Under a collaborative agreement between the Federation of European Aquaculture Producers (FEAP), the Fondazione COISPA ETS and Aristotle University of Thessaloniki

Report – Scientific and technical study on the barriers for effective implementation of the EU legislation on organic production on fish farming

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1. Executive Summary

Despite clear political support, organic aquaculture remains a niche market in the European Union. Although certified shellfish production has increased steadily, finfish only makes a marginal contribution to total organic aquaculture output. This study reveals that structural and systemic constraints compromise the economic viability and expansion of organic fish farming. Drawing on surveys and interviews with fish and feed producers across Europe, the analysis shows that the organic aquaculture sector in the EU is characterised by persistent constraints spanning technical, economic and regulatory domains. Feed-related challenges are at the forefront, particularly the high cost of certified organic feed, the limited availability of adequate certified ingredients, particularly for new species and early life stages, and the restricted number of suppliers with limited formulation flexibility under current organic regulations. The above feed issues are the main obstacle to profitability and scalability, particularly for carnivorous species that rely on marine-derived proteins. The second major bottleneck is organic-certified juvenile availability, where scarce hatchery production has forced some farmers to rear their own broodstock, which can increase costs and operating complexity, while others were forced to stop the organic production. Market-related weaknesses also persist, with insufficient price premiums and limited consumer awareness dampening demand and deterring further investment. Regulatory and operational barriers, including difficulties in obtaining licences, the inability to access new production sites, and the lack of expertise of certification bodies about organic aquaculture, further complicate expansion efforts. While species-specific challenges vary, they commonly reflect these overarching issues. The findings indicate that the sector is constrained by a combination of intertwined technical, economic, and regulatory barriers. The availability/cost of feed and juveniles is the core bottleneck for nearly all species, while regulatory rigidity and insufficient market recognition make it difficult to sustain or expand organic fish production. Without targeted policy adjustments to facilitate access to certified inputs, encourage innovation in feed formulation, and strengthen market recognition, the development of organic fish farming in the EU risks stagnating or declining. At the end of the report, we propose a series of short-term and medium/long-term recommendations.

2. Context and scope of the study

The European Union is currently promoting the development of organic aquaculture. The support for this is reflected in policies at both the European and national levels[1]. Despite significant growth in the last decade, primarily driven by organic mussel production, the sector continues to face substantial technical and regulatory challenges and the total volume of certified organic fish remains marginal compared with conventional aquaculture.[2,3]. This gap suggests that significant structural, technical, and economic barriers still constrain the growth of the organic sector.

In this context, the European Commission invited FEAP to provide scientific and technical evidence to substantiate the challenges faced by the organic aquaculture sector, with a view to suggesting changes to legislation following a FEAP position paper. Many of these challenges were also highlighted in a European Commission working document released in 2023[4].

The aim of this study was to identify the technical and economic challenges of implementing the EU organic regulation on fish farming and to propose technical and policy recommendations. Key areas of focus include feed ingredients, juvenile supply, fish health controls, and general farm management. The report focuses specifically on European sea bass (*Dicentrarchus labrax*), Gilthead seabream (*Sparus aurata*), common carp (*Cyprinus carpio*), Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*), although it also mentions meagre (*Argyrosomus regius*).

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[1] Toomey et al. (2025). Unlocking the Potential of Organic Aquaculture in the EU: A Review of Policy Support and Supporting and Constraining Factors. *Reviews in Aquaculture* 17(4): e70089. https://doi.org/10.1111/raq.70089.
[2] EUMOFA (2022). Organic Aquaculture In The EU – Current Situation, Drivers, Barriers, Potential for Growth. https://eumofa.eu/documents/20178/432372/Organic+aquaculture+in+the+EU_final+report_ONLINE.pdf
[3] AAC (2023). Recommendation on Organic Aquacture. https://aac-europe.org/wp-content/uploads/2023/07/10.-AAC-Recommendation-Organic-Aquaculture_2023_10.pdf
[4] European Commission (2023). Working Document - Issues impacting the development of EU organic aquaculture. https://agriculture.ec.europa.eu/document/download/e5b9c6fe-23ac-408c-9670-b938a5dad326_en?filename=wd-issues-on-organic-aquaculture-082023_en.pdf

3. Methodology

A two-stage investigation was conducted. First, a questionnaire (see Annex 1) was sent in August 2025 to ten feed or fish producers or producer representatives (n = 1 feed producer and n = 9 fish producers/producer representatives, respectively) who are members of the member associations of FEAP and are based in eight EU countries. This was done to gain an overview of the challenges encountered in the organic aquaculture sector. Among the parties contacted, two of the fish producers were no longer certified organic (one since 2021 and one since 2024). The farms contacted have, as a group, a history of organically producing sea bass and seabream (four farms), meagre (one farm), carp (one farm), Atlantic salmon (one farm) and rainbow trout (three farms). Following the questionnaire, 45-minute to 1-hour follow-up interviews were conducted in October 2025. One person represented two rainbow trout farms during the interview and an additional farmer, who had not responded to the initial questionnaire, was also included in the interview process. This brought the total number of sea bass/seabream and meagre farmers to five and two, respectively. The interviews aimed to explore the initial answers provided in the questionnaire in greater depth, as well as the reasons behind the respondents' scores and the specific situations they face. The interviews also allowed respondents to elaborate on the strategies they adopt to mitigate their constraints and to elaborate freely on their experiences and raise additional issues. A scoring exercise based on that used in the questionnaire (see Annex S1, Figures S1 and S2) was also carried out during the interviews to identify major challenges. This exercise had a more precise and detailed structure than the first initial questionnaire, providing a more comprehensive overview of the challenges faced. Quantitative scores (from 1 [not a challenge] to 10 [critical challenge]) were summarised and visualised through figures produced using the statistical analysis software R. Qualitative responses were arranged thematically to provide supporting explanations and examples. The results are presented in three sections: (1) overall patterns emerging across all respondents, (2) species-specific findings, which highlight the particular constraints affecting different production systems, and (3) the feed manufacturing perspective.

4. Results

A. Global patterns across the EU organic aquaculture sector

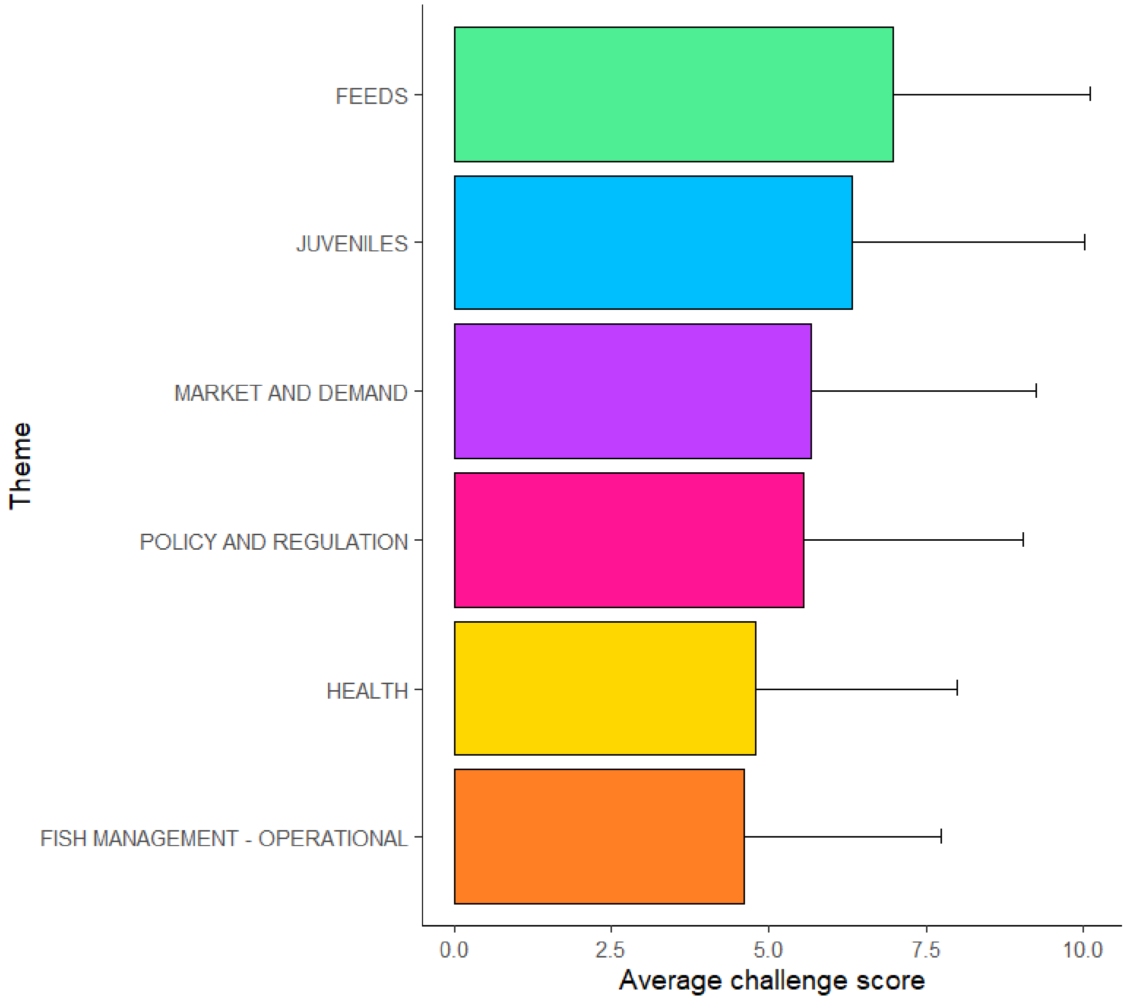

Figure 1. Average challenge score across major themes relative to organic aquaculture (N=9 fish producers/fish producer representatives; scores ranging from 1 [not a challenge] to 10 [strong barrier]).

The study revealed a consistent pattern among respondents in identifying similar core obstacles to the development of organic aquaculture. Two interlinked themes emerged across countries and species: organic feed and juvenile supply. The highest mean scores among fish farmers were attributed to problems relating to certified organic feed, followed closely by issues linked to the supply of certified juveniles, as well as market and demand factors (Figure 1). Other frequently mentioned challenges were related to policy, health management under organic constraints, and operational factors (Figure 1). However, Figure 2 shows that there are some differences in the priority of challenges across species, with the top challenge being juveniles in sea bass and seabream, feed in meagre and rainbow trout, market and demand in common carp, and policy and regulation in Atlantic salmon.

