



# MedArtSal

## MedArtSal

### Sustainable Management Model for Mediterranean Artisanal Salinas

#### WP3 | OT3.3 - MedArtSal Model-building process and testing

#### Final report

Activity 3.3.1: Building Part I. Biodiversity

Activity 3.3.2: Building Part II. Economics and productivity

Activity 3.3.3 Building Part III. Salinas management (or action) plan

Activity period: 05/11/2020 – 04/06/2023

Partner in charge: UCA

Partners involved: all

Status: final

Distribution: public



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## 1. Summary

Coastal salt pans are places where seawater is canalized through different channels until it evaporates completely and the salt is crystalized. Depending on how this salt is recollected, there can be artisanal, extensive or mixed salt pans, being artisanal those where workers only use traditional methods to harvest the salt. Historically, salt has had a great economic, social and cultural value; allowing Salinas to become a new ecosystem with its own characteristics. Nevertheless, now this heritage is being lost due to the considerable reduction of profitability of the salt extraction business. This is the main reason that it is necessary to revitalize Salinas, diversifying their activity while preserving nature and resources for future generations; to make them profitable and sustainable.

The aim of this report (methodology and model completed in August 2022, final test in June 2023) is to develop a Sustainability Model for Coastal Artisanal Salinas in Mediterranean countries. By using it, salt owners will be able to assess their sustainability in terms of economy, environment and innovation, identifying their strengths and weaknesses in order to improve. The obtained model will be a complex mix of economic, social, cultural, management and governance variables. Of all of them, the quantitative variables have been used to construct the Salinas Sustainability Index (SSI . OT3.2), which will allow salt workers to improve socio-economy, environmental and innovation aspects of their facilities.

SSI has been built with the information obtained from surveys answered by 21 Mediterranean artisanal salt pans (>50% of total artisanal Salinas in the Med), and with the contribution of experts and specialists, an online self-assessment toolkit (SSI Toolkit) was developed for any salt flat owner to assess the sustainability of their own Salina and identify aspects to be improved (see report from Activity A.3.2.1 about Development of and Sustainability Index tailor made for Salinas).

Complementally, two mathematical models have been carried out in order to simplify and analyse the set of variables that have been used in the SSI construction. These analyses showed us that Mediterranean Salinas could be grouped in three clusters depending on their productivity and profitability. On top of that, artisanal salt flats are strongly correlated to variables like local sales, extraction of gourmet salt and development of eco-tourism activities.

Ultimately, in this report we present a series of improvements most widely implemented in the Mediterranean Salinas in order to acquire a higher level of sustainability in the 3 main building topics of the model: Biodiversity ; Economics and productivity ; Salinas management.

## 2. Introduction - Purpose of the report

The profound technological transformation that society underwent after the industrial revolution and the appearance of refrigeration systems in food preservation led to a reduction in salt extraction and the abandonment of a large part of the Salinas. From hundreds of coastal artisanal Salinas in the whole Med, only 34 are nowadays active. This abandonment in many cases is not followed by a pre-Salinas ecosystem recovery. Humans have been shaping the system through millennia and in many cases water flow cannot be recovered after abandonment and abandoned Salinas lose a great part of their ecosystem services. Therefore, by maintaining and restoring Salinas we can recover the economy, ecosystem services and cultural human heritage.

One of the aims of the MedArtSal project is the development of a Sustainability Model for Coastal Artisanal Salinas in Mediterranean countries. This model will allow knowing the most important aspects in terms of sustainability in a salina and at the same time, the model will allow Mediterranean Salinas to improve their salt production & economic management, environmental management & conservation and development of innovative & diversified activities. This model is intended to be easily applicable, taking into account future scenarios. Moreover, this model will allow the sustainability of artisanal Salinas in the Mediterranean to be assessed, highlighting their strengths and identifying their weaknesses.

Sustainability is a term widely used and sometimes with different meanings, therefore there are numerous definitions of the concept of sustainability, but they all converge towards the same idea, which can be summarized as «Sustainability is the development that meets the needs of the present without compromising the capacity of future generations, guaranteeing the balance between economic growth, protecting the environment and social well-being». This term of "sustainable development" was first coined in an official document in the text of the agreement signed by thirty-three African countries in 1969, under the auspices of the International Union for Conservation of Nature (IUCN).

In the context of the MedArtSal project, a sustainable Salina would be one that uses natural resources to obtain economic income, but in a socially and environmentally respectful way, ensuring the future use of resources (Figure 1).

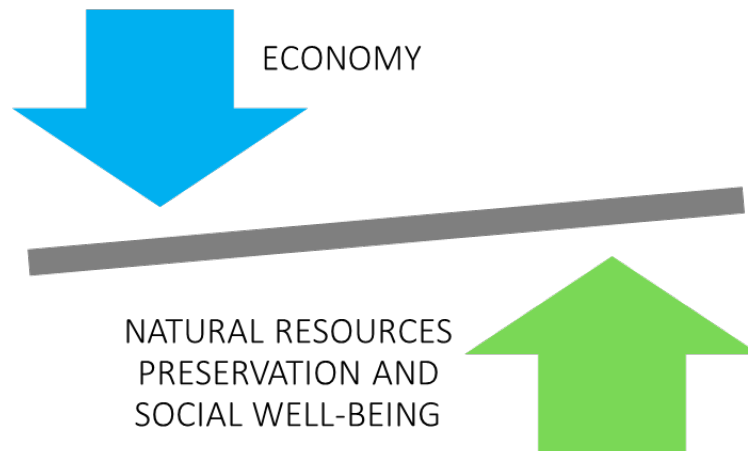


Figure 1. Balance between the economic income and the maintenance of natural and social resources.

The generation of the model that is exposed in this report has been developed for mainly coastal Salinas, due to their high number, greater homogeneity and common problems. However, as many of the processes in both types of Salinas are similar or the same, many aspects of the model can be applied equally to inland Salinas.

## 2.1. Why a sustainability model?

The creation of a model aimed at simplifying the explanation of environmental heterogeneity and the relationships among its variables is always a challenge. Although the model developed will never explain 100% of the system variability, such models are widely used in research to help us understand the most probable scenarios or make reliable predictions of future changes (Halpern *et al.*, 2012; Mori & Christodoulou, 2012). In this case, the model will be a multispectral complex model as it has to take into account economic, social, cultural, management and governance variables. Due to this complexity, a mixed model integrating quantitative as well as qualitative aspects will be developed. With the development of this model, we will be able to identify the priorities and goals to focus in order to obtain a sustainable Salina. In this regard, a model is nothing more than knowing how an ideal Salina would be in terms of the economy, to be profitable, environmentally, to preserve natural resources, and with the capacity for innovation that allow them to advance in a future sustainable way, as well as evaluate the best governance model to optimally carry out all these activities aimed at sustainability. By knowing the ideal values for each of these terms, we can know where we want to move forward. Therefore, with these reference values or ranges, a Salina can be evaluated and defined towards where and how it can advance in sustainability.



However, a multitude of factors must be taken into account to assess this sustainability, as depicted in Figure 2. In the following paragraphs we will delve into the different parts that this model feeds on.

## MEDARTSAL: MULTIESPECTRAL COMPLEX MODEL

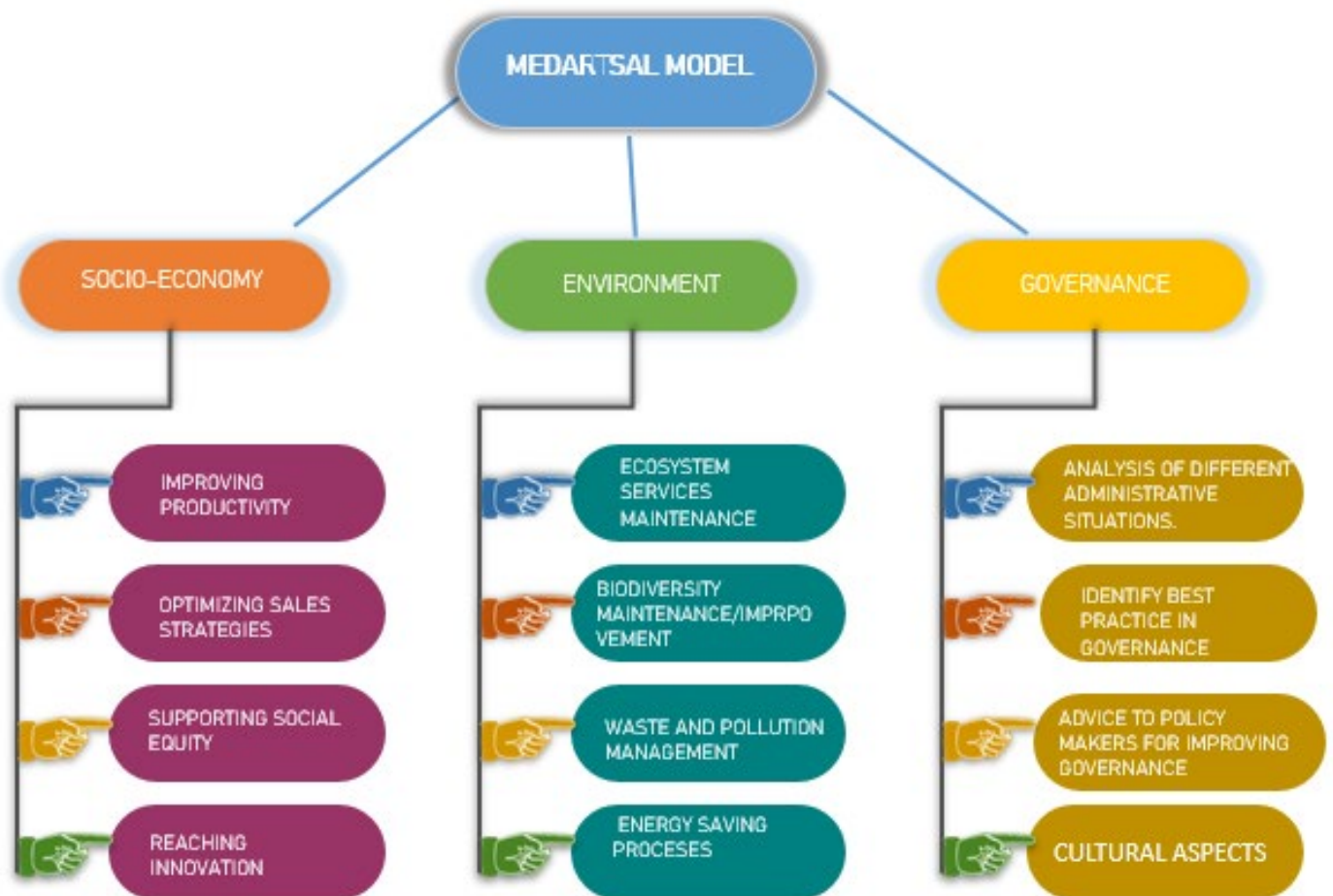


Figure 2. Different sections considered in the complexity of creating a sustainability model for Salinas

### 3. What we know about Salinas

#### 3.1. Salt and Mediterranean Artisanal Salinas

Salt is an essential chemical compound for life. Our body needs small doses of this compound formed by sodium chloride (NaCl) to regulate the amount of water present in our organism, to maintain a constant pH in our blood or to allow the correct transmission of nerve impulses. Salt provides the salty taste, increases our appetite and stimulates food intake, which is why it has always been used in the seasoning of dishes and as a preservative for salting meats, fish and pickles.

Salt can be extracted in different ways, from natural salt extractions from coastal lagoons, where seawater penetrated spontaneously, evaporating rapidly and precipitating its salt crystals, to the large salt-mining facilities for harvesting and large-scale mechanical processing where large mountains of salt are a characteristic element of the landscape.

Salinas have existed since the beginning of civilization. Throughout the world and in all cultures, salt has been an indispensable element since immemorial times, used mainly for the preservation of food. From a historical perspective, salt has always been related to human commercial activities, contributing to the progress of civilization. Thanks to its properties as a preservative, salt has been used to keep different types of food from spoiling. For many years, salt was so highly valued that even rulers and kings tried to manage the salt mines, turning it into a good with high commercial value. The importance of this mineral in the development of human society has been so high that it was used as a method of payment, barter or currency, and the term salary was coined etymologically from salt.

From the first salt pans of ancient China to the modern Salinas of today, the deep technological transformation that society underwent after the industrial revolution and the appearance of refrigeration systems for food preservation led to a reduction in salt extraction and the abandonment of many of the salt pans.

However, this ancestral coexistence of the human being with the Salinas has allowed the development of a new ecosystem unlike any other, it has shaped the landscape, history, culture, society and the natural environment of many areas with a salt tradition.

In the Mediterranean in particular, the salt trade was a prominent activity from ancient times and a reflection of this splendour is the current existence of almost 227 Salinas (90 of which are currently active) across 18 countries in the Mediterranean area (EUMC and MPC).



