

# OS Aqua

## Open Sea Aquaculture in the Eastern Mediterranean

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Ευρωπαϊκή Ένωση  
Ευρωπαϊκό Ταμείο  
Περιφερειακής Ανάπτυξης



Κυπριακή Δημοκρατία



Διαρθρωτικά Ταμεία  
της Ευρωπαϊκής Ένωσης στην Κύπρο

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## Executive Summary

The purpose of this document is to provide guidance on the various stages that the project needs to reach towards its main goal of providing a roadmap for the development of open sea aquaculture in the Eastern Mediterranean. In this document it is explained that to achieve the main goal, the complex problem of marine spatial planning and the difficulties of assessing the social, economic, financial, and environmental feasibility and sustainability must be solved. To solve such a complex problem that includes multiple interconnected aspects, associated with high risk, a principled approach must be followed that is based on logical steps. These steps break down the problem into manageable tasks, gradually eliminating options as informative decisions are made, and refining the choices made as more evidence is sought and acquired. The various tasks are associated with Milestones. Milestones serve as indicators on how the project advances.

This document takes a further step to justify the selection of the Milestones based on the principled approach. Furthermore, the document provides an assessment of the quality of the events leading up to the achievement of Milestones. This assessment is important, as the events, that include a collection of efforts by the partners in the consortium and external entities, need to be based on scientific reasoning and include all relevant social, financial, technological, and environmental aspects.

Finally, the List of Milestones that has been extended to include justification and qualification, provides an indispensable tool for consultation within the partners, allowing the determination of the course of action at every step of the progress of the project, and a conflict resolution instrument in the case of opposing opinions. Therefore, this document will ensure the effective progress of the project and the quality of its outcomes.



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## 1 Introduction

This document outlines the Milestones, selected in the early stages of the project. The Milestones provide significant achievements that serve the progress of the project towards its intended goals. The project deals with the complex problem of selecting candidate areas for aquaculture and assessing the suitability of each candidate area. The complexity is due to the fact that a) numerous factors influence both the selection of candidate areas and the suitability of the candidate area and b) the decision is based on an incomplete set of data from heterogeneous sources. The problem to be solved has, therefore, more than one possible solution, each associated with a degree of correctness and a risk of miscalculation. The risk of making an erroneous decision on the location of candidate areas, the carrying capacity, the level of investment required, and the impact on the natural environment can prove costly or catastrophic affecting the society, economy, and the natural environment.

Therefore, the complexity of the problem and the high cost associated with any error, requires the set-up of a rigorous approach of a) identifying sources of information, b) data and information collection, c) decision, and d) elimination of possibilities based on the current information, f) repetition of the previous steps where each step is refined and executed in more detail and extent, leaving fewer, higher quality, options to investigate. The elimination step followed by a repetition of the steps mentioned is essential to limit the extensive search space of options for aquaculture that include location, conflict with human and natural environment activity, financial, and technological aspects.

The Milestones are essential tools for identifying the completion of the tasks and assessing the quality of each outcome that results from each step of the decision-making process described above. In this document, the selection of Milestones is justified based on the logical sequence of the steps provided above. Additionally, the qualifications required from each Milestone, that provide guidance on the assessment of the result marked by the Milestone, are outlined and explained.

## 2 Milestone Selection Process

The milestones were determined based on the work plan described in the project contract, in association with the various tasks and the guidelines in [1]. The selection of candidate AZAs is essential to the project progress. Any study on the carrying capacity, social, environmental, economic, and legal aspects, and availability of technology to be used for OS Aqua stations, depend on the availability of locations that could possibly host OS Aqua stations. Such locations should not cause conflicts with other activities nor negatively impact the natural environment. These candidate locations will result in an initial list of possible locations that will further be refined based on factors that include technological and financial feasibility.

Therefore, the milestones that arrive earlier in time relate to the initial selection of areas based on environmental parameters, the legal framework, and irreconcilable conflicts with existing or planned activities. In other words, the most prominent exclusion criteria for candidate areas are first taken into consideration. Milestones are further enriched and extended to cover the project duration, based on further detailed data collection and analysis related to the initially selected areas with the goal to refine the areas selected and move on to provide assurances on the environmental impact and technological feasibility, and financial sustainability and profitability.

Each milestone is accompanied by the justification of selecting the milestone and with quality indicators that assess the impact of the reached milestone on the project's progress. A justification and qualification should necessarily accompany the selection of the Milestones, as Milestones expressed without these two qualities do not guarantee the progress of the project nor the quality of its outcome. For example, the "initial selection of candidate areas for open sea aquaculture" appears as a good selection for a Milestone. The justification is that this milestone enables future steps of a more detailed analysis of candidate areas and a further selection of the most suitable areas. However, a definition of the qualification for the candidate areas is also necessary. For example, a quality criterion that would promote the progress is that the initial selection of candidate areas should be based on environmental and socio-economic factors that are rigorously collected and interpreted. On the other hand, a random guess for candidate areas could still satisfy the Milestone, however, it would not provide a solid quality criterion and would have an adverse effect on the project progress. While some concepts, such as the example provided above, are easily identified and well accepted, it is expected that, during the course of the project, the complexity of the marine spatial planning problem will overwhelm experts with excess of information. Therefore, the enriched justified and qualified list of milestones will guide the consortium and steer efforts towards the correct course of action.