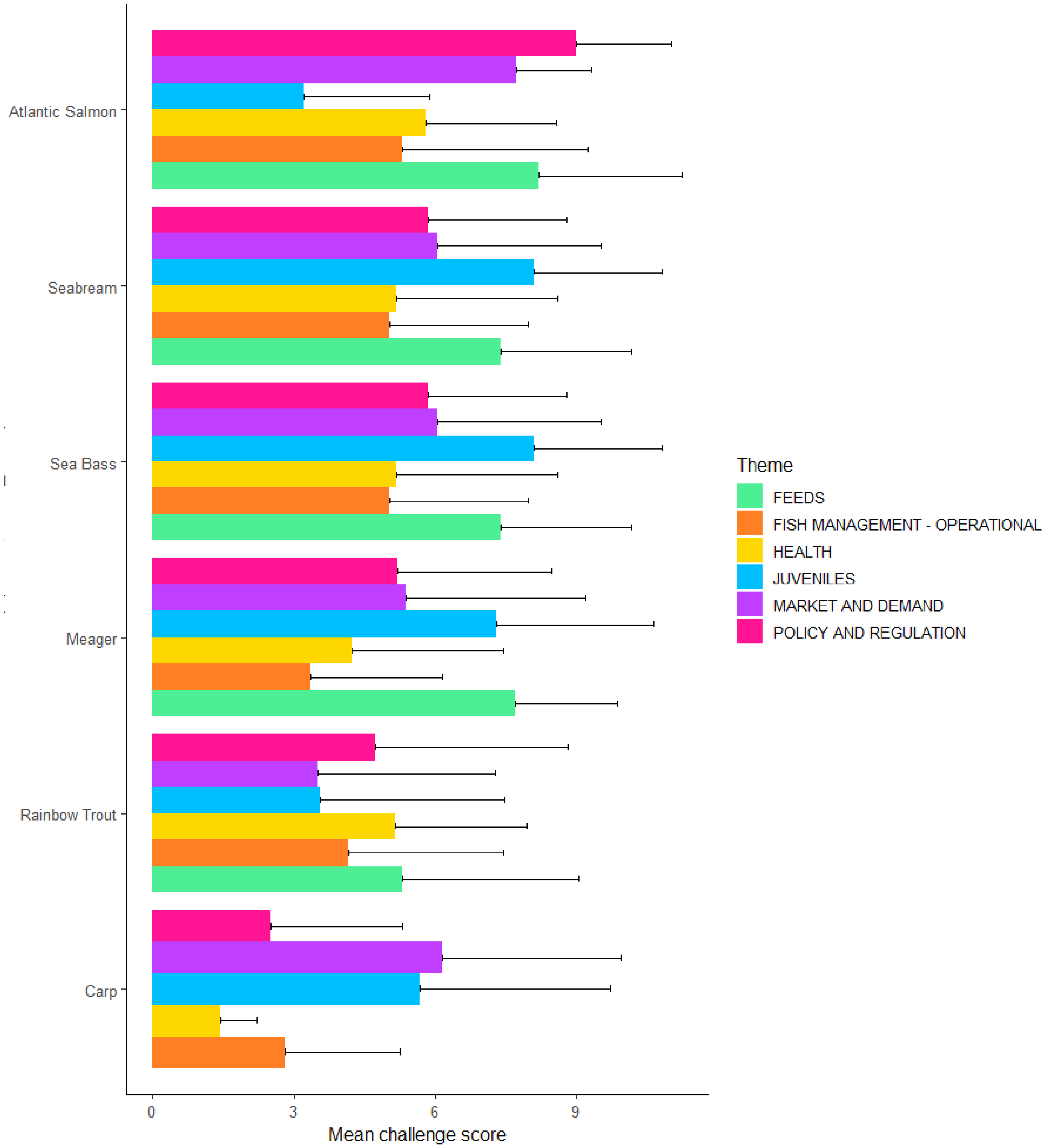

Figure 2. Average challenge score per species across major themes relative to organic aquaculture (N=9 fish producers/fish producer representatives; scores ranging from 1 [not a challenge] to 10 [strong barrier]).

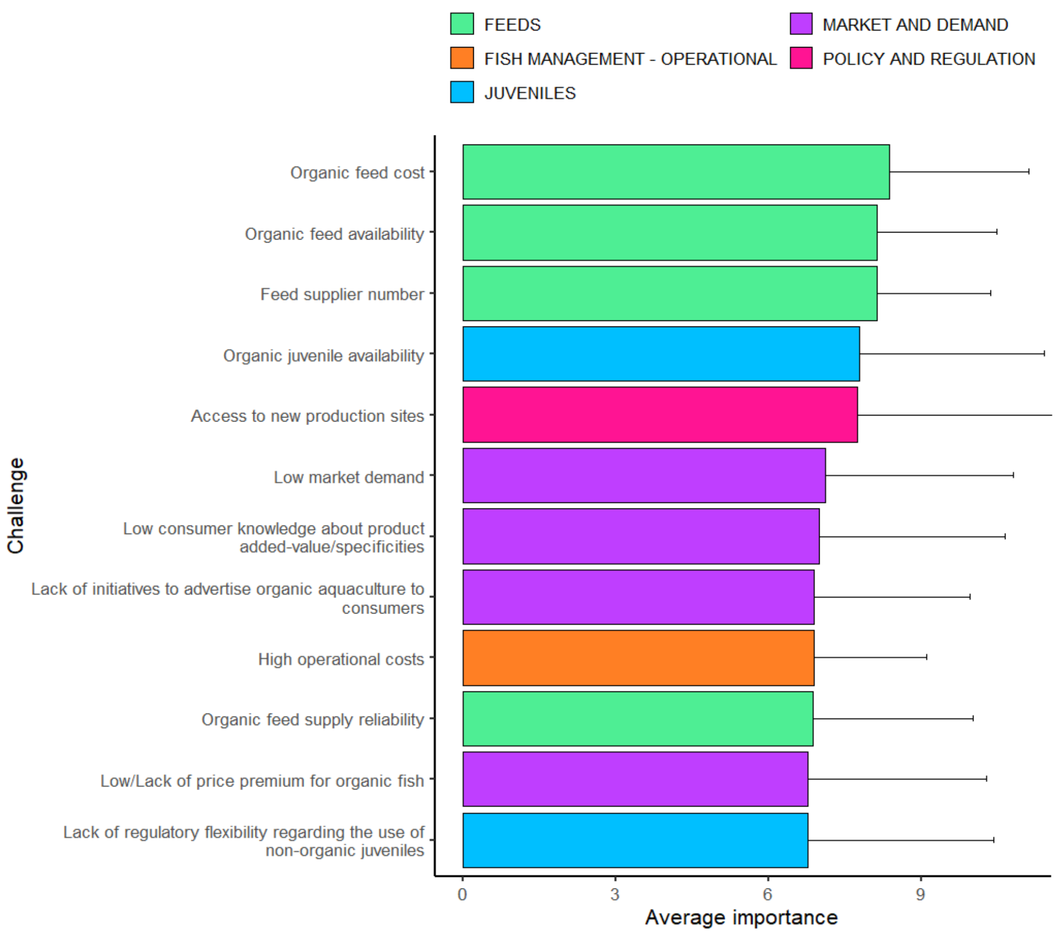

Figure 3. Top 12 highest-scoring challenges related to organic aquaculture (N = 9 respondents; scores ranging from 1 [not a challenge] to 10 [strong barrier]). Colours refer to the challenge theme.

Looking at the top 12 of challenges identified across species (Figure 3), the top three regards feed challenges, with the cost identified as very high and limiting profitability, the availability of high-quality certified organic feeds being limited, particularly for the farming of new species or first-life stages, and also due to the limited number of organic feed suppliers. Feed manufacturers and farmers alike repeatedly highlighted the restricted basket of allowable ingredients under current organic rules, which constrains formulation flexibility and limits nutritional optimization, particularly for carnivorous marine species. Producers emphasized that even when feed is available, prices are substantially higher than for conventional feed, and volatility in raw material costs can severely impact profitability. One feed producer confirmed that sourcing certified high-quality raw materials remains a serious challenge, as the global supply is narrow and subject to intense demand (i.e. competition with other sectors). The heatmap of respondents versus barriers (Figure 4) further shows that feed-related concerns were uniformly high, except for common carp which does not require feed input and rainbow trout for which contrasted answers were provided across the two producer representatives (see the section relative to species-specific patterns). Carnivorous species, such as salmon, meagre, sea bass, and seabream, tend to cluster together (Figure 4), reflecting their shared dependency on high-protein diets and marine-derived feed ingredients.

The availability of certified juveniles emerged as the second most critical limitation (Figure 3). This issue is especially acute for Mediterranean species such as sea bass, seabream, and meagre (Figure 4), for which producers consistently reported difficulties in obtaining certified juveniles (scarce certified hatcheries) in sufficient quantities or at the appropriate time for stocking. The variable interpretation on the concept of separation between conventional and organic productions in one production site and the absence of a reliable, updated, centralised database of organic fry suppliers further impede planning and production stability. The absence of organic juvenile suppliers forced some farms to rear or consider rearing their own broodstock, increasing operational costs and technical complexity, while others were forced or risk to stop the organic production.

Market-related constraints also represent a major structural weakness of the sector (Figure 3). Many farms operate with narrow margins, and the limited price premium for organic products fails to compensate for the higher input costs. In Spain and Hungary, interviewed farms reported having stopped their organic activity due to weak market demand and distribution barriers, although the situation looks better for Mediterranean farmed species (Figure 4). Even in markets where organic fish is available, consumer awareness remains low, and retailers often fail to differentiate organic products through branding or pricing. These challenges were also acknowledged by feed producers, who see limited growth potential without stronger downstream incentives.

Operational and regulation issues also contribute significantly to the perceived difficulty of maintaining organic production. Access to new production sites was identified in the top 5 challenges (Figure 3) and this issue was raised as a major bottleneck across all species, except for common carp (Figure 4). Although there were not among the most important bottlenecks identified, certification costs, licencing procedures in some particular states, and the interpretation of organic standards were often described as cumbersome, with reported inconsistencies between certifying bodies and member states.

Finally, health management under organic constraints received intermediate mean scores, not belonging to the top-12 challenges and presenting variable perceived importance among species. Most producers felt that limitations on the number of allopathic treatments (Annex II Part III point 3.4.1.2 (d) and (e) were challenging, but that they were globally manageable and central to the principles of organic production. Producers of Atlantic salmon and rainbow trout rated this constraint moderately high (see details below in the species-specific sections). In contrast, producers of extensive species such as carp reported fewer health-related concerns, suggesting that this barrier is closely linked to farming intensity and species sensitivity.

