Ocean & Coastal Management 118 (2015) 247–258

Contents lists available at ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Effective mussel-farming governance in Greece: Testing the guidelines through models, to evaluate sustainable management alternatives

Zoi I. Konstantinou*, Katerina Kombiadou, Yannis N. Krestenitis

Department of Civil Engineering, School of Engineering, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece

ARTICLE INFO

Article history:
Received 31 January 2015
Received in revised form
9 April 2015
Accepted 5 May 2015
Available online 19 June 2015

Keywords:
Governance
Mussel farming
Spatial planning
Management tools

ABSTRACT

The last twenty five years multiple management issues concerning the suspended farming of filter feeding bivalves in Greece have emerged from the deficient implementation of different legislation regimes, that, on their own account, have been proven insufficient. Specifically, regarding the planning and management of cultivation areas, multiple alternatives have been proposed through the years, with some still being under consideration. Yet most of them were selected based on purely spatial criteria and none has been thoroughly investigated, regarding the system's carrying capacity. As the current governance structure, in combination with the previous and current legal framework, seems unable to solve the existing problems, a question arises: are the "legal" solutions the optimum —or even among the best- regarding the environmental and socio-economic sustainability of the coastal aquaculture in the areas under consideration? In this paper we attempt a discussion between science and management, regarding the 3 main mussel-farming areas of Thermaikos gulf, Greece: Chalastra, Imathia and Pieria. The tools that were designed in the context of integration between science and policy are used in order to investigate the appropriate structure and flexibility of the legal framework controlling the activity and the governance level in which this control should take place. Previous and ongoing research results from combined management models, implemented or developed, for the mussel-farming areas of Thermaikos gulf are the starting point of this discussion. The goal is to detect "weak spots" of the current legal framework and to investigate if and how scientific management tools can assist in the development of more flexible, yet more effective environmental legislation.

1. Introduction

When discussing the term "integrated management" of coastal and marine activities, it is anticipated that, at some point, the discussion will have to involve: (a) the level of governance in which essential management decisions are taken and (b) the governance tools used to implement these decisions, i.e. the various forms of legal instruments. These instruments may vary significantly both in power and in spatial and temporal coverage. The obvious goal of any management attempt is to create the necessary legal means that will allow the flexible, yet coherent, coastal and marine management, in an integrative and sustainable context. Although obvious, this goal is much easier conceived in theory than realized in everyday practice. As various researchers point out, the international differences in the structural characteristics of governance and the associated cultural divergences, among other things, can lead otherwise good and effective practices to complete failure (McKeena and Cooper, 2006).

In Greece, 90% of the suspended bivalve farming activity of the Mediterranean mussel, *Mytilus galloprovincialis*, takes place in Thermaikos gulf, in the northern part of the country, in 3 main cultivation territories, as presented in Fig. 1: Chalastra (east area), Imathia (central area) and Pieria (west cluster of areas). Although the activity was very promising in both qualitative and quantitative terms of productive capacity, it is, nowadays, facing major organisational and operational problems, nested mainly in the obstacles created by the endogenous weaknesses and generalizations of the legal tools, as well as from the time-consuming manner in which governance is implemented in the sector (Konstantinou et al., 2012). The issue is multidimensional and complex; some of its aspects have been discussed in previous works (Konstantinou et al., 2012; Konstantinou and Krestenitis,

* Corresponding author.
E-mail address: zkon@civil.auth.gr (Z.I. Konstantinou).

http://dx.doi.org/10.1016/j.ocecoaman.2015.05.011
0964-5691/

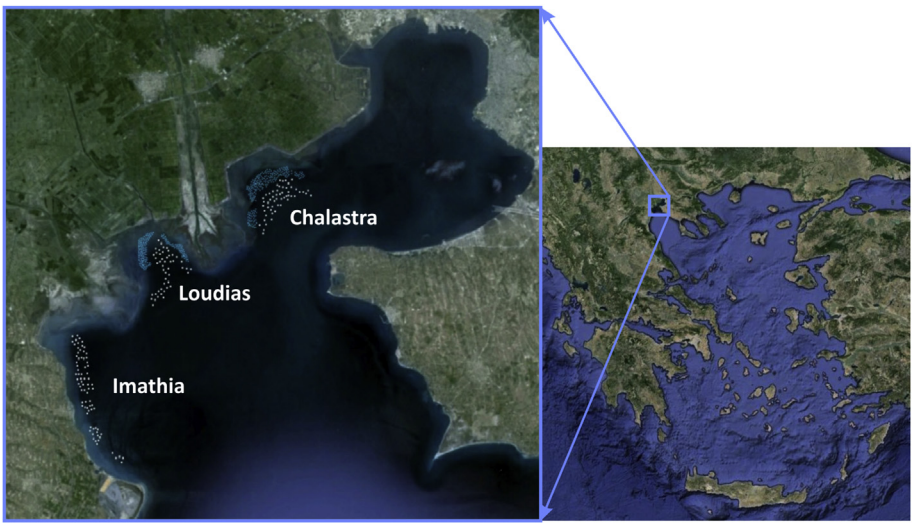

Fig. 1. The location of the major mussel-farming areas in Greece, where approximately 90% of the national *Mytilus galloprovincialis* production is cultivated.