[1] Macias, J.C., Avila Zaragoza, P., Karakassis, I., Sanchez-Jerez, P., Massa, F., Fezzardi, D., Yücel Gier, G., Franičević, V., Borg, J.A., Chapela Pérez, R.M., Tomassetti, P., Angel, D.L., Marino, G., Nhhala, H., Hamza, H., Carmignac, C. & Fourdain, L. 2019. Allocated zones for aquaculture: a guide for the establishment of coastal zones dedicated to aquaculture in the Mediterranean and the Black Sea. General Fisheries Commission for the Mediterranean. Studies and Reviews. No 97. Rome, FAO. 90 pp.

### 3 List of Milestones, their Justification, and Qualification

The following list of milestones is provided without the timeline that is provided in the next section. Instead, the focus is placed on the justification for selecting each milestone as an important landmark in the progress of the project. Furthermore, a focus is placed on the qualification of the events leading up to the Milestone based on their relevance to the various tasks of the project and their influence on the quality of project's outcome. With the end-goal in mind, the events leading up to the Milestones and the Milestone sequence aim at the main outcome of providing an evidence-based roadmap for the establishment of an Open Sea Aquacultural industry in Cyprus that is acceptable and beneficial to all.

According to the approach outlined in the Introduction, the identification of the sources of information and data/information collection are the first steps to be taken prior to any informative decision. Data and information include marine environmental data, including data on marine life and oceanographic parameters, data on human maritime activities that may cause conflict with planned aquaculture activities, and information collected from stakeholder engagement.

However, it is recognized that a significant amount of time is required to collect all data and gather information from stakeholders. In fact, data and information collection and interpretation will continue throughout the project's duration as new sources of information are identified. Therefore, initial data and information collection will be used for the exclusion of some of the many options available for open sea aquaculture to limit the search space to a manageable size for further consideration.

#### **M1 Collection and representation of initial GIS data and stakeholder information on marine and maritime aspects**

This first milestone provides the essential information needed for preliminary identification of areas that can host open sea aquaculture. The areas will consider obvious exclusion criteria. For example, exclusion criteria may include areas hosting sensitive critical infrastructure, marine protected areas, shipping routes, shooting ranges, or any areas that may have a direct or indirect negative impact on the natural environment and, perhaps, national security. This information should be collected early in the project. Any other exclusion criteria that need to be identified through extensive stakeholder engagement, technological factors, financial data and projections will arrive later in the project and will be used for a refined selection. In fact, such in-depth collection and analysis cannot happen unless an initial exclusion of potential areas occurs, revealing which are the few candidate locations that appear to be feasible for aquaculture.

#### **M2 Preliminary Selection of suitable areas**

This Milestone is a natural consequence of achieving M1. It is, furthermore, a distinct milestone that represents the result of the consultation between the partners based on the initial information provided. The quality of this Milestone depends on the quality of the M1, and therefore, the quality of M1 should be strictly secured by the consortium.

This Milestone is essential to the following Milestones as it eliminates much of the search space, freeing consortium resources to deepen the understanding required to assess further areas.

### **M3 Refined selection of suitable areas for OS Aqua**

To reach this Milestone, the steps to be taken by the consortium are to collect more data and conduct more deliberation sessions with stakeholders. However, the greater collection of information to refine the selection of candidate areas will depend on the quality of the outcome marked by M2. This Milestone qualifies as a positive step towards the project goals if data and other information are collected from valid sources and in greater detail compared to previously collected information. Such information should be related to parameters affecting the choices to be made for open sea aquaculture development which are associated with the environment, for example, sea currents, possible conflicts with other activities, emerging from new data or information from stakeholders, and factors that are associated with financial aspects, such as distance from harbor facilities that are related to the cost of fuel for transport and maintenance. A refined, qualified selection of suitable areas will facilitate and positively influence the progress and quality of the following milestones.

### **M4 Initial estimation of carrying capacity of selected areas**

Following the completion of a refined selection of candidate areas, an initial estimation of the carrying capacity of the selected areas is conducted. The estimation of the carrying capacity is only initial as only the size of the candidate areas is available, while ocean and waste modelling that follows this Milestone will reveal the impact on the natural environment. The carrying capacity will be provided to the modeling team so that the following Milestone is achieved.

### **M5 Ocean and waste modeling and further assessment of candidate areas**

After determining suitable candidate areas and estimating their carrying capacity, the GIS tool is updated and upgraded to include specific areas that will be used for ocean and waste modeling. These areas should be small enough in size so that modeling can proceed at high resolution. The result of high-resolution modeling will determine the sea currents and waste dispersion characteristics of the selected candidate areas. The consortium will utilize these characteristics to possibly exclude candidate areas or rank them in terms of the impact on the seabed and water column.

