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Environment, Development and Sustainability

A Multidisciplinary Approach to the Theory and Practice of Sustainable Development

ISSN 1387-585X

Environ Dev Sustain
DOI 10.1007/s10668-020-00697-y



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Local perceptions regarding a social–ecological system of the mediterranean coast: the Mar Menor (Región de Murcia, Spain)

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Received: 7 November 2019 / Accepted: 19 March 2020
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Abstract

The social–ecological system of the Mar Menor located in southeastern Spain is facing serious environmental degradation which is generating important economic and social impacts. This article analyzes the local community perception in the Mar Menor area about the causes, consequences and possible solutions to current problems, especially the eutrophic crisis in the Mar Menor lagoon. For this research, a survey based on a questionnaire was conducted in 2017 and answered by 498 people. The collected data were analyzed using descriptive statistics and principal component analysis. Results showed significant differences among the groups of respondents, according to their profession and main economic activity, but the results also point to an important consensus in the group of respondents. It is worth noting that the broad consensus was that agricultural activities are the main causes of the entry of nutrients into the lagoon, and the respondents indicated that the priority should be given to measures to reduce nutrient inputs. This consensus, which is very different from the results obtained in previous studies, represents a very recent change of perception in relation to the role of agriculture in the Mar Menor. However, the broad consensus in the diagnosis of the current problem is not reflected in the varying opinions regarding the possible solutions or management options. Survey responses regarding solutions varied greatly across groups: There were important differences between (a) the respondents' perceptions of the best solutions, and (b) the main management practices undertaken by the public administration at this point. This finding highlights a potential conflict that should be considered in any decision-making processes.

Keywords Social–ecological system · Agrarian pollution · Coastal lagoon · Social perceptions · Sustainability

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1 Introduction

The analysis and management of social–ecological systems (SES) are of vital importance to understand the relationships and interactions between society and ecosystems (Holling et al. 1998; Berkes and Folke 1998; Audouin et al. 2013; Fischer et al. 2015). The scientific literature raises several attributes necessary to carry out the practice of SES management. Among the SES management attributes most commonly mentioned and developed (Challenger et al. 2014) are: the interdisciplinary approach, incorporate knowledge of the local population, mainstreaming, effective governance, adaptive monitoring and co-management, the use of indicators of sustainability and social participation.

Stakeholder's knowledge and perception about the natural environment and about some of its components are aspects of great importance for the integral management of a region and, especially, for the conservation and sustainable use of its biodiversity (Challenger et al. 2014; Delgado-Serrano et al. 2015). The interdependence between the ecological components and the multiplicity of users at the SES level requires that all stakeholders know the functionality of the system and participate in the design and implementation of management practices. In this sense, participatory governance processes require a good stakeholder analysis (Yang 2014; Comino et al. 2016), especially in cases of complex socio-environmental conflicts, as happens in the socio-ecological system of the Mar Menor (SESMM) located in the Mediterranean coast (SE Spain).

The main economic uses in the SESMM are the urban-tourist development and agrarian activity, although some fishing activity is maintained in the lagoon. The first two activities have involved the entry of nutrients into the lagoon, although with different relative effects, as the nutrient inputs from urban uses have been significantly reduced by the improvement in the wastewater treatment and its reuse, while the input from agricultural practices has continued to grow due to the expansion of irrigated areas following the arrival of the Tajo-Segura transfer in 1979. This large increase in water transfers to the Campo de Cartagena watershed increased water and nutrient flows to the lagoon and its wetlands (Martínez Fernández et al. 2005, 2014, 2017; Esteve et al. 2008, 2016; Carreño et al. 2008; Carreño 2015). Estimates indicated that the agricultural nutrient inputs represent about 85% of the total into the lagoon (Martínez-Fernández et al. 2014; Esteve Selma et al. 2016).

This high input of nutrients into the lagoon is the main reason why, in the middle of 2016, the current eutrophic crisis emerged abruptly with serious ecological impacts on the species and habitats, the loss of the traditional transparency of the waters and important damages to the tourist quality and other ecosystem services. In addition, this (Esteve Selma et al. 2016; Carreño 2015; Martínez Fernández et al. 2005) can lead to a “domino” effect, whereby many of the economic activities that the lagoon directly supports will lead to job losses and associated impacts.

The scientific literature includes the study of other coastal lagoons with similar pressures to the Mar Menor such as Salton Sea (USA), the Thau lagoon (France) or La Mar Chica, also called Nador (Morocco) (Glenn et al. 1999; Caillaud 2017; García-Ayllón 2017). Specifically, Salton Sea and the Thau lagoon have suffered serious environmental impacts that have required large recovery plans and complex integrated management.

Although in recent years there has been an attempt to manage the SESMM from a holistic perspective, sectoral visions have predominated so far, and it has not been managed from a systemic and integral approach (García-Ayllón 2018, 2019). Failure to comply with current regulations, lack of coordination and the absence of effective measures to prevent and address the multiple problems of the SESMM, and in particular the eutrophication of

Mar Menor waters, have caused a serious conflict that has spread to the different spheres: environmental, social, economic, political and institutional (Comité de Asesoramiento Científico del Mar Menor 2017).

Along with the scientific and technical diagnosis that have been made in recent years in the SESMM (Esteve et al. 2008, 2016; Martínez-Fernández et al. 2014, 2017; León and Bellido 2016; Comité de Asesoramiento Científico del Mar Menor 2017), it is also necessary to understand the social perception in the study area. Thus, we view management practices with an integrated approach, taking into account the key stakeholders' involvement, including the local community, with the common objective of improving the environmental and socioeconomic situation of the SESMM.

This article aims to contribute to a better understanding of the local community perception in the Mar Menor area through the completion of a survey, in order to identify their perceptions about pressures, impacts and possible management practices to improve the current status of SESMM and specifically the ecological status of the lagoon.

2 Study area

The SESMM, located in the east of the Region of Murcia (SE Spain), includes the Mar Menor lagoon, the surrounding wetlands and the Campo de Cartagena watershed (Fig. 1). The lagoon is separated from the Mediterranean Sea by an ancient sandy bar that is 22 km long and varies between 100 and 900 m wide, crossed by five very shallow channels that

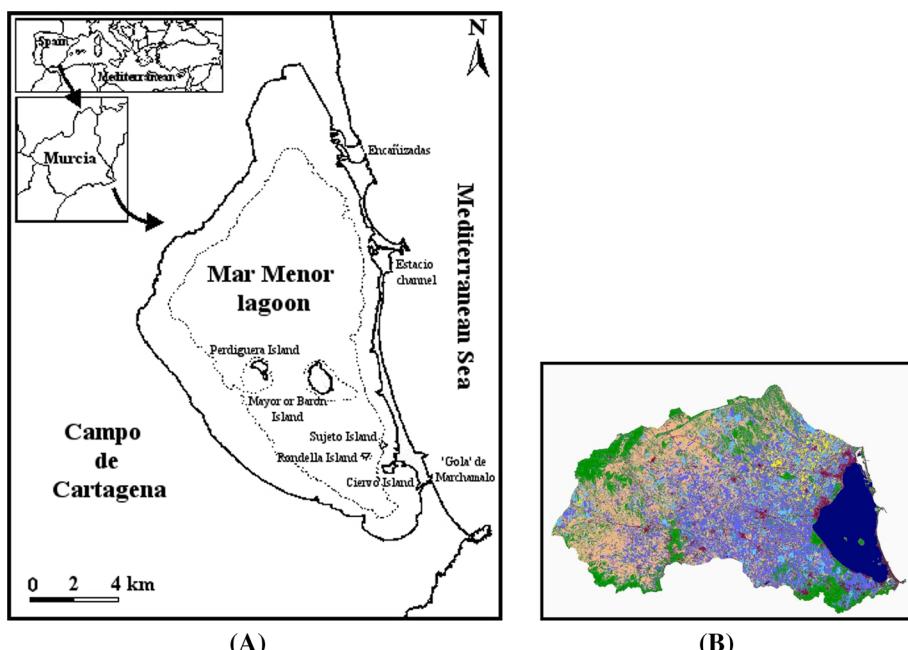


Fig. 1 **a** Location of the SESMM. **b** The SESMM, made up of the lagoon and its watershed. The main uses of the watershed are indicated. Green: natural; blue: outdoor irrigation; yellow: greenhouses; cream: dry; garnet: urban and infrastructures

connect the lagoon to the Mediterranean Sea; some of these natural cuts have been widened to allow the passage of boats between the lagoon and sea. This coastal lagoon, the largest in the Western Mediterranean, covers an approximate area of 135 km² and has a volume of 610 hm³, with a maximum depth of 7 m and a mean depth of 4.5 m. The low rainfall which does not exceed 300 mm per year in much of the region and the high temperatures (annual mean of 17 °C) determine a water deficit (difference between precipitation and evapotranspiration) around 600 mm/m² per year, which has favored the hypersaline nature of the lagoon's waters. Another of its unique characteristics has been its oligotrophic character until a few years ago (Comité de Asesoramiento Científico del Mar Menor 2017).

