid. Spain.
[5] Instituto Tecnológico de Canarias (ITC). Dpto. de Agua. Playa de Pozo Izquierdo s/n, 35119, Santa Lucía, Las Palmas, Spain.

CECOMA 2016 Challenges in the Environmental Management of Coastal and Marine Areas
Las Palmas de Gran Canaria, Spain.
25-29th of January 2016

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 no 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 agriculture and livestock sectors (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.

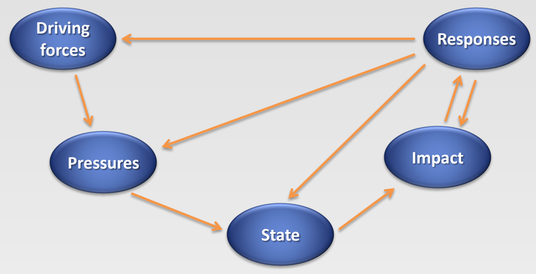

Figure 1. The Driving force, Pressures, State, Impact and Responces (DPSIR) framework scheme.

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 two specialists in these driving forces, 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 by the two experts considered according to three criteria: relevance, data availability and ease of interpretation.

Results and discussion

The AHP set 45 indicators initially, divided into DPSIR categories (Table 1). The experts observed the importance granted in parentheses to the criteria of suitability (72.4%), data availability (19.3%) and ease of interpretation (8.3%). In driving force category, it was gave a 7 % to “agriculture and livestock” indicators, a 64 % to “agriculture” and a 28 % to “livestock”. In response category, it was gave a 25 % to “survaillance and control” and a 75 % to “Accompanying measures and technical assistance to the sector”. 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 Figure 2. The most relevant indicators are highlighted in Figure 2 and their names appear in bold in the Table 1. 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.

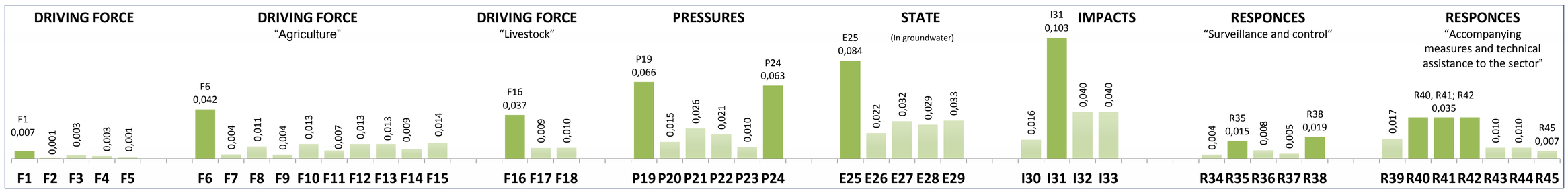

Figure 2. Normalized weights resulting from the Analytic Hierarchy Process (AHP).

Table 1. Names of the 45 indicators used in the Analytic Hierarchy Process (AHP).