### 3.2. How does a Salina Work?

Throughout this document, we will refer to saltpans, salt ponds or saltworks as Salinas<sup>1</sup>, and particularly under the definition of a Salina as the natural deposit of various salts that form in lagoons, coastal, depressed areas where a plant for the extraction of salt is present. In this model, we do not consider the salt mines due to the large differences from the target of the project both for salt production method, and for other important aspects such as different landscape, flora, fauna, etc.

Salinas where salt is obtained by evaporation can in turn be categorized into **inland Salinas** and **coastal Salinas**.

**Inland Salinas**, are those located away from the coast and therefore there is no contribution from seawater evaporation. Thus, the extraction of salt in these areas can only occur if there are salt-rich soils, or if the water source is either from a spring or from an inland lake. These Salinas are made of fewer basins, “corresponding” to the crystallization ponds of sea facilities. This is because the brine entering the facilities is much more concentrated than seawater, and it does not contain the low solubility salts, which are normally precipitated in the evaporation ponds of the seacoast facilities.

**Coastal Salinas** are those that use seawater directly, either by upwelling or by the effect of the tide, filling a deposit with water that is circulated by gravity until its complete evaporation. In these evaporation Salinas, there are a series of watertight enclosures, arranged such that each is below the level of the previous one, thus favouring the circulation of brackish water by the simple effect of gravity. Through this process, the concentration of the Salinas increases progressively due to evaporation, until the precipitation of sodium chloride is finally reached. These salt flats can adopt different forms depending on their size, the topography of the substrate on which they are established and the climatic conditions of the area. However, they all basically follow the same model, which consists of three main units: the tank or decanter, where brackish water is stored and decanted; the evaporation zones, where, due to exposure to the sun, the saline concentration increases; and the crystallizers, where the maximum concentration is reached and where the salt finally crystallizes. All these elements are connected by a system of channels through which the water passes to the crystallizer.

#### Filling and decanting tank or storage pond

This is a large space or lagoon, which is used to store salt water. It normally occupies around a third of the total area of the Salinas and is located next to the tidal channel from which it is fed through a system of gates built at intermediate depths between the levels reached at high tide. Due to the absence of tides,

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<sup>1</sup> Salinas (also called saltworks, saltpans or salt ponds) are anthropogenic habitats used for obtaining salt by evaporation of seawater (Masero, 2003).





Mediterranean salt flats have to be located in the lowest part of the old coastal lagoons, and are frequently filled using wind energy or the waves themselves. In the case of inland Salinas, salt water is pumped to the basins through a series of tubes.

The estuary, in addition to serving as a reservoir, is also used in some cases as an aquaculture-breeding pond, into which fish are dragged by the tidal current. Sales of these fish can provide an additional source of income for the owners of the Salinas.

### The concentration zone

This is usually made up of long corridors and intricate narrow channels (3-7 m) which are increasingly shallow. This intermediate zone favours evaporation and the consequent increase in saline concentration. In this area, the precipitation of unwanted minerals takes place, which is a very important step in the salt production process. The Mg and Ca sulphates/carbonates precipitate, allowing the salt produced in the crystallisation ponds to reach a high quality.

### The crystallization zone

As the name suggests, this is where salt crystallization occurs. This area, the lowest area of the salina is made up of large squares arranged in pairs and in parallel, where the work of washing and salt extraction is carried out. It is very shallow and only occupies a small area compared to the other sections of the Salina. This important zone is where the salt crystallizes and is collected (Fig. 3).

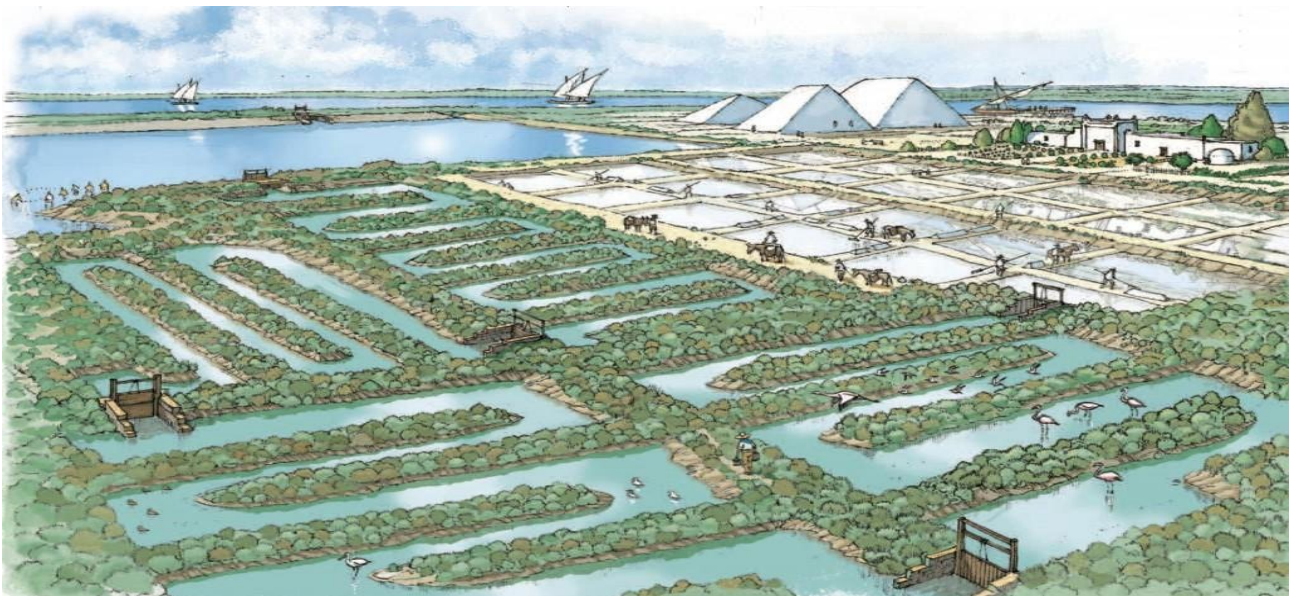


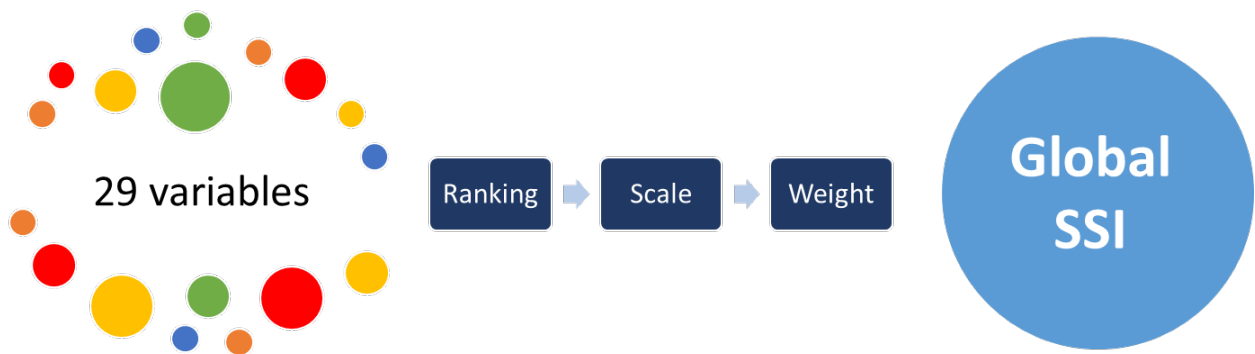
Figure 3. Diagram of the different sections in an artisanal Salina. Consejería de Medio Ambiente, Junta de Andalucía, 2009. (C) Arturo Artefacto.

## 4. Salinas Sustainability Index

The model drafted is based on quantitative values by which a Salina can evaluate itself and be able to determine its degree of sustainability. In this way, the quantitative part of the model has been developed on the Salinas Sustainability Index (SSI), which includes the values and ranges according with Salina economic, environmental and innovation aspects to be considered as sustainable. Note that this SSI does not include governance since the salt worker cannot manage directly to improve this aspect. The SSI includes the three main parts that a salt worker can improve in terms of sustainability: socio-economy, environmental and innovation aspects (through diversification of products).

The SSI has been developed in the project output 3.2.

For a more detailed explanation of variables used, see report of Activity A.3.2.1 about the Development of and Sustainability Index tailor made for Salinas.



$$\text{Salina Sustainability Index (SSI)} = \sum_{1}^{n} Var_n * Weight_n$$

Figure 4. Diagram of the global SSI construction process.

## 5. Results and assessment of the MedArtSal salinas

During the surveys and mapping (OT3.1) and next engagement activities (WP4-WP5-WP6), a total of 37 potential artisanal Salinas was identified in the Mediterranean that fell within the study area. Information about the project was sent to all these Salinas together with the aforementioned survey (<https://d138.uca.es/encuesta-medartsal-english>) translated into all the languages of the participating countries. Finally, 31 completed surveys were received, of which 21 were from artisanal Salinas (>50%). Therefore, the index constructed in this document is based on the 21 artisanal Salinas that participated by completing the survey.

After applying the two different methodologies to evaluate the degree of sustainability of the artisanal Salinas that responded to the survey, we can state that there are no major differences between these methodologies, and that each of the Salinas obtained similar results under each approach. When ordering the Salinas according to their SSI values under both methodologies, the first four positions are occupied by the same Salinas, and in the same order. The last two positions also correspond to the same Salinas under both methodologies (Table 4).

Hence, despite minor differences, both methodologies can be useful and appropriate for evaluating the sustainability of artisanal Salinas in the Mediterranean.

Table 4. Comparison of the order of the Salinas from most to least sustainable under the two methodologies evaluated.

	Method 1	Method 2
Salina #1	57.96%	51.27%
Salina #2	71.91%	63.61%
Salina #3	63.55%	56.21%
Salina #4	33.61%	29.73%
Salina #5	29.20%	25.83%
Salina #6	49.94%	44.17%
Salina #7	17.96%	15.89%
Salina #8	52.53%	46.47%
Salina #9	34.40%	30.43%
Salina #10	36.89%	32.63%
Salina #11	50.90%	45.02%
Salina #12	46.77%	41.37%
Salina #13	40.33%	35.68%



Salina #14	32.42%	28.68%
Salina #15	11.07%	9.79%
Salina #16	85.18%	75.35%
Salina #17	57.28%	50.67%
Salina #18	66.71%	59.01%
Salina #19	65.70%	58.11%
Salina #20	65.41%	57.86%
Salina #21	35.70%	31.58%

### 5.1. Evaluating a complementary mathematical model: Principal component analysis

The information obtained from the surveys completed by the collaborating Salinas have provided a database with a large number of variables that could describe the different types of Salinas that are currently active in the Mediterranean.

As we indicated previously, we have received a total of 31 surveys, artisanal, extensive and mixed Salinas. Some of them indicated that they were abandoned and others did not offer enough data to be included in the analyses. For this reason, we were finally able to count on a total of 21 (>50%) Salinas information to prepare an analysis that allows us to describe the general situation of Mediterranean Salinas. In order to complement the results obtained in the SSI and the structure and different components of the conceptual-theoretical model, we carried out a first mathematical approach and a simple mathematical model to analyse the most important variables that describe sustainability in Med-Salinas. To achieve this aspect, we have used principal component analysis, which is a widely used method to simplify the complexity of a reality described by many dimensions while preserving its essential information. In this way, it allows grouping the set of variables included in the model in a smaller number that facilitates its understanding. This method allows the representation of the original data (Salinas and variables) in a space with a lower dimension than the original space, while limiting the loss of information as much as possible. (Maćkiewicz & Ratajczak, 1993; Abdi & Williams, 2010).