Wetlands that surround the lagoon are typified as littoral crypto-wetlands, coastal salt-pans and micromareal salt marshes (Vidal-Abarca et al. 2003), with total cover of approximately 1000 hectares, and with a high biodiversity. Due to the high natural value, the lagoon and surrounding wetlands have led to the creation of multiple regional, national and international protection declarations.

The Campo de Cartagena watershed has an area of 1270 km² and is drained by more than 20 ephemeral watercourses locally called "ramblas" that flow into the Mar Menor lagoon. The population of this study area is 357,266 inhabitants in 2017. The main uses and activities in the watershed are intensive irrigation agriculture (especially of horticultural crops (lettuce, broccoli, melon and others), citrus fruits (oranges and lemons) and greenhouse crops) and urban-tourist development. The Campo de Cartagena watershed has suffered significant changes during the last few decades due to the presence of human activity. But it is after the start-up of the first irrigation system using subterranean water, and later with the Tajo-Segura surface water canal transfer in 1979, when these changes are most evident. Data from Carreño (2015) indicate that between 1988 and 2009, the irrigation of the watershed increased by 141%, going from 25,150 ha to 60,700 ha. Currently (2020), the Campo de Cartagena watershed is one of the most competitive areas in Europe in fruit and vegetable production. These crops have needed to be competitive, large amounts of water coming mainly from the Tajo-Segura transfer, from the pumping of groundwater and more recently from desalinated water (from brackish groundwater and very recently also from desalination marine), whose rejection brine has been poured uncontrollably into channels or injected into wells in the upper aquifer itself, with the consequent environmental impact of contamination that this entails in the medium and long term due to the high nitrate content (Martínez Fernández and Esteve Selma 2000; Velasco et al. 2006). These crops have also needed strong fertilizer and phytosanitary inputs, and the development of the long-distance road transport network (and its associated greenhouse gas emissions), as well as a workforce in a state of social and economic irregularity. An especially relevant impact of the agricultural activity in the Mar Menor lagoon is the discharge of the effluents loaded with nutrients, surpluses of intensive fertilization which is causing an acute process of eutrophication of the waters (Martínez Fernández et al. 2005, 2014, 2017; Velasco et al. 2006; Esteve et al. 2008, 2016; Carreño et al. 2008; Carreño 2015). Another important effect of the agricultural activity is the transformation and breakage of soils.

On the other hand, since the 1960–1970s, urban-tourism and second-home development have led to the increase in temporary residents (local, national or international), including increases in services associated with such increased development of urban areas and infrastructure such as the construction of roads, ports (such as the Canal del Estacio), boardwalks, dikes, beach regeneration and riverbed occupancy. All this has exerted a strong ecological pressure on the Mar Menor lagoon and its surrounding wetlands, which have finally negatively impacted the water quality of the lagoon and its associated biodiversity. Ultimately, these negative impacts lead to decreased goods and services that the system

provides to society, with a wide range of negative social and economic impacts (Conesa and Jiménez-Cárceles 2007). For example, activities such as tourism, fishing or recreational diving are already seeing the consequences of the loss of bath water quality (due to the loss of traditional water transparency) and marine biodiversity. This reduction in biodiversity and ecosystem services of the lagoon, especially as a result of the ecological collapse caused by the eutrophic crisis that has been suffering since 2016, has a negative impact on both the ecological and economic and social value of the coastal ecosystem (Martínez Fernández and Esteve Selma 2020).

Regarding the political and legislative measures that have been approved or applied for the SESMM, it is worth highlighting the numerous protection figures: San Pedro del Pinatar Regional Park, Protected Landscape of Open Spaces and Mar Menor Islands, declaration of the Mar Menor and surrounding wetlands such as ZEPA (Special Protection Area for Birds) and SCI (Site of Community Importance), Ramsar list of wetlands (Wetland of International Importance of the Ramsar Convention) and ZEPIM (Specially Protected Area of Mediterranean Importance). Also a broad European, state and regional regulations, such as the declaration in 2001 of the Campo de Cartagena watershed as a Vulnerable Zone in application of the Nitrates Directive (91/676 ECC), the declaration of the lagoon as a Sensitive Area in application of the Urban Wastewater Directive (91/271 ECC) and the application of the Water Framework Directive (2000/60 EC), which obliges to achieve and maintain The Good State of all water bodies, Law 1/2018, of February 7, on urgent measures to ensure environmental sustainability in the Mar Menor environment, the Integrated Management Plan for the protected areas in the Mar Menor and the strip of the Mediterranean coast of the Region of Murcia or the Strategy of integrated management of coastal areas of the socio-ecological system of the Mar Menor and its surroundings, among others.

3 Methodology

A survey was conducted with 23 questions with categorical and dichotomous type responses. The questions of the survey were distributed in five blocks: (1) urban-tourist development, (2) agrarian activities, (3) the state of the Mar Menor lagoon, (4) environmental values and ecosystem services and (5) metadata (Appendix 1).

The type of sampling was simple random sampling, and the survey was directed to different sectors of the population over 18 years of age in the Mar Menor area and to organizations involved in the activities and management of the SESMM. The questionnaire was subjected to a pilot test with a group of 35 people among students of the University of Murcia and members of the Pacto por el Mar Menor citizen platform, to determine whether the questions had been correctly understood by the population and whether the duration of the survey was excessive.

Considering that the size of the population in the study area is greater than 100,000 inhabitants, for a confidence level of 95% and assuming a margin of error of $\pm 5\%$, it was necessary to have a sample size of approximately 400 respondents. A total of 498 people responded during the months of February to May 2017. The survey was sent and answered by email in order to have a greater diffusion, participation and representativeness of the local community.

As part of the survey metadata, respondents were classified into ten groups according to their profession and main economic activity: (1) public administration (12%), (2) agricultural sector (8%), (3) tourism sector-Services (5%), (4) tourism sector-Hotels and

restaurants (4%), (5) fisheries sector (1%), (6) construction and real estate development sector (2%), (7) industry sector (8%), (8) academic sector (professor or researcher) (17%), (9) students (21%) and (10) others (liberal professions, retirees and other occupations) (22%). In total, 60% of the people who answered the survey were men and 40% women, with an age range between 21 and 74 years and with a level of higher education (university and postgraduate) in 80% of cases. Regarding the respondent's relationship with the Mar Menor, half of the people who responded to the survey were regular visitors to the Mar Menor, 30% residents and 20% sporadic visitors. Half of the people who answered the survey participated in some type of association, mainly those related to the environment and the other half were not associated with any association.

The data were analyzed using the statistical software R (R Core Team 2019). For the analysis of the questions on the perceptions related to pressures (Q1, Q2, Q7, Q8), state (Q14, Q15_1, Q15_2, Q15_3, Q16, Q18), impacts (Q9, Q11, Q20, Q21_1, Q21_2, Q21_3, Q21_4, Q22, Q23_1, Q23_2, Q23_3, Q23_4) and responses (Q5, Q19) (Appendix 1), a bivariate analysis was carried out by means of contingency tables on two nominal variables: on the one hand, profession and main activity economic and on the other the answers of the respondents to the questions on the pressures, state and the impacts in the SESMM. Pearson's Chi-square nonparametric test (χ^2) or Fisher's exact test (Agresti 1992) was applied, depending on the case, according to the observed frequencies, applying the Monte Carlo simulation of the p values to determine whether the answers to the questions depended on the profession and main economic activity group of each surveyed individual.

