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Issues and Needs for the Sustainable Development of Shellfish Farming in Italy

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Abstract: The Italian shellfish industry mainly comprises clams, mussels, and oysters. While clam production thrives and Italy leads Europe, mussel farming faces economic challenges. Oyster production is relatively new and holds potential. Sustainable development is crucial for meeting growing seafood demand while ensuring resource conservation and food safety. This paper, part of the VALUE-SHELL project funded by the Italian Ministry of Agriculture, Food Sovereignty and Forests (MASAF) as part of support activities for the National Strategic Plan of Aquaculture, combines desk research on industry structure and public interventions using a collaborative approach involving stakeholder interviews and focus groups with producers and local entities to assess the sector's most compelling needs. The collaborative process highlighted key challenges across the following four sustainability pillars: environmental (global warming, predator control, and pollution mitigation are critical concerns for ecosystem balance); economic (increased production costs and limited diversification opportunities affect profitability); social (fear of generational decline due to limited training and education opportunities poses a threat to the industry's future); and institutional (lack of a dedicated aquaculture law and fragmented governance hinder long-term planning). The project identifies policy bottlenecks hindering the sector's potential, caused by not fully addressing producer needs. Sustainable development strategies are essential for addressing these challenges and ensuring the Italian shellfish industry's future.

Keywords: shellfish farming; Italian shellfish industry; sustainable development; blue economy; needs assessment; focus group meetings; multi-actor approach



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1. Introduction

In this paper, we analyse the current problems and needs of the Italian shellfish sector using the categories of socio-economic, environmental, and institutional sustainability to identify the main constraints that slow down the sectorial development and respective corrective actions. This article is in fact part of the lively existing literature on the sustainability of shellfish farming activities and provides a comprehensive framework to understand the current state of the Italian shellfish industry and provides a prioritisation of the stated issues.

During the last decades, aquaculture has been affirmed as one of the most growing food sectors globally, constituting an increasingly larger share of the total fish production. Indeed, starting from 2016, global aquaculture production overtook fisheries regarding human consumption [1], and it is supposed to continue to grow in the next 10 years with an average yearly rate of 1.9% (+23% in 2031 compared with 2021) [2]. However, the distribution of aquaculture development is not homogeneous: the largest part of the increase is due to Asiatic production [2], while Europe is losing a relative share of production.

Despite the ongoing trend, European aquaculture still presents margin for growth and development, provided that a transparent and efficient regulative and administrative framework are adopted [3] and that measures and policies are designed and implemented in a sustainable manner and apply an ecosystem approach [4,5].

At the global level, for fisheries and aquaculture, a discrete amount of datasets are available, which originate from different kinds of sources: FAO publishes a specific statistic report annually [6–8] and has made a software available for the comparison of data and historical series [9]; OCSE-FAO jointly annually provide forecasting indications on production, consumption, prices, and commerce (import–export) for the following decade [2].

Regarding European aquaculture, the following sources should be noted: EUROSTAT, publishing data on weight and economic value directly provided from EU Member States (according to Regulation (EC) No. 762/2008); EUMOFA (European Market Observatory for Fisheries and Aquaculture) for data, historical series, and thematic reports; and STECF (Scientific, Technical and Economic Committee for Fisheries), producing thematic reports for the European Commission.

At the national level, in Italy, some relevant sources are reported: the Three-year National Fisheries and Aquaculture programme and the National Strategic Plan for Aquaculture 2021–2027, although being planning instruments, do contain information on the state of the sector; ISTAT (Italian National Institute of Statistics) produces data on production and consumption; BMTI (Italian Telematic Commodity Exchange) produces data for price and market analysis; ISMEA (Institute of Services for the Agricultural Food Market) publishes an analysis on market and domestic consumption and quantifies the value of refunds for animal killing or dead animals during catastrophic events; BDN (National Livestock Database) features data on farms and enterprises; and SINAB (National Information System on Organic Farming) features data on organic aquaculture. National data are also provided by the aforementioned EUROSTAT, EUMOFA, and STECF.

The whole aquaculture sector has become the object of a noticeable scientific effort during the past decades, also with particular reference to Italian coasts [10]. Shellfish farming is no exception, also considering its lower environmental impact when compared with other forms of aquaculture (i.e., pisciculture) and that, moreover, it provides some precious collateral benefits: ecosystemic services [11]. However, an effective and sustainable development of this segment does require the positive alignment of many factors, including positive environmental and economic conditions and the presence of a stable and clear regulatory framework. That being said, it is clear why the scientific community is so interested in issues related to the sector and how this cooperation can make enormous contributions to primary production.

Bush et al. conducted [12] an in-depth review of many published studies on the aquaculture value chain, comparing what is already available on topics such as multipolarity, diversity and scale, dynamics of transformation, performance and equity, and technical and institutional innovation. Also, the analysis of the shellfish supply chain has been the object of many publications, starting with the study of its transformation, perspectives, strategies, and problems [13–19].

Environmental sustainability is the category in which most studies are currently available. Among the most frequently addressed aspects must be cited the impacts of ongoing climate change on the industry and its mitigation strategies [20,21], the best practices for the reduction of shellfish farming's environmental impact [22–24], the effects of contaminated water on production (i.e., from microplastics or different agents) [25,26], the study of the shellfish farming–environment mutual relationship, the ecologic role of mussels and their ecosystem services [24,27–30], and analysis performed through life cycle assessment (LCA) [31,32].

With respect to socio-economic sustainability, numerous reports and analyses are available on price and market issues, targeted at both production and scientific communities [33,34], studies on the social acceptance of shellfish farms by coastal dwellers [35], and studies on measuring the impact (and potential) of EU subsidies and policies [36].

The analysis of institutional sustainability in shellfish farming focuses on issues such as managing and granting the maritime public domain concessions for aquaculture use [37], the relationship between institutional framework and economic–environmental sustain-

ability [38,39], and the analysis of national strategies [40]. An FAO technical paper [41] reviewing the regulation frameworks of aquaculture is also worth mentioning.

Also, in recent years, studies based on participatory and multistakeholder approaches have been becoming increasingly popular. This aligns well with the ecosystem approach advocated by the FAO [5] and European Union. Some of these cases concern coastal and maritime area planning [42,43], social acceptance [35], analysis of internal, market, and production risks perceived by producers [44], or participatory socio-economic analysis [45].

Despite the plethora of existing studies and datasets on the shellfish sector, this paper seeks to offer a currently missing comprehensive analysis of the sector's present condition at a national level, emphasising its environmental, economic, social, and institutional sustainability dimensions. Adopting diverse perspectives, especially encompassing those of producers, researchers, and regional administrators, is instrumental in garnering crucial insights and facilitating structural adjustments within the supply chain as well as fostering policy innovations and adjustments.