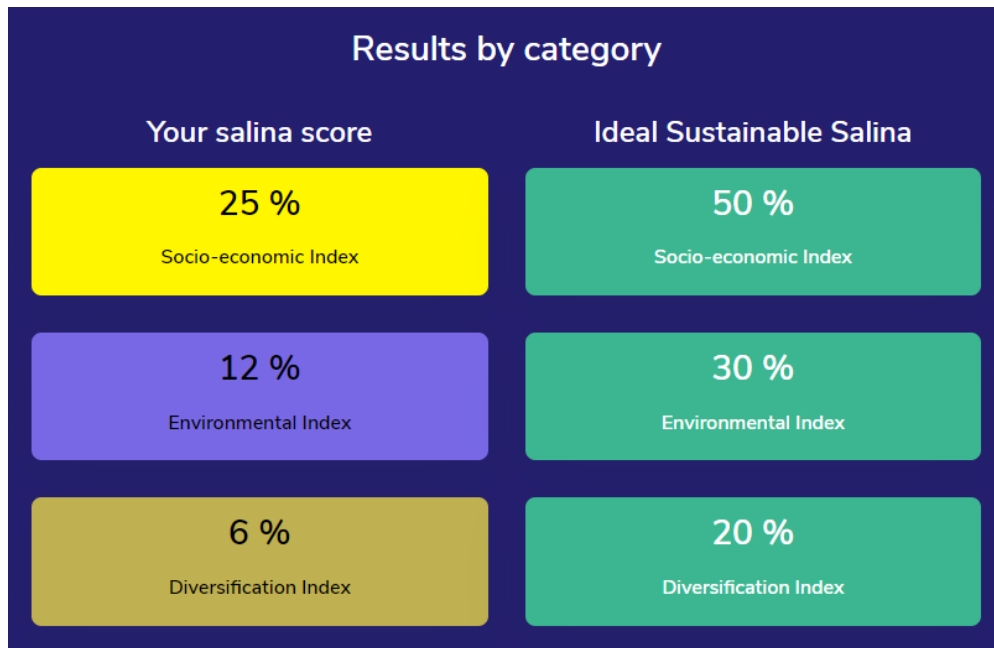


Figure 5. An example of a particular result in relation to the different categories that make up the SSI, socio-economic, environmental and diversification

The main results obtained due to the correlation matrix (Fig. 6) shows how artisanal Salinas are highly correlated with variables such as having a local shop in the facilities, with local, national and online sales, and they perform their own packaging. In addition, these Salinas also show high correlations with the extraction of Flor de Sal and with the development of different eco-tourism, gastronomic and cultural tourism activities. Similarly, artisanal Salinas are negatively correlated with large productive areas, high salt productions, and international sales. And finally, the correlation matrix shows us how artisanal Salinas are negatively correlated with high profitability.

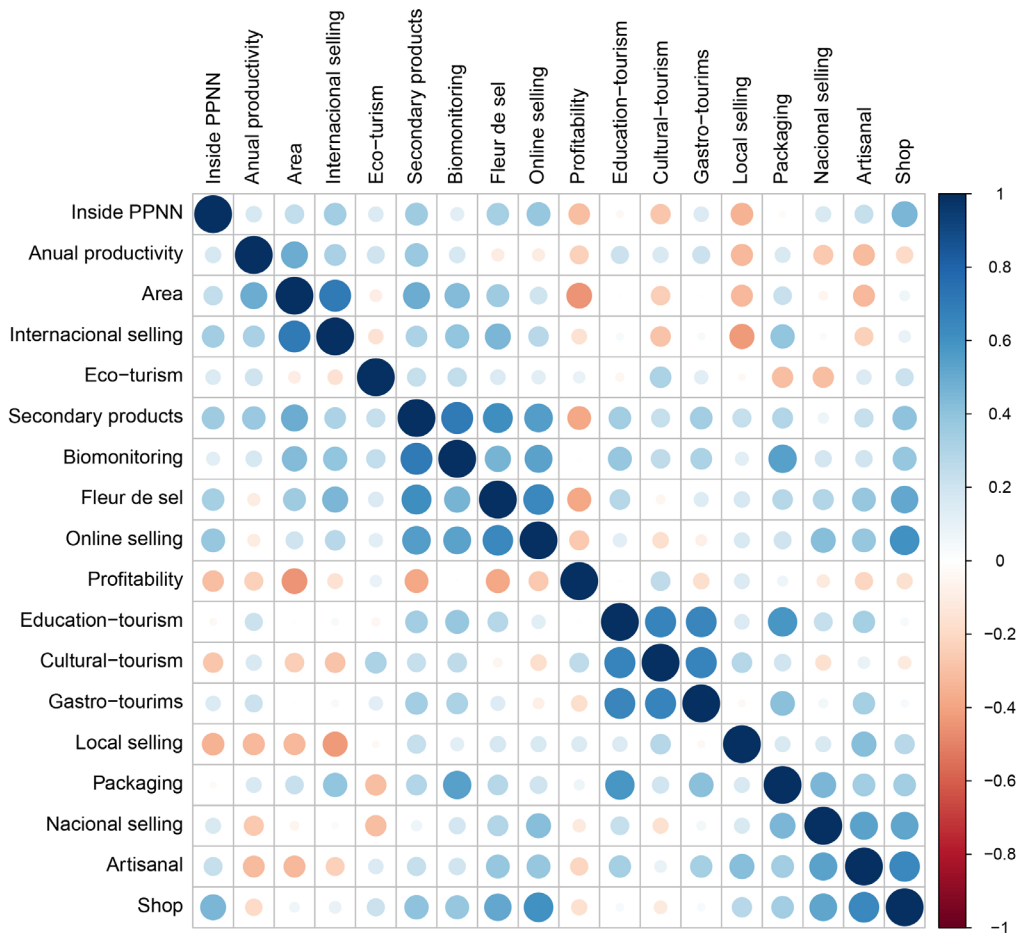


Figure 6. Correlation matrix of the variables considered in the PCA (Principal Component Analysis) in Mediterranean Salinas.

After applying the PCA test with a limitation to two dimensions in order to obtain simple and explainable results, we observe that there are mainly two types of Salinas in the Mediterranean. One of them is located in the upper right quadrant, which would be the artisanal salt flats, which sell locally, with the development of cultural, educational and gastronomic tourist activities. On the other hand, we find in the lower right quadrant those large Salinas that sell internationally and have high annual productivity. This type of Salinas resembles the characteristics of extensive ones.

However, the result obtained for the variable 'Profitability' is interesting, which appears independently in the upper left quadrant, showing a negative correlation with extensive Salinas and no correlation with artisanal ones, which would indicate that, according to the surveys completed by the salt sector, profitability would not be one of the most significant variables for either of the two types of Salinas (Fig. 7).

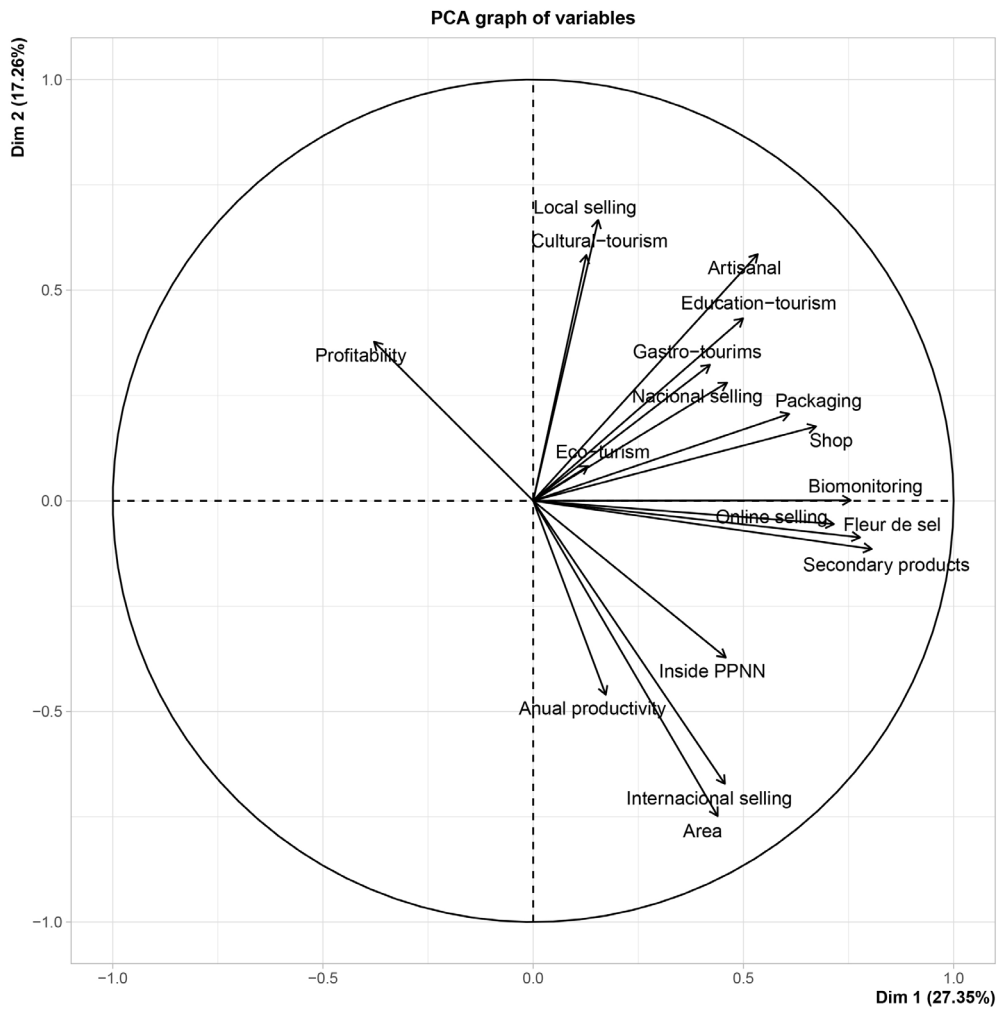


Figure 7. Distribution and weights of the different variables considered in the PCA analyses of the Mediterranean Salinas.

Finally, if we group the different Salinas into a small enough number of categories to easily explain said grouping (clusters), according to the weight in each of the two dimensions of the PCA, we observe that the Salinas could be grouped into three different clusters.

The characteristics of the Salinas grouped in cluster 1 (red) would correspond to extensive Salinas with high productivity; cluster 2 (green) would correspond to those Salinas that indicated in the questionnaires that they maintained an artisanal production but with little productivity and profitability; and the Salinas grouped in cluster 3 (blue) would be those that indicate being artisanal with high productivity and extension (Fig. 8)

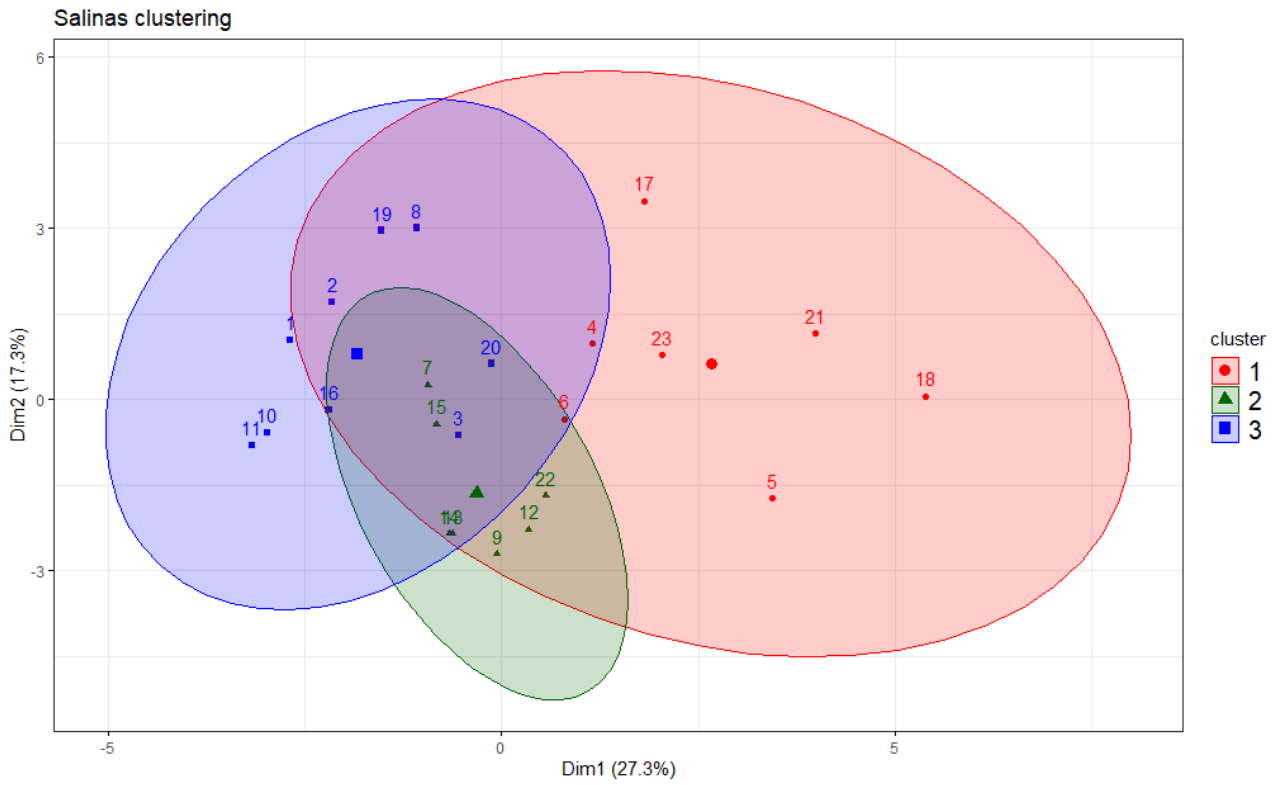


Figure 8. Clustering of the results of the PCA analysis of the different Mediterranean Salinas. The numbers inside the clusters indicate different Salinas included in the analysis.