For the analysis of the questions referring to the solutions or possible management measures to be adopted (Q6 and Q12), the respondents were asked to order ten possible measures to improve urban-tourist development (Q6_1, Q6_2, Q6_3, Q6_4, Q6_5, Q6_6, Q6_7, Q6_8, Q6_9 and Q6_10) and nine measures to limit the entry of nutrients into the Mar Menor lagoon (Q12_1, Q12_2, Q12_3, Q12_4, Q12_5, Q12_6, Q12_7, Q12_8 and Q12_9) (Appendix 1), with the option that each respondent could also reject those measures that they did not consider of interest by assigning that measure the value 0.

First, a principal component analysis (PCA) (Wold et al. 1987) was carried out considering each of the two questions according to the average value obtained in the group of respondents according to their profession and main economic activity, with the aim of grouping the different groups of measures and see which were more related to each other. Secondly, we made biplot representations (Kassambara and Mundt 2019) to know the relationship between each of the variables or management measures, regarding the groups of respondents according to their profession and main economic activity. Third, we established an order of preference for management measures according to the average value of the respondents.

The analysis of results was based on the classification of respondents according to their profession and main economic activity, because the classification of respondents according to other variables, such as age, gender or place of residence, did not give rise to significant differences of opinion. On the other hand, some of the main stakeholders associated with SESMM are identified by their main economic activity, so that the results of the survey according to said variable allow a first approximation to their perceptions. It should be noted that the active population for each of the groups of respondents classified according to their profession and main economic activity, is different and in some cases unknown and difficult to calculate, which explains the level of participation proportionally higher in those groups of respondents with a higher active population. In this sense, although the survey is not stratified, in the answers where majority consensus is obtained, the results can be considered representative of the population.

The validation of the final data of the survey was verified through 20 interviews with scientific–technical experts from different disciplines in the environmental, social, economic and institutional dimensions.

4 Results

4.1 Social perceptions about the pressures in the SESMM

Most of the respondents (86.2%) considered that the urban-tourist development in the Mar Menor area is too crowded (Q1) with a position in favor of greater urban-tourist development in the tourism sector (hotels and restaurants) and in the construction sector compared to the rest of the groups. The respondents assessed the current tourist quality between regular and bad (75.2% between both qualifications) (Q2). 52.3% of the tourism sector dedicated to the hotels and restaurants assessed the quality of tourism between acceptable and good, unlike the consensus established by the rest of the groups of respondents about the regular and bad tourist quality.

Almost half of the respondents (47.1%) considered agriculture as a relatively important economic sector, although it does not generate the greatest economic wealth of the Mar Menor area and around a quarter of the respondents considered that irrigation does not contribute significantly to the richness of the study area. The other quarter of the respondents considered that agriculture is an essential sector for the economy of the Mar Menor area. This assessment of the agricultural activity in terms of its economic importance in the SESMM (Q7) was assessed in one way or another depending on the group of respondents according to their profession and main economic activity (Table 1). In addition to the expected greater support for the economic importance of agriculture within the agricultural sector (64.3%), the results showed a divergent behavior between the construction and tourism sectors: While 50% of respondents from the construction sector considered agriculture as essential, in the tourism sector this percentage did not reach a quarter of the number of respondents.

Almost half of the respondents (44.1%) considered that the agricultural activity is controlled by large companies that create scarce and precarious employment, while 37.2% thought that it generates many jobs, but the employment is not high quality nor with a guarantee of longevity. Only 18.7% considered that irrigated agriculture is very important because of the quantity and quality of employment it generates, and that irrigation is a guarantee of present and future opportunities for the surrounding population. The answers to the social importance of the agrarian activity in the SESMM (Q8) depended on the group of respondents according to their profession and main economic activity (Table 1). Only the agricultural sector had more than 50% support of the option that irrigated agriculture is very important for the quantity and quality of employment it generates and that irrigation is a guarantee of present and future for the surrounding population, expressing an opinion contrary and statistically significantly different compared to the rest of the groups.

4.2 Social perceptions about the state and impacts in the Mar Menor lagoon

Regarding the assessment of the environmental impacts caused by intensive agriculture (Q9), the majority of respondents (97.6%) considered that agriculture is mainly responsible for the eutrophic state of the lagoon, and more than half (58.7%) thought that the agrarian

Table 1 *P* values for independence test between the groups of respondents according to their profession and main economic activity and the variables corresponding to questions Q1, Q2, Q5, Q7, Q8, Q9, Q11, Q14, Q15_1, Q15_2, Q15_3, Q16, Q18, Q19, Q20, Q21_1, Q21_2, Q21_3, Q21_4, Q22, Q23_1, Q23_2, Q23_3 and Q23_4

Questions	<i>P</i> value
Q1	0.00001
Q2	0.00081
Q5	0.31784
Q7	0.00001
Q8	0.00005
Q9	0.04346
Q11	0.05787
Q14	0.00004
Q15_1	0.04638
Q15_2	0.13361
Q15_3	0.00001
Q16	0.00023
Q18	0.00014
Q19	0.00002
Q20	0.97149
Q21_1	0.0386
Q21_2	0.34849
Q21_3	0.00034
Q21_4	0.00341
Q22	0.13825
Q23_1	0.02632
Q23_2	0.32163
Q23_3	0.0051
Q23_4	0.15617

sector should assume its share of co-responsibility, as in the application of the polluter pays principle. Significant differences were found according to the groups of respondents by economic activity (Table 1). Within the agricultural sector, this attribution of responsibility is the lowest, but it reaches the substantial proportion of 38%, followed by construction (50%) and by the rest of the sectors which reached values higher than 50%.

Among the main effects of irrigated agriculture on the Mar Menor lagoon and its surroundings (Q10), the most noted were: pollution by pesticides and fertilizers, negative effects on other sectors such as tourism (tourism quality), degradation of the landscape, and negative effects on recreational and leisure uses of the Mar Menor lagoon. Given this situation, almost all respondents (98.6%) thought that the entry of nutrients into the lagoon should be limited (Q11), and no significant statistical differences were found among the groups of respondents (Table 1).

Almost all respondents (99%) felt that the Mar Menor lagoon has important environmental values and ecosystem services (Q20); therefore, no differences were found among the groups of respondents. The most relevant environmental values and ecosystem services (Q21) in order of importance were the conservation of the biodiversity of the lagoon and its associated wetlands, fishing production, cultural identity and quality of life, and the recreational and tourist aspect. A total of 98.8% of respondents perceived that these environmental values and ecosystem services are threatened (Q22), there being no differences between the groups of respondents (Table 1).

A total of 91.3% of respondents felt that the water quality of the lagoon is no longer good (Q14). The answer to this question depended on the profession and main economic activity of the respondent (Table 1), so that, construction and tourism sectors (Hotels and restaurants and Services) reached the highest percentages of those who believe that the water quality of the lagoon is good despite specific episodes of pollution (40%, 20% and 24%, respectively, values much higher than the other groups of respondents). Agricultural discharges were considered the main causes of pollution in the lagoon (Q15), without differences of opinion between groups reaching the level of statistical significance (Table 1).

Regarding attribution of responsibilities (Q16), most of the respondents (83.5%) thought that the main responsibility for nutrient pollution is the regional administration (Ministry of Water, Agriculture and Environment) and state administration (Confederación Hidrográfica del Segura), due to its insufficient control and monitoring of agricultural activity and water use, although some of the respondents also pointed to other responsible parties such as farmers and even agricultural advisory technicians. The answer to this question was varied significantly depending on the group of respondents (Table 1). It should be noted that the respondents belonging to the public administration also expressed the majority opinion (86%) that they are the main responsible for nutrient pollution.

In addition, most respondents (81.6%) felt that climate change could worsen the state of the lagoon (Q18). Although this opinion is majority in all groups, significant differences were found, with that opinion being less expressed by the tourism sector (Table 1).