2012, 2013; Konstantinou, 2013). In this paper, we initiate a discussion focusing on the possible modifications that could be made in the governance and legal framework of mussel-culture in Greece, by providing means of management alternatives' evaluation, both for the local policy-makers and the stakeholders, through the use of modelling tools.

The modelling tools used to support our argument take into account: a) the cultivation attributes of every individual mussel-farm and b) the spatial-planning alternatives in the 3 major Greek mussel-farming areas, by focusing mainly in the hydrodynamic circulation and its importance for the activity. Water circulation is of paramount importance for mussel (and bivalve) culture in general. The farm establishments should be placed in areas protected from strong water currents (Baluyut, 1989) both to protect the structure of the farm and to enable viable filtration conditions for the organisms. Yet, water circulation still has to be sufficient, so as to transfer oxygen and food (phytoplankton, suspended matter) to the cultivated organisms (Inglis et al., 2000). Additionally, water circulation can have impact on the deposition of mussel-farming waste at the benthic area beneath the establishments, affecting the vertical concentration of oxygen, the resuspension of organic matter and nutrients, etc. Last but not least, water circulation significantly influences the flushing time of the farming areas, affecting, among other things, the faster recovery from pollution and contamination episodes (Koukaras and Nikolaidis, 2004).

Yet, the use of hydrodynamic circulation as key management parameter is only a stepping-stone: our main goal is to highlight key-aspects for sustainable management, the most significant being the need to create and utilize a bond between science and governance, in order to fully take advantage of scientific findings to enhance policy-making. And although the results presented refer to a relatively small area of interest, they can be added to the rather long and promising list of research efforts, underlining the fact that science can be a strong support mechanism for the development of flexible, innovative, efficient and sustainable management and thus policy-making (Ballé-Béganton et al., 2010; Canu et al., 2011; Caroppo et al., 2012; Dinesen et al., 2011; Engelen, 2004; Guimarães et al., 2012; Hopkins et al., 2012; Mongruel et al., 2011; Pahl-Wostl, 2007; SMP, 2005; Stojanovic et al., 2004; Tett et al., 2011; Westmacott, 2001; Worrapimphong et al., 2010).

2. Materials and methods

2.1. Legal and institutional framework analysis

The Greek legal enactments, directly or indirectly related to the mussel-farming activity, are well over 20, covering issues such as the minimum accepted water quality for bivalve cultivation, public safety hygiene protocols, the appropriate procedures for licensing, etc. The discussion regarding the form and utilization of those legal enactments is a matter requiring individual analysis; our interest here falls in those legal guidelines controlling parameters of instrumental management of the mussel-farming activity. The relevant parameters are the type of cultivation establishments (long-line and pole), the cultivation attributes used in each of them (total farming area, number of and distance between the long-lines, number of and distance between the cultivation socks, etc.) and the relevant placement (i.e. spatial planning) of these mussel-farms in the available space. These parameters can be altered relatively easily and are affecting the qualitative and quantitative performance of the activity, both in individual farm and in farming area scale. Thus they are crucial management tools in an effort to achieve optimum results in what concerns mussel production, good environmental status, economic efficiency and social equity (Konstantinou, 2013). The legal enactments relevant to those parameters are the *Common Encyclical for the regulation of issues relevant to aquaculture farms* (C.E. 121570/1866/2009) and the Ministerial Decision regarding the national special framework for spatial planning and sustainable development of aquaculture (M.D. 31722/2505/2011), which, among other aspects, determines the areas in which Organised Areas of Aquaculture Development (OAAD) will be created. These two legal instruments have different power: the Common Encyclical can be easily altered through collaboration between the responsible managing authorities (overlooking Ministry, regional and local Fisheries Directorates), whereas the Ministerial Decision is the result of years (more than 10) of deliberation and negotiation between different Ministries, with related high-level planning, and any changes require similar time- and money-consuming procedures.

According to the C.E. 121570/1866/2009, two types of farming establishments are allowed in Greek mussel-farming activity: (a) the main, modern, long-line cultivation system, used in areas where the water depth is over 6 m and (b) the traditional pole