



## LEARNING FROM THE ADMINISTRATION 'BOTTLENECKS' AFFECTING SUSTAINABLE EXPLOITATION OF LAGOONS FOR AQUACULTURE

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### Abstract

The administration process and 'bottlenecks' in sustainable management of lagoons was studied based on face-to-face interviews and plenary workshop participatory methods. The consensus between stakeholders in relation to the main issues that affect negatively the sustainable management of lagoons fall into 8 categories: climate change, freshwater supply and management, accidental or intentional disposal of industrial by-products, illegal fishing, fisher behavior, inefficient legal framework, lack of funds and sciences/research. The identification of the main issues and especially the identification of the main stakeholder responsible for this issue and the identification of the stakeholder responsible to solve the issue as well as the identification of which issues are solvable and which are not, are of paramount importance for the first step towards sustainable lagoon management.

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### 1. Introduction

Coastal brackish lagoons are important ecosystems supporting several services such as recreation/aesthetic, cultural, carbon sequestration, flood prevention, nutrient sinking and cycling, migratory bird protection and others (Davoudi et al., 2016; Ressurreição et al., 2012). Among those services, aquaculture (food supply service) is more prominent since it can directly affect the welfare of the local population providing income and jobs. Their formation and evolution was the result of interrelated natural, economic, political, cultural and economic processes (Davoudi et al., 2016). Traditional extensive lagoon aquaculture is practiced in many European regions and in particular in the Mediterranean using extensive and semi-intensive methods ([https://ec.europa.eu/fisheries/cfp/aquaculture/aquaculture\\_methods\\_en](https://ec.europa.eu/fisheries/cfp/aquaculture/aquaculture_methods_en)). The high human population concentration along the coastal zones and the large variety of economic activities, create a complex environment from the administration and management point of view. This complexity combined with the different administration procedures and authority distribution among managers and stakeholders, affect negatively the outcome of many or all sustainable management attempts in order to maintain and enhance aquaculture production. These constitute important pressures today to the lagoons and adjacent coastal areas causing the loss of habitats and the acceleration of crucial processes for their sustainability (for example, erosion; Davoudi et al., 2016; Meiner and Reker, 2013).

In Greece, lagoon aquaculture is practiced by fisher cooperatives who lease the lagoons from the government (central or local). Fishery production is based on the extensive method either by exploiting the natural annual repopulation of the lagoons due to the inland migration of various species at the juvenile stage or with the application of stock enhancement practices using fish fry (mainly gilthead seabream and European sea bass) purchased from local private hatcheries. The aim of this paper is to present and discuss administration process and management procedural 'bottlenecks' which affect the sustainable exploitation of lagoons using as case study, the Western Greece lagoons.

### 2. Materials and Methods

Data were collected from various stakeholder groups using face-to-face interviews and plenary workshops in the region of Epirus, Western Greece. The stakeholders, which participated, were: several scientists from local tech Institutes and Universities, three fisheries administrators of the local Prefectures, two local protected area authority and two local environmental NGOs. The purpose of the plenary sessions was to gain consensus on the identification and responsibilities regarding the administration issues, problems and 'bottlenecks' in local lagoon management.

### 3. Results and Discussion

The main issues, processes and risks, which affect the sustainable management of the lagoons, are:

a. *Climate change - sea level rise and coastal erosion.* This is a global human induced phenomenon which is expected to overcome the natural or man-made separations between open and lagoon waters. This will result to the loss of natural aquaculture space and the further intrusion of seawater in the underground freshwater resources of the adjacent areas. There is an obvious lack of funds to create the appropriate works to prevent this



and lack of consideration of sea level rise for the ongoing public works for the maintenance of the lagoon barriers. On the other hand, until today there are no signs of effects of this phenomenon in the region.

b. *Freshwater supply management and quality.* Public works during the last decades to support the local intensive irrigation and drainage agriculture system resulted to the partial or full isolation of the lagoons from freshwater, causing the increase of temperature and salinity of the lagoon waters during the dry season. In addition, most of the rivers in the area are enriched with agriculture chemicals and livestock production by products, which partially flow into the lagoons altering water quality and reducing substantially the space available for aquaculture close to the gates between the lagoon and the open sea. There is no control of the freshwater input (in terms of amount and quality) to the lagoons due to (a) the works carried out by the fisher who rent the lagoons, (b) actions taken by illegal fishers who break the barriers to concentrate the fish, (c) uncontrolled water abstraction for agriculture and (d) the livestock farms operating on the banks of the local rivers without waste management facilities. Finally, an important issue is the operation of hydroelectric power plants upstream the main rivers which supply the coast and the lagoons with freshwater. The control of water flow from these plants during the year, in some cases either almost drains the riverbed or creates floods downstream.

c. *Accidental or intentional disposal of industrial by-products.* There have been cases of accidental or intentional disposal of fruit juice and olive oil by-products into land channels, which reached the sea through the local rivers and torrents. Eventhough local police and coast guard acted immediately, the damage to the ecosystem of the local gulfs and the lagoons was not prevented.

d. *Illegal fishing.* Many illegal fishing cases have been recorded in the area. The damages to the local fisher cooperatives who rent the lagoons cannot be readily estimated but are expected to be high since these fishers often purchase and enrich the lagoons with fish fry purchased from local private hatcheries (mainly gilthead seabream). Also there are damages to local populations of protected species and especially eels which are considered as protected species and their marketing is strictly managed under EU and national laws.