### **M6 Onsite survey and data collection**

After the modeling is completed, the candidate areas will be possibly further reduced in number. Modeling has required the restriction of candidate areas so that areas can be modeled in greater resolution with computational and person month constraints. The onsite survey and data collection requires fieldwork that is also resource consuming and demands an ever more restricted number of areas of determined size. Moreover, the buoy available that will provide a testbed for ongoing monitoring can



only be deployed once. Therefore, this Milestone naturally follows the preceding Milestones and depends on their quality. Together with the modeling effort, the data collected provide sufficient evidence to start the phase of finalization of the selection of the various aspects of OS Aqua.

### **M7 Final definition of OS Aqua Zones**

This milestone will depend on all other Milestones and will utilize all past and ongoing information from stakeholder deliberation to define OS Aqua Zones. The consortium will, at this point, begin the preparation of completing the roadmap for open sea aquaculture and determine the steps for the finalization of technologies used, finfish species cultured, and legal and financial aspects.

### **M8 Finalization of OS Aqua station and mooring designs, and finfish species selection**

Equipped with the final selection of candidate areas together with all detailed information collected from the candidate areas, the work of selecting or designing the OS Aqua Stations, including cage and mooring, and selecting the suitable finfish species will be determined. The complexity of the steps leading up to the achievement of this Milestone depend on the similarity of the candidate areas selected. If candidate areas have similar environmental characteristics, then the designs can be finalized at this point. Other aspects that affect financial viability, such as proximity to harbor facilities, that may equally affect other possible designs. However, in case of candidate areas are found in significantly varying environments (for example west versus east of Cyprus with significantly different characteristics), then multiple scenarios of stations, mooring, and species may be envisioned. In that case, as a contingency, the consortium will produce a single station design for one of the areas, while existing designs offered in the market will be proposed in alternative investment scenarios in other areas. An estimation of CAPEX and OPEX that includes human or automated monitoring and maintenance will be provided as input to the financial considerations and the business plan.

### **M9 Finalization of the design of the OS Aqua Station and plan for environment ongoing monitoring**

Through stakeholder engagement, and specifically the interviews of technology providers and a survey for available technologies, a design for an OS Aqua Station (cage and mooring) will be completed and suitable ongoing monitoring systems will be selected. These systems will monitor the station (structural health, fish health, food waste), and the surrounding environment (waste dispersion, seabed state, conflict with other activities). The identification of these systems will provide an estimation of CAPEX and OPEX that will be included in the financial analysis and support the finalization of the business plan.

### **M10 Finalization of Business Plan**

The business plan will include input from all tasks executed in this project, providing information on areas and carrying capacities, types of finfish species, CAPEX and OPEX of OS Aqua Stations and monitoring systems, number of trips to harbor facilities, and many more aspects that affect financial feasibility. As mentioned, it may be necessary to provide more than one business plan in case candidate areas include areas with different characteristics and, consequently, require significantly different OS Aqua facilities, equipment, consumables, and operational characteristics.

## 4 Milestone Timeline and Lead Organization

<b>ID</b>	<b>Month</b>	<b>Description</b>	<b>Lead Organization</b>
<b>M1</b>	3	Collection and representation of initial GIS data and stakeholder information on marine and maritime aspects	Geomatic/DFMR
<b>M2</b>	6	Preliminary selection of suitable areas	All partners
<b>M3</b>	8	Refined selection of suitable areas for OS Aqua	All partners
<b>M4</b>	12	Initial estimation of carrying capacity of selected areas	UNRF
<b>M5</b>	12	Ocean and waste modeling and further assessment of candidate areas	HCMR
<b>M6</b>	20	Onsite survey and data collection	CSCS
<b>M7</b>	24	Final definition of OS Aqua Zones	All partners
<b>M8</b>	24	Finalization of OS Aqua station and mooring designs, and finfish species selection	UNRF
<b>M9</b>	28	Finalization of the design of the OS Aqua Station and plan for environment ongoing monitoring	OC-CY
<b>M10</b>	32	Finalization of Business Plan	FRC

Table 1: Project's Milestones

## 5 Conclusions

Though the discussion between the partners it has been agreed that the List of Milestones, as decided in this document, provides an invaluable tool for planning and consultation. Planning has been facilitated as Milestones provide indications of the progress towards the goal of the project, which is the development of a roadmap for the establishment of an Open Sea Aquaculture. Consultation is also facilitated as Milestones have been associated with a) justification of the need of having the specific milestone as a necessary step towards reaching the main goal and b) qualification based on the procedures to be followed for sustainable development of aquaculture based on social, economic, and technological considerations. Therefore, the document serves as a communication tool among consortium partners to ensure the successful completion of the project, securing the effective progress and quality of the project's outcomes.