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The OMARCOST project, "Strategy for environmental sustainability of cross-border coastal environment" carried out, among other activities, the selection of environmental indicators in the geographical area of the Canary Islands (Spain) and the Coast Region Souss Massa Drâa (Morocco). These indicators are presented as efficient and descriptive tools of phenomena, for it these are optimal for integrated coastal zone management (ICZM). DPSIR framework (Driving force, Pressure, State, Impact and Response) was used as a frame for selecting ICZM-indicators of sustainability on the island of Gran Canaria (Spain). DPSIR is useful in analyzing connections between socioeconomic trends, ecological phenomena and institutional responses in an integrated manner. This paper describes a proposal of indicators for the agriculture and livestock sectors, because both are two very influential driving forces on the coast of the Canary Islands (Gesplan 2012). The selection was based on their suitability, data availability and ease of interpretation, through the use of multi-criteria analysis (Saati, 2008). *In short, the main 11 selected indicators were:* 1.Annual variation rate of the final agricultural production (and / or gross value added of the branches of agricultural) (driving force), 2.Agricultural area as a percentage of the total littoral area per local government, 3.Number of animals according to the kind of livestock (driving force), 4.Mass of animal excretions according to the kind of livestock (pressure), 5. Packaging and remnants of pesticides in containers (pressure), 6.Percentage of sampling stations in aquifer where nitrate is more than 50 mg /l (state due agriculture), 7.Number of complaints per year by poor state of bathing and recreational areas where agriculture pollutes water (impact), 8.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-), 9.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-), 10.Number of farmers/year have received information and training on the proper management of agricultural waste (response about training) and 11.Number of farmers/year and ranchers/year have received information and training on proper application of agrochemicals (farmers) and waste management (ranchers) (response about training). This work has been carried out with the support of the European Union (EU) and cofounded by European Regional Development Fund (ERDF) and POCTEFEX Programme.

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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.
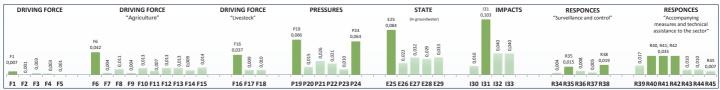

Figure 2. Normalized weights resulting from the Analytic Hierarchy Process (AHP).

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

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

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