## 6. How to improve Sustainability in Salinas

Thanks to the analysis carried out of the surveys received from a total of 31 Salinas that have participated by completing the questionnaire prepared to know the current status of the Mediterranean salt flats (see Benchmarking report, A.3.1.2), we know that the current status of the salt flats in the study area is very disparate.

Most of the answered surveys received have come from artisanal Salinas, with almost three quarters of the surveys received (Fig. 9). In fact, 21 answers were from artisanal Salinas (> 50% of all artisanal Salinas in the Med).

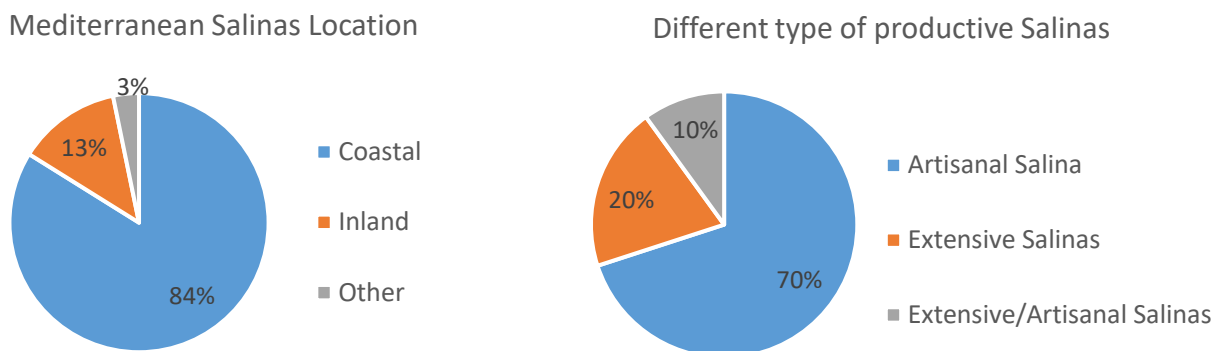


Figure 9. Percentage and type of Salinas by productivity and location

Most of the Salinas indicate they are in normal operation and active production (53%). However, a notable number of the Salinas which answered are currently abandoned and without production (21%). Salt production is obviously much higher in those Salinas with extensive production, although the profitability of all of them is generally low (Fig. 9).

The average area of Salinas in the Mediterranean differs greatly between artisanal and extensive. In extensive Salinas, many of them exceed 1000 hectares. On the other hand, artisanal salt flats usually have a few hectares, sometimes less than one hectare. Among the surveys received, only one artisanal saline, located in Slovenia, has a large area of almost 500 hectares (Fig. 10)

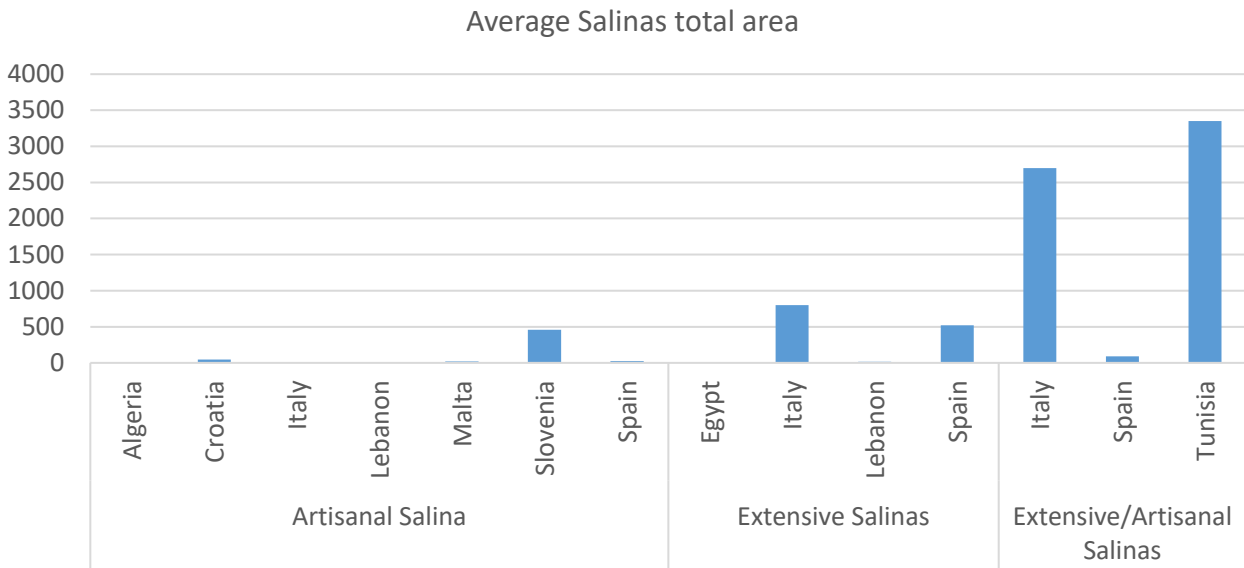


Figure 10. Average area of the Salinas per production type in the countries that completed the surveys

In general, the destination of the artisanal salt is for products not related to food and extensive Salinas sells their salt production to non-food purposes. Regarding gourmet salt, artisanal Salinas produces the most fleur de sel. Concerning diversification, Salinas that produce a greater number of secondary products (brine, fish, mud, etc.) are those of artisanal production (Fig. 11).

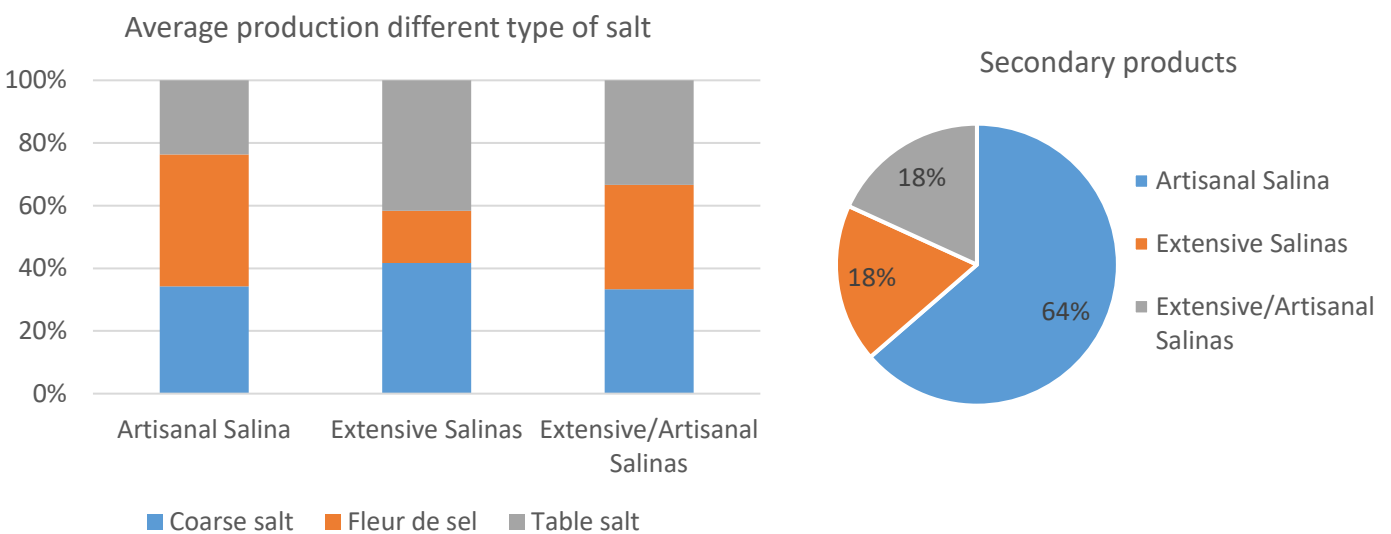


Figure 11. Proportion of production of the different types of salt in the Mediterranean Salinas and proportion of Salinas that produce some type of secondary product

More than half of the Salinas that have answered to the surveys are within a Protected Natural Area, the most frequent being the Natural Park (with regional influence) (Fig. 12). Regarding the monitoring of biodiversity in the Salinas, clearly these activities are carried out in artisanal ones, where the monitoring of birds, fish and flora is widespread. In extensive salt flats, birds are only monitored in some of them (Fig. 13).

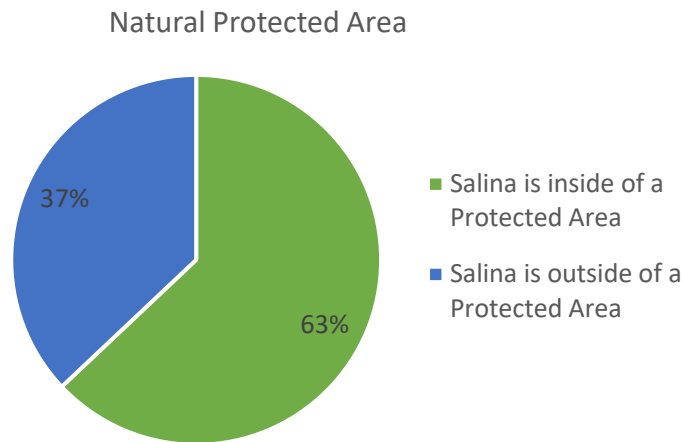


Figure 12. Proportion of Mediterranean salt flats that are within Protected Natural Areas

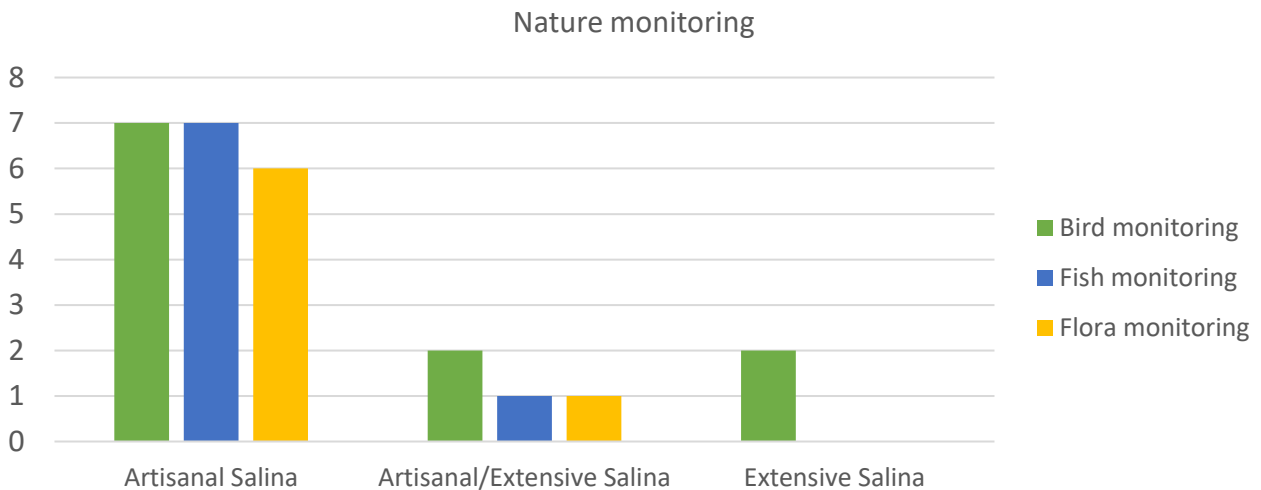


Figure 13. Number of Salinas that monitor biodiversity by type of Salinas.

Regarding, tourist activities, activities of all kinds of tourism are carried out in a generalized way in the artisanal Salinas. However, ecotourism is the most frequent activity. In the extensive Salinas, all these activities are also carried out but to a much lesser extent (Fig. 14).

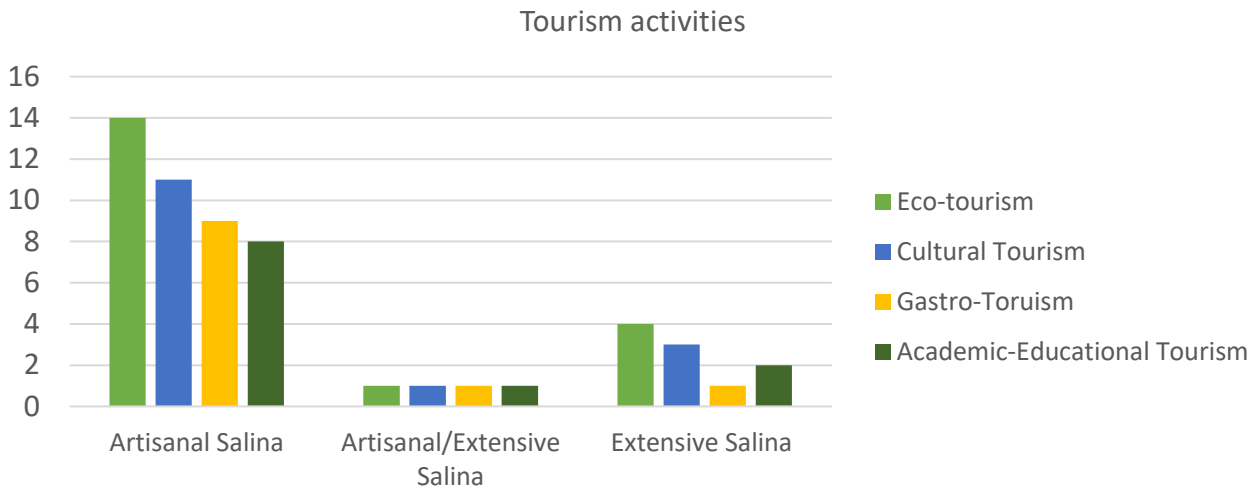


Figure 14. Number of Salinas that carry out some type of tourist activity within their facilities.

