Project ARIEL: *Promoting small scale fisheries and aquaculture transnational networking in Adriatic –Ionian macroregion*

Training cycle

Act. 3.2. Training and Capacity Building

Theme: Spatial conflicts and co-management tools

Utilization of GIS and decision-making methods to support interactive zoning for marine aquaculture

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Background

A worrying decrease in capture fisheries underscores the importance of aquaculture production to address the issue of global food security. Aquaculture is recognised as an important food production sector that is contributing global economy, and more specifically to increase employment opportunities through economic growth in the coastal areas. Finding suitable space for aquaculture is probably the most essential factor that determines the economic, social and environmental viability of an aquaculture project. The competition for the space in the coastal area has become one of the most important factors determining sustainable development of any coastal activities. Such an environmental pressure can make the process of site selection and site management for aquaculture quite tough, because of its high dependency on ecosystem good health. The secret to success lies in an integrated approach that will optimize zoning for aquaculture, improve the public acceptance of aquaculture product contributing both global economy and rural development (Bostock et al. 2016). . By adopting tools such as the Ecosystem Approach to Aquaculture (EAA), and Marine Spatial Planning (MSP) it is expected to improve the environmental and social sustainability of the sector in question. Following an integrated based principles in planning future aquaculture development, and respecting the interest of all stakeholders may mitigate conflicts among users, increase synergy, improve the public perception of aquaculture, and facilitate the sustainable expansion of the industry. A test case in assessing suitability of an area for marine aquaculture is demonstrated by applying an interactive computer-based tools.

GIS-based Decison Support System (DSS)

GIS and related models could be used to identify suitable sites for aquaculture development following the Ecosystem Approach principles and could provide a framework for monitoring aquaculture activities. It is a computer-based system for capturing, storing, checking, integrating, manipulating, analysing and displaying relevant data. These might be represented as several different layers where each layer holds data about a particular kind of feature. Because of its ability to integrate information, GIS is used to characterize and decide on the selection of potentially suitable areas for different sectoral activities. In selecting potential aquaculture cage farming areas, multi-criterion analysis (VKA) is an indispensable tool.

The first step is an "interactive database in GIS format". It is necessary to design a "GIS project" that is composed of thematic layers from the Spatial Plan of Local Self-Government (e.g. County), i.e. planning documentation of municipalities and cities and other accessible public spatial databases data. Main

biophysical factors to be considered includes depth profile, exposure to prevailing winds, fetch maximum wave height, currents, substrate data, conflicting uses in the area like marine traffic corridors, protected nature, etc. (Fig. 1). All these information presented in GIS format should be intersected as layers to be confronted to the pre-set suitability criteria for marine aquaculture zoning. Such a GIS-based approach to MCA in the first stage resulted with elimination of unsuitable zones, remaining with the zones to be further examined.

The second phase is more complex. GIS is used to collect as much as possible input data on the all potentially suitable zones for marine aquaculture (Fig. 1).