4.3 Preferences on management measures in the SESMM

4.3.1 Management measures on urban-tourist development

A total of 95.5% of the respondents considered it necessary to take urgent measures to improve urban-tourist quality (Q5), and there were no significant statistical differences between the groups of respondents (Table 1). According to the PCA in Table 2, it was observed that the first two components explained the variability of the variables corresponding to the measures related to urban-tourist development (Q6).

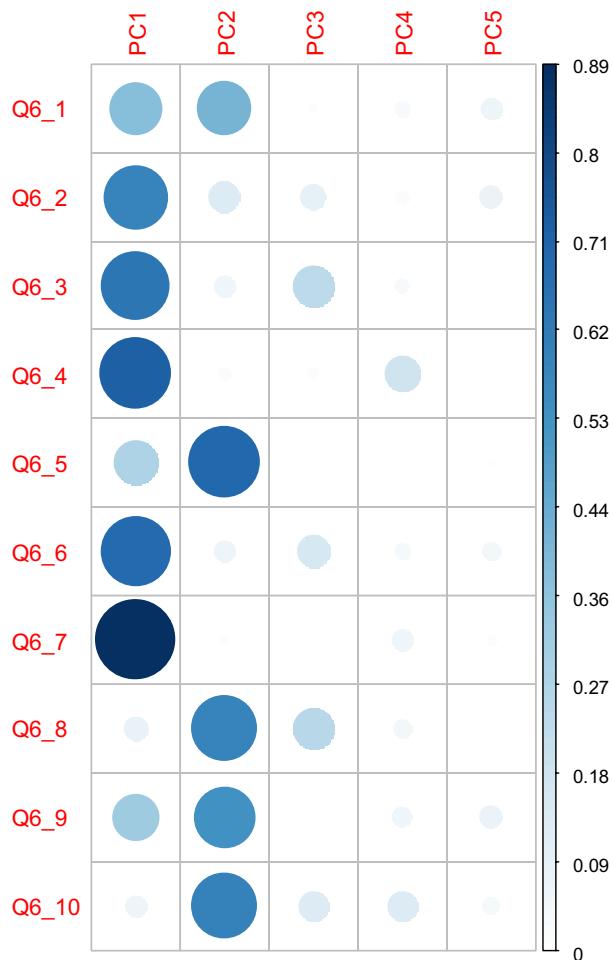
Table 2 Contribution of each component of the PCA to the total variance explained for the management measures to improve urban-tourist development in the SESMM

	Eigenvalue	Percentage of variance	Cumulative percentage of variance
Component 1	4.648947e+00	4.648947e+01	46.48947
Component 2	3.138831e+00	3.138831e+01	77.87779
Component 3	8.944562e-01	8.944562e+00	86.82235
Component 4	6.026995e-01	6.026995e+00	92.84934
Component 5	3.264989e-01	3.264989e+00	96.11433
Component 6	2.349651e-01	2.349651e+00	98.46398
Component 7	1.204169e-01	1.204169e+00	99.66815
Component 8	2.664344e-02	2.664344e-01	99.93459
Component 9	6.520653e-03	6.520653e-02	99.99979
Component 10	2.055888e-05	2.055888e-04	100.00000

The first two main components collected a cumulative total variance of 77.9%. It was observed that the measurements Q6_7, Q6_4, Q6_6, Q6_3 and Q6_2 are the best represented in the first component (PC1) (Fig. 2). These measures are those related to sustainable mobility and the management and protection of natural protected areas and areas that allow construction, as well as two types of measures that are negatively correlated and that most of the respondents wanted to reject and not carry out (Q6_4 and Q6_3). This set of measures, according to the quality of their representation in the PC1, was:

- Improve the public transport network (Q6_7).
- Do not make a greater offer of second homes Q6_4).
- Improve the bike lane and the spaces adapted for walking and sports (Q6_6).
- Do not carry out more hotel construction (Q6_3).
- Improve the management and protection of the natural areas around the Mar Menor, coastal wetlands and free areas of buildings (Q6_2).

Fig. 2 Weight of the variables (management measures to improve the urban-tourist development in the SESMM) in the first five main components



On the other hand, the measurements Q6_5, Q6_10, Q6_8, Q6_9 and Q6_1 contributed most weight to the second component (PC2) (Fig. 2). This second group of measures had a very high positive correlation with the measures related to the improvement of the public infrastructure already built and the urban moratorium:

- To remodel built buildings for an improvement of tourist image (Q6_5).
- Improvement of parking areas (Q6_10).
- Improvement of the infrastructure for road traffic (Q6_8).
- Improvement of accessibility to urbanizations and beaches (Q6_9).
- Urban moratorium (Q6_1).

The biplot presented in Fig. 3 showed the relationship between each of the variables or management measures studied, with respect to the average score of the groups of respondents. It was observed that the management measures Q6_10, Q6_8 and Q6_5 are related, and the representatives of the administration were the group of respondents that acquired a closer position to carry out these measures. On the other hand, the management measures Q6_6 and Q6_7 are also related to each other and the people who are in the services of the tourism sector (TouristS) were the ones that had the greatest preference for these management options. It should be noted that respondents engaged in fishing had a greater affinity with management measures Q6_2 and Q6_1.

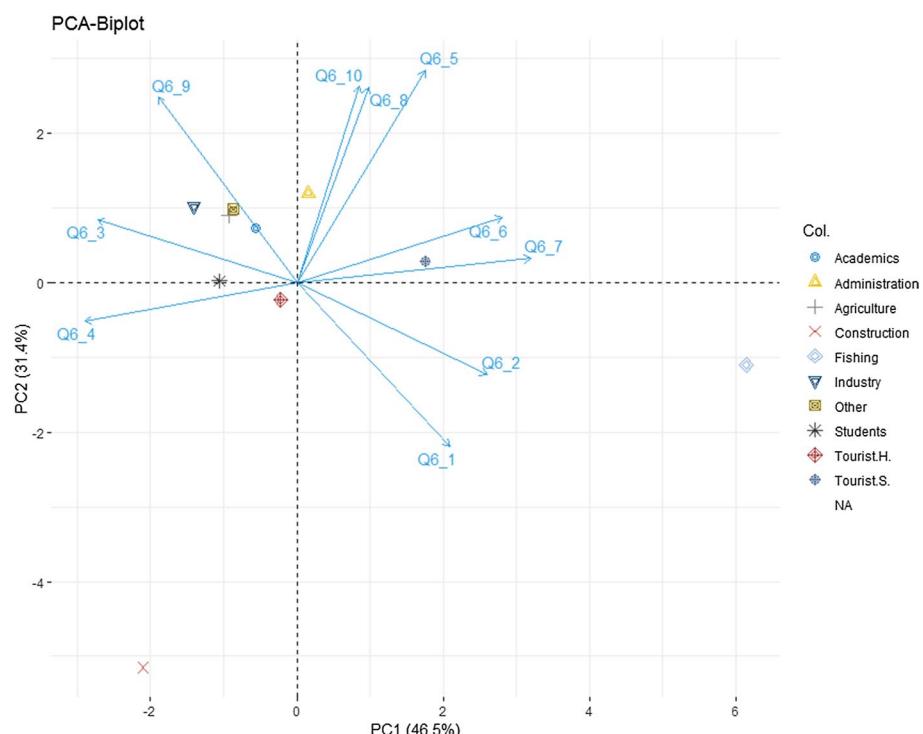


Fig. 3 Biplot for the management measures to improve the urban-tourist development of the SESMM and the groups of respondents in the study according to their profession and main economic activity

The order of preference according to the level of importance of the management measures to improve urban-tourist development of the Mar Menor area, established according to the average value of the respondents, was:

1. Do not make a greater offer of second homes (Q6_4).
2. Improve the public transport network (Q6_7).
3. Remodeling built buildings for an improvement of tourist image (Q6_5).
4. Improvement of parking areas (Q6_10).
5. Improve the bike lane and the spaces adapted for walking and sports (Q6_6).
6. Improvement of accessibility to urbanizations and beaches (Q6_9).
7. Improve the management and protection of natural areas around the Mar Menor, coastal wetlands and free areas of buildings (Q6_2).
8. Urban Moratorium (Q6_1).
9. Improvement of the infrastructure for road traffic (Q6_8).
10. Do not carry out a greater construction of hotels (Q6_3).