Italy, as predictable from the length of its coast, is one of the most important European countries for fisheries and aquaculture production despite the contribution of the national sector having a negligible impact on the primary sector in terms of both added value and employment (1.9% and 2.2%, respectively, in 2021). Its importance, however, is far greater than its economic contribution, as it constitutes the employment and income base of a significant part of the coastal populations and of some areas where most activities are concentrated [46].

Fishing and aquaculture have in common the supply of seafood products, but they present very different development trajectories with obvious repercussions on employment: The Italian fishing fleet is shrinking, following the EU policy aimed at progressively reducing the fishing effort, while aquaculture farms are an expanding model. Italy is among the European leaders in the production of trout and valuable marine species, as well as mussels and clams.

In 2022, according to data from the Italian Fish Farmers Association (API), national fish farming quantities will amount to 53,900 tonnes with a value of EUR 304 million [47]. Fish farming in Italy includes the breeding of several species, but almost all national production is concentrated on a few of them: trout for fresh waters and sea bass and sea bream for marine and brackish waters. The record is held by trout breeding, with which 29,000 tonnes is worth more than EUR 113 million, followed by sea bream and sea bass, with 17,600 tonnes and about EUR 146 million. It is worth mentioning that the production of juveniles of sea bass and sea bream has further increased, with a value of EUR 37.8 million, and that the production of embryonated eggs of rainbow trout and other salmonids has a total value of about EUR 4.2 million. The production of caviar is growing at 62 tonnes, and the production of trout eggs for human consumption is at 40 tonnes.

The MASAF-CREA data on shellfish farming referring to 2021 show a production of 85,300 tonnes; the composition of the production is made up of 72% mussels and 27% clams, while the production of oysters at about 300 tonnes is still marginal, although slightly growing. The value of production, equal to approximately EUR 271 million, can be 78% attributed to clam culture and 21% to mussel farming, while oysters account for 1%.

Considering the importance of the Italian shellfish industry and the availability of specific sectorial interventions, both at the European and national level, this paper provides an overview of the issues and needs related to shellfish farming as gathered through a multi-actor and participatory approach.

While the focus is on the Italian context, the insights garnered from this study hold significance for the broader aquaculture community and for policymakers across the globe.

Aquaculture, as a vital component of the global food system, faces common challenges irrespective of geographical boundaries. Issues of sustainability, economic viability, and regulatory frameworks resonate deeply with aquaculture industries worldwide. By delving into the nuances of the Italian shellfish sector, this study contributes valuable insights that can inform strategies and policies in other regions grappling with similar challenges.

The findings of this research offer a lens through which to examine the interplay between economic, environmental, social, and institutional factors in aquaculture sustainability. The prioritisation of sustainability pillars and the identification of key challenges underscore the universal imperative for a holistic approach of managing aquaculture operations.

Furthermore, the strategies proposed for enhancing production, restructuring supply chains, and addressing regulatory hurdles are not confined to the Italian context but can be adapted and implemented in diverse geographical settings. The emphasis on innovation, diversification, and stakeholder collaboration resonates with broader discussions within the global aquaculture community.

Lastly, Italy's position within the European Union ensures that its aquaculture sector operates within a framework of common policy tools and economic regulations shared by other European countries. The European aquaculture industry faces similar challenges and opportunities; thus, the insights gained from studying Italy's shellfish sector can be extrapolated to inform broader discussions within the European context. Policies aimed at promoting sustainability, fostering innovation, and streamlining regulatory processes resonate not only within Italy but also across European member states, emphasising the interconnectedness and mutual learning among European aquaculture stakeholders.

2. Materials and Methods

This paper gathers some of the results of the VALUE-SHELL Project, a study that is part of the institutional and technical scientific support to the Ministry of Agriculture, Food Sovereignty and Forestry (MASAF) for the implementation of the Strategic Plan for Aquaculture 2014–2020.

Numerous participatory activities were carried out during the project, including: ten interviews with experts in the sector (from the worlds of scientific research, production, and institutions), five focus groups on a regional basis, and an online questionnaire submitted to producers. The last two types of activities, requiring the participation of numerous producers, were carried out successfully thanks to the involvement of Mediterranean Aquaculture Association (AMA), one of the most representative Italian producers' associations in the sector.

Activities were aimed at identifying the problems and needs of the national shellfish farming industry, also considering their relationship with the role of sectoral policies. The methodology was based on a desk and field analysis through knowledge sharing among different types of actors with complementary expertise (multi-actor approach).

The desk analysis mainly took into consideration national planning/evaluation documents (Strategic Plan for Italian Aquaculture 2021–2027, Three-year National Programme for Fisheries and Aquaculture, European Maritime and Fisheries Fund-EMFF Operative Programme evaluation) and the main statistical sources mentioned above and was aimed at acknowledging the structural framework of the sector.

After the desk analysis, the participatory analysis was arranged by involving the main actors through interviews and focus groups. The interviews were oriented at obtaining information that was useful for defining some staple elements: the impact of the sector's policies upon small producers and cooperatives, the characteristics of local production techniques, the organisation and integration of the supply chain, the role of scientific research, and the main problems of the sector. The interviewees were chosen by including different types of stakeholders: the production world, regional administrations (Tuscany, Veneto, Apulia, Marche, and Emilia-Romagna), research institutes (DISTAL-University of Bologna, CNR-IRBIM), and AMA. The interviews were conducted between 10 March 2021 and 29 April 2022.

After the interviews, focus groups were organised together with AMA, considering the territorial and production characteristics of the sector. The focus group methodology was selected as an analysis and research tool because it was considered particularly effective in our specific case to guarantee the participation and real direct involvement of producers in the identification of sectoral problems and needs. Furthermore, focus groups are a suitable

tool for acquiring very detailed information from a small group of participants (in our case between 5 and 13 per meeting), allowing them to discuss and freely express their point of view through simple questions addressed to all. Focus groups also allow relations to emerge between participants and stimulate a debate among them that can not only highlight information on existing problems, but also on possible solutions.

Focus groups were carried out between June and October 2022 (two in person and three in an online mode) in some regional production realities: Liguria, Emilia-Romagna, Sardinia, Apulia, and Campania. The meeting in Emilia-Romagna was also attended by some producers from other adjacent regions such as Marche and Veneto, as they were considered to belong to the same maritime sector or, in any case, operated in comparable economic and social conditions.

During the meetings, the moderator directed the discussion so that all participants, in turn, answered the following questions based on their professional experience:

1. What are the main problems you encounter when carrying out shellfish farming?
2. What are the most urgent needs to develop the activity?
3. How do you view sectoral policies (EMFF or others)? Have you benefited from them in the past? If yes, which measures? If not, for what reasons?

During all meetings, the same questions were asked to facilitate the comparison of information from the different meetings and to draw considerations from them that could potentially be extended to the national level.

In the phase of analysing the information gathered in the participatory survey, all topics discussed were identified and aggregated when recurring in more than one meeting, thus integrating the information received for each topic as comprehensively as possible. The key was identified in the four “pillars” of sustainability (environmental, economic, social, institutional). Finally, the needs related to the issues that emerged were made explicit and prioritised through the online survey carried out in collaboration with AMA and directed at small producers in the sector (with 50 responses).