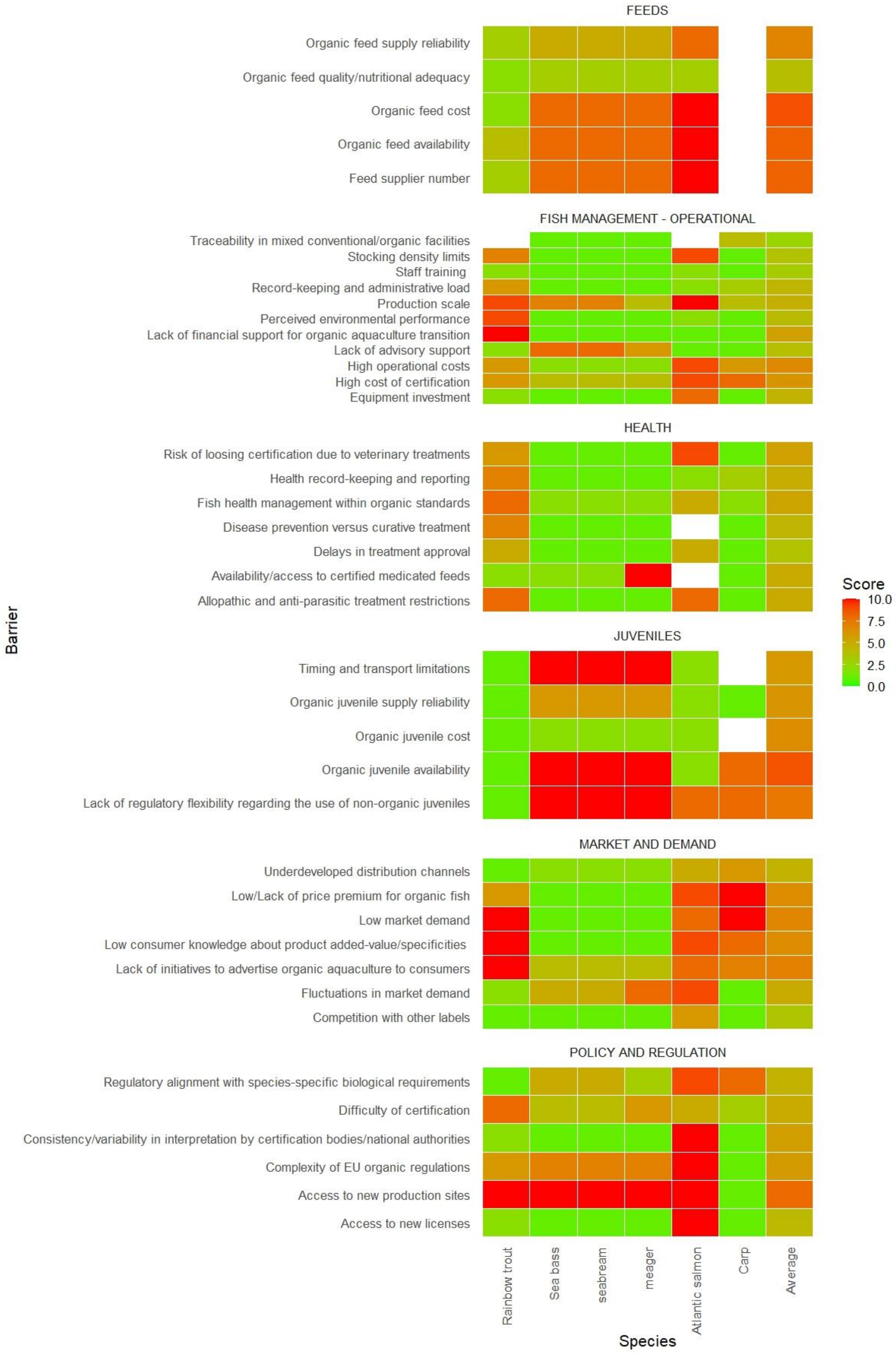

Figure 4. Heatmaps of challenges related to organic aquaculture per theme and per species (N = 9 respondents; scores ranging from 1 [not a challenge; green] to 10 [strong barrier; red]).

Taken together, the global results reveal a consistent picture of a sector constrained by technical bottlenecks (feed and juvenile supply), economic imbalance (high production costs *vs*. weak price recovery), and lack of regulatory flexibility. Figure 4 summarises the mean category scores by species group, illustrating how feed and juvenile constraints dominate almost across all types of production, whereas health and regulatory issues vary more by species and region.

B. Species-specific results

Although the general trends are common across the sector, the intensity and nature of the constraints differ among species and sometimes among countries. The following subsections synthesise species-specific findings combining both scoring results and qualitative evidence.

B.1 Atlantic salmon (N=1 producer)

One farm located in Ireland was interviewed, which has been certified since 2017 and produces only organic Atlantic salmon. Organic salmon aquaculture in the EU faces an array of persistent and interconnected challenges.

Organic Atlantic Salmon farming major constraints

The most significant barrier is the regulatory and licensing framework (Figure S3). Obtaining new or renewing organic licenses is extremely arduous, with applications having been pending for over a decade. Licensing procedures in Ireland have been slowed down by the fact that licences granted in the 1980s and '90s are no longer relevant to current rearing practices and technology. The complexity and interpretation of EU environmental regulations and directives, which vary from one jurisdiction to another, has been seen as significantly slowing down the licensing process at the national level. These bureaucratic delays were cited as a major deterrent to the expansion of organic aquaculture, also preventing access to capital funding or grants. While organic salmon aquaculture is seen as a unique selling point with growth potential, its expansion cannot be expected to happen unless licensing procedures are improved.

There are also concerns about feed, with limited access to certified fishmeal and fish oil derived from trimmings (there is only one supplier of certified material), which implies a risk of shortage (Figure S3). Global fluctuations in commodity supply directly threaten both price and availability. The limited range of approved ingredients also poses a challenge in terms of technical quality and the cost of feed formulation. No major concerns were raised regarding juveniles, which are produced in-house, or health management. However, it was mentioned that there is a risk of losing the organic label after a bacterial infection due to the use of antibiotic treatments, although this rarely occurred, as well as challenges related to parasite control, which led to the development of their own cleaner fish programme as a biological control measure.

Markets

Demand for EU organic salmon over the next decade is seen as uncertain and highly dependent on the fortunes of individual countries and the price of conventional salmon. Due to economic uncertainties and the cost of living, consumers' spending power could be lower. As organic salmon is more expensive, it can be seen as a luxury product, so it may be necessary to target richer countries or demographics who are willing to buy it. Prices of Atlantic salmon have been under threat this past year due to oversupply, leading the interviewed farm to sell a part of the organic production as conventional in order to avoid pulling down the price of organic products.

Questions were also raised about the equivalence of the standards applied to imported organic Atlantic salmon products from third countries, which are sold at a lower price, and the associated controls carried out.

The multiplicity of labels causing confusion for consumers was also mentioned. In the case of the interviewed farm, organic Atlantic salmon used to be ASC-certified, but this was discontinued as consumers could not differentiate between the labels, and the certification was considered too expensive with no additional benefit to the final price.

Stocking density

Finally, the need for scientific research to define the optimal stocking density for Atlantic salmon was raised, as the current density imposed by the organic regulation is not, in the respondent's view, supported by the scientific literature. The Turnbull et al. (2005) study[5] was cited as an example, in which the authors found a non-linear relationship between the stocking density of farmed Atlantic

[5] Turnbull, J., Bell, A., Adams, C., Bron, J., & Huntingford, F. (2005). Stocking density and welfare of cage farmed Atlantic salmon: application of a multivariate analysis. *Aquaculture*, 243(1-4), 121-132. https://doi.org/10.1016/j.aquaculture.2004.09.022

salmon and the welfare score of these fish. They established that stocking density above a certain threshold (22 kg/m^3) negatively impacted welfare, whereas below this threshold, density had no measurable negative effect on the welfare score of farmed fish. However, the conclusions of this study do not align with the current imposed stocking density (maximum of 10 kg/m^3 in net pens[6]).

B.2 Rainbow trout (N=2 respondents)

Overview

The two interviewees referred to three farms located in France and Denmark that were 100% organic and only produced rainbow trout. Although trout producers typically run small or moderate-sized organic operations, they identified several structural constraints (Figure S4). Rainbow trout producers in Europe face distinct challenges, influenced by country-specific regulatory frameworks, production systems and market conditions.

Production and recirculation limitations in Denmark

The number of Danish trout producers operating under organic conditions has declined year on year, and today only one or two remain who are engaged in 100% organic production. The main reason for this decline is attributed to national regulations. While Denmark implements the EU organic rules, it supplements them with statutory orders that notably include environmental requirements. These include control of discharges and nutrient loads, as well as site restrictions, which have driven a shift towards emission- or performance-based regulation. This has prompted a policy shift in the aquaculture industry towards technology and recirculating aquaculture systems, in an effort to reduce nutrient discharge. However, fully recirculated aquaculture systems are not permitted under organic regulations. This hinders organic trout farms from scaling up, since producing more than 100 tonnes would require a high degree of recirculation. Indeed, it is not clear to what extent the suggestions on the reuse of water included in the EGTOP report adopted in July 2014 have been considered compatible with EU organic regulation.

[6] Consolidated text: Commission Implementing Regulation (EU) 2020/464 of 26 March 2020 laying down certain rules for the application of Regulation (EU) 2018/848 of the European Parliament and of the Council as regards the documents needed for the retroactive recognition of periods for the purpose of conversion, the production of organic products and information to be provided by Member States - Annex II - Detailed rules with respect to the stocking density and the specific characteristics of production systems and containment systems for aquaculture animals as referred to in article 22 - https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02020R0464-20211125

The Danish market and value chain

Other challenges, such as low national demand for organic trout, higher operational costs, and a lack of financial support for transitioning from conventional to organic production were mentioned, but were considered to be less important than the bottleneck caused by national regulations. Feed availability and diversity are much less of a problem in Denmark thanks to the proximity of major feed manufacturers. Nor is sourcing organic juveniles considered a barrier, as Danish producers maintain their own supply due to small volumes and the need for an integrated value chain. Market conditions for organic trout in Denmark are characterised by low domestic demand, a lack of public funding for conversion, and insufficient public initiatives to promote organic aquaculture. Despite high consumer awareness of organic labels, volumes are low and most of the production is exported.

The French production and the feed issue

From a regulatory perspective, French trout producers do not view EU or national organic regulations as an obstacle themselves. However, obtaining certified organic feed is the main bottleneck. The feed supply chain is highly concentrated, with only one provider available to comply with certain specifications, which makes producers vulnerable to supply disruptions or changes in feed formulation. The higher price of organic raw materials compared to conventional products also poses a challenge for feed formulation. Additionally, feed composition that aligns with organic standards is considered as an environmental issue due to the high phosphorus discharge in the farms' effluents.

Organic juveniles and fish welfare challenges in France

The limited supply of organic eggs and juveniles was also identified as a significant challenge, given the small number of certified hatcheries and the unpredictable nature of logistics. Following the closure of organic juvenile production from one major supplier and variable juvenile quality from another (high mortality rates for the three consecutive years), the French professional union interviewed for this study was forced to create their own internal supply programmes for organic trout juveniles to secure and maintain production continuity. However, the supply and quality of organic eggs is limited due to the difficulty of getting organic breeding stock, as both males and females must be maintained for reproductive purposes. This presents particular challenges. Firstly, it is difficult to identify true males because it is not possible to use neomales as is done in conventional trout aquaculture (point 3.1.2.2 of Part III of Annex II to Regulation (EU) 2018/848). Secondly, males kept in the same production environment as females tend to mature precociously. At this point, the sexual maturation process stops their growth stops and their flesh becomes unmarketable. At that stage, males are more susceptible to diseases such as saprolegniosis, a lethal fungal infection that is the most common. Weak, infected males become a source of disease for the rest of the farm. According to the respondent, the only viable alternatives to prevent losing significant amounts of stock to early male maturation are to authorise female-only production with eggs sourced from conventional broodstock selected for disease resistance and growth, or to implement costly national selective breeding programmes for male and female lines. Overall, the current requirement for males in the reared stock raises welfare issues and affects the health of the entire organic trout population.

Water supply and recirculation limitations in France

Maintaining both females and males in the stock creates additional issues when stock densities need to be lowered during periods of low water. Production takes place in raceway systems, but full recirculation of the water is not permitted in organic aquaculture. However, low water levels in summer can lead to water supply restrictions when groundwater tables are lows. To survive dry summers, some organic production sites have been converted back to conventional production.

Disease control and health management

Apart from issues linked to male production, health management was considered satisfactory overall, and alternatives to formalin were suggested to improve health management within the constraints of organic production. The restrictions on allopathic treatments (point 3.4.1.2 of the of Part III of Annex II to Regulation (EU) 2018/848) are acknowledged as an issue, but reportedly manageable. Producers have not reported losing organic status of batches due to necessary treatments. Record-keeping and audits are not considered to be more time-consuming or labour-intensive than in conventional farming. Additional production costs were highlighted due to the need for water intake filtration and new ponds to comply with stocking density limits, as well as certification costs.

Market situation in France

French producers reported relatively stable markets for organic trout, suggesting that constraints on the production side are more critical than market demand for this species. Demand actually exceeds their supply capacity, partly due to major organic trout producers having withdrawn from the market. Nearly all organic trout production in France is for the domestic market, and it is used as a strategic lever to support better terms for the sale of both organic and conventional fish to buyers.

Overall, there is potential for organic French trout production to expand if issues relating to feed and juveniles can be resolved. Nevertheless, it was noted that conventional production has improved significantly in terms of sustainability, and the historic distinction between organic and conventional production is shrinking. On the contrary, the future of organic rainbow trout production in Denmark looks quite limited.

