

CURRENT SITUATION AND DEVELOPMENT PROSPECTS FOR MARICULTURE IN THE REPUBLIC OF CROATIA

Helena Volarić, mag. ing. traff., Assoc. Prof. Ines Kolanović, Full. Prof. Tanja Poletan Jugović
University of Rijeka, Faculty of Maritime Studies
E-mail: volaric@pfri.hr, ines@pfri.hr, poletan@pfri.hr

Abstract: *Mariculture in the Republic of Croatia has a long tradition involving cultivation of white fish, oil-rich fish and shellfish. It is an interesting fact that in Europe cultivation had started in the territory of the Republic Croatia where it has been maintained until today. As the Republic of Croatia has joined the European Union, it has gained access to numerous opportunities for further development and progress of this activity. The Republic of Croatia has adopted the National Strategic Development Plan of Fishing in compliance with provisions of the Council Regulation (EC) No. 1198/2006 on the European Fisheries Fund whereby strategic and development guidelines for this activity are provided for the period 2014 -2020, in harmony with the Common Fisheries Policy.*

The aim and purpose of this work is to analyze the current state of mariculture in the Republic of Croatia and to give a comparative presentation of this activity within the European Union, as well as to estimate prospects for the development and positioning of mariculture of the Republic of Croatia within the European Union member states.

KEYWORDS: AQUACULTURE; EUROPEAN UNION; MARICULTURE; REPUBLIC OF CROATIA, COMMON FISHERIES POLICY

1. Introduction

Nowadays, mariculture as a branch of aquaculture and an important segment of fishing activity is increasingly emphasized by its importance. Farming of marine organisms, especially fish and shellfish, seeks to compensate for their ever smaller presence in the Adriatic Sea. Due to excessive fishing beyond the prescribed quotas, which is increasingly threatening the sustainability of the ecosystem, the Adriatic Sea has been rather depleted of the stock of marine organisms. Globally speaking, mariculture is considered one of the most propulsive activities, in particular in the southern Mediterranean. The advantages of the Adriatic Sea are particularly evident in natural predispositions such as numerous coves, channels and bays, suitable for the development of this activity, in addition to climatic conditions that favor faster and more efficient cultivation of fish and shellfish.

According to the Treaty of Rome, a Common Fisheries Policy (CFR) has been adopted with the main objective to ensure sustainable fishing and to secure income and steady jobs. Its main feature is to ensure fishing activities by contributing to sustainable long-term prerequisites concerning the environment and at the same time contributing to economic and social development [1]. In Croatia, mariculture contributes significantly to the survival of sensitive island communities, where it is socially fully accepted and where it represents one of the activities that provide continuous jobs throughout the year, thereby enhancing the tourist offer. Its importance is reflected in the fact that artificial farming in ecologically acceptable fish farms reduces the fishing rate of marine organisms. The basis of modern achievements in all sectors is the disclosure of information to the public with the aim to raise public awareness of the importance and significance of mariculture. The system of product certification and labeling as well as the production of information materials are the basis for success in the wider public. At present, the perception of mariculture still bears a negative sign, except in areas where there is no clean sea and people are accustomed to fish farming. Due to insufficient information on farming products, the vast majority of the public does not understand the fact that the nutritional value of breeding products is still stable and therefore 8 out of 10 people prefer 'wild fish' to farming products, maintaining that cultivated fish is fatter, softer and less tasty.

Within the common goal of all EU countries, priorities have been defined regarding the preservation of fishing resources, fisheries control and enforcement of fisheries regulations, structural assistance in fisheries, producer organization and joint market regulation, international relations and aquaculture. One of the structural and investment funds for the period 2014-2020 is the European Maritime and Fisheries Fund (EFPR). The Fund is an important financial instrument to support the EU Common Fisheries Policy. Apart from its importance to promote sustainable fisheries, control and implementation of data collection, the EFPR supports the achievement of the goals of tackling maritime and coastal area management issues, support for scientific research to increase

knowledge of the sea and spatial planning of the coastal area, at the European Union level. Accordingly, each Member State is allocated a share out of the total budget of the Fund, depending on the size of its fishing sector. With the access to the European Union, the Republic of Croatia has been opened the door to the international market, guaranteeing quality, greater employment rate, cross-border cooperation and the prosperity of small producers through access to the global market.