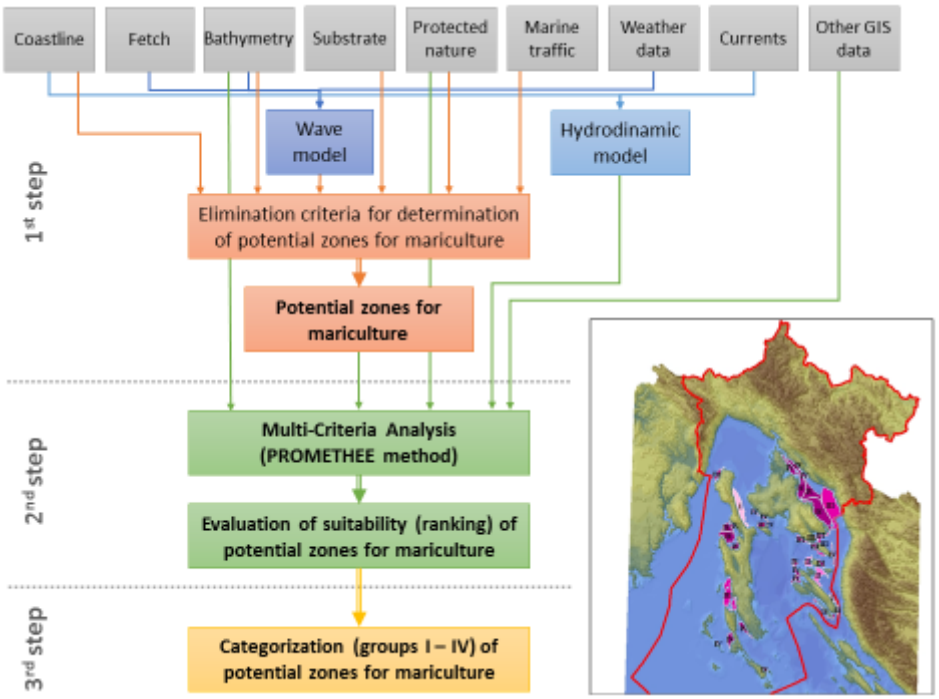

Figure 1. Diagram showing the procedure for assessing the suitability of the Aquaculture Zone

Input data represent evaluation of each potential zone for marine aquaculture, on each criterion. Therefore, some of the information are spatial data (potential for expansion, acceptability to the site, maritime characteristics, infrastructure, etc.), and some of the data are of non-spatial nature (socio-economic, environmental, and governance objectives) although they are also some-how connected with some spatial attributes. Definition of criteria may include broad number of issues like criterion objective (minimization or maximization), criterion parameters, and criterion weight (different weights or ponders for different criteria). In solving all these rather complex relationships, the PROMETHEE method (Brans et al., 1984) is helpful to evaluate and rank potential zones for marine aquaculture (Fig. 2). In performing MCA method for aquaculture, zoning four groups of criteria representing economic, technical, social and environmental aspects should be considered.

The third stage is the interpretation of results in GIS format. By using GAIA (Geometrical Analysis for Interactive Aid), it is possible to get numerical results and graphs that help the "decision-maker" to more realistically see the problem and gain a more complete insight into the relationship between the criteria and the activities.

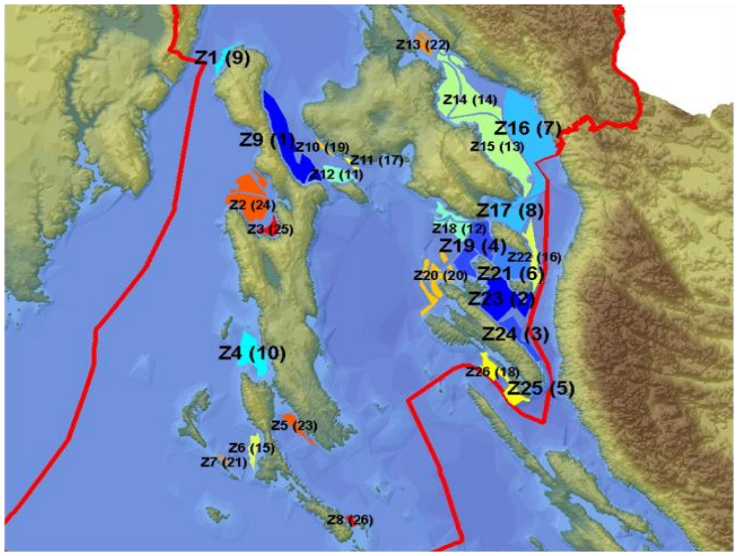

Figure 2. Results of two-stage Multi-Criteria Analysis: potential zones for marine cage aquaculture evaluated and ranked (rank of each zone is presented in the brackets).

Discussion and Conclusion

Just a systematic approach and multicriteria analysis allow to the decision-making process incorporate all existing and potential users of the area (space) to be analyzed. Otherwise, as the practice has shown, the proposed solutions could cause more difficulties and problems than it in its basic setting solved. Due to the extreme complexity of an aquatic system, it is very important to identify all connections between components of the system and the interactions of this and other systems (social, economic, environmental), and define possible solutions for the verification of the existing sites, and of course for new investment into infrastructure and physical facilities.

The presentation demonstrates how an interactive computer-based system can be applied in the process of effective use of all kind of data and models in finding space for aquaculture in a respective area. GIS based MCA has been integrated into decision-making process as to identify and solve problems and make decisions (Power et al, 2011). An effective use of all kind of data, documents and/or models in evaluating clear potentialities for marine aquaculture would not be possible without such computational technology. Although such an approach has focused on cage finfish farming, it can be easily applied to shellfish and other types of aquaculture. The similar process may be applicable and reproducible in other sectors and variety of coastal scenarios that are linked to specific biophysical, socioeconomically and cultural particularities.

References

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