B.3 Sea bass, seabream, and meagre (N=5 farms)

Interviews with five Mediterranean aquaculture producers reveal a sector constrained by supply chain fragility, regulatory rigidity, and uneven market recognition. Among the respondents, one producer had discontinued organic certification in 2021 (formerly producing organic sea bass and seabream in sea cages), while the remaining four currently operate certified organic sites. These farms collectively rear/reared sea bass (n = 5; sea cages and ponds), seabream (n = 5; sea cages and ponds), and meagre (n = 2; sea cages). Two farms are fully organic, while the others maintain/maintained organic production as a small share of total output (around 5%), partly illustrating the difficulty of scaling up under current conditions.

Juvenile supply as the main bottleneck

Across all interviews, the limited availability of certified organic juveniles emerged as the most critical and persistent bottleneck (Figure S5). The number of certified hatcheries producing sea bass and seabream has decreased markedly in recent years, one French and one Greek supplier having stopped production, leaving only two potential sources to the knowledge of interviewed farms. One of these hatcheries produces primarily for its own use, while issues with delivery delays and fry quality for one species were reported with the second supplier, resulting in missed growth seasons and an extra production year to reach market size and subsequently higher end-product cost (about 30% more). For meagre, the situation is even more constrained: no organic juveniles are currently available commercially, forcing producers to rely on in-house hatchery production or repeated derogations from certification bodies. One producer reported being at risk of losing certification after resorting to conventional sea bass juveniles due to the absence of high-quality certified organic alternatives. In response to the chronic shortage of certified fry, several producers have begun developing their own hatcheries or plan to do so. However, they described the current requirements for organic hatchery certification (Point 3.1.2.3 of Part III of Annex II to Regulation (EU) 2018/848) as technically and economically difficult to comply with. For instance, mandated low larval stocking densities were reported to generate strong size heterogeneity in the cohorts, leading to cannibalism, inefficient feeding, and excessive use of live plankton. Producers also emphasised the poor nutritional quality of the certified organic hatchery feeds available and the prohibition of live feed enrichment due to the artificial processes used, which negatively affect larval performance. Two of the five companies reported disagreements between certification bodies and national authorities, or an absence of clear responses regarding aquaculture system setups and rules in cases of mixed production (organic/conventional). More specifically, two companies encountered an issue concerning the interpretation of the requirement to separate conventional and organic productions (Annex II, Part III, Point 1.2). One company wants to convert a part of its hatchery as organic (using a different water system) but the national authorities estimated that the entire hatchery should be organic, whereas the certification body had asserted that mixed production was acceptable given the distinct water circuits. This has led to planned hatchery investments being halted and has left the company in a difficult situation, as they have not yet been able to find an organic juvenile supplier after their main supplier stopped producing organic juveniles. Another company reported a similar problem regarding juvenile on-growing. They were considering using one of their three water systems for non-organic seabream and sea bass production, while keeping the first two systems for organic production. However, they did not receive a definitive answer from the national authorities, and the certification body was also unable to provide one. This has blocked any further change so far. Respondents also criticized the lack of updated information available to both national authorities and certifiers: the EU databases on organic juvenile availability remain incomplete and based on voluntary updates, leaving operators without reliable data when requesting derogations. This led to a difficult situation for one producer, as the national certification body had three potential organic juvenile suppliers on record. In reality, however, two of these had ceased organic juvenile production, and the third corresponded to a supplier with whom the producer had experienced delivery delays and quality issues with the juveniles (an extra year was needed for them to reach commercial size) for two consecutive years. This left the producer with no viable option for sourcing good-quality juveniles.

Organic feed

Organic feed cost was identified as the second major constraint (Figure S5, Table 1), organic feed availability being also cited as a major bottleneck. Respondents cited only two active organic feed suppliers across their networks, limiting choice and negotiating capacity. Transportation costs are significant, especially for remote sites, and feed prices were reported to be 30–50% higher than conventional equivalents. The limited range and quality of raw materials available for organic feed production has direct nutritional and economic repercussions. Producers noted frequent difficulties maintaining consistent levels of long-chain omega-3 fatty acids (EPA and DHA) in the diets due to the scarcity and high cost of certified marine ingredients. Some available alternatives, such as trimmings or bone meal, were deemed nutritionally inadequate (low in omega-3s, high in phosphorus), contributing to digestibility issues and environmental impact (higher phosphorus content; Table 1). In addition, there are no species-specific certified feeds for new entrants like meagre, which has forced one producer to recently suspend organic meagre production entirely. Respondents underlined that feed formulation rules must remain flexible and dynamic, allowing gradual improvement without sacrificing product quality.

Table 1. Example of a comparison between organic and conventional feed provided by one of the farms interviewed, which makes its own formulations and orders tailor-made feeds from one feed manufacturing supplier.

Feed	Price	Ash content	Phosphorus content
Organic feed	1800 euros / tonne	14%	1.95%
Conventional feed	1120 euros/tonne	8%	1.2%

Disease and health management

Health management was generally considered satisfactory (Figure S5), owing largely to the lower rearing densities typical of organic systems, which reduce disease transmission risks. One company reported not using any allopathic treatments (whether parasitic or antibiotics), emphasising that this absence of treatment is central to the principles of organic production. Another producer highlighted that the success of disease control in organic aquaculture hinges on prevention, system design and early detection rather than curative measures. They stated that there is a need to increase support for identifying preventive measures for prophylaxis. Nevertheless, respondents emphasized the time-consuming administrative workload linked to reporting and documentation. Some producers also expressed concern about future risks under climate change, with warming waters expected to increase disease outbreaks. The absence of organic medicated feed was cited as a weakness that could compromise fish welfare in future scenarios.

Markets

The marketing of organic fish was overall described as demanding and uncertain. Consumer awareness of aquaculture practices remains low, and in several countries (notably Spain), alternative certifications such as ASC are perceived by retailers and consumers as more prestigious than the organic label. As a result, the price premium for organic products is often insufficient to offset higher production costs. One producer reported selling 30–40% of their organic production as conventional, due to limited market demand. Others described the need for extensive marketing efforts to differentiate organic fish and justify price premiums. However, contrasting experiences also emerged:

in some cases, demand outstripped supply, indicating potential for growth if supply chain stability could be ensured. Respondents warned that the instability of juvenile supply threatens market continuity and could quickly erode retailer confidence if producers cannot guarantee steady volumes.

Additional technical barriers were highlighted (Figure S5), including the requirement for electrical stunners to access key export markets such as Switzerland and the United Kingdom. While this requirement is external to EU organic regulation, it effectively excludes small-scale producers lacking the financial means or vessel capacity to install such equipment. One respondent reported losing its large export market in Switzerland as a result.

Organic regulation implementation challenges

Spatial planning and licensing issues were also raised among challenges, particularly in Greece, where the scarcity of available sites for aquaculture represents a major structural constraint to organic development. Several producers also criticized the lack of expertise of certification bodies in aquaculture, as inspectors often come from livestock or crop backgrounds. This leads to inconsistent interpretations of rules and a lack of precise answer regarding particular concerns such as the establishment of mixed conventional/organic hatcheries. There was broad consensus on the need for greater flexibility and regulatory pragmatism. Respondents argued that the current rigidity of the organic framework risks killing the sector before it develops, as innovation and adaptation are constrained by procedural and conceptual inertia. To ensure the credibility and long-term viability of organic aquaculture, producers called for a holistic improvement approach, one that enhances sustainability throughout the production cycle, encourages the use of the most environmentally responsible inputs, and allows gradual regulatory evolution without penalizing early adopters.

Overall, Mediterranean producers reported among the highest constraint scores in the broader European survey, reflecting the combined pressures of scarce and unreliable juvenile supply, expensive and nutritionally limited feed, administrative complexity, and fragmented markets (Figure S5). Producers emphasized that reforming the EU organic regulation to incorporate flexible, species-adapted standards and to foster innovation in feed production is essential to prevent organic aquaculture from stagnating. Without targeted adjustments to the regulatory and supply frameworks, organic sea bass, seabream, and meagre farming risks remaining confined to a niche, or disappearing entirely.

B.4 Common carp (N=1)

The production of organic carp presented a distinct picture from that of other species (Figure S6). One farm was interviewed that previously had one 50-hectare pond (out of a total production area of 1,000 hectares) that was certified organic until 2024. While biological and technical constraints were not considered particularly challenging, market demand and lack of price premiums were given the highest scores (Figure S6).

Market demand, the main bottleneck

The main barrier reported was market demand. As EU food safety regulations are already very strict, consumers were reported to be unwilling to pay price premiums for the organic label. It was noted that conventional extensive carp production is already regarded as environmentally friendly and sustainable, so consumers do not perceive organic certification as offering any added benefits. While the adjustments required for the transition from conventional extensive pond production to organic are not significant, the cost of certification is considered burdensome, especially in the absence of clear market advantages or additional revenue streams. Due to the low demand for organic carp, the majority of organic production was being sold as conventional. The limited consumer interest in organic carp means that certification was not economically viable as the additional costs (e.g. certification, marketing, independent transport and separate storage) could not be recovered through the final product price. This low demand is also linked to global fluctuations in the carp market supply and price. Market demand for carp has remained static and has even decreased slightly over the last decade. In the late 2000s, organic carps were occasionally sold as organic, primarily to Austria, but demand for this product collapsed after 2010. Organic carp could potentially have been sold for export (e.g. to Germany and Austria), but given the low production volume, the additional marketing effort and transport costs were deemed unworthy. Organic certification was maintained over time, as establishing an organically certified production system takes time (cf conversion rules; point 3.1.1 of Part III of Annex II to Regulation (EU) 2018/848) and effort, but certification was eventually ceased in 2024.

Other challenges

Given the extensive and low-input nature of carp farming, feed and health management were not considered major obstacles (Figure S6), but economic viability remains the central barrier to sustaining this activity. The health management process was relatively straightforward. Carp are resilient under extensive conditions, rarely suffering from notable diseases. The adoption of organic standards, coupled with regulatory limitations on medicated feeds and treatments, did not pose any operational challenges.

At that time, the derogations available allowed the partial use of conventional juveniles produced in-house. However, the current requirement of using only organic juveniles is considered very challenging, as hormonal induction is needed for carp reproduction, which is prohibited by the regulation (point 3.1.2.2 of Part III of Annex II to Regulation (EU) 2018/848). To the interviewee's knowledge, there was no possible external supply of organic carp juveniles.

To summarise, the key challenges faced by organic carp aquaculture were not related to operations, compliance or health. The main challenges were the absence of viable market demand and a lack of differentiation in consumer perception. The supply of organic carp juveniles would also have posed a substantial barrier to continuing with organic production. The cost-benefit analysis for sustaining organic carp production is consistently unfavourable, compounded by factors such as low national fish consumption, negligible price premiums, and inadequate promotional support. Significant changes in market structure and consumer awareness would be required for producers to sustain organic carp aquaculture.

C. Organic feed producer perspective

One of Europe's leading feed manufacturers, producing organic feed for a wide range of aquaculture species, including sea bass, seabream, carp, rainbow trout, shrimp, and sturgeon, was interviewed. According to the company, organic feed currently accounts for around 14% of total production, down from 25–33% in previous years. This decline is primarily attributed to reduced demand rather than production constraints. Several of their clients have ceased organic production, reverted to conventional systems or closed entirely. The company emphasised that it has no limitation in production capacity and remains able to meet demand. However, the market contraction has led to logistical adjustments, such as centralising organic feed manufacturing on a single site to maintain efficiency, although this potentially increases delivery times and costs.