Regarding the differences between countries, some countries only have men working in their salt flats, while in other countries where we find a higher gender parity. Regarding the type of Salinas, we find a higher gender parity in employment in the mixed Salinas, with artisanal/extensive production. (Fig. 15).

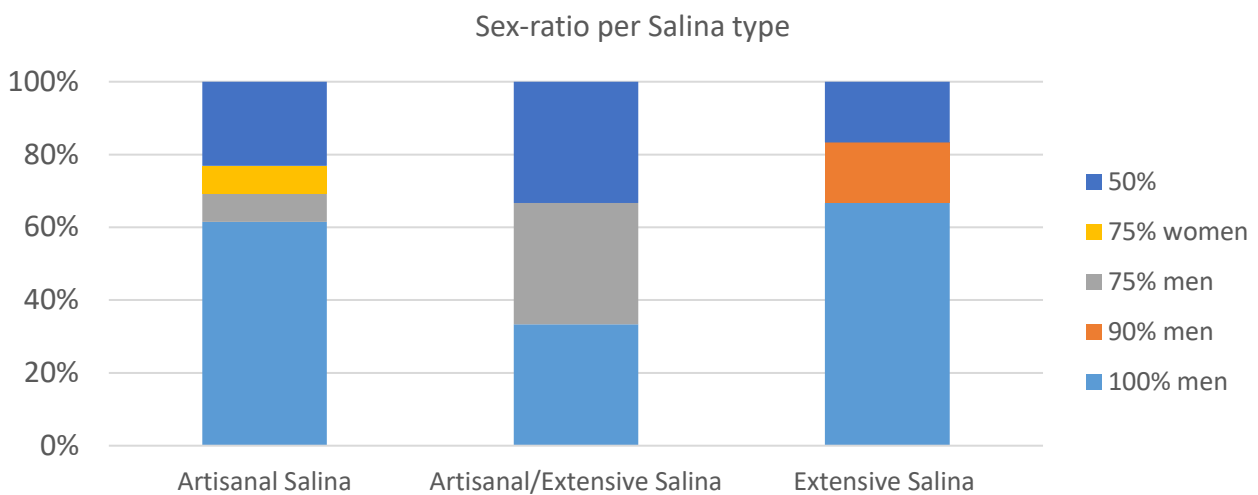


Figure 15. Gender ratio in employees of the different types of Mediterranean Salinas.

Given all the above, salt workers indicate that their facilities have low or very low profitability. Only a low percentage of extensive salt flats indicate that they achieve a profitability of more than 30%, while artisanal salt flats indicate that their yield rarely exceeds 10% of profitability (Fig. 16).

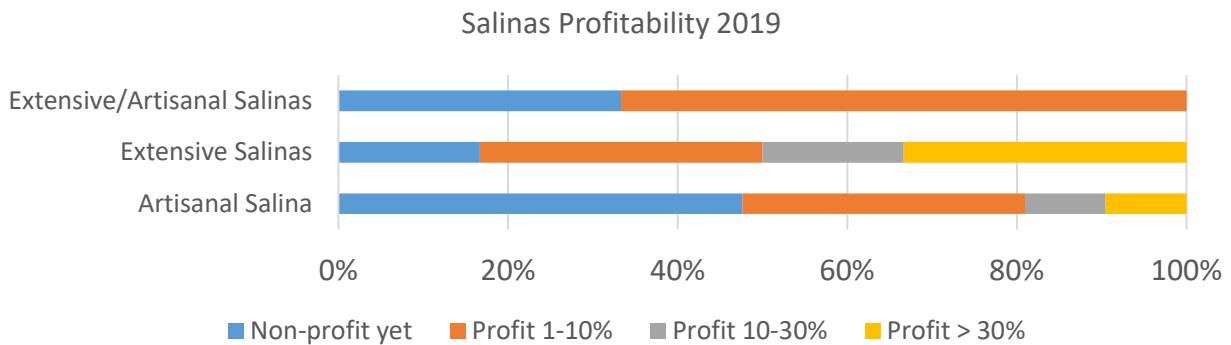


Figure 16. Profitability of the different types of Salinas in the Mediterranean during 2019

Faced with this situation, and with the aim of increasing their profitability in a sustainable way, many Salinas incorporate into their ordinary activity a series of different actions regarding the diversification of products, services, new methodologies and improvements in their environmental conservation status. Among the most important and most widely developed in the Mediterranean we can find:

1. **Best practices in sustainable tourism**
2. **Products diversification**
3. **Increase biodiversity and improve the state of conservation of the environment**

### 6.1. Best practices in sustainable tourism

Sustainable tourism is the form of tourism that meets the needs of tourists, the tourism industry, and host communities today without compromising the ability of future generations to meet their own needs.

According to The World Tourism Organization (WTO), sustainable tourism should:

- **Make optimal use of environmental resources**
- **Respect the socio-cultural authenticity of host communities**
- **Ensure viable, long-term economic operations, providing socio-economic benefits to all stakeholders.**

Tourism generates income and will encourage Salina maintenance, helping to preserve an ancient cultural tradition and a unique and biodiverse habitat. It will furthermore raise the awareness towards the conservation of their cultural and natural heritage, in locals and tourists. Salinas combine cultural and landscape values, and natural characteristics that allow coexistence of a great variability of organisms and high biodiversity.



The forms of tourism proposed for Salinas, such as cultural, conference, maritime, gastronomic, and ecotourism (e.g. bird watching), are based on and should protect the unique characteristics and resources of these areas. Tourism type and impact has to be controlled and compatible with environmental protection and artisanal salt production. Salinas may be used for a combination of education, recreation and adventure activities. Recently, the local tourism sector is recognising that artisanal salt production constitutes an element that differentiates the region and that may become important again at a regional and also national level. Salt museums may contribute to the preservation of the cultural heritage of an area and raise public awareness by setting up environmental education projects (Rodrigues *et al.*, 2011).

This type of sustainable tourism should bring a set of benefits to the development of Salinas by:

- Developing new businesses and alliances
- Expanding job opportunities
- Increasing income
- Marketing new products
- Improving infrastructures
- Encouraging diversification
- Integrating local economy
- Promoting community pride
- Higher quality of life for local population

Within this type of sustainable tourism, we can find a multitude of examples developed in different Salinas (Mediterranean and beyond) where the development of sustainable activities within the framework of the salt industry value the salina. Among the sustainable activities, we can find:

Table 5. Examples of sustainable tourism activities carried out in different salt flats worldwide

Examples of Activities	Examples of Salinas
Accommodation (e.g. houseboats or floating homes)	Salgado de Aveiro in Portugal
Artisanal salt production (e.g. guided or free tours, salt harvesting)	Salgado de Aveiro in Portugal
Creative tourism (e.g. salt producing workshops, rakes for coarse salt and squeegees for flower of salt)	Camillone saltpan (Cervia)
Cultural Heritage and educational activities (e.g. salt museums, salt interpretation centres and eco-museums)	Batz sur Mer (France); La Maison des Paludiers (France); Salinas de Añana (Spain)
Event tourism for fairs, meetings, receptions, conferences, training sessions or concerts and parties (e.g. photography workshop or music performance)	Wieliczka Salt Mine in Poland; Salgado de Aveiro in Portugal
Gastronomic activities (e.g. salt and local recipes tasting, culinary heritage activities)	Salgado de Aveiro in Portugal; Salina Preciosa and Environmental Resources Center in Spain
Nature tourism (e.g. hiking and cycling, wildlife and bird watching)	Salinas de Brito (Cuba); Terre de Sel (France)
Recreational activities (e.g. group adventures, bungee jumping, underground balloon flights; barbecue or rest areas)	Salgado de Aveiro in Portugal; Wieliczka Salt Mine in Poland; Salina Preciosa in Spain.
Sport tourism (e.g. training facilities for athletes, table tennis, handball courts and playgrounds for children, water sports, fishing)	Camillone saltpan (Cervia)
Wellness and health treatments (e.g. medical consultation, diagnostics, physiotherapy, kinesiotherapy, yoga and a rehabilitation clinic)	Salinas de Añana and Environmental Resources Center (Spain)

Some examples of best practices in tourism:



Figure 17. Tours of a salt pan ‘La Maison des Paludiers (France), Thalassotherapy (Slovena) and Saltwater inhalation - Bad Kreuznach (Germany).



Image 18. Salt spa and cultural tourism in Salina de Añana (Spain).



Image 19. Wildlife and birdwatching in Salinas de Brito (Cuba) and Salt Marshes Museum in Batz sur Mer (France)



Image 20. Visit salt pan by boat, canoe excursions and 'Saltworker for a day' in the Camillone salt pan (Cervia, Italy)





### *Ecotourism MEET Network: an opportunity for Salinas*

Among different tourism approaches, probably the most innovative methodology for sustainable tourism is the Mediterranean Experience of Ecotourism (MEET) network program, which allows the creation of high-quality ecotourism experiences, based on the cultural and natural attractions of protected areas, that benefit conservation and local communities. This programme was created through a synergy among two projects ENI CBC MED Programme MEET and Interreg Mediterranean Programme DestiMED ([www.meetnetwork.org/](http://www.meetnetwork.org/)).

MEET Experiences are nature-based, cultural experiences which allow travellers to discover a new side of the Mediterranean. The development of the final tourism packages offered to the tourist target are created by governance structures called Local Ecotourism Clusters, where both Natural Parks and private tourism sector have a voice and benefit equally from ecotourism activities.

MEET methodology has been tested in several Mediterranean countries with exceptional results. We can find Ecotourism Experiences in more than 40 protected areas throughout the Mediterranean. All MEET Experiences undergo robust quality and sustainability monitoring, using Ecotourism Standard and Monitoring Tools, that will guarantee that the tourist offer complies with the MEET sustainability requirements and conservation goals.

#### *A testing example in Salinas*

In the MedArtSal project, within activity 4.1 of WP4, a working group has been created to develop different eco-tourism packages between the Salinas of the Bahía de Cádiz Natural Park, a place of great historical and natural value in the south of Spain. The Local Ecotourism Cluster has already been created and two touristic packages will be tested in Salinas of the Natural Park in the next months. This tourist offer will allow Salinas to improve their competitiveness and sustainability.

## 6.2. Diversification of products

Diversification in the sale of products and services is undoubtedly one of the best allies to increase profitability in the production of salt establishments. Many Salinas in the Mediterranean and beyond have included other elements related to salt in the commercialization of their products and as an example, we could cite different initiatives where the sale of these secondary products to salt, could provide new benefits at the same time as attract new customers.

In the research for obtaining new resources and derived products, photosynthetic microorganisms, such as microalgae and cyanobacteria, are becoming increasingly important, both in the search for valuable products. An example of the different applications and uses of the production of these microalgae are already being developed in aspects such as:

- Agronomic fertilisers
- Human and animal consumption
- Aquaculture
- Nutraceutical industry
- Production of bioactive compounds
- Production of biofuels
- Wastewater treatment



Image 21. Microalgae cultivation of reactors in batch growth tests



In addition to microalgae, macroalgae (seaweed) are also among the highlights products developed in the Salinas. The development of seaweed culture in Salinas can be an excellent opportunity to diversify their products and maintain the biodiversity of the area. Diverse authors have studied the potential culture of green (*Ulva* spp.) and red algae (*Gracilariopsis longissima*, *Gracilaria vermiculophylla*, *Chondracanthus teedei* or *Hydropuntia cornea*) under fishpond effluents, obtaining high removal rates of N and P coming from the aquaculture farms, thus reducing the risk of eutrophication and producing high valuable algal biomass. And as we have indicated, extensive fish aquaculture is also a common activity in Salinas, so the combination of this activity with algal cultures in earthen ponds could be an interesting option.

In addition, the production of seaweed offers very good results for its application in cosmetic products thanks to the advantage of using algae extracts due to their antioxidant activity. Algae normally live in stressful conditions (high radiation, temperature fluctuations, desiccation periods, etc.), which means they live in a very oxidative environment. Thus, algae have developed protection mechanisms against these oxidative conditions known as antioxidant defense systems.