2. Analysis of the actual position of mariculture in the Republic of Croatia

Mariculture is mostly represented in the Republic of Croatia in the areas of the Split-Dalmatia and the Zadar County, although other coastal counties are also represented. In these areas, there is significant cultivation of the Atlantic blue tuna (*Thunnus thynnus*), gilt-head (sea) bream or orata (*Sparus aurata*), sea bass (*Dicentrarchus labrax*), while ostriches (*Ostrea edulis*) and mussels (*Mytilus galloprovincialis*) [2] are most distinguished among shellfish. For bivalve breeding, a great control of the sanitary conditions is necessary. The coastline of the eastern Adriatic, rich in channels, coves and bays protected from the action of waves and winds, is an ideal area for breeding in floating cages. Cultivation of Mediterranean oysters (*Ostrea edulis*) has the longest tradition along the Adriatic coast. Yet, mussel farming is considerably more represented in the Republic of Croatia than the oyster farming. The problem currently faced in the Republic of Croatia in the field of mariculture is the absence of shellfish nursery grounds, which implies the need for the necessary technology for the production of young oysters. The end product of traditional oyster breeding methods reaches a higher price on the market since owing to the protected designation of origin and the authenticity of the product. The cultivation of tuna is specific to the development of Croatian fisheries, as mariculture had started with its breeding. According to the data presented in Table 1, the total mariculture production in 2017 was 13,843 tons, which slightly exceeds the one of the preceding year, 2016. The largest share of production in mariculture belongs to sea bass and gilthead of 5,616 tons and 4,830 tons respectively. Interestingly, the eastern coast of the Adriatic is more favorable for breeding the sea bass. Tuna farming recorded increases and decreases in the production of these organisms in the observed period. The highest quantity of tuna was cultivated in 2016, to fall in 2017 to the smallest rate in the whole period since 2013 to only 2,162 tons. It is assumed that the differences in production in certain years were conditioned by the market demand.

According to available data, it is estimated that there are about 700,000 oysters grown annually in the Malostonski Bay. Finished products are sold on the domestic market, out of which almost 90% in the area of the Dubrovnik-Neretva County, where they play a significant role in the hospitality sector and in the trade with domestic employers. The Malostonski Bay is economically the most viable field for shellfish farming because the breeding products are

used in tourism and gastronomy. Sea shellfish breeding also takes place in the areas of Limski Channel, the Pula and Pirovac Bays and the Klimno Cove respectively.

Table 1: Total mariculture production 2013 - 2017

Species	2013.	2014.	2015.	2016.	2017.
Mussel	1950	714	746	699	920
Oyster	50	32	52	64	62
Shaping cap			0.016	0.06	0.04
Tuna	2616	2224	2603	2934	2162
Sea bass	2826	3215	4075	5310	5616
Sea bream	2978	3655	4488	4101	4830
Hama	44	60	67	125	253
Dentex	6	49	4	1	
Trout	4	13			
Rhombus		0.5			
Pagar		40			
Total (t)	10474	9960	12043	13235	13843

Today's export price for sea bass is 5.16 EUR, and it is important to add that until 1 July 2013 EU-export was limited by duty-free quotas, which had a considerable impact on export itself. Mariculture as an activity provides great opportunities for employment on islands, thus contributing to the stability of employment and the expansion of the tourist offer. It is important to note that Croatia had declared ZERP before having entered the European Union, in order to maintain its sovereignty over a certain part of the Adriatic Sea, the total surface having thus reached over 31,067 km² of territorial waters.

According to the data kept by the Register of the Republic of Croatia Ministry of Agriculture for 2014, there were 159 fish farmers, out of which 33 white fish breeders and 4 tuna breeders [3]. There were 345 fish farming locations in total, 267 of which were used for shellfish farming, 49 for white fish farming, 10 were designated for polyculture, 15 for tuna breeding, while only 4 locations were used for white fish nursing ground. Cage fish farming in Croatia is one of weaker links in the Republic of Croatia due to its underdeveloped condition in terms of technical and technological correctness. Another significant issue concerns a small number of remedies that could pose a threat to the further development of mariculture. The Republic of Croatia is not significantly positioned in mariculture, which can be seen in a way as an advantage where the occurrence of major damage and illness is involved. For future imports of fish fry, breeders should be linked to veterinary services as to prevent the risk of diseases. Generally speaking, the demand for fish and other marine organisms has been increasing on a daily basis. Our market has been increasingly promoting fish and shellfish farming because the sea is significantly depleted of marine organisms. The prices of marine products have a steadily growing trend and therefore the production demands increasing investments in the infrastructure and ecological stability. Quality mariculture greatly contributes to economic, social and environmental well-being, which is why it must be based on a well-developed infrastructure, properly qualified and professional human resources and well-regulated market.