4.3.2 Management measures on the water quality of the Mar Menor lagoon

Although most respondents chose to reduce the input of nutrients to improve the water quality status of the lagoon (72.6%), some groups of respondents also supported other options (Q19), with different preferences according to the group of respondents (Table 1). In the agricultural sector, almost half of the respondents chose different measures, the expansion of communication channels of the lagoon with the Mediterranean (23.8%) and intervention measures within the lagoon (11.9%). In the construction sector, these two other measures received the support of 30% and 10% of the respondents, respectively. In the sector of public administration, although 65.5% of respondents chose to eliminate or reduce the entry of nutrients, 27.3% considered the application of measures inside the lagoon.

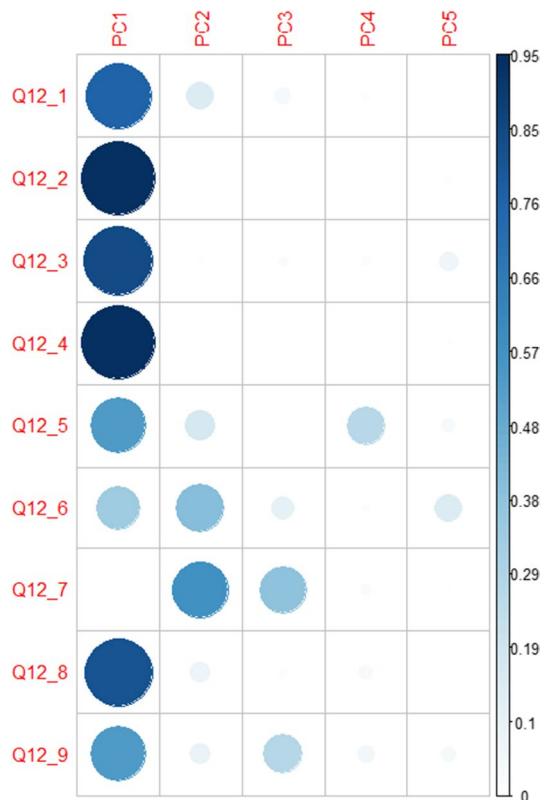
Within the specific measures to reduce the entry of nutrients into the lagoon, the PCA allowed the identification and grouping of two groups of measures: those related to the control of pressures and those related to nature-based solutions (PC1), and other measures less related with solving the problem at source (PC2).

Table 3 presents the percentage of variance explained by each main component. It was observed that the first two components explain a large part of the variability of the variables under study and that the cumulative variance percentage reached 79.8%. In addition, Fig. 4 indicates that the measurements Q12_4, Q12_2, Q12_3, Q12_8, Q12_1, Q12_5 and Q12_9 are those of greater weight in the first component. It should be noted that measure Q12_5 was rejected by most respondents who preferred not to consider it. The set of these measures, according to the quality of their representation in the PC1, was:

- Establish and monitor the application of maximum fertilizer input values (Q12_4).
- Elimination of irregular uptake of groundwater (Q12_2).
- Require that each desalinator includes a brine treatment (Q12_3).
- Apply natural measures of water and nutrient retention at plot scale and in the watershed (e.g., green hedges, small ponds, etc.) (Q12_8).
- Reduce the irrigated area (Q12_1).
- Do not collect the brines and pour them directly into the Mediterranean Sea (Q12_5).
- Recover and enhance the lost surface of natural wetland in the periphery of the lagoon (Q12_9).

Table 3 Contribution of each PCA component to the total variance explained for management measures to limit the entry of nutrients into the Mar Menor lagoon

	Eigenvalue	Percentage of variance	Cumulative percentage of variance
Component 1	5.742676140	63.80751266	63.80751
Component 2	1.443675028	16.04083364	79.84835
Component 3	0.844636518	9.38485020	89.23320
Component 4	0.419507002	4.66118891	93.89439
Component 5	0.321633412	3.57370458	97.46809
Component 6	0.122616230	1.36240256	98.83049
Component 7	0.081287470	0.90319411	99.73369
Component 8	0.018313137	0.20347930	99.93717
Component 9	0.005655063	0.06283403	100.00000

Fig. 4 Weight of the variables (management measures to limit the entry of nutrients in the Mar Menor lagoon) into the first five main components

For its part, management measures Q12_7 and Q12_6 were well represented in the second component:

- Build a green filter to treat the flow of the Albujón watercourse (Q12_7).
- Collect the brines and part of the flows of the waters of the “ramblas” and after their dislocation, pour their reject flow into the Mediterranean Sea (Q12_6).

Figure 5 presents the biplot representation for management measures to limit the entry of nutrients into the Mar Menor lagoon, with respect to the average score of the groups of respondents involved in the study. It was observed that management measures Q12_6 and Q12_1 are related, and the representatives of the administration were the group of respondents who point to them. In addition, management measures Q12_2 and Q12_4 are also related to each other, and the people surveyed who belong to the fishing sector were those who agreed with these options. It should be noted that the representatives of the construction sector, the tourism sector and the academic sector were all similar with respect to preferences associated with the management measure Q12_7.

The order of preference according to the level of importance of the management measures to limit the entry of nutrients into the Mar Menor lagoon, established according to the average value of the respondents, was:

1. Reduce the irrigated area (Q12_1).
2. Require that each desalinator includes a brine treatment (Q12_3).
3. Elimination of irregular uptake of groundwater (Q12_2).
4. Recover and enhance the lost surface of natural wetland in the periphery of the lagoon (Q12_9).
5. Apply natural measures of water and nutrient retention at plot scale and in the watershed (e.g., green hedges, small ponds, etc.) (Q12_8).
6. Establish and monitor the application of maximum values of fertilizer contribution (Q12_4).
7. Build a green filter to treat the flow of the Albujón watercourse (Q12_7).
8. Do not collect the brines and pour them directly into the Mediterranean Sea (Q12_5).
9. Collect the brines and part of the flows of the waters of the “ramblas,” and after their dislocation, pour their reject flow into the Mediterranean Sea (Q12_6).

5 Discussion and conclusions

The results confirmed that the general perception of the surveyed groups regarding the pressures, state and impacts of the main uses and activities in the SESMM coincides with the diagnosis that the scientific–technical community has been making in recent decades (Martínez-Fernández et al. 2014; Esteve Selma et al. 2016; Comité de Asesoramiento Científico del Mar Menor 2017; Martínez Fernández et al. 2017). In this sense, there seems to be a certain consensus in the diagnosis of the problem, but that consensus does not fully translate into responses or management measures. Regarding such potential response measures, there are greater differences among the groups of respondents, and also between the perceptions of the respondents and the main measures that have been carried out or are currently envisaged by the public administration. This evolution closely follows the life-cycle curve of environmental policies. This theory explains how the degree of disagreement and