Image 22. Rope cultivation of macroalgae in artisanal salt flats



Image 237. Cosmetic products done using autochthonous algae from Salinas.

More information on how to grow macro and microalgae in Salinas can be found in the Activity A.4.1.1. report.

Other salinas commercialize by-products of salina activity or services such as brine, mud, or spa and relaxing therapies.



Image 24. Salina spa in one of the salt flats located in the province of Cádiz (Spain).



Image 25. Pack of typical products from the artisanal salina of Salina de Cádiz (Spain).

On the other hand, in some medium-large artisanal salt pans, salt exploitation is made compatible with the rearing and fattening of aquaculture fish in evaporation ponds. There are many examples where Salinas were abandoned after the decline of the salt market and they decided to adapt their structure and operation for the development of aquaculture activity. In a similar way, active artisanal Salinas could dedicate part of their facilities to the breeding and commercialization of semi-free-range fish, such as estuary fish with high economic performance.



Image 26. Salt facilities adapted for the breeding and cultivation of fish through the development of aquaculture.

### 6.3. Increase biodiversity and improve the state of conservation of the environment

Salinas are located in natural places and usually found in protected natural areas, often within environmental protection zones, such as SPA or SAC (Special Protection Areas for birds and Special Areas for Conservation), which implies that the salt extraction activity has helped to maintain habitats with the appropriate conditions for species of community interest within the Natura 2000 Network. The development of the salt extraction activity from an ecosystem perspective must consist of a strategy for the integration of the activity in the ecosystem in the broadest sense, in a way that promotes sustainable development, equity and the resilience of interconnected socio-ecological systems. It is currently recognized that artisanal Salinas can favour biodiversity and offer important ecosystem services in addition to food production, which can enhance their competitiveness if properly practiced. (Walton *et al.*, 2015; Soares *et al.*, 2018).

Moreover, in the Salinas ecosystem we can identify a wide range of ecosystem services in each of the three categories defined by the Common International Classification of Ecosystem Goods and Services (CICES) (Haines-Young & Potschin, 2010) (Fig. 19).

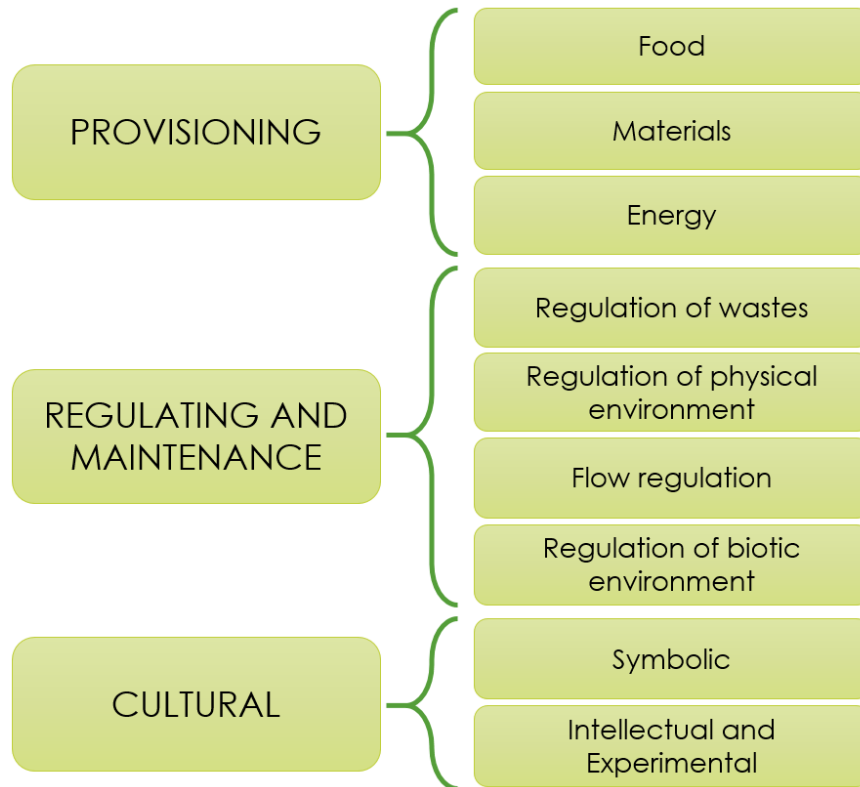


Figure 27. Scheme of ecosystem services provided by Mediterranean artisanal Salinas according to the Common International Classification of Ecosystem Goods and Services (CICES) for Integrated Environmental and Economic Accounting (Haines-Young & Potschin, 2010).

In a recent study published in 2018, up to 13 different ecosystem services classified in the CICES categories were identified in artisanal Salinas. In a bibliographic review, Soares *et al.*, (2018) identified ES related to the regulation and maintenance of the environment in 36.36% of the analysed studies. Of these studies, 100% describe ecosystem services related to the maintenance of biodiversity (especially providing habitats for migratory and aquatic birds). The second category in terms of scientific references found by these authors was that of the provisioning ecosystem service (22.73% of the studies reviewed), where the contribution of food is essential. The regulation of services appears in 18.18% of the consulted works, where the quality and maintenance of water together with climate regulation are the fundamental processes. Finally, 22.73% of the studies highlight the existence of cultural services of the Salinas, where tourism and historical value are revealed (Fig. 20).

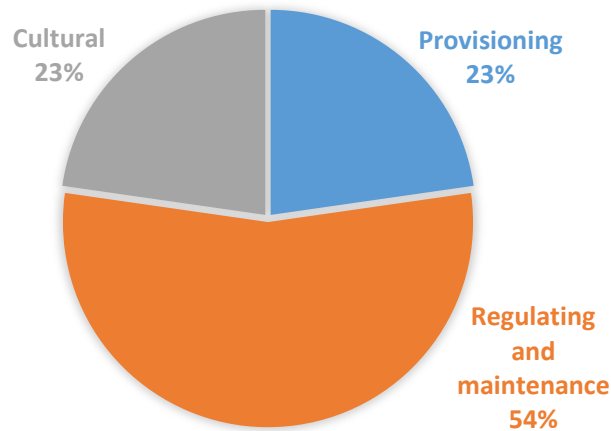


Figure 28. Percentage of ecosystem services provided by Salinas, from Soares *et al.*, (2018).

In summary, of all the ecosystem services provided by the salt flats, we would highlight:

**Provisioning service:** Direct harvest of salt produced by the evaporation of salt water. In addition, there are other secondary products that increase this provisioning ecosystem service, such as aquaculture, with the breeding of estuary fish, the cultivation of micro and macroalgae with various applications in the market.

**Reduction of flood risk:** Another ecosystem service provided by salt farms is environmental protection against erosion by the sea. The physical barrier provided by the outside walls and containment dams of the Salinas protects against erosion caused by seawater. In fact, this barrier may be a key element in mitigating the flood risk faced by many coastal cities.

**Recreation and leisure:** The Salinas provide a place of recreation and leisure for society. In fact, the walls and structures of many Salinas have been adapted to create trails for public or private use by the population for purposes of tourism and recreation.

**Species maintenance:** Last but not least, Salinas regulates and maintains the environment by housing numerous species of living organisms that are only able to survive in this highly specific, hypersaline environment.

**Blue carbon (BC) stock:** IUCN carried out a study on the role of the transformation of saltmarshes for salt production on carbon storage in saltpans (**Annex I of this report**). Salt marshes are considered to potentially absorb and store large quantities of carbon dioxide from the atmosphere, in addition to providing others ecosystem services (e.g., salt products, fishes or edible seaweeds). However, little is known about this role of saltmarshes for salt production on carbon storage in saltpans. Therefore IUCN studied blue carbon (BC) stock in an artisanal and in an industrial saltpan in the Cadiz Bay.





The results of this research indicate that tidal saltmarshes managed for salt production in coastal ecosystems contribute to the storage of BC stocks. This argument highlights the necessity to integrate human-managed salt pans with potential for BC storage within strategies for climate change mitigation, such as voluntary carbon credit mechanisms or carbon markets, to promote the management of human-shaped ecosystem with the aim of producing carbon sinks, along with other ecosystem services.

#### 6.4. Best practices to improve biodiversity in a Salina

As we have seen, the Salina is a place of extremes, where the sun and the wind are essential elements to achieve the evaporation of the salt water so that the salt precipitates. Few species are capable of adapting and surviving in these extremophile environments. These extreme conditions of salinity mean that Salinas are areas with highly specialized species but very little diversity. Organisms of particular interest can be found in these Salinas. Some have managed to adapt in order to regulate excess salt and avoid water loss, while some feed on other organisms that only grow in the Salinas. It is a singular and unique ecosystem.

##### 6.4.1 Flora

As regards the plant kingdom, plants can be found in the Salinas which have evolved through adaptation to avoid water loss, waterproofing their leaves by covering them with waxes to avoid drying out caused by excess salt in the environment.

Some of the best examples of characteristic flora in a Salina can be found in species such as *Limoniastrum monopetalum*, which excretes salt through special glands, the Quenopodiaceae family, which has stems compartmentalized into small 'sachets' where they store water or *Halimione portulacoides*, which stores excess brine in specialized organs.

Micro and macroalgae are found submerged in the brackish water. They are crucial to life on Earth as they provide us with much of the oxygen we need to breathe through photosynthesis. As unicellular organisms, microalgae have a much higher capacity for growth and biomass generation than higher plants. The diversity of marine microalgae species is immense, making these organisms a promising sustainable resource. On the other hand, macroalgae are a very characteristic biological element of Salinas. Thanks to their photosynthetic pigments, they capture solar energy and transform it into new chemical energy that flows throughout the food web. Macroalgae are the basis of new trophic chains and feed a large number of organisms in the Salinas: from small invertebrates to herbivorous fish. They also incorporate nutrients dissolved in the water and oxygenate it, thus contributing to the environmental quality of the Salinas.



## Flora improvement

As previously indicated, the characteristic flora present in a Salina plays a fundamental role in its functioning while providing potential alternative uses. Moreover, as indicated before, the development and cultivation of species such as micro and macro algae will improve and protect the biodiversity of flora in the Salinas.

To maintain or improve the flora of the saline, it will be necessary to maintain the circulation of water and the levels of salinity since they are very special species with a very limited range of salinity and flooding and when these are lost, the flora disappears.

In the same way, there is a need for control over the possible inclusion of exotic and invasive flora that could have produced negative effects on the native flora of Las Salinas because continuous monitoring of the Salinas is necessary.

### 6.4.2 Crustaceans, mollusks and fishes

The sediment of the estuaries in a salina, composed essentially of clays and small-grained sands, is the vital substrate for numerous species of benthic macroinvertebrates. This substrate retains the large contributions of nutrients (organic matter and nitrates) from the sea and from land, leading to high productivity. This substrate is fundamental to nemerteans, annelids, mollusks, crustaceans and insects. However, one of the most representative crustaceans of the invertebrate fauna in the Salina is the genus *Artemia*. There is increasing interest in the study of these crustaceans because their larvae are essential as food for the first larval stages of many species of fish and other cultured crustaceans in the different aquaculture facilities currently operating throughout the world. There are many species of the genus *Artemia*, such as *A. Parthenogenetica*, *A. salina* (*A. tunisiana*) and *A. Urmiana*, all of which are found in Europe.

Many species of marine fish have complex life cycles and go through different feeding phases depending on whether they are adults or juveniles. This means that certain habitats, such as drainage pipes of Salinas and salt marshes, are very important areas for the juvenile phase in many species of fish. In the case of tidal Salinas, once the fish have entered the estuary to increase in size and gain weight, they often remain there unable to return to open sea and the adults are extracted annually as fish production.

### Improvement for crustaceans, mollusks and fishes

The production of fish and molluscs through aquaculture is an emerging activity that is currently considered as the main alternative to the overexploitation of natural fishing resources worldwide (FAO, 2020). The adaptation of disused salt flats or part of the facilities of a salt works with salt exploitation is perfectly compatible and could yield benefits in a short period of time.



In most Salinas that dedicate part of their facilities to extensive aquaculture development, species such as sea bass and sea bream are produced, although mullet, sole, bream and expensive eels are also cultivated. Crustaceans are also farmed, although to a lesser extent.

These traditional primary activities, linked to the use of natural resources - saline and extensive traditional aquaculture of estuaries - are considered essential elements to guarantee the conservation of these resources, being in many cases, the factor that has shaped the landscape and enhanced natural values.

#### 6.4.3 Birds

Aquatic birds are the most striking or most characteristic animal group when we think of the fauna of a salina. The habitat provided by a salina is home to abundant populations of waterfowl, mainly flamingos, waders, and seagulls. As previously detailed, the Salina consists of different specific production zones, from the filling and decanting deposit areas or estuary, to the saline concentration zones and finally the crystallization zone. These different areas provide the Salinas with sufficient heterogeneity to host different groups of shorebirds. Several studies point to the Salinas as an alternative, viable habitat for the different life stages of birds in the face of the transformation of natural wetlands (Ma *et al.*, 2010). In fact, many species of waders are perfectly adapted to the Salinas, with similar eating habits in the Salinas and in their original wetlands. Many of them even make the Salinas their preferred habitats. It is estimated that 50% of the Mediterranean waders use the Salinas for food and many also use them for reproduction (Sadoul *et al.*, 1998).