The survey, hosted on an online service, asked producers to identify, in a non-orderly fashion, the five (at most) most personally perceived problems out of all those identified during the meetings and interviews.

Finally, the results of the research were shared with the representatives of the Association for dissemination purposes.

3. Results

3.1. Environmental Sustainability

3.1.1. Predatory Species

In some areas of the country, predatory species (gilthead sea bream—*Sparus aurata*; and turtles—*Caretta caretta*) can cause great damage to shellfish farming. In the Gulf of La Spezia (a port area and therefore prohibited professional fishing spot), the difficult coexistence between mussel farming and fish farming facilities has been reported: in fact, from those areas, specimens of gilthead sea bream escape and form voracious colonies. Climate change also exacerbates the predatory action of sea bream by stimulating their metabolism. In the Gulf of La Spezia, producers have reported how this problem leads to product losses of up to 50%. In addition to the individuals being physically preyed upon, the breaking of nets can lead to the entire contents of the nets being spilled on the seabed. The magnitude of the problem in some areas is such that operators are likely to abandon the sector in the future if no solution is found.

In this regard, producers have expressed two different needs that can be considered as complementary: on the one hand, short-term financial relief; and on the other hand, environmental-ecological solutions that can act in the medium/long term. From a financial point of view, suitable instruments would already exist, such as the EMFF Measure 2.57 “Aquaculture stock insurance” or privately concluded insurance contracts. However, in reality, the implementation of these instruments and their effective use come up against

obstacles and barriers, the most important of which being the difficulty in quantifying the damage suffered and the probabilistic estimation of the possibility of the event occurring.

Definitive solutions identified by producers consist of two types: the installation of external cages to protect the rest and the deployment of purse seines boats, known in popular terms as “cianciole” (an industrial fishing technique that uses large purse seine nets, carried out at night and usually with the aid of lights to attract fish around the boat). While cages or protective stocking offer protection from predators, they also come with drawbacks. The use of these structures increases costs due to the additional equipment and labour required. Additionally, the mesh size and buildup of algae and other deposits can limit water flow and nutrient exchange, potentially hindering mussel growth.

Purse seines can catch important portions of schools of fish at the peak of the reproductive phase, but they are faced with two obstacles: the lack of fishermen who carry out this now rare and “antiquated” service and the bureaucratic formalities required to approve it as “experimental fishing”, as it is within a prohibited professional fishing area. Because this type of licence is only issued on an annual basis, it is impossible to guarantee a prompt amortisation of the expense.

The *Caretta caretta* turtle, on the other hand, is considered a protected species and as such cannot be fished.

3.1.2. Water Quality and Production

For the quality and quantity of shellfish production, an element of fundamental importance is the quality of the water in which the plants operate. Threats to this balance, often interlinked, can take the form of phytoplankton scarcity, overheating of the water, various forms of pollution, and the alteration of the natural course of the water cycle.

Many participants of the focus group meeting held in the Liguria Region reported a drastic decrease in phytoplankton in the La Spezia Gulf in recent decades, leading to lower growth of farmed mussels and a consequent decrease in farm profitability. The excessive density of mussel farms may accelerate this phenomenon and aggravate its effects. Overheating of waters due to climate change also has negative effects on mussel production. The result of a heatwave depends on several factors such as intensity, duration, and site-specific characteristics (among others, currents and depth) and can even lead to deaths. In the case of mussels, it strongly alters the growth cycle, causing significant indirect economic effects due to the need to change harvest and sale periods and/or product quality. In fact, heatwaves usually affect all producers in the same area: in order to safeguard at least part of the batch, copious quantities of product are sold off quickly at low prices.

Further factors worsening water quality are linked to the processes of industrialisation and overbuilding of the hinterland. In the case of La Spezia, the industrialisation of the port area has modified and reduced the supply of freshwater springs and consequently altered the local ecosystem balance.

A further indication concerns production in the Gulf of Olbia (Sardinia), where there is a civil purification plant along the Padrongianus River. Under certain environmental and atmospheric circumstances, the purifier has caused wastewater and muddy material to be released into the sea which, as a consequence, can lead to the temporary downgrading of the waters where the farms are located.

Water quality has direct economic and relevant effects on farmers and is classified into three categories; in the transition from area category “B” to area category “C”, farmers are forced to suspend production indefinitely, but also in the transition from area “A” to area “B”, new costs and burdensome commitments materialise (related to the obligation to establish the product and control activities of the Local Health Board—ASL).

The need to undertake structural actions to mitigate anthropogenic damage to the marine environment should therefore be highlighted. These will necessarily have to consider both macro-geographical and local actions. Also, the need for producers to operate within a systematic planning of land and coastal use must be highlighted, in which

the direct and indirect repercussions of each decision are assessed for all operators present in the area.

3.1.3. Plastic Waste Management

One of the main environmental problems related to the sustainability of shellfish production is the heavy use of plastics during the production cycle, which then turn into waste. The issue is divided into at least three components: waste that is unintentionally lost at sea, waste that is intentionally abandoned/sunken, and proper disposal practices for the structural production of plastic.

Plastic residues from aquaculture activities are to be considered special non-hazardous waste (Legislative Decree No. 152/2006, art. 184). The legislation requires that, for each port, the institutions produce a Plan for the collection and management of ship-generated waste and cargo residues, with qualified operators being entrusted to organise and implement the services. However, most of the Plans remain without official entrustment and therefore without implementation. Nevertheless, operators are still required to conduct the disposal of their special waste individually, causing an extreme fragmentation of delivery practices that selectively impacts the competitiveness of aquaculture enterprises operating in certain areas, particularly those that are economically less developed.

Where public management of the Plans is not implemented, operators have to agree on the disposal on a case-by-case basis with private entities, agreeing on timing, costs, and modalities, if the territory offers any available entities. In the testimony of the Apulian producers, who first relied on a local company and later on a consortium, disposal costs were more than 0.4 EUR/kg.

At the local level, the focus group meetings highlighted how administrations could find some solutions (even partial ones, such as the installation of collective containers in ports) that could both facilitate the activities of shellfish farmers (by making them safe from sanctions or semi-illegal situations) and protect the environment. What is needed is a dialogue that often fails to take place due to a lack of political-electoral interest or a failure to recognise the positive externalities that would result, even net of the possible costs borne by the public. The issue of waste management is therefore characterised by the presence of three different needs: the need for the development of environmental awareness among operators, the implementation of scientific research to identify alternative materials, and the development of a homogeneous and properly implemented regulatory framework.