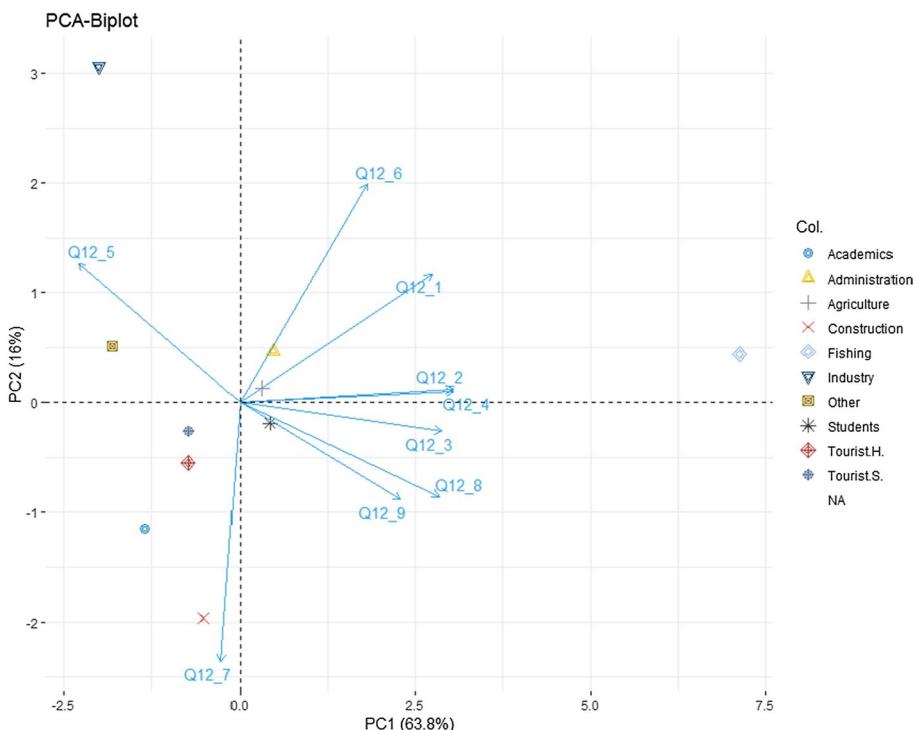


Fig. 5 Biplot for management measures to limit the entry of nutrients into the Mar Menor lagoon and the groups of respondents in the study according to their profession and main economic activity

the political weight of the different phases of an environmental policy change. According to this theory, environmental problems go through an initial stage in which the disagreement is very high and includes the recognition of the existence of the problem itself. This stage gives way to other phases in which the disagreement is giving way to acceptance and formulation, where consensus is first reached in the diagnosis but there is still disagreement about the measures to be applied, until the final stages of implementation and control (Nebel and Wright 1999) when the consensus also covers the measures.

There are statistically significant relationships among the different groups of respondents that vary according to their profession and main economic activity, and the groups vary in their perception of urban-tourist development and its impacts, agricultural activities and their impacts and the state of the Mar Menor lagoon. It reflects the existence of different interests, expectations and values in the different groups of respondents, as expected, which in turn is partly reflected in the responses obtained. Thus, as expected, the agricultural sector considers mainly that its activity is essential for the economic development of SESMM. Likewise, within the agricultural sector more than half consider that agricultural activity is very important because of the quantity and quality of employment it generates; while in most other groups of respondents, they consider either such employment to be not of quality, or without future guarantees, or that the employment is controlled by large companies that create scarce and insecure employment. In the same way, continuing with the more or less expected

results, regarding the measures to limit the entry of nutrients into the Mar Menor lagoon, the priority position of the representatives of the public administration is to collect the brines and, after treatment and denitrification, pour them into the Mediterranean Sea, line of work in which, precisely, several actions of the regional government are framed (BOE 2019).

However, some of the results are striking and less obvious, such as differences of opinion within the tourism sector, comparing those engaged in the hotels and restaurants to those working in the service sector. Specifically, half of the former favored greater urban-tourist development and valued the quality of tourism to be between acceptable and good. The service sector, on the other hand, thought that the urban-tourist development surrounding the Mar Menor lagoon is too crowded, and they valued the current tourism quality between regular and bad, which was similar to the rest of the groups of respondents. Other studies (Aledo et al. 2007; Gaja 2008) also confirm how the model of urban-tourist development in the Mar Menor area and in other areas of the Mediterranean coast, has not generated a quality tourism structure and has also brought negative environmental consequences (Romero Díaz et al. 2011; Pérez Morales et al. 2016).

It should also be noted that a quarter of the tourism sector as a whole perceived that the lagoon's water quality is good despite the fact that there are specific episodes of pollution and that they do not believe that climate change affects its state, a view contrary to most of the rest of the groups surveyed, as well as the latest studies on climate change in the Region of Murcia and particularly in the Mar Menor (García-Ayllón and Miralles 2014; Martínez-Graña et al. 2018). The National Climate Change Adaptation Plan points out that La Manga del Mar Menor will be one of the areas most threatened by the sea level rise (OECC, MIMAM 2006).

It is important to point out that with regard to management measures to improve urban-tourist development, the fishing sector took a closer position to improve the management and protection of the natural areas around the Mar Menor, coastal wetlands and free zones of buildings, as well as the urban moratorium. The representatives of the administration were closer to the second group of management measures, measures that were related to the improvement of the infrastructures already built, while people working in the service sector (TouristS) gave more priority to the measures related to sustainable mobility such as improving the bike lane and the spaces adapted for walking and sports, as well as improving the public transport network.

However, what is more remarkable is the existence of important consensus, among all the groups of respondents, regardless of their profession and main economic activity. These basic consensuses, some of them certainly not expected, can be summarized as follows: (a) They believe it is necessary to apply improvements in urban-tourist development; (b) consider that the entry of nutrients into the Mar Menor lagoon should be limited; (c) think that the main cause of pollution in the Mar Menor lagoon is agriculture; (d) consider that the Mar Menor lagoon has relevant environmental values and ecosystem services and (e) believe that such values and services are threatened (Table 1).

Regarding the consensus about the urban-tourist sector, the best supported measures to improve the urban-tourist development of the SESMM were those related to sustainable mobility. It is also important to highlight a majority consensus on the part of all the respondents to not apply the measures that promoted new urban developments, such as a greater construction of second residences, and instead to focus more on the remodeling of existing buildings. This perception is analogous to findings of recent studies on the environmental and socioeconomic effects of the "urban sprawl" in the Mediterranean coast of Spain, where Region of Murcia is located (Romero Díaz and Pérez Morales 2017; Pérez Morales et al. 2015; Docampo Calvo 2011). In a less priority position than the previous ones, the

urban moratorium was also supported. Although in February 2017, the Regional Assembly approved a motion in favor of an urban moratorium, its approval was controversial and was not implemented (and it was approved with the vote against the party in the regional government). It should be noted that the regional government has not adopted legislative initiatives to improve urbanism in the SESMM, despite the fact that the Autonomous Community has sufficient powers in this area to lead, in collaboration with the municipalities involved, the necessary control of urban-tourist development in the SESMM. There are current (2019) measures that the regional government proposes to carry out, or have been carried out, to improve the urban-tourist development in the SESMM. For the most part, they are far from the group of priority measures proposed by the respondents in this study, and that derive from this study, a result which shows the existence of clear differences between what the regional government is doing or proposes to do in this area and what the population really wants. In this sense, the results of the survey point to a divergence between the preferences of the local community and the policies promoted by the regional government.

Continuing with the elements of consensus, it is striking to see the widespread recognition of agriculture as the main cause of pollution in the lagoon, since until recently there was no such consensus on the role of intensive irrigation. Thus, studies carried out in the previous decade (Martínez-Paz et al. 2005) showed that most of the local community and stakeholders in the Mar Menor area considered the improvement in wastewater management to be much more important than actions in the agrarian field. This perception is possibly based on the greater visibility of pollution by wastewater with respect to the diffuse agricultural pollution. The correct identification of the main origin of the contamination detected in our results could be due to the continuous work of dissemination carried out from the scientific field and from different environmental organizations and, above all, to the great impact in the population that the eutrophic crisis generated in 2016. The magnitude of the change, with the drastic transformation of the traditional transparent waters of the Mar Menor into the so-called green soup, broke the inertia of perception, invalidated the explanatory mechanisms that until then had been working and allowed the dissemination of the causes of problem made from scientific fields would receive the echo and the necessary public attention.

The change in this general perception, and the correct identification of agrarian activities as the main source of pollution in the lagoon, could support the idea that, although the specific interests of the different groups of respondents contribute to shaping the opinions of the same (Rickson 1985), the degree of knowledge that we have about the processes of the basin and the lagoon (which is significantly greater at the present time as a result of the eutrophic crisis) is also an important factor when explaining the local perceptions and changes over the long term.

Regarding the priority measures to limit the entry of nutrients into the Mar Menor, most respondents preferred the application of measures related to the control of pressures such as reducing the irrigated area, forcing each desalinator to include a brine treatment or the elimination of irregular uptake of groundwater. On the other hand, they also expressed support for those related to nature-based solutions, such as the recovery of wetlands and natural water retention measures, in the line of the results obtained by other works (Martínez-Paz et al. 2013; Perni and Martínez-Paz 2013). They also rejected the measure of collecting the brines and dumping them directly into the Mediterranean Sea. It is striking the consensus around the rejection of this management measure since it is a measure that has been proposed on different occasions. This rejection of the direct discharge to the Mediterranean could be explained, on the one hand, by the increase in environmental awareness about the impacts in the Mediterranean Sea and, on the other, by the ecological collapse

of the Mar Menor lagoon, which perhaps has been visualized as an example of what could also happen in the Mediterranean.