The most important groups of aquatic birds found in the Salinas are flamingos, waders, herons, storks, spoonbills, gulls or birds of prey such as the osprey. These species of aquatic birds are particularly abundant during migration and wintering when the Salinas provide them food and rest areas. In addition, Mediterranean Salinas provide an ideal habitat for reproduction of other important bird species. This fact is of still greater relevance for species catalogued as Vulnerable or Endangered in the red list of threatened species by the IUCN, such as the Red-knobbed coot *Fulica cristata*, endangered in Europe or the Marbled duck *Marmaronetta angustirostris* listed as Vulnerable. At regional level, Salinas are also a priority habitat for threatened species included in the catalogues of the different countries. In the case of Spain, for example Salinas are very important areas for regionally threatened waders such as the Kentish plover *Charadrius alexandrinus*. More details can be found in the State of the art report, 3.1.1.

#### Improvements for birds

In relation to birds, Salinas are a fundamental element in their habitat, both for reproduction, food and rest for a very large group. The adaptation or management of different areas of the Salina could promote the use and/or settlement of different species of aquatic birds as a substitute habitat for their natural area.



### *Water level management to favour the feeding of waders*

On the one hand, the control of the water by the salt workers, provides areas with different levels of water depth and its salinity, which gives it great importance in terms of the survival of many birds, especially waders (Pérez-Hurtado et al., 1993; Pérez-Hurtado, 2004).

This water control can be carried out in the water reservoir areas that Salinas usually have, which have the function of storing the extra water from a Salina. Different zones with different water levels provide feeding areas for a great variety of aquatic birds adapted to exploit these differentiated zones.

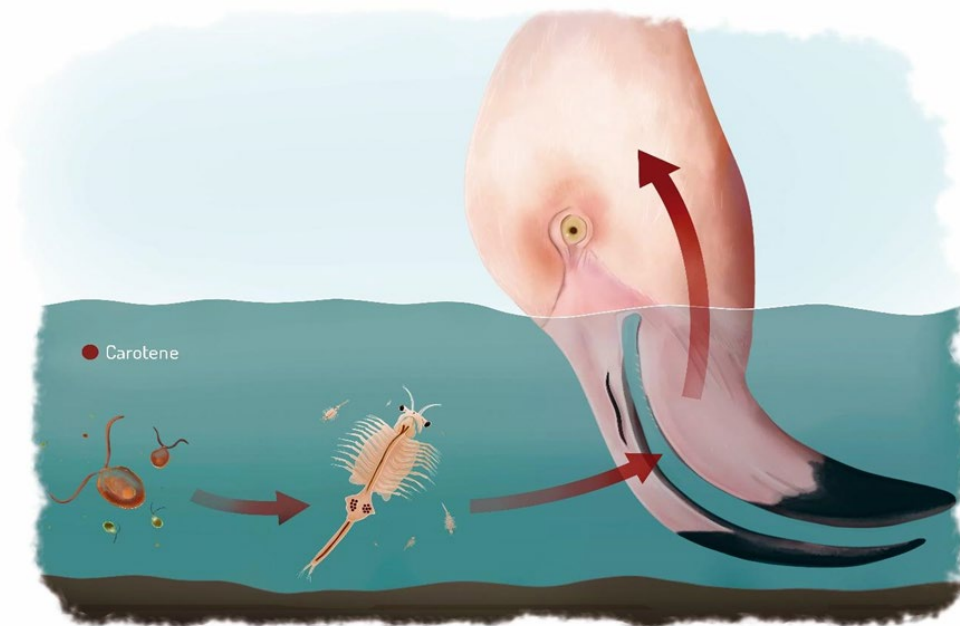
In addition, these reservoirs can also be used for aquaculture purposes, where those areas with greater water capacity can be used for the rearing and fattening of different species of fish adapted to brackish waters (Pérez-Hurtado, 2004).

This water management should not present compatibility problems with the extraction of salt, since the time of greatest abundance of birds in Salinas occurs in the winter months, when the salt production activity decreases due to less solar radiation and the absence of dry winds that promote the evaporation necessary for accumulation. It is therefore in these winter months where the water levels in the different areas of a Salina could be managed to increase accessibility to the birds that use this habitat, thus increasing their number of birds and their diversity (Broche, 2006; Holm y Clausen, 2006; Bolduc y Afton, 2009; Pérez Hurtado y Hortas, 2009).

Some authors recommend keeping the water levels small during the winter months, with a maximum depth of approximately 4 cm in the crystallizers, a maximum of around 20 cm in the evaporators and a maximum depth of around 40 cm in the estuaries and reservoirs, all with a few gradually sloping banks to improve accessibility (Castro *et al.*, 2014). In particular, different sizes of species will better exploit different environments and depths.

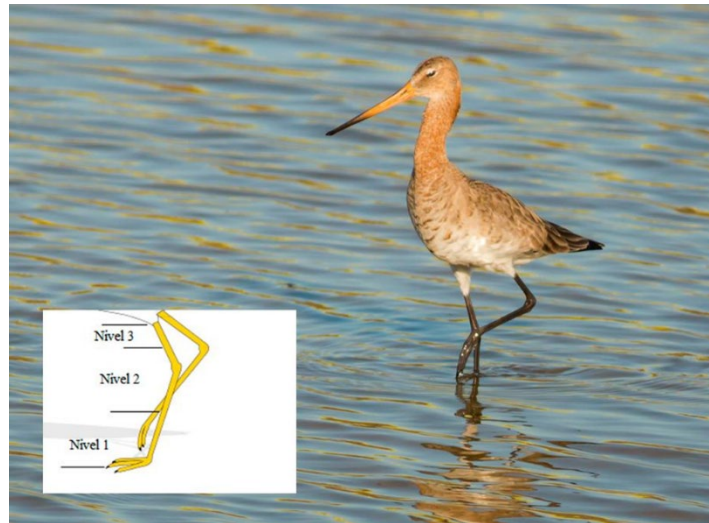
#### **Large size birds**

Regarding the level of water in which large species (flamingo and spoonbill) feed more favourably in a saline, we find that this level ranges between 10 and 37 cm. It may be surprising that in some studies we find very small feeding depths, as in the case of the common flamingo (Britton *et al.*, 1986), however, this species has as one of its preferred prey the genus *Artemia*, an anostracean capable of living in very high salinities and that during the day is distributed equally throughout the depths of the pond. Therefore, although the common flamingo has the ability to feed in high levels of water depth, it does not always choose them because its preferred prey is more accessible at lower levels. This could be one of the reasons why there is such a wide range possible for its intake, from 10 to 40 cm (Britton et al., 1986; Pérez-Hurtado, 2004).



### Medium size birds

Something similar occurs in the medium-sized birds described in this study that never exceeded 15 cm in depth. In fact, except for the Black-winged stilt, which can feed in a depth of up to 14 cm (Ntiamoa-Baidu *et al.*, 1998) for the rest, no studies have been found where a feeding exceeds 10 cm deep is depicted. However, depending on the type of preferred prey of each bird, it can make variations in the choice of the depth of its feeding that will be more or less wide depending on its morphology (Ntiamoa-Baidu *et al.*, 1998).



### Small size birds

Small birds, as expected, are those that, due to their morphology, have a lower water depth range for their food. All the studies find them feeding between 0-4 cm deep, so when choosing the habitat for these species it will be decisive that these levels occur. The Salinas that provide these water levels, therefore, will attract a greater diversity of birds by the mere fact of being accessible to all small specie (Broche, 2006).





In addition, some authors recommend for similar habitats (artificial saline swampy ponds) the construction of additional ponds that alternately maintain the levels conducive to smaller birds (Bolduc and Afton, 2009). In the case of Salinas that already have this type of additional ponds, this technique of rotating temporary drains could be encouraged to maintain said levels with shallow water depth. If this rotation system were maintained year after year, it would increase the predictability of these habitats and therefore their use by birds.

#### *Active management measures to promote the reproduction of waders in Salinas*

On the other hand, Salinas are fundamental reproduction areas for many waders, and in this sense, different actions carried out in the salt works can favour the settlement and reproductive success of these species.

1. **Clearing** the walls to improve the visibility of the birds against predators and therefore increase the area available for breeding
2. **Contribution of calcareous substrate** (shells) to promote the use of the area as a breeding area, following what the scientific literature proposes in that in many cases there may be a carbonate deficit for egg formation and a contribution of this substance can benefit species settlement (Fig 21).
3. **Contribution of microstructures** to promote reproduction. This action consists of the contribution of small Y-shaped sticks, which has been proposed in the scientific literature as an improvement to favour the settlement of some species such as Kentish plover nests (Fig 22).
4. **Improvement in the control of water levels** in the Salina, which allows a more efficient management in terms of water levels, salinity and, therefore, increased biomass and accessibility of potential bird prey.



Figure 29. Images of Little tern, Kentish plover and Pied avocet nests respectively located on the provided shells.

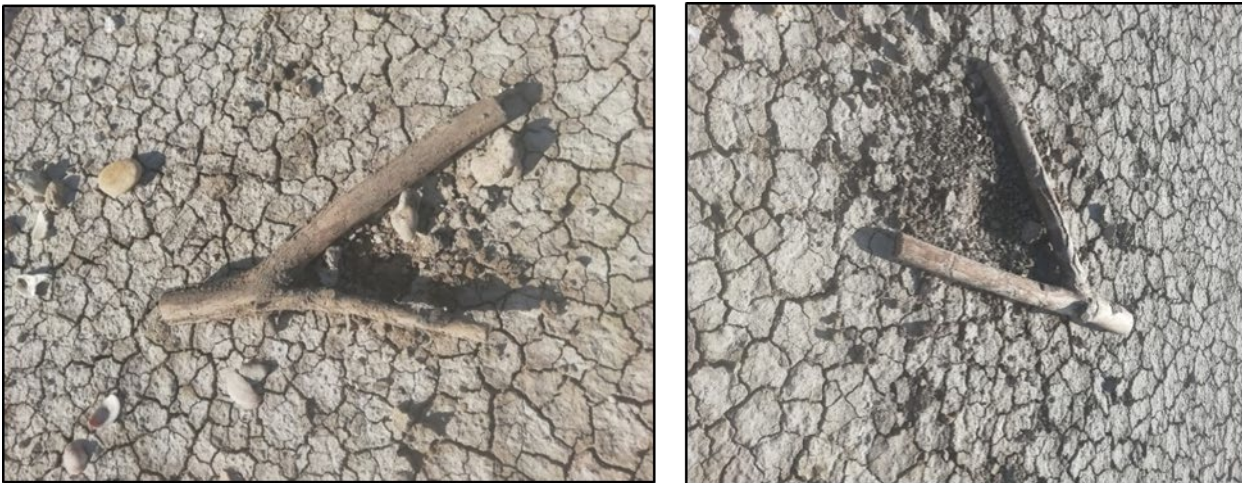


Figure 30. Base images (first phase of nest construction) of Kentish plover on the Y-shaped microstructures provided.

These management actions have been tested in artisanal Salinas such as Salina de la Esperanza in Puerto Real (Cádiz, Spain) with successful results far exceeding initial expectations. The response only a few months after



the completion of the actions was immediate with the nests setting of different species such as Kentish plover, Little tern and Pied avocet, increasing the number of nests estimated in previous seasons.



Image 31. Kentish plover

chicks and egg in the nest.

More details on Biodiversity of Salinas are available in report 4.1.3, testing different management schemes for enhancing biodiversity in salinas.

## 6.5. Improving marketing in Salina

The artisanal salt market is an interesting niche that has grown significantly in recent years and where the business opportunities are encouraged by the fact that the control of the distribution channels is much lower than the industrial salt one. In the global market, the demand for gourmet salts is increasing in meat, poultry and fish products. People are beginning to see gourmet salt as a way to recover Salinas.

However, after the Benchmarking analysis (see report A.3.1.2) we discovered that one of the main difficulties for Mediterranean artisanal Salinas was the commercializing of their products internationally. Almost all of them sell their salt and extra products at a local or national level, without associating with other companies or producers. Consequently, the gourmet salts market is highly fragmented and highly competitive, with a large number of small local players and few global players.



Through research (See Marketing plan and strategy report, A 5.1.3.), MedArtSal has defined some strategies for companies interested in developing innovative marketing ideas in order to globalize their products:

- **Price:** the price has to respond to factors like the positioning of the brand, the variety of salt or the packaging used.
- **Cooperative:** MedArtSal proposes and encourages the association of the different companies of Salinas in a cluster through which to develop, promote and commercialize products and services.
- **Brand:** a brand with an ecological, gourmet, exclusive and global nature under which the products developed by MedArtSalt cooperative Salinas would be commercialized has been suggested. The brand logo is presented in Figure 23.



