



Socio-economic analysis and stakeholder involvement: Mussel-farming in the Gulf of Trieste



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ABSTRACT

Stakeholder engagement is a crucial component of the Ecosystem Approach to Aquaculture (EAA). However, stakeholder engagement is often hampered by problems that occur, for example, when the perceived benefits are low relative to the cost of participation or when there is a lack of trust among the stakeholder groups. The objective of this paper is to discuss the primary results of a coastal research project on mussel farming sustainability, focusing on (1) the key qualities of the interaction between the scientists and the mussel farmers and (2) the role of the funding institution. The primary results of the socio-economic analysis are presented. These results include objective data and information regarding the mussel farmers' perceptions of the problems and opportunities involved and the relevant environmental issues. A cooperative involvement was established with some of the stakeholders, and open bilateral meetings were held that allowed the participants to share ideas and results. Interviews and a survey were conducted to collect information directly from all of the mussel farmers. This approach made it possible to develop a 'common pool of knowledge' that the scientists and mussel farmers could share.

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1. Introduction

This paper focuses on the interactions between the scientists and stakeholder groups involved in the project SosteMiTS (Raccolta dati di base ed elaborazione di un modello di gestione ambientale per la molluschicoltura triestina [1]), which was funded by the local Regional Agency (RA). The project sought to assess the sustainability of mussel farming in the Gulf of Trieste (North Adriatic Sea, Italy) from a physical, environmental, ecological and social perspective. The System Approach Framework (SAF) proposed [2] and tested [3] in the EU SPICOSA project (Science and Policy Integration for Coastal Systems Assessment), was followed. More specifically, the SosteMiTS project examined the implementation of Marine Spatial Planning in the area and the willingness of the participants to constrain the possible expansion of this activity according to Ecosystem Based Management (EBM) paradigms.

In mussel farming, the animals feed on local natural resources, receiving no external or added food sources or medications. Therefore, the environmental impact of mussel farms on the water column and the underlying sediment is typically considered to be weaker than that of other aquaculture activities. However, several

adverse visual and ecological impacts can be identified. Some research has suggested that the mussel filtering process increases water transparency and water quality, that longline structures act as an artificial habitat that improves local biodiversity [4] and that such farming ensures healthy water quality because of the frequent mandatory environmental testing required of mussels consumed by humans. Other studies stress that the deposition of organic material and farming discharge negatively impact sediments [5], thus altering the structure of macrobenthic communities [6,7] and of the smaller benthic communities [8,9]. Furthermore, the selective removal of particles can have cascading effects on the entire marine food web, potentially harming other species. In other cases, however, mussel farming does not significantly alter the functioning or trophic states of the coastal marine ecosystem [10]. These impacts vary according to the characteristics of the local environment, as evidenced by two sites located in the Gulf of Trieste [11] and according to local management decisions.

The project assessed and quantified some of these aspects in the study area. The results showed no statistically significant impact on the concentration of dissolved compounds or on suspended material; however, they revealed a clear alteration in the composition of the upper sediment below the mussel farms [1]. Nevertheless, the results also indicated that the latter change could be reversed after farming had ended. The socio-economic dimensions of the issue were considered through the quantitative

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analysis of the data and information gathered. Moreover, the data were considered together with environmental and ecological factors using a hierarchy of computational models [1] and synthetic indicators of sustainability such as the Ecological Footprint [12] and the eMergy balance [13]. The emerging global picture has indicated that mussel farming is a green activity with a low and reversible impact. This outcome could be used as a marketing tool, as the scientific basis for an eco-label for this industry, and as a planning tool for future development in this sector.

Stakeholder engagement played an important role in the project. Stakeholders contributed reliable information that made it possible to assess the socio-economic dimensions of mussel farming and described revealing first-hand experiences with the productive cycle and its possible ecological impacts. This interaction furthered the dialog concerning scientific and environmental issues such as carbon sequestration, ecological footprints, quality labels, and EBM, thus improving reciprocal knowledge and understanding. More importantly, stakeholder involvement will play an even larger role in the future because stakeholder participation is a prerequisite for the successful implementation of an EBM [14–17]. However, researcher-stakeholder interaction in fishery and marine research is not a trivial or straightforward concern [18,19], as, among others, there is a risk that fishers' self-interest will compromise the validity of their input [20]. Moreover, the research project did not include the implementation of management processes that best encourage stakeholder engagement [21].

This paper presents the results of the socio-economic assessment of mussel farming, and focuses on how the interaction between the researchers and stakeholders evolved during the project in comparison with other experiences.