It should be noted that some of these measures, such as the application of natural measures to retain water and nutrients at the scale of the plot and in the basin, are also included in Law 1/2018 on urgent measures to guarantee environmental sustainability in the Mar Menor area. This law, approved by the Regional Assembly in February 2018, focuses on measures in the agrarian field, including the obligation to devote 5% of the area of agricultural land to hedges, revegetation with wild species and similar actions. It also establishes the obligatory nature of soil conservation practices and runoff control. The approval of this law was also very controversial (it was approved with the vote against the party in the regional government and with strong opposition from the agrarian sector) and it is not being applied; however, the results of this work show that a good part of the measures included in the aforementioned Law 1/2018 have broad support from the respondents. Again, this points to divergent positions between the measures that the majority supports the population and those that have greater support and priority for the regional government. The results obtained also show the social acceptability of some measures (recovery of wetlands) whose environmental and economic viability has been widely established by other studies, which show that the construction and especially the restoration of wetlands is an option with a high cost-effectiveness to reduce diffuse pollution in agricultural watersheds (Gren et al. 1997; Zanou et al. 2003; Lacroix et al. 2005; Elofsson 2010; Trepel 2010).

The need to apply measures to limit the entry of nutrients into the Mar Menor lagoon is also reinforced by the legal obligations arising from the declaration in 2001 of the Campo de Cartagena watershed as a Vulnerable Zone in application of the Nitrates Directive (91/676 ECC), of the declaration of the lagoon as a Sensitive Area in application of the Urban Wastewater Directive (91/271 ECC) and of the application of the Water Framework Directive (2000/60 EC), which requires reaching and maintaining the Good Condition of all water bodies.

To conclude, the results of this work reveal that the local community of the SESMM perceives an ecological crisis that brings a crisis and important social impacts for the population of the study area in terms of loss of quality of life and progressive decrease in socioeconomic opportunities linked to the lower functionality of the system. The crisis is fundamentally of management, of governance of the SESMM, with little effective, efficient and coherent policies and little informed, participatory and transparent ways of doing politics, which has allowed the SESMM to arrive at the current situation. This has generated a high social concern that so far has not been well attended by those responsible for the management of this SES.

According to the scientific community (Comité de Asesoramiento Científico del Mar Menor 2017; Ruiz Fernández et al. 2019), the main key actions that must be taken to promote the desired changes are: to stop the entry of sediments and nutrients with prevention measures at source, improving the techniques and efficiency of agricultural fertilization, applying different solutions based on nature and recovering the surfaces of natural wetlands located on the periphery of the lagoon, the only systems capable of retaining and eliminating a good part of the sediments and nutrients transported during the flood events. To this must be added the elimination of irregular irrigation, compliance with current European, state and regional regulations [e.g., the Nitrates Directive (91/676 ECC) and the Water Framework Directive (2000/60 EC)], as well as not promoting new urban developments. Publicizing the impacts of excessive urban development in the Mar Menor where massive construction has been promoted for its tourist exploitation could help not to make the same mistakes in other similar characteristic lagoons, such as the coastal lagoon of Nador or Mar Chica (NE, Morocco), an area in a state of incipient development with traditional activities such as agriculture and

fishing, but where there are development plans as a national and international tourist center (Raji et al. 2013). It should be noted that these actions are in line with what the population proposes in this work, but instead are far from the planned actions by the regional government.

The cost of not acting and managing the SESMM with an integral and holistic approach could be very high from an economic, social, ecological and public health point of view and lead us to situations such as Salton Sea, the largest lagoon in California (USA) (Upadhyay et al. 2013). The contamination by agricultural spills and an unbridled urban planning for decades has led to an ecological deterioration of this lagoon, with enormous ecological and socio-economic consequences, as well as on public health in the area and that currently the Californian government does not know how to solve (Bradley and Yanega 2018; Marshall 2017). The traditional solution to management conflicts in the SES has been to delegate all responsibility to the government. However, there is evidence that centralized and vertical style management approaches are inappropriate due to their inflexibility and lack of adjustment to the complexity of socio-ecological processes (Jassen and Ostrom 2006; Ostrom 1990; Holling and Meffe 1996).

In this regard, several authors have highlighted the need for participatory approaches to improve decision-making in the management of SES and contribute to the transition of these systems toward sustainability (Reed 2008; Ban and Mills 2013). The sustainable management of natural resources cannot be achieved without the involvement of the affected community, so other alternative governance approaches to centralized management such as co-management are required. Therefore, an aspect of great relevance for future work is the identification and characterization of the key stakeholders and their interests in the SESMM, in order to formulate consensus alternatives (Mumtas and Wichien 2013; Purnomo et al. 2017). For this reason, the establishment and construction of dialogues, trust and cooperation processes should be promoted through the exchange of information, perceptions, needs, visions and the implicit and explicit knowledge of the key stakeholders (Prell et al. 2009; Hauck et al. 2016).

This article supports the widely accepted vision by other authors (Sodhi et al. 2009; Castro et al. 2011; Perni and Martínez-Paz 2013) that local knowledge must be explicitly taken into account for the successful management of complex socio-ecological systems such as the Mar Menor. The analysis of stakeholders, together with the knowledge of the local community perceptions that this work exposes, would allow to support and improve the selection, efficiency and effectiveness of the policies and projects that are carried out in the future in the management of the SESMM.

Appendix 1: Structure and content of the survey

Block I: Urban tourist development

Q1. Do you think that the current urban tourist development of the Mar Menor area is adequate?

- Yes
- No. Should be developed more.
- No. It is too crowded.

Q2. How do you assess the current tourist quality of the Mar Menor area?

- Very good.
- Good.
- Acceptable.
- Regular.
- Bad.

Q3. What aspects have you taken into account to make your assessment? Order them from 1 to 3 in order of importance, without repeating the assessments, with 1 being the most important and 3 being least important. Put 0 if you have NOT taken it into account.

- Ecological aspects (Landscape, water quality of the Mar Menor lagoon and nature).
- Economic aspects (Affordable travel, lodging and hotel services costs).
- Social aspects (Cultural offer, leisure, available health services, tranquility).
- Others. Which one?

Q4. Indicate how you would place the tourism quality of the Mar Menor basin compared with the tourism quality in Spain according to the following aspects, taking into account: 1=on the average, 2=above the average, 3=below the average, 4=I do not have elements of comparison. Do not give the same value to different aspects.

Q4_1. Ecological aspects (Landscape, water quality of the Mar Menor lagoon and nature).

- Average.
- Above.
- Below.
- I do not have elements of comparison.

Q4_2. Economic aspects (Affordable travel, accommodation and hotel services costs).

- Average.
- Above.
- Below.
- I do not have elements of comparison.

Q4_3. Social aspects (cultural offer, leisure, health services available).

- Average.
- Above.
- Below.
- I do not have elements of comparison.

Q5. Do you think there is a need for improvements in the urban tourist development of the Mar Menor area?

- Yes (In this case, answer question 6).
- No.

Q6. What aspects and measures need an urgent improvement in the urban tourist development of the Mar Menor area? Order them from 1 to 10 in order of importance without repeating the assessments, with 1 being the most important and 10 the least important. Put 0 for that activity that you DO NOT want done.

Q6_1. Urban moratorium.

Q6_2 Improve the management and protection of the natural areas around the Mar Menor, coastal wetlands and free areas of buildings.

Q6_3 Greater construction of hotels.

Q6_4 Greater offer of second homes.

Q6_5 Remodeling built buildings for an improvement of tourist image.

Q6_6 Improvement of the bike lane and spaces adapted for walking and sports.

Q6_7 Improvement of the public transport network.

Q6_8 Improvement of the infrastructure for road traffic.