Figure 32. Brand logotype of MedArtSal.

- **Packaging:** The design of salt packages is very important so that companies can differentiate their products from others and gain the attention of consumers, ensuring that their product ends in the shopping cart.



Figure 33. Graphic examples of packaging designs.

- **Distribution channels:** Salinas may use different channels strategies from direct sales to long channels including importers, distributors, wholesales, retail, HORECA (Hotels, Restaurants and Catering) and others.
- **Promotion:** it is essential to combine traditional and digital strategies, since the internet channel has the greatest interest for the commercialization of the potential products generated in Salinas. All this must be reinforced through products and services promotion campaigns. Some useful ideas of promotion are shown in the Figure 25.



Figure 34. Promotional strategies for products and services developed in Salinas.

## 6.6. Governance in Salinas

The management of Salina areas in the Mediterranean is not regulated under a common European framework. In fact, the management of Salinas, production and marketing may present notable differences from one country to another, even coming to depend on different organisms of different nature, such as mines,



agriculture or the economy. In table 6, we summarize the most relevant aspects in relation to the most important aspects related to governance in Mediterranean salt flats in the countries participating in the MedArtSal project.

Table. 6. Main aspects related to governance in the MedArtSal project countries

Country	Ministry/Department facilities	Area/Sector	Permissio n	Time and regulation	Salt products
Spain	Ministry for Ecological Transition and Demographic Challenge	Energy / 'Mining and Explosives'	Yes	Most of them under concession period of time	Technical-Sanitary Regulations
	Ministry of Finance		Yes	Each year	
	Ministry of Public Works and Transport (if public domain)		Yes		
Italy	Ministry of Economy and Finance	Agenzia del Demanio (State Property Agency)	Yes	Most of them under concession period of time	
	Regional Department of Industry (Sardinia and Sicily)		Yes		
Lebanon	Ministry of Finance		Yes		
	Ministry of Transportation and Public Works		Yes		
Tunisia	Ministère de l'Energie , des Mines et de la Transition	Direction Général des Mine	Yes	Most of them under concession period of time	Monthly and annual report of the works carried out and the quantities produced and sold during the financial year

### Improving Governance

A more detailed analysis of the different aspects related to governance are provided in the report: A.3.4.2 'Drawing up guidelines for policy development contribution at national and Med level'.

However, in general, the salt sector advocates some basic lines that improve governance in its economic activity, such as:

- Unify the salt exploitation within a single department or ministry, such as agriculture.
- Simplify the number of steps to obtain the corresponding authorizations.
- Development of administrative simplification regulations.

## 7. Testing the Model

The MedArtSal model has undertaken a comprehensive assessment of Artisanal Salinas in the Mediterranean region, with the objective of enhancing their sustainability and central to this effort is the Salinas Sustainability Index (SSI). Based on shared information among project tasks, SSI was created as a practical tool for salt owners and managers to evaluate the sustainability of a salina in terms of economy, environment, and innovation. The SSI is the quantitative tool for the model application, and in this phase for the model evaluation.

As already said and described in OT3.2 deliverables, the SSI has been developed to be used as a general index, taking into account all the 22 variables, but it can also be employed in three separate sub-indexes, which can provide information on specific aspects of Salinas: socio-economic, environmental and diversification/innovation sub-indices.

**SSI (100%): SOCIOECONOMIC (50%) + ENVIRONMENT (30%) + DIVERSIFICATION (20%)**

The first assessment was conducted in 2020 and the resulting 15 SSI values can be seen in Table 1.

Table 1 Sustainability index of the Mediterranean Salinas evaluated in 2020.

Salina	Socio-Economic Index	Diversification Index	Environmental Index	SSI	SSI (%)
El Aguila	57	0	84	141	53.7
Saline San Vicente	84	22.5	49	155.5	61.2
Saline Santa María de Jesús	81	15	77	173	66.6

Marchamalo	21	22.5	70	113.5	36
Preciosa y Roqueta	43	15	63	121	43.4
Hafez Jreij	79	0	35	114	50
Abdallah Khoury	25	0	14	39	16.7
Georges Sleiman	47	7.5	35	89.5	35.5
املاحن فرعةن بجاية	44	0	35	79	32.5
جورج النجار (Al-Najjar Salinas)	39	0	21	60	25.8
Elias Sleiman	55	0	21	76	33.8
وحيد نخول	45	0	42	87	35.1
Malek	45	0	28	73	30.9
Saline de belayal	42	0	21	63	27.3
Le Salina di Lingua	9	0	63	72	23.4
<i>Hypothetical salina with the highest score</i>	125	45	105	275	100

For three years, 15 Salinas have been supported by the project in order to delve into their sustainability enhancing activities like product diversification, restoration or environmental conservation. This part of the report presents the results of the SSI survey conducted in June 2023 among some of the sub-granted salt owners, aimed at investigating the efficacy of the MedArtSal project's actions in promoting sustainable practices and their impact on the overall sustainability of these unique coastal ecosystems.

## 7.1. Results

Six salt owners have answered the survey, which allowed us to calculate their SSI (Table 2).

Table 2 Sustainability index of the Mediterranean Salinas evaluated in 2023.

Salina	Socio-Economic Index	Diversification Index	Environmental Index	SSI	SSI (%)
San Vicente	105	7.5	42	154.5	66.6
Marchamalo	15	0	98	113	36.9
Preciosa y Roqueta	75	45	63	183	65.4
Georges Sleiman	62	30	42	134	49.6
Blanc Sel Al Najjar artisanal Salinas	83	22.5	35	140.5	56.5
Malek	69	30	63	162	59.4
<i>Hypothetical salina with the highest score</i>	125	45	105	275	100



The results showed interesting progress in the efforts of these coastal salt producers to adopt sustainable practices. A comparison between 2020 and 2023 SSI (Table 3) will allow us to assess the progress in their efforts towards achieving greater sustainability in salt production, considering key aspects such as economic development, activity diversification, and environmental conservation measures. Here we closely analyse emerging trends and significant achievements of each Salina, providing a comprehensive insight into the positive impact that the MedArtSal project has had in promoting more sustainable practices in the Mediterranean region.

As for Spanish producers: San Vicente made notable progress, increasing its %SSI from 61.2 to 66.6. Though experiencing a slight drop in the economic aspect, they showed significant improvements in diversification and environmental practices. Marchamalo's SSI had a slight increase from 36% to 36.9%, mainly due to their focus on enhancing environmental measures. Preciosa and Roqueta stood out with impressive growth, raising their SSI from 43.4% to 65.4%. Their dedication to improving both their economic performance and diversification initiatives was evident. As for Lebanese salt owners: Georges Sleiman Salinas also demonstrated improvement, increasing their SSI from 35.5% to 49.6%. They made strides in various areas to boost overall sustainability. Al-Najjar Salinas showed remarkable progress, doubling their SSI from 25.8% to 56.5%, thanks to their dedicated sustainability efforts. Lastly, Malek Salinas almost doubled their SSI, achieving 59.4% compared to the initial 30.9%.

Table 3 Comparison of the indices calculated in 2020 and 2023.

Salina	SSI (%)		sustainability improvement
	2020	2023	
San Vicente	61.2	66.6	+
Marchamalo	36	36.9	=
Preciosa y Roqueta	43.4	65.4	++
Georges Sleiman	35.5	49.6	++
Blanc Sel Al Najjar artisanal Salinas	25.8	<b>56.5</b>	+++
Malek	30.9	59.4	+++
<i>Hypothetical salina</i>	<i>100</i>		

Overall, although not all the sub-granted Salinas have answered the SSI evaluation survey after the pilot action activities, by the answers gathered so far it can be said that all of them are showing positive steps towards becoming more sustainable, and the Salinas Sustainability Index has played a crucial role in guiding their efforts. Their dedication to sustainability is contributing to a brighter future for the Mediterranean coastal ecosystems.



## 8. Conceptual summary of the sustainable model for artisanal Salinas

As a summary and conclusions of all stated in the previous paragraphs, we graphically show the main conclusions about the fundamental aspects to develop in order to achieve a Sustainable Mediterranean Salina.





## 9. References

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## Annex

### Accessibility, Mobility and Inter-Modality:

- Latvian Greenways Network

<https://www.interregeurope.eu/policylearning/good-practices/item/3795/latvian-greenways-network-new-and-unique-product-for-visitors/>

- Promoting accessible Tourism in Mallorca Island

<https://www.interregeurope.eu/policylearning/good-practices/item/3915/promoting-accessible-tourism-in-mallorca-island/>

### Business Networking and Cooperation:

- Plums as connecting link in the development of the tourism in the Szatmár Region

<https://www.interregeurope.eu/policylearning/good-practices/item/2396/plums-as-connecting-link-in-the-development-of-the-tourism-in-the-szatmar-region/>

- Well-O-live: The Road to Wellness - <https://go.coe.int/vgvTm>

### Certifications and Awards:

- Iter Vitis Award - <https://go.coe.int/y7mat>

- ViniPortugal: development of a best practice manual in wine tourism in Portugal

[https://www.researchgate.net/publication/331201822\\_Development\\_of\\_a\\_best\\_practice\\_manual\\_in\\_wine\\_tourism\\_in\\_Portugal](https://www.researchgate.net/publication/331201822_Development_of_a_best_practice_manual_in_wine_tourism_in_Portugal)

### Cultural Heritage Tourism:

- Atlante dei Cammini (Trails Atlas)

<http://www.enicbcmmed.eu/crossdev-culture-and-sustainability-local-action-plans>

- Revitalisation of a closed coal mine into a living science and art centre (Walbrzych)

<https://www.interregeurope.eu/policylearning/good-practices/item/803/revitalisation-of-a-closed-coal-mine-into-a-living-science-and-art-centre/>

### Gastronomic tourism:

- Honey Routes in rural Larnaca (Cyprus)

<https://medfest.interreg-med.eu/sustainable-gastronomy-experiences-of-the-mediterranean/honey-routes-in-rural-larnaca-cyprus/>

- The Öland island Harvest Festival (Sweden)

[https://ec.europa.eu/regional\\_policy/en/projects/Sweden/the-Oland-island-harvest-festival](https://ec.europa.eu/regional_policy/en/projects/Sweden/the-Oland-island-harvest-festival)

### Digitalisation and ICT:



- Riberana - online experiences to visit natural routes and museums

<https://www.interregeurope.eu/policylearning/good-practices/item/3905/riberana-online-experiences-to-visit-natural-routes-and-museums/>

- Comunitat Valenciana - <https://alter-eco.interreg-med.eu/index.php?id=9040>

#### Nature Tourism:

- Sandhill Crane Festival (Lodi, California)

<https://cranefestival.com/overview.php>

- Eco-Adventures of Sam the Squirrel

<https://www.interregeurope.eu/policylearning/good-practices/item/3799/eco-adventures-of-sam-the-squirrel/>

#### Sport and Wellness Tourism:

- Fishing Tourism in Cyprus An alternative way to learn traditional fishing culture

<https://www.interregeurope.eu/policylearning/good-practices/item/2519/fishing-tourism-in-cyprus-an-alternative-way-to-learn-traditional-fishing-culture/>

- Sauna Region of the World (Central Finland)

<https://www.interregeurope.eu/policylearning/good-practices/item/4323/central-finland-sauna-region-of-the-world/>

#### Other activities (e.g. education, entertainment, events):

- Green boat (Prespes Lakes)

<https://www.interregeurope.eu/policylearning/good-practices/item/2538/green-boat/>

- Sambuca di Sicilia

<http://www.enicbcmmed.eu/crossdev-sambuca-di-sicilia-less-known-tourist-destination-virtuous-example-good-practices>

#### Websites:

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- Batz sur Mer (France) - <https://en.labaule-guerande.com/visit-salt-marshes-museum-batz-sur-mer.html>
- Camillone saltpan (Cervia) - <https://www.turismo.comunecervia.it/it/scopri-il-territorio/ambiente-e-natura/parchi-riserve-naturali/la-salina-di-cervia>
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- Nin Salt Works Park in Croatia - <https://www.solananin.hr/en/home/>
- Piran Salt Pans in Slovenia - <http://www.soline.si/en>
- Salgado de Aveiro in Portugal - <https://salinasaveiro.com/>
- Salinas de Añana (Spain) – <https://vallesalado.com/SALT-VALLEY-HOME>
- Terre de Sel (France) - <https://en.labaule-guerande.com/visit-terre-de-sel-guerande.html>
- Unirea Salt Mine in Romania - <http://www.romanianmonasteries.org/romania/salt-mine-slanic>
- Wieliczka Salt Mine in Poland – <https://www.wieliczka-saltmine.com/>
- Zigong salt mine in China - <http://www.zgshm.cn/English.html>