3. Comparative analysis of mariculture in the Republic of Croatia and EU countries

The objective of the Common Fisheries Policy (CFP) is to enable aquaculture and fisheries to contribute to a sustainable and long-term environmental-related concept that is needed for economic and social development. Owing to the common market arrangements, the Republic of Croatia, as well as many other EU member states, has harmonized the balance between supply and demand. The prices of import and export products are determined according to the rules that are equal for all countries. The common fisheries policy should contribute to increased productivity, an adequate standard of living and stable markets, and should ensure resource availability and affordability of the offer to consumers at

reasonable prices. The European aquaculture compared to the global one shows that the trend in Europe is noticeably worse. The European aquaculture is leading in 4 species: mussels (39% of total volume), trout (15%), salmon (14%) and oysters (8%).

The Republic of Croatia has a share in the total production dominated by mussels breeding with 920 tons, followed by 62 tons of oysters in 2017. In a slightly smaller quantity, other types of organisms are produced such as bass and smooth or brown Venus-clam. The main producers among the EU member states in the aquaculture sector are Spain (22%), France (17%), United Kingdom (16%), Italy (13%) and Greece (8.5%), and their production in 2011 represented 77% of total production in aquaculture.

With respect to product value, the leading producers are the United Kingdom (21%), France (19%), Greece (13%) and Spain (12%).

The production of each country depends on the tradition of fish farming, the development of the area and indentedness of coastal areas. Croatia's production differs greatly from that of Italy. In Croatia and Greece, intensive production is used in areas where coastal zones are protected, while production in Italy comes from extensive and semi-intensive cultivation in lagoons. Extensive farming means any production based on the development of organisms not stimulated by additional feeding. Intensive farming system includes breeding techniques mainly aimed at and featured by the establishment of highly controlled farming, which implies control of the area where certain species are grown. The offshore method is applied in countries such as France and Spain and in island countries like Malta and Cyprus where such a method has been fully accepted.

The EU fishing industry is the fourth largest in the world and it supplies the fish market with approximately 6.4 million tons per year. There are approximately 350,000 persons employed in the fish processing and fish farming sector. To provide sources of fishermen's income and at the same time to end overfishing and depletion of fish stocks are precisely the goals of the Common Fisheries Policy implemented by the European Union. Fisheries, as a branch of agriculture, play an important role in the economy of European Union countries, especially in coastal localities where it contributes to employment and economic activities. In some European countries more than half of the jobs refer to the fisheries sector. In Spain, it employs a quarter of the total number of workers, while in Italy, Portugal and Greece taken together it employs 70% of the total number of employees in EU fisheries. The aquaculture sector employs 85,000 people and also contributes to socio-economic prosperity. Fish farming production is 1.25 million tons, which makes 20% of total production in EU fisheries and 1.5% in the world. The European Union fish farming is placed seventh, the aquaculture production relying mostly on crustacean farming, followed by seawater and freshwater fish farming. Leading countries are Great Britain, France, Spain, Italy and Germany, the major portion of the production consisting of canned fish, crustaceans and mollusks.

Table 2 shows the aquaculture production by the country in the period 2011 - 2015. All the countries feature a notable increase in the production, while the Republic of Croatia was close to the production in Sweden. Compared to 2014, production increased by 2,700 tons, which is obviously attributable to the development preceded by the Common Fisheries Policy. Great Britain and Greece occupy the top of the chart, followed by Italy, Spain and Germany.

Table 2: Aquaculture production by the country in the period 2011-2015

Country	2011.	2012.	2013.	2014.	2015.
UTD.KINGDOM	161033	175292	174,897	178417	201578
GREECE	111217	116073	125,58	115200	112159
SPAIN	61992	59920	55694	59356	64186
ITALY	64781	58100	57590	57990	55480
FRANCE	45980	44540	40205	41641	44595
DENMARK	38653	33552	39281	38934	38829
POLAND	28745	32524	33535	37070	38590
CZECH REPUBLIC	20448	19462	18201	19092	19113
GERMANY	16467	15155	16150	16449	15341
HUNGARY	15434	14477	14251	14378	16124
FINLAND	9220	9000	9954	12448	12500
IRELAND	13434	13434	12450	11400	12000
SWEDEN	11963	12441	11657	11144	11144
CROATIA	10687	8822	8512	10201	12903
NETHERLANDS	6150	5620	6305	6305	6305
PORTUGAL	5130	7000	3635	5760	5919
CYPRUS	4665	4313	6171	4810	5409
AUSTRIA	2823	3007	3121	3128	3128
Grand total (t)	628731	632732	637189	643723	674493

Table 3 shows the aquaculture production, where it is obvious that the sea bream and sea bass prevail in cultivation. In the period between 2013 and 2015, production was increased by almost 3,500 tons.