3.1.4. The Mussel Farming Environment: A Public Opinion Problem

In view of the importance of the production area for shellfish farming, the relationship between the latter and the environment requires proper management in order to not become problematic. The aforementioned issue of plastic waste means that in areas with weak sea currents, plastic deposits can accumulate on the bottoms of plants and adjacent areas, as well as on the coast. Furthermore, the environmental sustainability of the industry must also come through wide-ranging considerations and efforts. Some of these require the active engagement of producers, e.g., by envisaging a kind of crop rotation that limits the environmental pressure exerted on individual concessions or by actively cleaning the seabed by cyclically collecting what is deposited there. Radical solutions, on the other hand, require an intensive effort on the part of the research community to find organic and/or biodegradable materials that are cheap and usable in the business.

From an economic point of view, it is of great relevance for the future of shellfish production to realise how necessary it is to convey to the public and consumers the image of a perfectly sustainable industry that also provides valuable ecosystem services. Indeed, the market is increasingly appreciating these characteristics. Therefore, there is a strong need for the industry for cultural and information activities to communicate the sustainability of shellfish farming to consumers, counteracting certain impressions that could damage its image.

3.2. Economic Sustainability

3.2.1. Mollusc Depuration Centres and the Mollusc Dispatch Centres

Within the shellfish industry's value chain, depuration and dispatch centres play critical roles. Depuration centres are essential for farms located in areas other than the highest classification ("A"). In these facilities, bivalve molluscs undergo a cleansing process to remove pathogens or pollutants (like mud, bacteria, or debris) before they are safe for human consumption. Dispatch centres, on the other hand, are necessary for all shellfish production. These facilities handle the final stages of preparation, including cleaning, grading, packaging, and labelling, before the product is shipped for sale.

Thus, a bottleneck conformation is configured for the supply chain; the control of this phase is truly relevant for the distribution of added value among the various stakeholders. In one interview, the desirability of greater producer control over dispatch centres emerged, also by exploring forms of association or aggregation of these centres, making it possible to exercise greater bargaining power in the price-making phase and thus retain greater shares of added value. It was reported in some interviews that in some areas of the country, there is a problem of availability and access to facilities, which particularly penalises small producers. At the same time, it was hoped that there would be a decrease in the obstacles and red tape that slow down the opening of new directly or collectively managed dispatch centres.

3.2.2. Production Costs and Inflation

The shellfish industry has encountered significant challenges due to inflationary pressures and the escalation of raw material and energy expenses. Consequently, enterprises within this sector are confronted with an expanding financial constraint, wherein the revenue level inadequately counterbalances the surge in operational costs. These escalating costs primarily stem from two sources: equipment (particularly nets and socks, prone to wear and tear and requiring frequent replacement) and in-house processing activities (e.g., electricity consumption at relaying facilities). These factors erode the already narrow operating margins of these businesses. Given the macroeconomic conditions resulting from pandemics and war events, it is difficult to imagine a specific intervention capable of calming this dynamic without diverting resources from general taxation to the sector, a feasible but political choice that necessarily presents trade-offs.

In order to frame the increase in costs within real economic dynamics, we report some testimonies of focus group participants: in Campania, the price of plastic nets has risen from 45 EUR/roll to 73 EUR/roll in a few years, and producers can fill up with diesel at 1.25 EUR/L; In Apulia, from 2020 to today, the cost of 1.500 m of plastic nets has risen from EUR 45 to EUR 65; in Liguria, in 2020, agricultural diesel costed EUR 0.50/L (while "car diesel" was quoted at around EUR 1.40/L), whereas today it is offered to producers at EUR 0.90/L.

3.2.3. Revenue and Demand

The markets covered by this document (clams, mussels, and oysters) have not followed the same price trend in recent decades. Mussels have declined gradually, to the point where it is difficult, particularly for small producers, to continue their activities. The reasons mainly lie in the structural features of the industry. On the one hand, power relations have crystallised in favour of distribution, which can therefore exert a greater price-making capacity and influence supply. On the other hand, a series of environmental emergencies (including water overheating and epidemics) are increasingly forcing a rapid sell-off of the product. Market dynamics lead producers in this situation to accept extremely low prices.

Besides the structural level, there are also specific problems related to the receipt of payments. It has been reported that the distribution players tend to pay what was agreed with the producers extremely late. This deferment, in turn, causes solvency problems for small- and medium-sized companies. It is worth noting that this postponement has a further negative consequence related to the value added tax (VAT), a tax system enforced

in the European Union and common in many countries. Unlike a traditional sales tax applied at the final point of sale, VAT is levied at each stage of production and distribution. Therefore, producers must pay VAT upfront based on the sale price, even before they collect money from their customers. This contingency creates a double burden for small producers, who are essentially financing the VAT payment while waiting for customer payments to arrive.

Although it is not an ingrained conviction throughout the industry, the focus groups and interviews revealed a clear desire to strengthen active collaboration with scientific research in order to find solutions that can increase product quality and price.

3.2.4. Revenue Integration

Due to the current market prices, mussel producers complain about insufficient income to calmly face possible periods of crisis such as adverse weather events, disease, or economic downturns, which could have devastating effects on the solvency and survival of small- and medium-sized enterprises. It is therefore desirable to restructure the supply chain to enable producers to retain a greater share of value. That said, a complementary strategy that companies can take is to diversify their income, introducing ancillary activities.

Examples in this sense are also increasingly gaining ground at the international level and are represented by the implementation of multi-culture systems (e.g., seaweed, oysters) and the start-up of touristic aquaculture-related activities. In this way, new revenue items would be created from tangible assets that are already present and amortised (such as boats, land structures, and the systems themselves) and from intangible assets to be put to value, monetisable in terms of service and branding. During the focus groups, producers expressed appreciation and interest in both income integration formulas.

At present, obtaining the necessary permits to carry out aquaculture is hampered by national legislation. The incomplete repeal of the old regulatory framework dating back to 1965 has created the paradoxical situation whereby port authorities require specific ministerial authorisation to embark people from outside the crew, even if they already hold a “fifth-category” licence. Some regions are studying solutions to simplify this process, but the managers interviewed said they would like to see an organic national reform and the establishment of a specific type of licence for vessels carrying out installations.

During the interview with the Veneto region administrators, the political will was expressed to actively support the development of polyculture in the coming years. This support should also manifest itself through investments in scientific research in support of production. The design of a sustainable multi-crop model must in fact start with the identification of new species that can be bred in the area in question and for which there is demonstrable market demand.

3.2.5. Aggregation of Supply

Given the generally low capacity of producers to influence market prices, it would be advisable to incentivise the centralisation of supply through the promotion of already regulated and existing aggregation structures. A first level of aggregation is that provided by corporate forms such as cooperatives or consortia which, depending on their statutes, may provide for variously integrated forms of common action (such as the obligation to confer, as well as collective investments in processing plants). As described by a regional representative interviewed, it is possible to typify shellfish cooperatives into two macro-categories according to the functions delegated to them by their members: the simpler supply “storage” cooperatives (which limit their functions to the management of the selling phase of the product to traders and to distribution) and service cooperatives, which also provide members with other services, such as accounting and relations with institutional subjects, facilitating dialogue through collective representation.