Q6_9 Improvement of accessibility to urbanizations and beaches.

Q6_10 Improvement of parking.

Q6_11 Other. Which one?

Block II: Agricultural activity

Q7. How do you assess the existing agricultural activity in the Mar Menor basin in terms of its economic importance? Check ONE option.

- Irrigated agriculture is essential for economic development in the Mar Menor area.
- Irrigated agriculture is a relatively important sector, although it does not generate the greatest economic wealth of the Mar Menor area.
- Irrigated agriculture does not contribute significantly to the general wealth of the Mar Menor area.

Q8. How do you assess the existing agricultural activity in the Mar Menor basin in terms of its social importance? Check ONE option.

- Irrigated agriculture is very important because of the quantity and quality of the employment it generates. Irrigation is a guarantee of present and future for the surrounding population.
- Irrigated agriculture generates many jobs, but employment is not quality or a guarantee for the future.
- Irrigated agriculture is in the hands of large companies that create scarce and precarious employment.

Q9. What is your assessment of the environmental impacts caused by the agricultural activity of the Campo de Cartagena on the Mar Menor lagoon? Check ONE option.

- Agriculture does not generate environmental impacts.
- Agriculture needs fertilizers and phytosanitary products, but its environmental effect is not considerable.
- Agriculture is causing pollution of the Mar Menor lagoon and measures are needed to reduce the impact of agriculture and the use of pesticides and fertilizers.
- The intensive agriculture of the Campo de Cartagena is the main responsible for the current eutrophic state of the Mar Menor lagoon. The sector must assume its share of co-responsibility, and the polluter-pays principle.

Q10. What effects does irrigated agriculture have on the Mar Menor lagoon and the value of its surroundings? Check ONE or SEVERAL options.

- Pesticide and fertilizer pollution.
- Negative impact due to the degradation of the landscape.

- Negative effects on recreational and leisure uses of the Mar Menor lagoon.
- Negative effects on other economic sectors such as tourism (Tourism quality).
- Positive effect because people like to see the irrigated crops of Campo de Cartagena.
- There is no effect.
- Others. Which one?

Q11. Do you think that the entry of nutrients into the Mar Menor lagoon should be limited?

- Yes. (In this case, answer question 12).
- No.

Q12. What measures would you use to limit the entry of nutrients into the Mar Menor lagoon? Order them from 1 to 9 in order of importance without repeating the assessments, with 1 being the most important measure and 9 the least important. Enter 0 for that activity that you DO NOT want done.

- Q12_1. Reduce the irrigated area.
- Q12_2. Elimination of irregular uptake of groundwater.
- Q12_3. Require that each desalinator includes a brine treatment.
- Q12_4 Establish and monitor the application of maximum values of fertilizer contribution.
- Q12_5 Collect the brines and pour them into the Mediterranean Sea.
- Q12_6. Collect the brines and part of the flows of the waters of the ramblas and after its dislocation, pour its reject flows into the Mediterranean Sea.
- Q12_7 Build a green filter to treat the flow of the Albujón watercourse ("rambla").
- Q12_8 Apply natural measures of water and nutrient retention at plot scale and in the basin as a whole (example: green hedges, small ponds, etc.).
- Q12_9 Recover and enhance the lost surface of natural wetland in the periphery of the lagoon.
- Q12_10 Other. Which one?

Block III: Water resources

Q13. Indicate what is the economic activity in the Mar Menor and its basin that requires more water. Order from 1 to 3, with 1 being the one that requires more water and 3 requiring less water.

- Agriculture.
- Urban tourist consumption.
- Industry.

Q14. Do you think that the water quality of the lagoon is good?

- Yes, the water quality is good.
- Yes, water quality is good despite specific episodes of pollution.
- No, the water quality in the lagoon is no longer good.

Q15. What do you think is the main cause of water pollution in the Mar Menor lagoon? Order from 1 to 3 in order of importance, with 1 being the most important and 3 the least important.

Local perceptions regarding a social–ecological system of the...

- Q15_1. Discharges spills.
- Q15_2 Discharges of agriculture.
- Q15_3. Discharges of urban-tourist wastewater.
- Q15_4. None of the discharges is relevant.

Q16. Who do you think is the main responsible with regard to water pollution by nutrients in the Mar Menor lagoon? Check ONE option.

- Many of the farmers with little responsible use of fertilizers.
- The autonomous public administration (Ministry of water, agriculture and environment) and state (Segura Hydrographic Confederation), for its insufficient control and monitoring of agricultural activity in general, and the uses of water.
- Agricultural technical advisors for their insufficient involvement or training in low-impact agricultural techniques (for example, in organic farming techniques, etc.).
- Others. Which one?

Q17. What would be the main problems caused by the loss of water quality in the lagoon? Order them from 1 to 5 in order of importance without repeating the assessments, with 1 being the most important and 5 the least important. Put 0 with the option you do not agree with.

- The loss of quality of bathing water (cloudy water, etc.).
- The loss of species and habitat most characteristic of the Mar Menor.
- Impacts on tourism quality and the image of the Mar Menor, with the arrival of fewer visitors.
- Changes and reduction of the fishing catch of usual species of the Mar Menor.
- Problem of legal breach at regional, state and European level.
- No additional problems generated by the loss of water quality.

Q18. Do you think that climate change can improve or worsen the state of the lagoon?

- Yes, climate change can make it worse.
- Yes, climate change can improve it.
- I do not think it affects.

Q19. What measures would be applied to improve the water quality status in the Mar Menor lagoon? Check ONE option.

- Eliminate or reduce the entry of nutrients from the basin.
- Expand communication channels with the Mediterranean.
- Apply direct intervention measures within the lagoon (supply of oxygen, promote filtering species in the lagoon, etc.).
- I would not apply any measure.
- Others. Which one?

Block IV: Environmental values and ecosystem services of the Mar Menor lagoon

Q20. Do you think that the Mar Menor lagoon has relevant environmental values and ecosystem services?

- Yes. (In this case, answer question 21).
- No.

Q21. What are the most relevant environmental values and ecosystem services of the Mar Menor lagoon? Order them from 1 to 4, without repeating the assessments, with 1 being the most important and 4 the least important. Enter 0 with the option that you do not agree with.

Q21_1. Fishing Production.

Q21_2 Biodiversity conservation of the lagoon and the surrounding wetlands.

Q21_3 Sports/recreational activities healthy, tourist and leisure.

Q21_4 Cultural identity and quality of life.

Q21_5 Others. Which one?

Q22. Do you think that the environmental values and ecosystem services of the Mar Menor lagoon are threatened?

Yes. (In this case, answer question 23).

No.

Q23. Which of these environmental values and ecosystem services are most threatened? Order them from 1 to 4, without repeating the assessments, with 1 being the most threatened service and 4 the least threatened service. Enter 0 with the option that you do not agree with.

Q23_1. Fishing Production.

Q23_2 Biodiversity conservation of the lagoon and the surrounding wetlands.

Q23_3. Sports/recreational activities healthy, tourist and leisure.

Q23_4 Cultural identity and quality of life.

Q23_5 None of the values and services are threatened.

Q23_6. Others. Which one?

Block V: Respondent information

- How old are you? years.
- Gender: Male Female.
- What is your level of education?

Basic studies.

Secondary.

Professional training (FP, Modules).

University.

Postgraduate (Master, Doctorate).

- Place of habitual residence.
- If you live in the basin or surroundings of the Mar Menor, how long have you lived in the Mar Menor environment? Years.
- What is your current occupation and main economic activity?

Fishing.

Agriculture. If you are a farmer, do you have an irrigation system? Yes No.

Livestock.

Tourism: (Hotels and restaurants).

Tourism: (Services).

Industry.

- Construction.
- University student or other similar levels.
- Professor or researcher.
- Administration.
- Others. Which one?
- What relationship does it have with the Mar Menor and the surrounding wetlands?
 - Resident.
 - Regular visitor.
 - Sporadic Visitor.
 - No visitor.
- Do you participate in any association?
 - Association of sports activities.
 - Neighborhood association.
 - Social or cultural association.
 - Association related to the Environment.
 - I do not participate in any association.

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