Table 3: Aquaculture production by the species 2013-2015

Croatia Species	Production(t)		
	2013.	2014.	2015.
Sea Bream	2466	3640	4500
Sea Bass	3014	3500	4500
Common Carp	2100	2100	2100
Portion Rainbow Trout	350	361	400
Silver Carp	350	350	315
Grass carp	200	200	200
Total	8480	10151	12015

The lack of capacity of the hatcheries and poorly developed infrastructure are the weaknesses of mariculture but also of aquaculture in general. Poor cooperation between the science and production sector makes the weakness of mariculture in the Republic of Croatia, which is to the largest extent related to the prevention and treatment of young organisms. What is beneficial for the Republic of Croatia are the European Structural Funds that are based on environment-friendly farming and encourage small producers to join the large European market. Having joined the European Union, Croatia has been opened numerous doors with regard to various funds, education and cooperation with foreign institutions, as well as to information from foreign institutions related to particular areas of food, which can represent the competitive advantage of products and improve consumer perception. Although mariculture plays a significant role in increasing employment, it also plays an important role in preserving fish stocks and increasing consumption of cultivated marine organisms. Collaboration with processors enables development of potentials for ever increasing competitiveness. Mariculture as part of the Blue Growth 40 strategy means an association of all institutions, Member States and producers to overcome challenges and ensure sustainable development and production and therefore its development is an important factor in achieving the EU development strategy by 2020 [4].

The European Commission proposes for the support of the maritime industry to be strengthened in comparison to the period from 2014 to 2020, taking into consideration the high potential of this sector whose world production is estimated at 1.3 billion EUR

which could be doubled by 2030. Coastal communities will be allocated greater support for establishing local partnerships and technology transfer across all "blue economy" sectors, including aquaculture and coastal tourism. The European Union has committed itself to making the sea and the oceans safer, with a higher quality of cleanliness and sustainable management at the international level, within the framework of the United Nations Sustainable Development Program for 2030. The new European Fisheries and Maritime Fund will, among other things, provide the necessary resources to improve maritime surveillance, security and coast guard cooperation.

The European Fund for Maritime Affairs and Fisheries finances projects beside the national sources of funding where each Member State has a share in the overall budget [5]. Member States draw up their national operational programs including clear plans for spending money. Once approved by the Commission, national bodies decide which projects they want to support. According to the established budget, new instruments are being harmonized with modernized programs in order to effectively achieve the European Union priorities and respond to new challenges.

4. Development prospects of mariculture in the Republic of Croatia

Looking at the broader picture of mariculture in the Republic of Croatia, this sector is currently in the phase of continuous increase in the quantity of cultivated organisms. Reduced fish stocks in marine environments have initiated shifting to new technologies such as seafood farming in controlled conditions. Far East Countries such as Japan, China and Indonesia currently dominate in mariculture. Other countries that are also outstanding in the quantity of cultivated products are France, Spain and Italy.

Although cultivation of marine organisms has been present for many years, numerous spatial locations as well as appropriate biological and economic advantages are an excellent prerequisite for its development and expansion. The fish farming activity in the Mediterranean has developed enormously in the last 20 years and is currently one of the fastest growing sectors in food production. In Croatia, mariculture as an economic activity provides employment of islanders throughout the year. Tourism brings revenue and, together with mariculture, they complement each other. Mariculture provides seafood products to numerous restaurants while tourism attracts populations from around the world [6]. If broad perspectives are analyzed, these activities complement each other and make a multiplication factor for economic development. According to the National Strategic Plan for Aquaculture Development of the Republic of Croatia 2014-2020, production is expected to increase by almost 300%, as presented in Table 4.