A second level of aggregation, on the other hand, consists of different instruments, including producer organisations, supply chain contracts (“Contratti di filiera”), and network contracts (“Contratti di rete”). Regarding POs, it is relevant to point out that these

items have historically been common in land farming, while mussel producers have only begun to form these groups in recent years.

The activation of a substantial aggregation process of supply clashes with, among other things, cultural barriers traditionally present in the fishery and aquaculture sectors.

As reported by regional administrators (and bitterly confirmed by the producers themselves), fish operators are characterised by having received and internalised a “fishermen’s” training and attitude, that is, being traditionally accustomed to a family-based business management. In some cases, producers tend to reject the idea of aggregation, believing that they will be able to receive a better price by acting alone than by collective bargaining, or they are motivated by the belief that they already have fixed customers they can rely on, and the administrators reluctantly give up.

3.3. Social Sustainability

3.3.1. Education and Training

The lack of training paths for young operators is a threat to generational turnover in the sector in a context where demand is expected to increase but the incomes offered are insufficient for attracting young people to this type of career. This problem is particularly felt in mussel production, whereas for clam farming, we have received reports of a more encouraging situation in some regions such as Veneto or Emilia-Romagna due to better business profitability.

The shortage of trained workers in the area is forcing some mussel producers to hire seasonal workers from abroad, increasing costs (also due to the need of providing housing solutions). One producer from Emilia-Romagna reported that in the past, they had to hire workers from Spain, a country where (particularly in Galicia) there are highly specialised schools in aquaculture and mussel farming. This is also valid for France. The type of work carried out on boats is indeed very vast, and producers would need to hire already trained staff, not to mention that investments in training could help to form a new generation of producers that are more predisposed to an approach based on an entrepreneurial mentality and are able to seize the opportunities offered by sector policies and efficient business management.

Several stakeholders in the supply chain have also pointed out the urgency of ensuring refresher and training courses for employees of the public administration, which was called upon to regulate elements where, in some cases, they do not fully understand due to lack of specialisation or dedicated structures. This would simplify an unnecessary bureaucratic burden and facilitate dialogue between producers and regulators, which is crucial for the local economy, while avoiding damage to the already proven social fabric.

3.3.2. Employment

During the focus groups, concerns about the economic future of their businesses and the very possibility of continued operation were reported by many mussel farmers in different areas of the country. Indeed, mussel farming is an important economic activity for many coastal communities, even beyond its direct effects. Indeed, both producers and a large employment supply chain, seasonally consisting of a large number of people employed in secondary activities, participate in the supply chain.

Many operators, in the absence of improvements or resolutions in the near future, could, as announced, be enticed to stop their activities. This scenario could create social tightness issues in rural coastal areas, where the fishing sector traditionally drives local economies, and a contraction of the sector could cascade to affect a significant share of resident households.

3.4. Institutional Sustainability

3.4.1. Port Management

Little consideration of the needs of the fishing and aquaculture sector was reported during the focus groups in the current management and administration of ports. In fact, the

tendency of the latter is to assume an increasingly purely touristic vocation, relegating fish producers to secondary attention. This situation reflects the interest of local governments in pursuing a development model based on a predominant role for tourism over other sectors of the economic fabric, partly because of its greater perceived economic contribution.

In practice, this lack of attention finds drop-off points in the lack of personal facilities, such as changing rooms or shelters, that could make it much easier and smoother to carry out the activity, especially in case of adverse weather. In some areas of the country, it is also necessary to create new landing points, possibly with the presence of local health board (ASL) veterinary controls to facilitate the performance of work and hinder irregular behaviour and practices (with strong reference to traceability) that penalise the competitiveness of honest producers.

In one case, producers indicated the need to install boat fuelling stations where none exist. In the case of La Spezia, there is only one diesel fuel station at the dock, while the only agricultural gas station is located inland. In the absence of easy solutions, and despite it being less economical, some producers found it preferable to refuel from regular “civilian” distributors (while discharging VAT).

At the institutional level, there has been a desire for a step change in port management. Certain differences in the interpretation of rules among the harbourmaster’s offices, in some cases even substantial ones, have the effect of creating interference in competition between producers in different areas. One example is the equalisation of fifth-category licences (so-called own use) for certain purposes, which is possible in some ports in Emilia-Romagna and much desired elsewhere.

One participant pointed out the military nature of the Coast Guard Corps. Instead, the introduction of civilian-type management would allow for the dialogue between administrators and different stakeholders to be approached on a more understanding, dialogical, and stable basis.

3.4.2. Mussel Farming Facilities

The current national plant stock, at least as far as mussel farming is concerned, would need a series of investments in modernisation and technological innovation. With many exceptions and excellences (particularly in the leading regions in terms of production), some Italian plants were described as shabby and at risk of breaking down. One interview raised the need for institutions to exercise a more prescriptive role, as is already the case in other European countries (including Spain) where, for example, legislators define through law and rules the maximum allowable size and density of rows.

The rationale for these interventions lies in the fact that in the event of a storm or other adverse weather sea event, the rupture of a single row can cascade to far greater destruction, amplified in the effects of currents. The mismanagement of a single plant can therefore also have negative repercussions on other farms in the vicinity, particularly in intensively exploited areas. Legislative intervention that can provide a framework of behaviour within which to operate is therefore desirable to defuse free-riding situations.

3.4.3. Political Instability and Institutional Fragmentation

A hindering issue for shellfish farming is political instability, both at the national and local level. Indeed, the administrative practices of state-owned area concessions are a key factor in business decision making and, in some regions, have been delegated to municipalities, subjects that are typically more frequently exposed to political turnover. In the event of a change of council, the relationships and dialogue established between producers and the offices in charge are usually reset.

The very coexistence of two different paths of competence (region or individual municipalities) for different areas of the country can open the door to unequal treatment and distortion of competition. Some focus participants said that they felt that they were disadvantaged by their personal situation in comparison with other production areas.

In the borderline cases of two producers having facilities situated in different municipal areas, regardless of how close they are, they may find themselves operating under substantially different conditions, with obvious repercussions in terms of competitiveness. The structural inability to manage this type of practice at the municipal level has been reported with particular reference to small municipalities, but large urban centres are often no different either.

In many cases, municipal governments are simply unable to equip themselves with prepared offices possessing adequate knowledge and expertise due to the lack of sufficient human or economic resources or economic/political foresight. They are thus unable, for example, to issue new concessions or ensure information on future renewals, blocking the potential development of shellfish activity in their area, even where there would be opportunities. In addition, the municipality's point of view is inherently lacking in the overview needed to plan the industry coherently and effectively.

In practical terms, the effects of institutional instability manifest themselves in the form of barriers to entry, lack of investment (due to the absence of the minimum conditions of stability or clarity in the permitting/licensing process), and unnecessarily wasted time and energy. The need to compete in a competitive arena with the same constraints and tools, with homogeneous characters across the boot, was therefore explicitly highlighted by producers.