Main challenges to organic feed production

From a technical standpoint, the production of organic feed is not considered to be more challenging than conventional feed manufacturing. Production takes place on shared lines, with mandatory cleaning (rinsing) steps to prevent cross-contamination. While these measures do incur additional time and cost, the overall operational barriers remain relatively modest (Figure S7). The primary challenge is in formulating nutritionally balanced and economically viable feeds that meet clients' requirements in terms of quality and price, while adhering to the EU organic regulations (point 3.1.3 of Part III of Annex II to Regulation (EU) 2018/848) and ensuring ingredient availability.

The availability and quality of certified organic raw materials, particularly high-protein ingredients, was identified as the most critical bottleneck (Figure S7). Conventional aquafeeds typically rely on highly concentrated protein sources such as wheat gluten, maize gluten and soy protein concentrate. However, these ingredients are often unavailable in organic farming, prohibitively expensive (due to competition with the human food market; e.g. wheat gluten concentrate) or produced via chemical processes (e.g. corn gluten concentrate), which are disallowed under organic rules. Consequently, organic formulations tend to rely more on alternative less protein-rich concentrates or produced through other processes, resulting in a less pure product. This has led to a greater reliance on fishmeal and marine products to meet protein requirements, which are costly and increasingly scarce. The use of certified sustainable or coproduct-derived marine ingredients is in line with the principles of circularity and resource efficiency. However, the increasing competition for these resources across various industries has resulted in rising prices and uncertainty regarding supply. The same issue arises with oils. For example, rapeseed oil is the richest vegetable oil in omega-3 and is therefore mainly used in aquafeeds. However, it is difficult to obtain due to competition with the food sector.

The prohibition on the use of synthetic amino acids (Annex II, Part III, point 3.1.3.1.e) also affects the ability to achieve optimal amino acid profiles in the feed formulations (especially lysine and methionine), which in turn triggers the need to look for raw materials which are less concentrated. This has implications for the nutritional precision and palatability of the feed, as well as for fish growth performance and cost of production. The company has acknowledged that while fish are growing well, there is still potential for enhancement in amino acid balance and health-promoting formulations. Another key constraint relates to the limitations in the use functional additives such as essential oils, medium-chain fatty acids, probiotics and prebiotics. These are commonly used in conventional aquafeeds to improve fish health and welfare. These compounds are usually excluded from organic feed because their extraction involves chemical processing steps, or because the base raw materials are not available in organic form. A few extracts from yeast or plants are available, though these are less concentrated. The resulting limited portfolio of authorised additives restricts innovation and the ability to address fish health challenges preventively, especially for species other than salmonids, which dominate feed additive research and regulatory approvals.

The interview also highlighted recent progress and persistent difficulties. For instance, monopolistic conditions for certain inputs, such as astaxanthin, have been known to reduce bargaining power and affect feed prices, though availability has generally been sufficient. Another example, vitamin B2 (riboflavin) was for several years a significant challenge in the production of organic feed, as the only available sources were produced using genetically modified bacteria, which are prohibited under organic standards. According to the feed company, a new non-GM alternative was recently approved, potentially resolving this issue. However, such occurrences highlight the vulnerability of organic feed producers to supply chain constraints resulting from restricted ingredient authorisations or monopolistic supplier situations.

Regulatory compliance overview

In contrast, policy and certification procedures were perceived as relatively clear and manageable (Figure S7). The EU Organic Regulation itself was not viewed as excessively complex or ambiguous, although its current scope limits innovation in feed formulation. The company suggested that opening the organic standards to certain food-grade processing aids (which are already permitted in the human food sector) could enable the development of new organic protein concentrates without compromising environmental integrity. Similarly, the use of specific synthetic amino acids or biotechnologically derived proteins, provided that production processes are sustainable and non-polluting, could help address current nutritional gaps.

Outlook

From an economic perspective, the production of organic feed is generally more costly than conventional feed. This is primarily due to higher raw material costs and formulation constraints, rather than manufacturing inefficiencies. This price differential poses a significant challenge for fish farmers, particularly when consumer demand for organic fish is subject to variation. To summarise, the primary barriers to the future growth of organic aquaculture feed production in the EU are not related to operational or regulatory complexity. Instead, these barriers are due to the structural scarcity and cost of suitable organic feed ingredients, along with restrictive formulation rules that limit nutritional optimisation and innovation. Addressing these constraints by updating the regulatory framework for ingredient processing and broadening approval for alternative lipid and protein sources and authorised functional additives is seen as essential to make organic aquaculture both nutritionally viable and economically sustainable.

5. Conclusions and link with scientific literature

The combination of survey and interview data provides a coherent and detailed picture of the current state of the European organic aquaculture sector. Although the regulatory framework has enabled certified production to be established for multiple species and regions, the system continues to be constrained by supply chain fragility, regulatory inflexibility, and insufficient market differentiation.

Table 1. Summary of the intensity of challenge themes across species. Average scores between 0 and 3 were classified as a minor challenge. Scores between 3 and 6 were classified as a moderate challenge. Scores between 6 and 10 were classified as a major challenge. 🔴 *Major challenge* | 🟡 *Moderate challenge* | 🟢 *Minor challenge*

Theme/Species	Seabass	Seabream	Meagre	Carp	Rainbow Trout	Atlantic salmon
Feeds	🔴	🔴	🔴	🟢	🟡	🔴
Juveniles	🔴	🔴	🔴	🟡	🟡	🟡
Market and demand	🔴	🔴	🟡	🔴	🟡	🔴
Policy and regulation	🟡	🟡	🟡	🟢	🟡	🔴
Management - Operational	🟡	🟡	🟡	🟢	🟡	🟡
Health	🟡	🟡	🟡	🟢	🟡	🟡

Feed remains the central challenge for all fed organic fish species (Table 1). The limited permitted ingredients under the EU Organic Regulation (point 3.1.3 of Part III of Annex II to Regulation (EU) 2018/848; see also [7]) impose nutritional and logistical difficulties. Overall, feed manufacturers lack cheaper and less marine resources dependant protein sources, as well as several additives that could improve farms performances and sanitary status. Ingredient restrictions contribute to higher feed costs and can negatively impact fish growth and performance, particularly for certain species. More particularly, the lack of highly concentrated products and the limitations on processing techniques (Annex II, part III, Point 3.1.3.1d) push up the price of organic feed. Moreover, trimmings are

[7] Mente, Jokumsen, Carter, Antonopoulou, Tacon (2019). Nutrition in relation to organic aquaculture: Sources and strategies. In G. Lembo & E. Mente (Eds.), Organic aquaculture: Impacts and future developments (pp. 141–188). Cham: Springer. https://doi.org/10.1007/978-3-030-05603-2_8

included in the regulation as a prioritised source of marine proteins (Annex II, part III, point 3.1.3.3) but this was raised as a growing concern because of (i) their limited availability due to competition with other sectors and the limited number of suppliers, (ii) their poor level of omega 3 compared to traditional fish meal, and (iii) their high content in phosphorus which can trigger digestibility issues and environmental issues because of phosphorus rich discharges. Therefore, feed manufacturers and organic fish producers advocate broadening the list of acceptable protein-rich and lipid sources, and providing funding support for research into alternative protein sources. Animal by-products and algal oil, for instance, were mentioned as being of particular interest for organic feed formulation. This issue has also been widely discussed in the literature [7,8,9,10] and reported in European projects [11,12,13,14,15]. The revision of the list of permitted ingredients should take into account the numerous

[8] Toomey, Alfonso, Carbonara, et al. (2025). Unlocking the Potential of Organic Aquaculture in the EU: A Review of Policy Support and Supporting and Constraining Factors. *Reviews in Aquaculture,* 17(4): e70089. https://doi.org/10.1111/raq.70089

[9] Beg, Roy, Ramesh, Moulick, Tiyasha, Bhagat, Abdelrahman (2024). Organic aquaculture regulation, production, and marketing: current status, issues, and future prospects—a systematic review. *Aquaculture Research*, 2024: 15521188. https://doi.org/10.1155/2024/5521188

[10] Sicuro (2019). An overview of organic aquaculture in Italy. *Aquaculture*, 509(10*)*: 134-139. https://doi.org/10.1016/j.aquaculture.2019.05.024

[11] OrAqua project. European Organic Aquaculture - Science-based recommendations for further development of the EU regulatory framework and to underpin future growth in the sector - Deliverable D4.1 Extracted and integrated/synthesized information from WP2 and WP3 (1st stakeholder event). https://www.oraqua.eu/content/download/110486/file/Deliverable%204.1.pdf

[12] Factsheet - Challenges and solutions for more sustainable aquaculture feeds. https://futureeuaqua.eu/wp-content/uploads/2022/11/Faktaark_Challenges-and-solutions-for-more-sustainable-aquaculture-feeds-WEB.pdf

[13] Reinecke, Jahrl, Willer et al. (2023). D1.3 Synthesis of key drivers and lock-ins for organic sector development. OrganicTargets4EU project. https://organictargets.eu/wp-content/uploads/2025/01/D1.3_OrganicTargets4EU_Synthesis-of-key-drivers-and-lock-ins-for-organic-sector-development.pdf

[14] OrAqua - European Organic Aquaculture - Science-based recommendations for further development of the EU regulatory framework and to underpin future growth in the sector - Deliverable D6.1 Recommendations for organic aquaculture regulation. https://www.oraqua.eu/content/download/110388/file/D6_1_Final_Recommendations.pdf

[15] Righi, Manuelian, Pitino et al. (2019). Natural vitamins in organic livestock. Organic PLUS project. https://organic-plus.net/wp-content/uploads/2019/02/5-natural-vitamins-factsheet.pdf

recent studies on alternative ingredients (see for instance [16, 17, 18, 19,20,21,22]) and should take into account species-specific needs. Research on additives has so far focused on Atlantic salmon and more research is needed on other species (e.g. use of amino acids derived from fermentation methods).

Similarly, the shortage of organic juveniles (relative to the point 3.1.2 point 3.1.2. of Part III of Annex II to Regulation (EU) 2018/848) severely undermines production stability and long-term planning, as highlighted in scientific literature [8,10, 23,24,25,26]. The Commission has expressed its intention to address the shortage of juveniles through EU-funded research and innovation projects[27], but this issue requires urgent attention. Several hatcheries that supply organic juveniles have recently ceased their organic operations, which has drastically limited supply possibilities. Without a reliable hatchery network, many producers can face recurrent interruptions or are forced to reduce their organic output, which threatens the future of several organic farms. Two of the farms reported being in a very difficult situation at present, with organic production future at risk, due to the impossibility of sourcing high-quality organic juveniles, while a third reported that the difficulty of sourcing organic juveniles was

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[16] Vasilaki, Mente, Fountoulaki, et al. (2023). Fishmeal, plant protein, and fish oil substitution with single-cell ingredients in organic feeds for European sea bass (*Dicentrarchus labrax*). *Frontiers in Physiology*, 14: 1199497. https://doi.org/10.3389/fphys.2023.1199497

[17] Tefal, Jauralde, Martínez-Llorens, et al. (2023). Organic Ingredients as Alternative Protein Sources in the Diet of Juvenile Organic Seabass (*Dicentrarchus labrax*). *Animals,* 13(24): 3816. https://doi.org/10.3390/ani13243816

[18] Toomey, Alfonso, Mente, et al. (2025). Toward the use of innovative environmentally sustainable feed in organic aquaculture: Impact on growth performance, health, and welfare of gilthead seabream (*Sparus aurata*). *Journal of the World Aquaculture Society*, 56(2): e70021. https://doi.org/10.1111/jwas.70021

[19] Tefal, Jauralde, Tomás-Vidal, et al. (2023). New Organic Raw Materials for Gilthead Seabream (*Sparus aurata*) Feeding and the Effects on Growth, Nutritive Parameters, Digestibility, and Histology. *Fishes*, 8(6): 330. https://doi.org/10.3390/fishes8060330