2. Materials and methods

2.1. Historical background

Bivalve farming in the Gulf of Trieste dates to the middle of the nineteenth century, when the Austrian Society of Fishery and Aquaculture, an organization with approximately 1500 members at that time, promoted the implementation of particular aquaculture practices for oyster farming and imported innovative technical solutions from French production sites [22]. After the decline of the natural banks that supplied the seed hatched by farmers, mussel farms progressively replaced oyster farms. By the middle of the twentieth century, mussel farming had become an important activity. Mussels (*M. galloprovincialis*) were traditionally harvested near the coast and were grown on wooden poles. In 1973, the local production was at its highest level (6000 t/year, 200 employment units) and a cholera outbreak occurred in Naples, 900 km from Trieste. This outbreak triggered the collapse of the mussel economy across Italy, including Trieste. When farming activities resumed, longline floating was used, which allowed farms to move further from the coast and into the deepest and cleanest waters [23]. Peak-level production and employment were re-established in 1990, with 7500 t of mussels produced annually and 198 workers employed [24]. However, production levels fell again at the end of the 1990s because of the presence of biotoxins and due to competition with foreign producers from Greece and Spain. Currently, mussel plants occupy approximately 200 ha along the coast, approximately 0.5 km from the coastline. Their presence does not prevent other tourist uses of the coast, but it alters the marine coastal landscape and partially impedes small boats from cruising.

At present, approximately 60 people are employed in mussel production in this area. They are organized into 16 small cooperatives, primarily family enterprises, and operate with 25 larger boats and 10 smaller boats for logistical support. Mussel farming is generally a family tradition, and the farmers typically have good

knowledge of the ecological processes that are in operation in the gulf and that influence mussel growth. Thirteen of the sixteen cooperatives are part of the local consortium of mussel farmers, COGIUMAR. A local Producers' Organization has not yet been formed, mainly due to the differing entrepreneurial choices of the mussel farmers. As is commonly observed in all of the primary sectors, including fisheries, a lack of cohesion among the producers has weakened their bargaining power with the wholesalers.

2.2. Stakeholder involvement and data collection

Scientist-stakeholder interaction was maintained throughout the project to determine the viewpoints of the stakeholders, share knowledge and improve the dissemination of the project results. Fig. 1 depicts the information flow to and from the project, with a particular focus on socioeconomic considerations and outputs. The dark gray boxes indicate the methods that the researcher used to interact with the mussel farmers and to access objective and subjective socioeconomic data. The main project outputs are listed on the right side of the figure. For this study, a formal participatory approach involving permanent forums and workshops was not established because, based on the first open meeting, it seemed that not many individuals were willing to participate in such forums. Direct, bilateral interaction was therefore preferred. In fact, some people were more communicative during the interviews than during the open meetings or preferred to talk with scientists individually. Iterative, ongoing communication was maintained throughout the project to permit progressive reflection on the ideas and results generated by the scientists and mussel farmers. The ultimate aim was to establish a cooperative relationship between these two groups based on the community science model [25,26].

2.2.1. Involvement in the Technical Scientific Committee (TSC)

The interaction between the scientists and mussel farmers was initiated at the start of the project, with bilateral meetings with major farming firms and invitations to stakeholders asking them to participate in the TSC. The TSC was ultimately comprised of two scientists, two foreign experts and two mussel farmer representatives (TSCReps), who were appointed by the president of the consortium. In addition to having an educational background in natural science at the university level, these representatives were farmers; thus, they possessed both field knowledge and practitioner expertise. They were also recognized leaders among the farmers. The original working plan was discussed within the TSC and was partially modified to incorporate portions of the farmer representatives' proposals. The TSCReps were invited to the mid-term and final scientific workshops and had the opportunity to comment on the technical report and the dissemination materials prior to their publication.

2.2.2. Open meetings and dissemination

During the first month, the project was presented to the public at an initial meeting, to which individuals and institutions with a stake in mussel farming were invited (i.e., local authorities, funding agency representatives, the local environmental protection agency and other stakeholders, including representatives of artisanal fishermen, sailors cooperatives, the local World Wildlife Fund (WWF) section, marine scientists not involved in the project and the local chamber of commerce). After the presentation, the floor was opened for discussion, feedbacks and suggestions. A second open meeting was held at the end of the project to present and openly discuss the project results. All of the information gathered, together with the information obtained from the other components of the project (Fig. 1), was integrated, analyzed,

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