3.4.4. Bureaucracy of Local Health Boards (ASLs)

Local health boards (ASLs), which are required to monitor the waters where plants are located, have sometimes been cited as an element of bureaucratic complexity and criticality. ASLs act differently from region to region, sometimes following procedures that are even significantly different from each other. This contributes a framework of uncertainty to the sector. Moreover, some ASLs consider narrower areas as uniform, while others do not make this differentiation.

Paradoxes can thus take shape, such as the one reported to us: the detection of an algal biotoxin on the border between Puglia and Molise resulted in the compulsory closure of plants operating up to more than 40 km from the sampling site in Puglia, while the much closer Molise plant was allowed to continue its operations. In the worst cases, the lack of uniformity across the country can increase the disparity in competition and penalise the blue economy of some areas.

Thus, the need for a clear, straightforward, and reasonable interlocution between producers and ASL was pointed out, transforming it from an obstacle to an opportunity to ensure positive spillover effects in terms of the sector's image.

3.4.5. Vessels' Licences

During interviews and focus groups, a call emerged for regulatory parity between the licensing of "own-account"-type vessels (recreational units) and "fifth-category"-type vessels (plant-serviced units). The two cases respond to different regulations, and in recent years, there has been a trend toward switching from fifth-category to own-account because of the greater operational simplicity the latter offers fish farmers. Indeed, with a vessel registered as an own-account use, it is possible to maintain more flexible crew management: a licensed operator is sufficient, while the other passengers on board can be hired as farm labourers without reporting to the harbourmaster's office. On the other hand, plant-serviced units (fifth category) require one to personally enter the maritime office and specifically report the people who will be part of the crew.

This kind of parity in some places is already a reality, but only at the level of individual port authority (Capitaneria di Porto). Therefore, it would be a matter of finding solutions that consider the specificities of the shellfish sector and ensure parity of treatment at the national level. In some northern ports, especially in Emilia-Romagna (e.g., Rimini and Porto Garibaldi), fifth-category vessels have been given the option of carrying out the activity by embarking

only one person, whereas they would normally require a captain/engine manager and a deckhand. Other port authorities, however, have been deaf to similar urgings.

The issue is also nullifying as it touches on the possibility of obtaining boat grants through the EMFF (which provides funds dedicated exclusively to the fifth category). It also questions the simplification of business as it allows or prohibits the possibility of boarding “unnecessary” operators and would simplify operations related to maritime activities.

3.4.6. Failure to Recognise the Specificities of Aquaculture Compared with Other Maritime Activities

Many producers have complained that the many specificities that characterise the aquaculture sector and differentiate it from fishing are often not considered by legislators.

In this field, a particularly onerous example for shellfish producers concerns the health and first aid aspect. Shellfish vessels are in fact required by law to be equipped with a decidedly oversized first aid medical kit, the same as that prescribed for large offshore fishing vessels, despite the obvious differences in rescue options.

Two reported and very illustrative cases of medicines and instrumentation not proportionated to the context are the Novocaine and Ambu Ball. The entire expense for the medical kit is around EUR 800–900, and it must be considered that some of those medicines possess an expiration date of less than a year, cyclically renewing the expense.

3.4.7. State-Owned Maritime Concessions

During most interactions with producers, the most frequently reported issue is that of state-owned maritime concessions for aquaculture use, both in terms of onerousness and the uncertainty that accompanies the process of issuance and renewal.

While remaining under state jurisdiction, the functions of concessions and the determination of maritime state fees are delegated to the regions.

“Super Fee” Affair

The regulatory framework that determines the price paid by producers for state concessions has undergone numerous transformations over the years. Over the past two decades, following the enactment of Legislative Decree No. 154/04, the so-called “super-fee” affair has contributed to a state of extreme uncertainty. The repeal of the rule that extended to non-cooperative companies the application of the “ricognitorio” fee (an old, symbolic, and extremely facilitated regime, provided for by Royal Decree No. 1604/1931) left a regulatory vacuum that suddenly resulted in a situation of substantial unequal treatment between cooperative/consortium companies (to which the rate of 0.00448 EUR/m² was applied as of 2022) and other companies operating in the sector (an average of 1.8 EUR/m²) while carrying out the same activity.

In the immediate term, noncooperative enterprises safeguarded themselves by reacting to the sudden fee increase by transforming their corporate form. Some regions have since proceeded to “freeze” the issue through their own measures (e.g., Friuli Venezia-Giulia 2010, Marche 2015, Sardinia 2018), but a final and homogeneous resolution could only come from a national measure aimed at lowering the fee for both cases to a level that would not affect the already shaky profitability of the mussel farming sector.

Moreover, the review of the matter is extremely urgent to avert further fallout. Indeed, it is possible that some ruling will abolish the rule favouring cooperatives, suddenly bringing all producers to the maximum cost. The Competition and Market Authority has also spoken out on the issue, calling the matter “likely to lead to competitive distortions, not justified by general needs and in any case not proportionated” (Document No. AS482 of 16 October 2008, Discipline of State-owned Maritime Concessions Fees for Fishing and Aquaculture Activities); moreover, there are fears of infringement proceedings being initiated by the European Commission.

Some producers (particularly from the Gulf of Taranto, being constrained by environmental and health issues) were also requesting the ability to merge several bodies of

water under a single concession application so that they would not be at a competitive disadvantage. This would be a relatively quick intervention and one that could bring immediate relief to mussel farmers.

Duration of Concessions

A critically important condition for producers is to operate in a regulatory environment that is clear, defined and, above all, has predictable outcomes.

Producers emphasised the urgency of securing state-owned maritime concessions (or renewals) of sufficient duration to allow for long-term business strategies. Otherwise, the participation in the funding opportunities provided by the European Maritime and Fisheries Fund may be impeded. The EMFF indeed provides financial support to producers whose proposals are in line with the fund's objectives, typically encompassing the advancement of sustainable fishing practices, the bolstering of coastal community development, and the fostering of innovation within the sector. It is stipulated, however, that funding eligibility is contingent upon producers possessing concessions with a minimum remaining duration of five years.

In addition, the ability to plan the company's business in the medium term would also allow for more risk-taking from investing with equity.

Instead, the current national regulatory framework creates conditions for each titular administration (regional or, where delegated, municipal) to apply different criteria. This creates large disparities in the investment propensity of producers and consequently in competition. This is particularly true for small municipalities which, as we have seen, often lack the human and institutional resources necessary to provide such a specific and important service for aquaculture activities.

3.4.8. Allocated Zones for Aquaculture (AZAs)

At the level of regulatory framework, the final delimitation of areas primarily dedicated to aquaculture activities in all regions is long overdue, an intervention that should make it possible to overcome some of the uncertainty surrounding the process of issuing concessions.

The instrument advocated by producers and awaited to be implemented soon in all the national territory is the Allocated Zones for Aquaculture (AZAs). AZAs have been defined by FAO-GFCM as "(...) a spatial planning system or zoning carried out at the local or national level and aimed at integrating aquaculture activities into coastal zone areas, where aquaculture should have priority over other activities and uses of marine space and resources, and where negative interferences with these activities and uses are minimised or avoided. It involves coordination among different authorities and is based on a participatory approach" [48].