[20] Toomey, Gesto, Alfonso, et al. (2024). Monitoring welfare indicators of rainbow trout (*Oncorhynchus mykiss*) in a commercial organic farm: Effects of an innovative diet and accelerometer tag implantation. *Aquaculture*, 582: 740549. https://doi.org/10.1016/j.aquaculture.2024.740549

[21] Tampou, Andreopoulou, Vasilaki, et al. (2024). Growth performance of gilthead sea bream (*Sparus aurata*) fed a mixture of single cell ingredients for organic diets. *Aquaculture Reports*, 36: 102105. https://doi.org/10.1016/j.aqrep.2024.102105

[22] Estévez, Vasilaki (2023). Organic production of gilthead sea bream (*Sparus aurata*) using organic certified green pea protein and seaweed. Effects on growth, feed conversion and final product quality. *Aquaculture*, 571: 739490. https://doi.org/10.1016/j.aquaculture.2023.739490

[23] IFOAM, 2015. IFOAM EU Position Paper on the Use of Non-organic Juveniles in Organic Aquaculture. https://www.coispa.it/cms/archivio/download/IFOAM_EU_positionpaper_14052015.pdf

[24] Adámek, Mössmer, Hauber (2019). Current principles and issues affecting organic carp (*Cyprinus carpio*) pond farming. *Aquaculture*, 512: 734261. https://doi.org/10.1016/j.aquaculture.2019.734261

[25] EUMOFA, 2022. Organic Aquaculture in the EU – Current situation, drivers, barriers, potential for growth. https://www.eumofa.eu/documents/20178/432372/Organic+aquaculture+in+the+EU_final+report_ONLINE.pdf

[26] Lembo, Toomey (2025). Enabling and Constraining Factors for Developing Organic Aquaculture in Europe. FiBL & IFOAM - Organics International - The World of Organic Agriculture – Statistics and Emerging Trends 2025. Frick and Bonn. https://www.fibl.org/fileadmin/documents/shop/1797-organic-world-2025.pdf

[27] European Commission, 2023. Working Document “Issues impacting the development of EU organic aquaculture”. https://agriculture.ec.europa.eu/document/download/e5b9c6fe-23ac-408c-9670-b938a5dad326_en?filename=wd-issues-on-organic-aquaculture-082023_en.pdf

preventing it from scaling up. Providing targeted support for hatchery certification and granting exemptions where provisioning is not possible could alleviate this issue, at least until organic juvenile supply is reliably established [28,29]. Moreover, an updated database on the availability of organic juveniles is needed. Article 26 of Regulation (EU) 2018/848 refers to Member States implementing databases to highlight operators who can provide organic juveniles. In practice, however, the provision of information is voluntary and those databases are not always up to date.

Regulatory rigidity further hampers the sector's adaptability and innovation potential. Organic farmers have reported to encounter inconsistent interpretations of standards and regulatory discrepancies among EU Member States and certification bodies [25,30]. Prolonged administrative procedures, exemplified by the Atlantic salmon case, can stall sector expansion. The divergent interpretations of "separation" between organic and conventional productions by Member States and certification bodies when establishing mixed hatchery or on-growing productions (Annex II, Part III, Point 1.2) also highlight the need for clarification. Consequently, streamlined, harmonised regulatory processes are critical to maintain producer confidence and stimulate investment [30]. Furthermore, one producer reported the need for more scientific evidence on stocking densities for Atlantic salmon, as the current limitations are not, in his view, fully consistent with a scientific study on this topic.

Overall, health management was reported as good. While most producers felt that limitations on the number of allopathic treatments were challenging, they were mostly manageable and central to the principles of organic production. However, the lack of organic medicated feeds was raised as a limiting factor while it could facilitate health management. Furthermore, farmers expressed concerns about future health management in the context of climate change. Finally, one species-specific issue worth mentioning is saprolegniosis in male organic rainbow trout. Having males in rearing stocks leads to welfare and production issues that should be discussed further to not jeopardize the future of rainbow trout organic production.

Economically, organic aquaculture faces a fragile cost structure largely defined by elevated feed prices, certification requirements, and operational demands, which contrast markedly with the limited

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[28] OrAqua - European Organic Aquaculture - Science-based recommendations for further development of the EU regulatory framework and to underpin future growth in the sector - Deliverable D6.1 Recommendations for organic aquaculture regulation. https://www.oraqua.eu/content/download/110388/file/D6_1_Final_Recommendations.pdf
[29] IFOAM, 2015. IFOAM EU Position Paper on the Use of Non-organic Juveniles in Organic Aquaculture. https://www.organicseurope.bio/content/uploads/2020/11/ifoameu_letter_aquaculture_201511191.pdf
[30] Toomey, Alfonso, Carbonara, et al. (2025). Unlocking the Potential of Organic Aquaculture in the EU: A Review of Policy Support and Supporting and Constraining Factors. *Reviews in Aquaculture,* 17(4): e70089. https://doi.org/10.1111/raq.70089

and volatile price premiums available on the market [31,32,33,34,35,36,37,38]. Strengthening consumer awareness and enhancing market differentiation for organic fish products will be pivotal to improving economic sustainability [34,35,39,40].

Despite these multifaceted challenges, many stakeholders remain committed to organic aquaculture, driven by ethical convictions, environmental responsibility, and/or favourable long-term market projections. Nevertheless, the risk of ceasing organic production looms if no regulatory and market changes are enacted in the near term [35].

In conclusion, the future of organic aquaculture in the EU is uncertain. While the sector has the potential to develop, it is currently held back by technical bottlenecks and economic imbalances. In order to realise its potential as a pillar of sustainable food production, policy action must address the root causes of these constraints. Reforming the supply chains for feed and juveniles, allowing the regulatory framework to be more flexible and reinforcing consumer engagement will be key to transforming organic aquaculture from a niche sector into a mainstream player in sustainable food production.

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[31] Gambelli, Vairo, Solfanelli, et al. (2019). Economic Performance of Organic Aquaculture: A Systematic Review. *Marine Policy,* 108: 103542. https://doi.org/10.1016/j.marpol.2019.103542
[32] Gambelli, Naspetti, Zander (2019). Organic Aquaculture: Economic, Market and Consumer Aspects. In: Organic Aquaculture, Springer, 41–63. https://doi.org/10.1007/978-3-030- 05603-2_3
[33] Castellini, Deboni, Gaviglio, et al. (2012). Prospects and challenges for development of organic fish farming in Italy. *New Medit*, 11(4 supplement): 23-26. https://hdl.handle.net/11585/132144
[34] EUMOFA, 2022. Organic Aquaculture in the EU – Current situation, drivers, barriers, potential for growth. https://www.eumofa.eu/documents/20178/432372/Organic+aquaculture+in+the+EU_final+report_ONLINE.pdf
[35] Toomey, Alfonso, Carbonara, et al. (2025). Unlocking the Potential of Organic Aquaculture in the EU: A Review of Policy Support and Supporting and Constraining Factors. *Reviews in Aquaculture,* 17(4): e70089. https://doi.org/10.1111/raq.70089
[36] Steinnes, Amilien, Vittersø (2019). Organic Salmon in Norway. In: Sustainability of European Food Quality Schemes, ed. F. Arfini and V. Bellassen, Springer Nature Switzerland AG, 529–548. https://doi.org/10.1007/978-3-030-27508-2_27
[37] Perdikaris, Paschos (2010). Organic Aquaculture in Greece: A Brief Review. *Reviews in Aquaculture*, 2(2): 102–105. https://doi.org/10.1111/j.1753-5131.2010.01025.x
[38] di Marco, Petochi, Marino, et al. (2017). Insights Into Organic Farming of European Sea Bass *Dicentrarchus labrax* and Gilthead Sea Bream *Sparus aurata* Through the Assessment of Environmental Impact, Growth Performance, Fish Welfare and Product Quality. *Aquaculture*, 471: 92–105. https://doi.org/10.1016/J.AQUACULTURE. 2017.01.012.
[39] Kaimakoudi (224). Policy initiatives towards enhancing consumer knowledge and tackling consumer confusion in aquaculture sector. *Aquaculture International* 32: 1–9. https://doi.org/10.1007/s10499-023-01143-2
[40] Lembo, Jokumsen, Spedicato, et al. (2018). Assessing stakeholder's experience and sensitivity on key issues for the economic growth of organic aquaculture production. *Marine Policy*, 87: 84-93. https://doi.org/10.1016/j.marpol.2017.10.005

6. Recommendations

The prevailing organic regulation is widely perceived by farmers as lacking sufficient flexibility and applied in a one-size-fits-all manner. The following recommendations are proposed on the basis of this study, with regard to the most pressing challenges currently being faced by organic fish farmers and feed producers:

Short-term impact

- Revising the list of permitted protein and lipid sources and additives for organic feed formulation, taking into account the current availability and quality of ingredients.
- Providing derogations for the introduction of non-organic juveniles for on-growing in cases where juvenile supply is unavailable, unstable and/or insufficient. This appears crucial until the long-term supply of organic juveniles is stable, which will be achieved through the development of future development of organic selective breeding programmes.
- Supporting the use and updating of a centralised database referencing the availability of organic juveniles, or requiring more regular updates from national databases. Current national databases are filled on a voluntary basis, but the interviews highlighted the lack of updated information as a source of conflict with certification bodies regarding the unavailability of organic juveniles.
- Clarifying and harmonising the interpretation of EU organic rules across Member States and certification bodies to reduce variability in interpretation. This has been mentioned in particular with regard to the implementation of mixed production systems (organic/conventional) and feeding requirements for first-life stages.
- Funding/promoting EU-wide and national consumer awareness campaigns, which are valid for the global aquaculture sector, to counteract negative global perceptions of aquaculture products and highlight the added value of organic seafood/rearing practices.

Medium and Long-term impacts

- Supporting research on alternative organic ingredients and additives to formulate tailored made species and age-specific certified organic functional feeds. In the interviews, this was particularly emphasised as crucial for new farmed species (e.g. meagre) and for the first-life stages.
- Supporting research and findings into breeding programmes operating under organic regulations to develop local organic juvenile production capacity.

- Encouraging Member States to facilitate new licences for organic aquaculture production.
- Strengthening preventive health and welfare management (IMTA, functional feeds) through research and knowledge transfer.

7. Supplementary material

Figure S1. Results of initial questionnaire scoring. Each challenge was rated from 1 (not a challenge) to 5 (a strong barrier to the development of organic aquaculture in the EU) by nine fish producers/representatives of fish producers and one organic feed producer.