Table 4: Presentation of growth in all forms of cultivation of organisms

Species	2012	2020
Breeding in the sea	4650	20000
Bluefin tuna	1907	2000
Shellfish	3150	10000
Hot-water freshwater species	3209	10000
Coldwater freshwater species	1000	1500
Total (t)	13916	44500

Cultivation of organisms in the sea continues to play a leading role in relation to freshwater farming. According to the data shown in Table 4, the most representative is bivalve breeding which amounted to 3.150 tons in 2012. According to the forecasts of the National Strategic Development Plan by 2020, a threefold increase is expected. For the Republic of Croatia this will mean a major step forward in sustainable development of seafood farming as well as a greater possibility of placing on the international and global markets

[8]. According to estimates, the total annual growth in 2020, in the sea, will amount to around 32,000 tons, which together with the cultivation in fresh water will amount to around 44,500 tons.

Obviously enough, marine environments have become ever more depleted of marine organisms and it is therefore essential for a long-term sustainable development to be first developed a broader perspective. One of the long-term goals is to bring Croatia to the leading position in the production of organisms, but it is necessary first to develop quality infrastructure and increase the variety of cultivated products [9]. While Croatian production is of a smaller scale, this integration in the wider society is a challenge for a small country. Tourism in the Republic of Croatia provides a major export market for national products and such a potential form of promotion and marketing of domestic products should be more accepted than classical exports, as it raises product prices. Mariculture and tourism should jointly develop a common gastronomic cuisine like countries such as Italy and Spain. There is also the world-famous tourist attraction "Swim with the Tuna" in the Australian city of Port Lincoln, where visitors can go sightseeing in the farm and dive with tunas. The length of guests' stay of at a tourist destination can be positively influenced not only by expanding the offer and developing new tourist attractions, but also by making visitors familiar with mariculture products applying an educational approach.

By joining the European Union, Croatia has set several strategic goals through the National Strategic Plan 2014, which should be achieved by 2020. Increasing the production of white fish hatcheries to 40,000,000 young fishes, increasing the production of whitefish cultivation to 18,000 tons are only some of the foreseen targets [7]. The emphasis is certainly placed on the reconstruction of existing hatcheries, the setting up of farms and the introduction of new species in breeding. After accession to the European Union, fisheries support within the framework of the Common Fisheries Policy was enabled for all countries, including the Republic of Croatia. Fisheries support is applicable through two European funds: European Maritime and Fisheries Fund (EMFF) for 2014-2020 and the European Fisheries Fund 2007-2013. Within the current EMFF, Croatia has available EUR 252.6 million, and a third has already been used. Croatia, like other countries, has the priority to offer an ecologically healthy and nutritiously rich product, which guarantees sustainable development in the future for the whole world.

As for the far future, the Republic of Croatia is aiming to become one of the leading countries in the field of fish and shellfish production, with the fulfillment of all ecological and quality standards. First of all, it needs to develop new technologies that will enable much easier manipulation and then develop ecologically profitable activity.

5. Conclusion

The Common Fisheries Policy (CFP) prescribes a series of regulations regulating fisheries issues across all EU member states. Marine wealth protection, structural measures, market regulation and ecologically sustainable development are the underlying goals of a common policy. The breeding of shellfish and marine organisms has great prospects for the Republic of Croatia and for the whole European Union. Today, farming products are increasingly replacing the reduced offer of natural catches. Fish breeding in suitable and environmentally friendly places guarantees a high quality product and affordable price. Entering the European Union has provided for island communities a high employment rate, product exports to the international market, production expanding and the end product that guarantees certified quality.

6. Literature

- [1] Bavčević L. et al.; Zoniranje obalnog pojasa za marikulturu - stanje, *Ribarstvo*, 59, 2001, (4), pp. 150-158
- [2] Treer T. et al.; *Ribarstvo*, Nakladni zavod Globus, 1995
- [3] <https://ribarstvo.mps.hr/default.aspx?id=15>
- [4] https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en
- [5] <http://www.strukturnifondovi.hr/eu-fondovi>
- [6] Odnos turizma i marikulture s osvrtom na Zadarsku županiju, Nina Jaša, 2016
- [7] Nacionalni strateški plan razvoja akvakulture za razdoblje 2014.-2020.
- [8] Studija korištenja i zaštite mora i podmorja na području Splitsko-dalmatinske županije, s naglaskom na djelatnost marikulture, u multisektorskom kontekstu Integralnog upravljanja obalnim područjem (IUOP)
- [9] Katavić I.; Strateške smjernice za razvitak hrvatske marikulture, *Naše more*, 51 (1-2), 2004