DRIVING FORCE “Agriculture and Livestock”
F1. Annual variation rate of the final agricultural production (and / or gross value added of the branches of agricultural)
F2. Annual variation rate of the agricultural exports
F3. Number of jobs in the agriculture and livestock sectors
F4. Agricultural Work Units (AWU) employed in agriculture
F5. Number of self-sufficient in the agriculture and livestock sectors
DRIVING FORCE “Agriculture “
F6. Agricultural area as a percentage of the total littoral area per local government
F7. Abandoned agriculture land area as a percentage of the total area per municipality
F8. Percentage of greenhouse cultivated area of the total surface per municipality
F9. Percentage of greenhouse area dedicates to hydroponic and aeroponic cultures
F10. The use of irrigation in agricultura (in cubic hectometers) in a year.
F11. Cubic hectometers of water a year extracted from wells and treated with some method of desalination
F12. Apparent consumption of chemical fertilizers per hectare and year
F13. Apparent consumption of pesticides per hectare and year
F14. Organic farming area as a percentage of usable agricultural area (UAA)
F15. Percentage of agriculture area whose owners claim to use organic fertilizers mainly
DRIVING FORCE “Livestock“
F16. Number of animals according to the kind of livestock
F17. Number of farms according to the kind of livestock
F18. Percentage of fully legalised farms from the territorial and environmental point of view
PRESSURES
•P19. Mass of animal excretions according to the kind of livestock
P20. Mass of non-biodegradable solid waste originated from agricultural and livestock
P21. Mass of biodegradable waste from agriculture
P22. Apparent consumption of antibiotics, hormones or other medicines in livestock
P23. Landscape units negatively affected by agriculture and livestock activities
PRESSURES
P24. Packaging and remnants of pesticides in containers
STATE - (in groundwater)
S25. Percentage of sampling stations in aquifer where nitrate is more than 50 mg /l
S26. Chloride concentration in coastal groundwater
S27. Concentration in by-products from pesticides used in agriculture and livestock
S28. Concentration in antibiotics, hormones or other medicines in coastal groundwater
S29. Concentrations in heavy metals and other inorganic elements in coastal groundwater
IMPACT
I30. Number of people who receive health care from exposure to pesticides, per municipality
I31. Number of complaints per year by poor state of bathing and recreational areas where agriculture pollutes water (impact)
I32. The value lost by the reduction of the economic functions of the groundwater, because its pollution (salinization, nutrients and pesticides).
I33. Percentege of water extracted from the groundwater that produce a added cost by desalinating it.
RESPONSES “Surveillance and control”
R34. Percentege of inspectioned installations that present a correct register (aparently) in the farm notebook (“cuaderno de campo”)
R35. Number of open investigation files because mismanagement of pesticide residues, chemical containers and other hazardous waste; and annual percents finished in penalty (response-surveillance and control-)
R36. Number of open investigation files because mismanagement of non - biodegradable and non-hazardous waste from agricultural sources; percentage of penalised cases.
R37. Number of open investigation files because mismanagement of biodegradable waste from agricultural sources; percentage of penalised cases.
R38. Number of open investigation files because mismanagement of generated manure on farms, according to the kind of livestock; and annual percents finished in penalty (response-surveillance and control-)
RESPONSES “Accompanying measures and technical assistance to the sector”
R39. Percentage< of the consumed water in agriculture from treated water by tertiary treatment.
R40. Number of farmers/year that have received information and training about proper management of agricultural wastes
R41. Number of farmers/year that have received information and training about the on the proper application of agrochemicals (fertilizers and pesticides)
R42. Number of farmers beneficiaries by information and training on proper management of livestock waste
R43. Number of stock breeders benefited by information and training on food and animal health
R44. Percentage of the abandoned agricultural land that receive some form of treatment to fix and reduce exposure to soil erosion
R45. Percentage of landscape units (indicator P23) subject to a rehabilitation program, and funding for it.

References

Diedrich, A, J. Tintoré & F. Navinés. 2010. Balancing science and society through establishing indicators for integrated coastal zone management in the Balearic Islands. *Marine Policy* 34: 772–781.
Doménech-Quesada, J.L. y F. J. Sanz-Larruga. 2010. Guía para la implementación de un sistema de gestión integrada de zonas costeras. Observatorio del Litoral de la Universidad de A Coruña. Netbiblo. S.L. 626 pp.
Gabrielsen, P. & P. Bosch, 2003. Environmental Indicators: Typology and Use in Reporting. *European Environment Agency*. 20 pp.
Gari, S.R., A. Newton & J.D. Icely. 2015. A review of the application and evolution of the DPSIR framework with an empashis on coastal social-ecological systems. Ocean & Coastal Management 103:63-77.
GESPLAN. 2012. Recopilación, análisis y evaluación de información territorial y ambiental. Proyecto LITOMAC, 166pp.
IOC. 2006 (Intergovernmental Oceanographic Commission of UNESCO). A handbook for measuring the progress outcomes integrated coastal ocean management, IOC Manuals and guides, nº 46; ICAM Diossier, 2. París, UNESCO, 2006.
OMARCOST. 2014. Propuesta de sistemas de indicadores de sostenibilidad ambiental del litoral. 586 pp.
Saaty, T.L. (1980). The Analytic Hierarchy Process. New York: McGraw Hill. International. Translated to Russian, Portuguese, and Chinese, Revised editions, Paperback (1996, 2000). Pittsburgh: RWS Publications.

Acknowledgments

The OMARCOST project (www.omarcost.org), "Strategy for environmental sustainability of cross-border coastal environment“ was carried out with the support of the European Union (EU) and cofounded by European Regional Development and Spain-External Borders Cross-Border Cooperation Operational Programme (POCTEFEX) .

PROGRAMA Cooperación Transfronteriza España-Fronteras Exteriores
Unión Europea
Fondo Europeo de Desarrollo Regional
Invertimos en su futuro