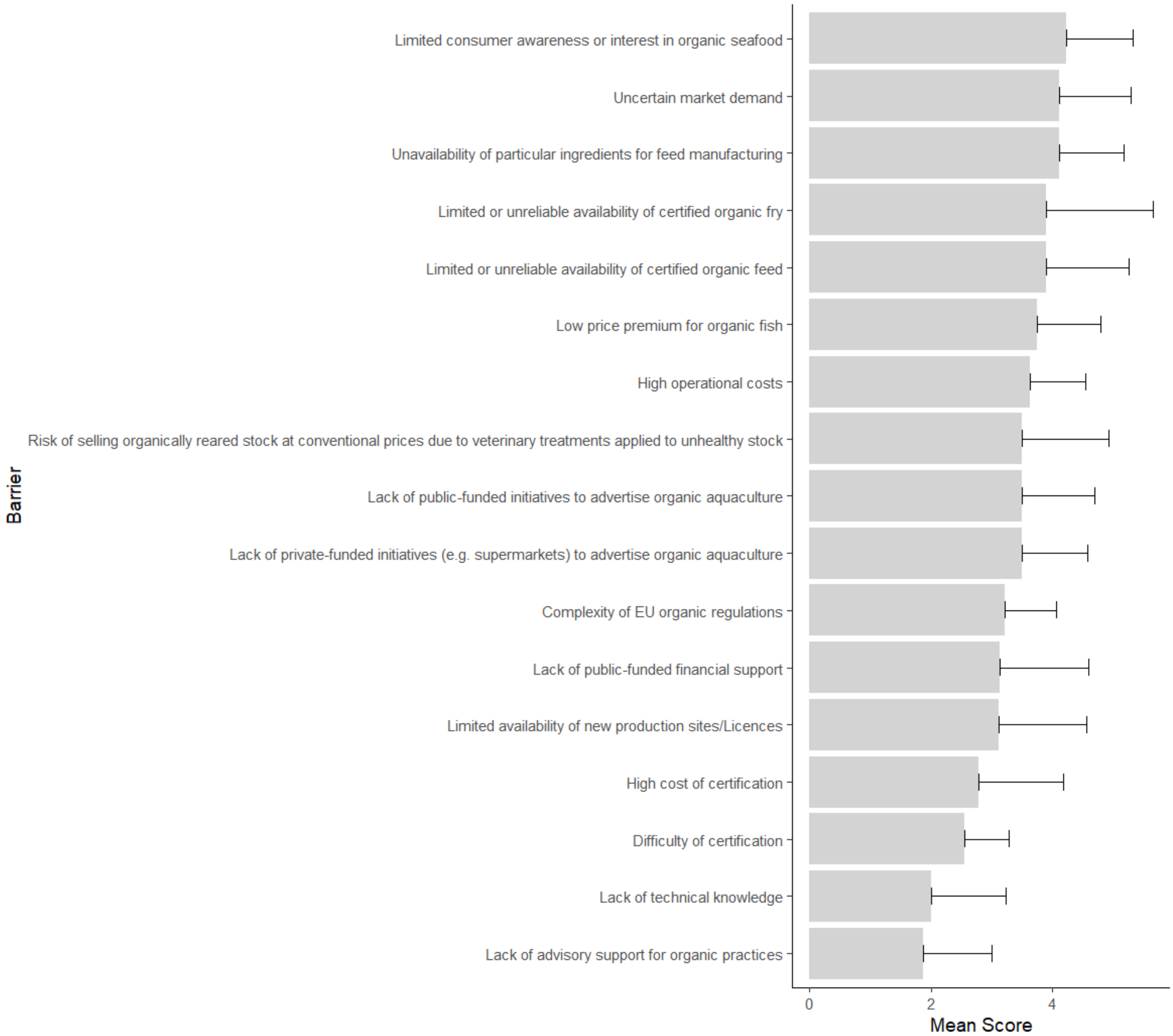
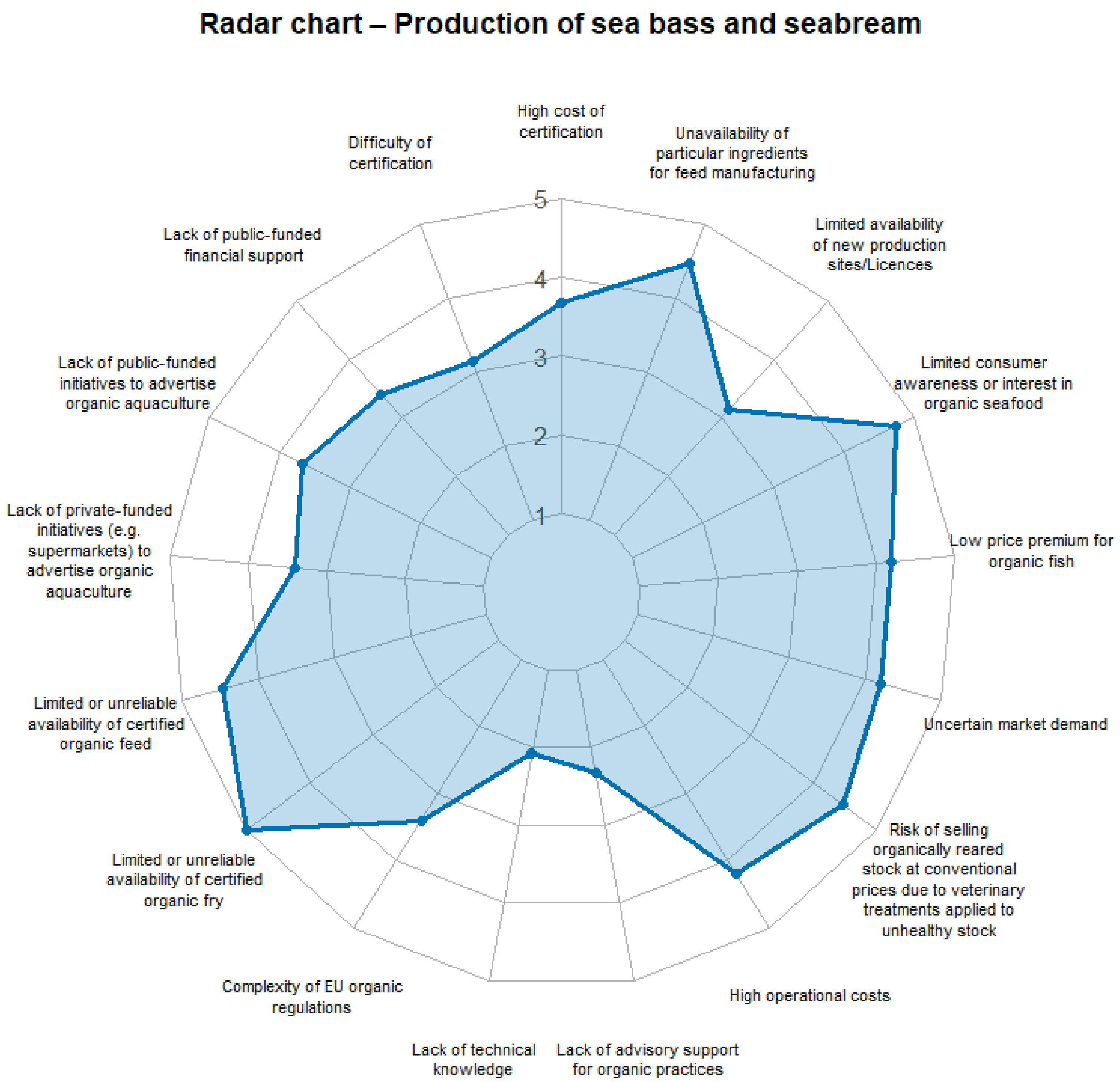
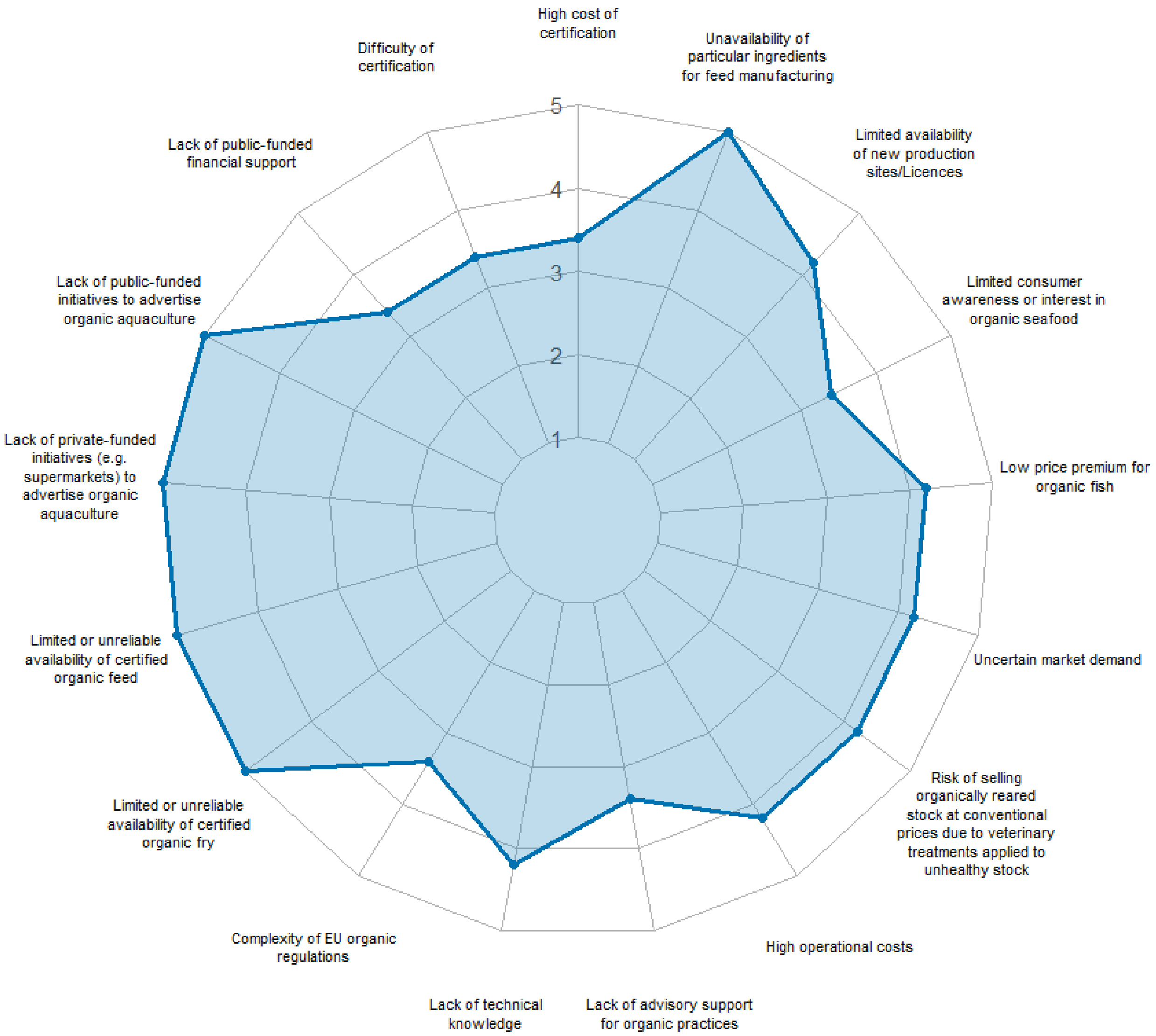
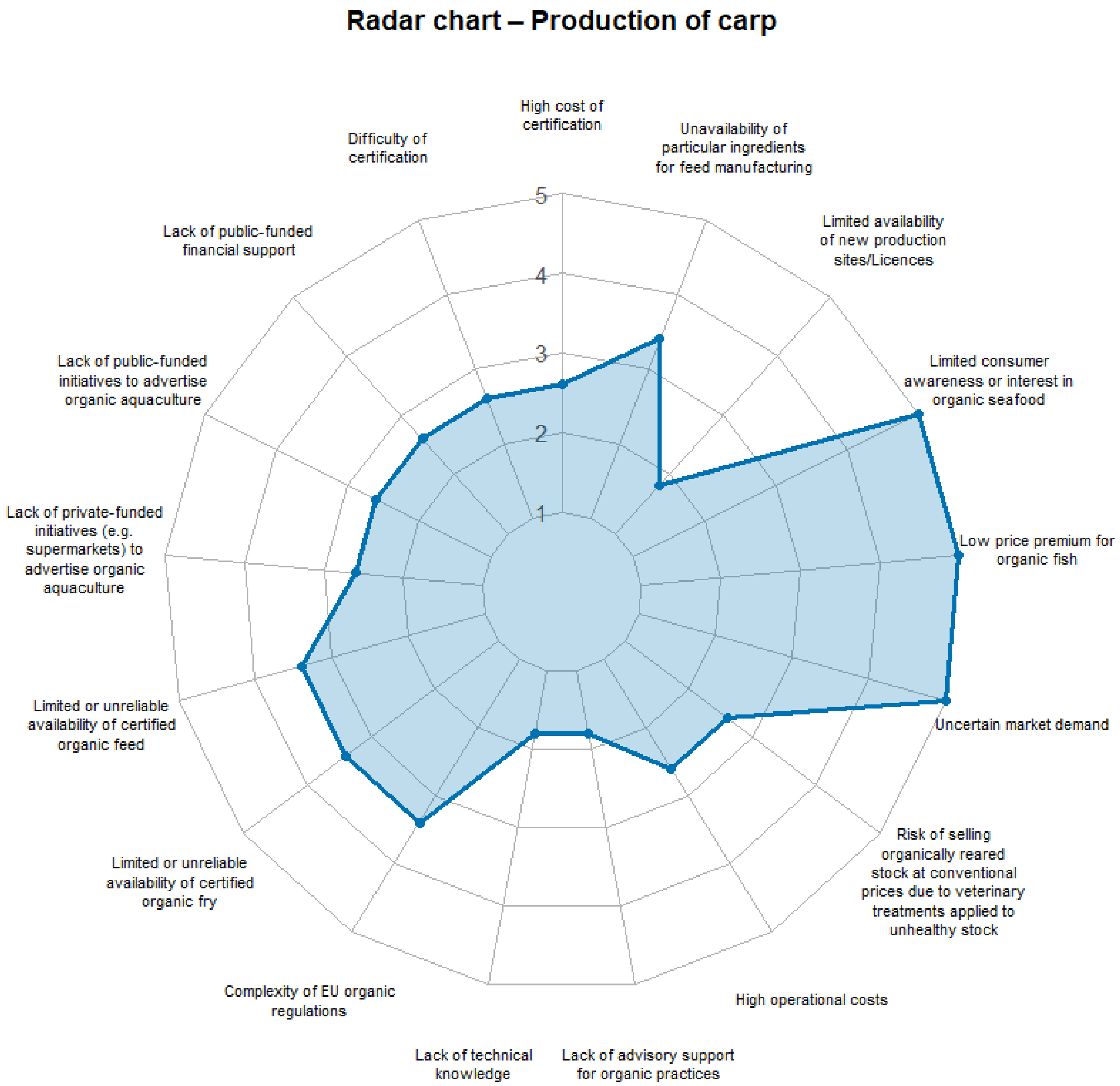