From the environmental point of view, spatial planning is an essential element in limiting the sector's ecological footprint. Indeed, it could prevent the appearance of new production areas in areas that are overexploited, at health risk, or subject to additional constraints, as in the case of natural parks and protected areas. Moreover, operating in unsuitable or suboptimal areas implies higher operating costs for producers.

The definition of AZAs was mentioned in the meetings as an essential element for serene production planning, entering into agreements and investments (at the micro level), and facilitating the entry of new players into the market. At the social level, it is also worth noting how AZAs could make it possible to overcome existing conflicts between the different uses of water surfaces, ensuring proper planning and regulation of the sea and also stimulating other sectors that make direct or indirect use of marine surfaces.

On the regulatory level, a regional contact person pointed out the current difficulties in overlapping the AZA instrument with the current Management Plans (Piani di Gestione).

3.5. Results Tables

In the following Table 1, the results of the survey are listed, including the items identified by the issue analysis and their respective needs. All items obtained through the project

have been categorised by the principal aspect of sustainability that the problem testifies. As mentioned, the model used identifies four pillars for full sustainability: environmental, economic, social, and institutional.

Table 1. Issues identification and needs assessment that emerged from the field research.

Sustainability Pillar	Issues	Main Needs Found
Environmental	Damage from predatory species: <i>Sparus aurata</i> , <i>Caretta caretta</i> , alien species such as <i>Callinectes sapidus</i>	Insurance/financial tools to compensate for predator damage, overcoming quantification issues Identification of tools for reducing predatory populations
	Water quality and production implications (phytoplankton lack, overheating, area downgrading risk)	Mitigation of anthropogenic damage to the marine environment
	Plastic waste management (failure to implement local Plans)	Ensure producers have a smooth and cost-effective system for disposing plastic waste Encourage the introduction of alternative materials to plastics
	Environment–mussel farming relationship	Communicative/informative actions to consumers and civil society
Economic	Shellfish purification centres and shellfish shipping centres scarcity	Quantitative increase in those centres where necessary (including through the creation of on-farm facilities) Forms of association or aggregation of producers for the collective management of the centres
	Rising production costs and high inflation	Operating within a stable and growing macroeconomic system
	Revenue–demand	Easing price pressure for mussels R&D to increase value added Acquiring skills and investment capacity for processing
	Income supplementation strategies	R&D for multi-culture Simplification of aquaculture tourism regulations
	Poor aggregation of supply	More managerial management of micro and small enterprises
Social	Education and training	Training tracks for practitioners (workplace safety, communication, marketing, policy access, networking, soft skills), youth (vocational training), and public administrators.
	Employment rate	Maintaining employment levels in coastal areas
	Port management	Greater attention given to fishing activities Uniform interpretation of rules among the Coast Guard
	Mussel farming facilities	Modernisation and technological innovation Regulatory requirements on row density and size
	Political instability and institutional fragmentation of competences	Greater attention given to fishing activities Institutional relations with sectoral overview at different levels
Institutional	Bureaucracy of local health boards (ASLs)	Uniform application of procedures among different local health boards
	Boat licencing system	Regulatory parity between “own-account use”-type licences (recreational units) and “fifth-category”-type licences (units subservient to facility)
	Failure to recognise the specificities of aquaculture versus fisheries	Specific assessment of aquaculture needs (e.g., first aid medical supplies, boat licences, aquaculture technical diving operator qualification)
	Concessions of state-owned areas for aquaculture use (cost, duration, bureaucracy, certainty of renewals)	Overcoming of the “super fees case” (application of lowered fee exclusively to cooperative enterprises) Possibility of figuratively merging small areas into a single concession Clear and uniform criteria on duration and renewals of concessions
	Allocated Zones for Aquaculture (AZAs)	AZA identification and mapping in regions where it is still not yet performed Overcoming difficulties of overlap between the AZA regional tool and maritime space management plans

Source: CREA elaboration.

After the interviews and focus group meetings, an online survey was conducted with the participation of the producers and the staple cooperation of AMA. Participants were instructed to identify, in a non-ordinal manner, the five most relevant issues from their professional point of view. Due to this methodology, the sum of the answers is way over 100%. In the survey, it was also possible to insert a comment to reiterate a particularly heartfelt concept or to signal a new one. The results of the online survey are reported in Table 2, which are related to the main aspect of sustainability involved.

Table 2. Online survey results.

Pillar	Issues	Number of Votes	Percentage of Votes
Economic	Production costs and inflation	22	44%
Environmental	Water quality and production implications (phytoplankton, overheating, area downgrading risk)	22	44%
Environmental	Damage from predatory species	20	40%
Economic	Cost of concessions for aquaculture use	17	34%
Institutional	Excessive and non-uniform bureaucracy of local health boards (ASLs) procedures	15	30%
Economic	Insufficient revenue (market price, problems in collection, VAT advance)	15	30%
Environmental	Plastic waste management (failure to implement local Plans)	14	28%
Social	Ensuring employment and generational turnover	13	26%
Economic	Weak aggregation of supply	12	24%
	Failure to recognise the specificities of aquaculture versus fisheries (e.g., first aid medical supplies, aquaculture technical diving operator qualification)	10	20%
	Port management (tourist vocation, lack of services such as fuelling points and ASL garrisons, difficult dialogue with the Coast Guard)	9	18%
Institutional	Need for parity between fifth-category boat licences and own-account-use licences	9	18%
	Political instability and institutional fragmentation (frequent change of council, unequal treatment between municipal and regional areas of responsibility)	9	18%
	Need for modernisation and innovation for mussel farms	8	16%
Social	Inadequate school/vocational training paths	7	14%
	Precarious duration of state-owned concessions for aquaculture use	6	12%
Institutional	Administrative difficulties carrying out complementary activities (aquaculture, polyculture)	5	10%
	Failure to implement AZAs (for regions that have still not identified them)	3	6%
Economic	Shellfish purification centres and shipping centres scarcity (lack, excessive cost of use, bureaucratic difficulties in opening new ones)	3	6%

Source: CREA elaboration.

4. Discussion

The VALUE-SHELL project successfully provided a comprehensive understanding of the issues, needs, and perspectives regarding the Italian shellfish sector, drawing from the experiences of producers and other stakeholders. By prioritising these concerns and categorising them under sustainability pillars, the project revealed several key insights:

- Economic sustainability: producers prioritise economic factors due to structural issues within the supply chain and recent economic events.
- Environmental sustainability: environmental challenges like climate change and related phenomena already pose a significant threat, particularly in sensitive areas like lagoons.