e. *Fisher behaviour.* The nature of the fisher profession as well as the legal framework for the operation of the cooperatives create alienation behaviors. The fishers seem not to trust the system and this is a problem created by the administration and the scientific community due to exclusion strategies in decision-making and management process. In addition, there seems to be different ways of thinking and perceiving the fisherman profession even among fishers from the same area (even village) in relation to the possibilities in supplementing income through other activities (for example fishing tourism, fishermen wives cooperatives etc.).

f. *Inefficient legal framework.* The existent legal framework for the operation of fisher cooperatives and the operation of the local management authorities is not adequate to allow the proper management of the lagoons. From the point of view of the management authorities, their legal framework renders them as only an advisory body instead of a management body with full authority over the wetlands. From the point of view of fisher cooperatives, the recent EU and national legislation on the marketing of eels (a primary and lucrative product of lagoons) was an important blow to their performance.

g. *Lack of funds.* The general lack of funds - not only associated with the recent crisis but also before - together with the reduction of the annual production and constant requirement of enrichments as well as the market competition of lagoon products with other fishery products and the low prices fetched, hinder the operation of the cooperatives and especially their capacity to cover the cost for works which could be beneficial for the lagoons. In addition, the funds for fishing infrastructure are not enough (for example, modern warehouses, ice machines, freezers, fishery products packaging etc.). Further to this issue an attempt to install a permanent monitoring system using telemetry data buoys was made several years ago, which is now non-operational due to the lack of funds for maintenance.

h. *Science and research.* Stakeholders question (a) the suitability of the studies carried out so far towards the understanding of the lagoon system, (b) the participation of local stakeholders in such studies which is minimal or non-existent, (c) the ability of the local management authority to remedy this situation and (d) at what extent the local management authority is able to exploit all these studies - a twofold issue: (a) the capacity of the staff and (b) the quality of the study.

## Conclusion

Stakeholder participatory methods applied in Western Greece lagoons identified 8 different groups of issues which hinder the sustainable management of lagoons and coastal areas and together, hinder the development of economic activities as aquaculture. Eventhough the consensus in the identification of the existing issues and the attribution of responsibilities to the group responsible for the issue and the group responsible for the resolution of the issue is clearly the first step towards sustainable management based on proper participatory foundations, it is our belief that progress has been very slow. At the same time, timing is of great essence due to the fact that uncertainty and unpredictability are 2 concepts which are apparent today more than ever in relation to environmental management (example, climate change; Davoudi et al., 2012). The magnitude of these literally basic issues, as identified above, indicate long-term mismanagement affecting the resilience of these sensitive ecosystems. From the scientific point of view, it can be considered that a lot of time of indifference and neglect has passed, when we should be discussing about ecosystem resilience, special context and scale, spatial and



temporal interaction between coast and adjacent areas and the conservation of ecosystem services which should be already quantified (Cumming and Allen, 2017). Such issues have been recognized internationally since the early 70s (Holling, 1973). Furthermore, we should have already advance our perception of protected areas and ecosystems and to regard them as social-ecological systems (term: linked systems of people and nature, emphasizing that humans should be considered as part or not part of nature; Berkes and Folke, 1998).

### Acknowledgements

The analysis presented in this paper was carried out within the HORIZON2020 project entitled "MEDAID - Mediterranean Aquaculture Integrated Development", grant agreement 727315 funded by the European Commission as Research and Innovation Action under the call SFS-23-2016 (Coordinator: Mediterranean Agronomic Institute of Zaragoza, International Centre for Advanced Mediterranean Agronomic Studies, Spain with 34 partners).

### References

- Berkes, F., Folke, C., 1998. Linking sociological and ecological systems: management practices and social mechanisms for building resilience. Cambridge University Press, New York, USA, 476 pp.
- Cumming, G.S., Allen, C.R., 2017. Protected areas as social-ecological systems: Perspectives from resilience and social-ecological systems theory. *Ecol. Appl.* 27, 1709–1717. <https://doi.org/10.1002/eap.1584>
- Davoudi, S., Shaw, K., Haider, L.J., Quinlan, A.E., Peterson, G.D., Wilkinson, C., Fünfgeld, H., McEvoy, D., Porter, L., 2012. Resilience: A Bridging Concept or a Dead End? “Reframing” Resilience: Challenges for Planning Theory and Practice Interacting Traps: Resilience Assessment of a Pasture Management System in Northern Afghanistan Urban Resilience: What Does it Mean in Planni. *Plan. Theory Pract.* 13(2), 299–333. <https://doi.org/10.1080/14649357.2012.677124>
- Davoudi, S., Zaucha, J., Brooks, E., 2016. Evolutionary Resilience and Complex Lagoon Systems. *Integr. Environ. Assess. Manag.* 12, 711–718. <https://doi.org/10.1002/ieam.1823>
- Holling, C.S., 1973. Resilience of ecological systems. *Annu. Rev. Ecol. Syst.* 4, 1–23. <https://doi.org/10.1146/annurev.es.04.110173.000245>
- Meiner, A., Reker, J., 2013. Balancing the future of Europe’s coasts-knowledge base for integrated management. (O’Doherty, J.J. Ed.), EEA Report 12/2013, European Environment Agency, Luxembourg, 68 pp.
- Ressurreição, A., Gibbons, J., Kaiser, M., Ponce, T., Zarzycki, T., Bentley, C., Austen, M., Burdon, D., Atkins, J., Santos, R.S., Edwards-jones, G., 2012. Different cultures, different values: the role of cultural variation in public’s WTP for marine species conservation. *Biol. Conserv.* 145, 148–159. <https://doi.org/10.1016/j.biocon.2011.10.026>