- Social sustainability: this is perceived by producers as critical. Low profitability and limited training opportunities threaten generational renewal, especially in mussel farming.
- Institutional sustainability: dysfunctionalities exist in various aspects of institutional support, requiring improved communication between institutions and stakeholders, regulatory recognition of sector specificities, and streamlined bureaucracy for micro and small enterprises that often cannot cope with the current administrative bureaucratic workload.

In general terms, an increase in demand for the entire aquaculture sector can be expected in the medium and long term. With this in mind, and taking into consideration the distressed phase that mussel farms in particular are experiencing in some areas of the country, it is necessary for the shellfish industry to prepare for future challenges and opportunities by implementing necessary structural changes.

First, ways need to be found to increase the amount that the sector can produce. This is possible by following two approaches: through increasing the number of production sites (quantity level) or through investment in machinery and new technologies (quality level). For the first case, the introduction of a more stable regulatory/economic environment is a prerequisite. The definition of AZAs, an instrument that secures long-term use rights (and guarantees access to active policies from which they would otherwise be excluded, such as the EMFF) and a supply chain structure that sufficiently remunerates producers could proceed in this direction. In the second case, investment in research and development is needed and, in some cases, a process of regulatory simplification.

It would also be necessary to address the competition issue, both domestic and foreign. Intensified horizontal competition among producers has been a major factor driving down their prices without impacting final consumer costs. To address this, implementing strategies to consolidate supply and enhance producer bargaining power is crucial. International competition, especially for the component involving the product imported and briefly re-immersed in domestic waters, would require an additional informational effort to alert the consumer to differences so that they can decide between the two options by having a complete and immediate information set available.

Increasing production and restructuring the supply chain structure may not be sufficient on their own for ensuring the achievement of targets for the sector. One intervention that could lift its fortunes (particularly for mussel farmers) is the introduction of business income supplementation. Very different activities fall into this category, but we can trace them within two main cases: production differentiation and the development of complementary tourism recreational activities. The first case is currently receiving strong attention from the scientific and production community [49]. In fact, oyster farming has been experiencing a phase of development in Italy in the last decade, partially thanks to the presence of a national demand currently satisfied through imports and the natural conformation of some areas of national territory, capable of yielding high-quality products with competitive growth rates compared with major EU players. It should also be noted that it is already technically possible for mussel farmers to inaugurate complementary oyster production lines within their facilities without excessively expensive or invasive structural interventions. Other forms of production diversification, like integrating with algaculture or multitrophic aquaculture [50], are attracting significant scientific interest and have the potential to become economically more relevant in the medium term.

The second case includes a series of complementary activities to be carried out both at sea and in onshore facilities, designed to cultivate consumer engagement and loyalty while simultaneously strengthening brand identity. This segment incorporates a variety of experiences for visitors, including food and beverage offerings featuring farm-raised products, tastings, welcoming receptions, and even guided tours of the aquaculture facilities aboard the very workboats used daily for production. It should be noted that these types of activities also have the merit of directing public opinion and sentiment towards shellfish farming, strengthening a direct connection with farmers and improving its image, which

has unfortunately been damaged in recent years by the misbehaviour of some producers and the consequent media hype.

The focus groups revealed a general willingness among producers to explore supplementary forms of income, as testified by pilot projects that have already been activated. However, bureaucratic hurdles that should be expeditiously removed resist, particularly with regard to regulations concerning transporting non-crew members on vessels.

The shellfish sector reveals enormous opportunities for development, offered both by the European conjuncture and by characteristics inherent in the Italian supply chain. At the same time, bureaucratic obstacles slow down the maturation of the supply chain and lead in some real cases to a real halt in activity. Indeed, in many cases it has been reported that carrying out bureaucratic activities related to the business requires an unreasonable amount of time and energy and often expertise that cannot be found within the business perimeter of small/medium enterprises.

These bureaucratic hurdles are especially tough in situations where farmers have to deal with municipal governments, and the positive resolution of paperwork and permissions may often not be taken for granted.

Building on the direct experiences of producers from different national productive areas, there is therefore a strong need for structural legislative intervention addressing issues of homogenisation, simplification and, where necessary and lacking, prescription, rectifying current disparities.

It is our opinion that a minimum level of regulatory clarity and guarantees should be provided to all producers regardless of the institutional interlocutor they have to deal with. This objective could also be realised through the enactment of a dedicated national aquaculture law. Currently, the legislative framework applicable to aquaculture lacks a comprehensive, standalone text and relies instead on being incorporated within fisheries legislation.

At the present time, the regulatory landscape within the sector exhibits notable ambiguities, exemplified by unresolved issues such as the super fee controversy, differences in the regulatory frameworks on state-owned maritime concessions, and the allocation of fifth-category licences. The stratified and “clumsy” legislative interventions in past decades have created regulatory voids in which regions have responded individually, thus failing to constitute a uniformly competitive national sector. In essence, the realisation of substantial investments in innovation, pivotal for propelling the sector towards a qualitative leap in the forthcoming years, hinges upon the establishment of a clear, uniform, and equitable regulatory framework spanning the entirety of the national territory.

In conclusion, this study underscores the need for continuous evaluation to gauge the effectiveness of evolving policy instruments like the EMFAF and National Strategic Plan for Aquaculture. Future research efforts should involve replicating field studies cyclically to capture the evolving impact of these updated plans on the industry. Looking ahead, four key areas warrant further investigation:

- Standardisation of production cost analysis: developing a common European methodology for analysing aquaculture production costs, similar to the Farm Accountancy Data Network (FADN) used for agriculture, would enable more robust comparisons and inform policy decisions.
- Economic multiplier effect analysis: in-depth economic analyses are needed to quantify the “multiplier effect” of policy spending, investigating the broader economic impact generated by each euro invested; these analyses should encompass different species, farm sizes, and geographical locations to inform resource allocation strategies with a nuanced understanding of economic impact.
- Effects of water overheating (particularly with respect to global environmental changes) and predatory species: this should be performed in order to develop adapting strategies and financial safeguard instruments.
- Generational turnover: a full analysis of the institutional, economic, and social problems that cause difficulties for small and medium enterprises in employing young

workers and that often require the acquisition of non-local labour, including the need for the activation of educational and training paths.

By pursuing these research avenues, policymakers and industry stakeholders can gain deeper insights that can be used to optimise policy design and resource distribution, ultimately fostering a more sustainable and economically robust European aquaculture sector.

5. Conclusions

The comprehensive analysis of the Italian shellfish sector has revealed multifaceted challenges and opportunities. The prioritisation of sustainability pillars underscores the need for concerted efforts in economic, environmental, social, and institutional realms. Structural changes are imperative to bolster the sector's resilience and readiness for future demand. Strategies to increase production, diversify activities, and enhance competitiveness domestically and internationally are crucial. Business income supplementation and production diversification offer promising avenues for growth, though bureaucratic hurdles must be addressed promptly. Legislative intervention to streamline regulations and foster a conducive business environment is essential for sustained progress. By aligning regulatory frameworks nationally, the sector can unlock its full potential and navigate towards a prosperous future.

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