Figure S2. Radar chart per produced species group highlighting challenges. N=3 producers farming organic sea bass and seabream, N=1 producer farming organic sea bass, seabream and meagre, N=1 organic carp producer, N=1 organic Atlantic salmon producer, N=3 organic rainbow trout farmers and N=1 organic feed producer.

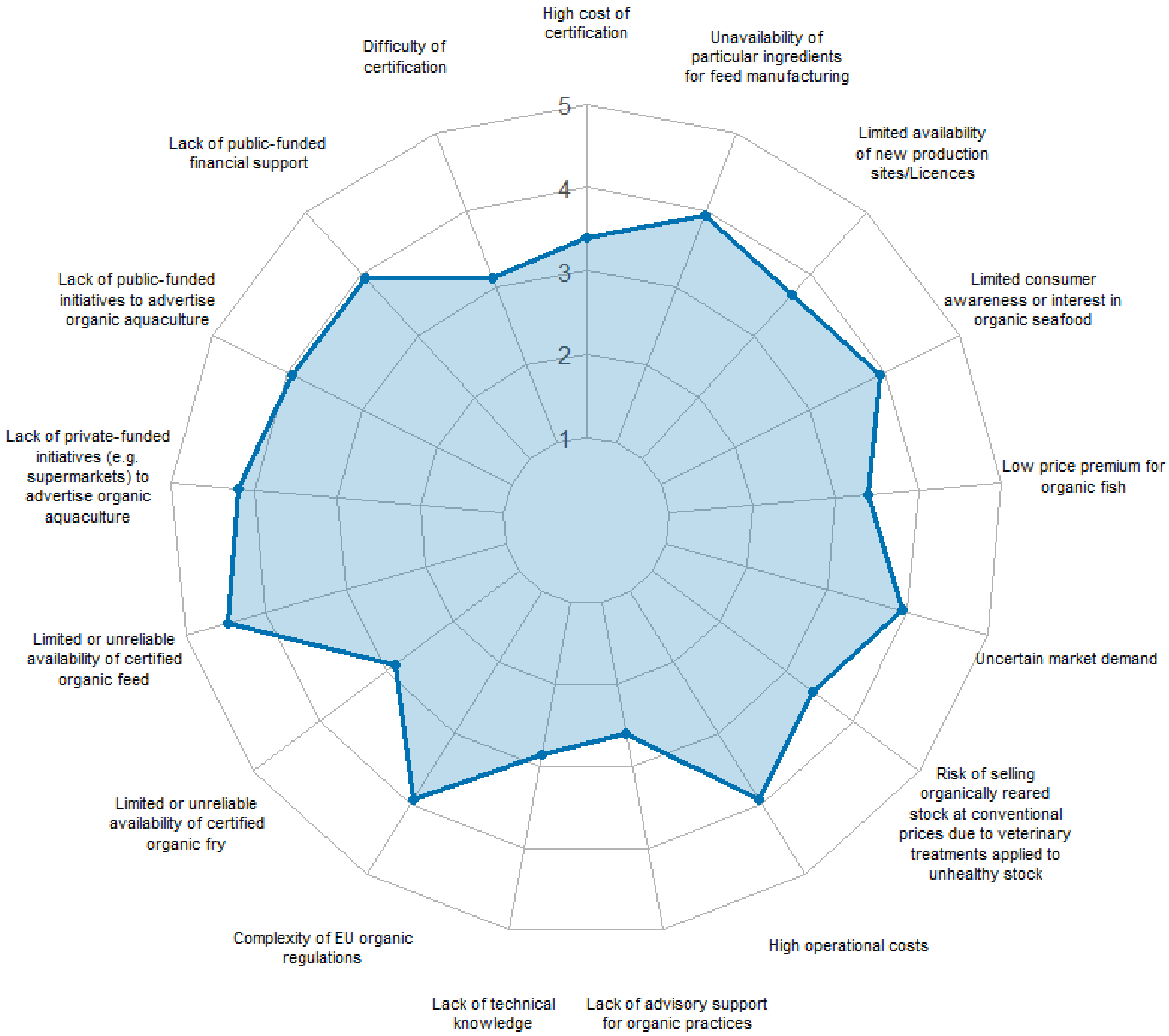


Radar chart – Production of sea bass, seabream and meagre




Radar chart – Production of carp
High cost of certification
Unavailability of particular ingredients for feed manufacturing
Limited availability of new production sites/Licences
Limited consumer awareness or interest in organic seafood
Low price premium for organic fish
Uncertain market demand
Risk of selling organically reared stock at conventional prices due to veterinary treatments applied to unhealthy stock
High operational costs
Lack of advisory support for organic practices
Lack of technical knowledge
Complexity of EU organic regulations
Limited or unreliable availability of certified organic fry
Limited or unreliable availability of certified organic feed
Lack of private-funded initiatives (e.g. supermarkets) to advertise organic aquaculture
Lack of public-funded initiatives to advertise organic aquaculture
Lack of public-funded financial support
Difficulty of certification
5
4
3
2
1

Radar chart – Production of rainbow trout



Radar chart – Organic feed producers

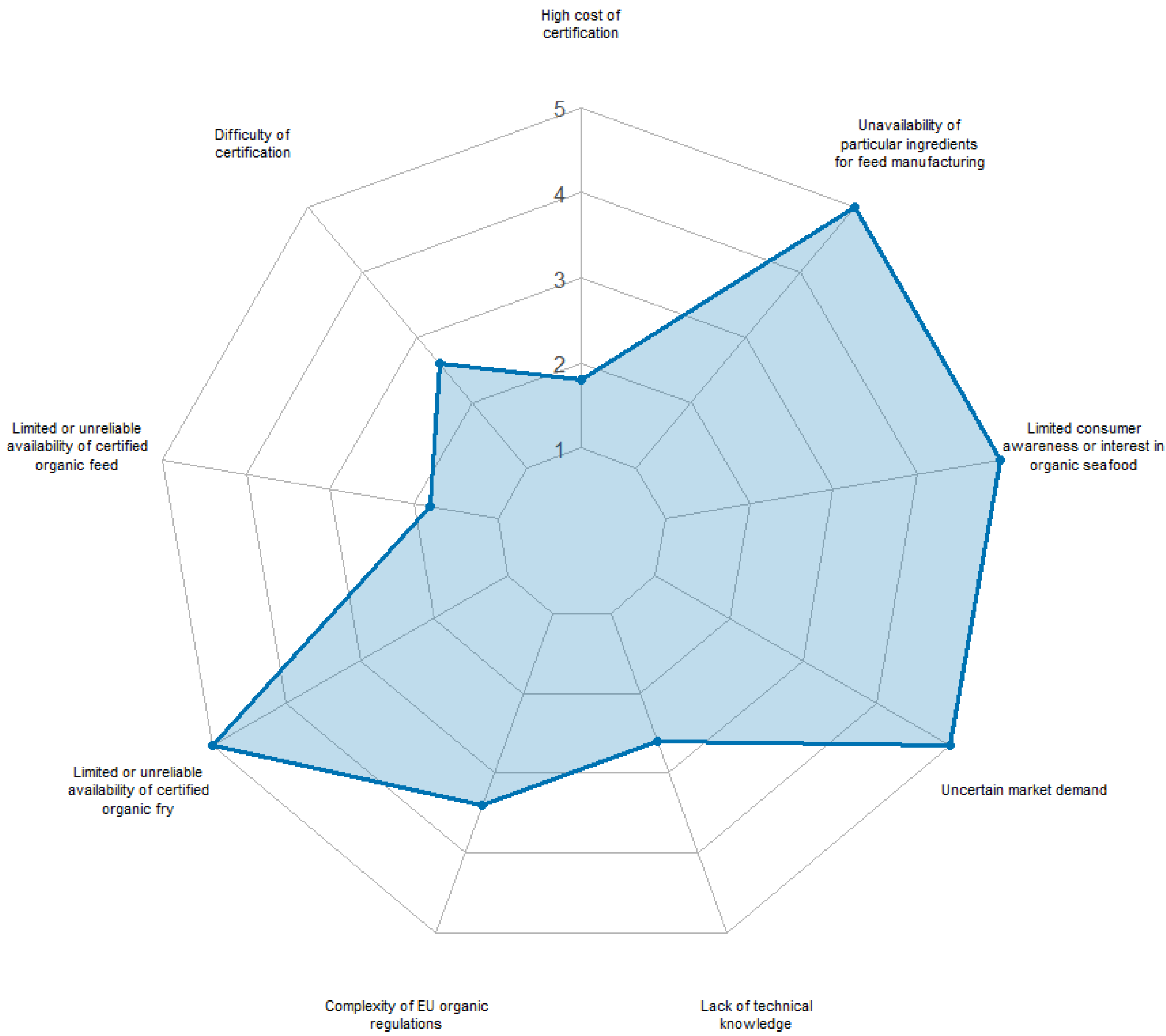


Figure S3. Challenge score obtained for organic Atlantic salmon (*Salmo salar;* N=one producer; scores ranging from 1 [not a challenge] to 10 [strong barrier]).

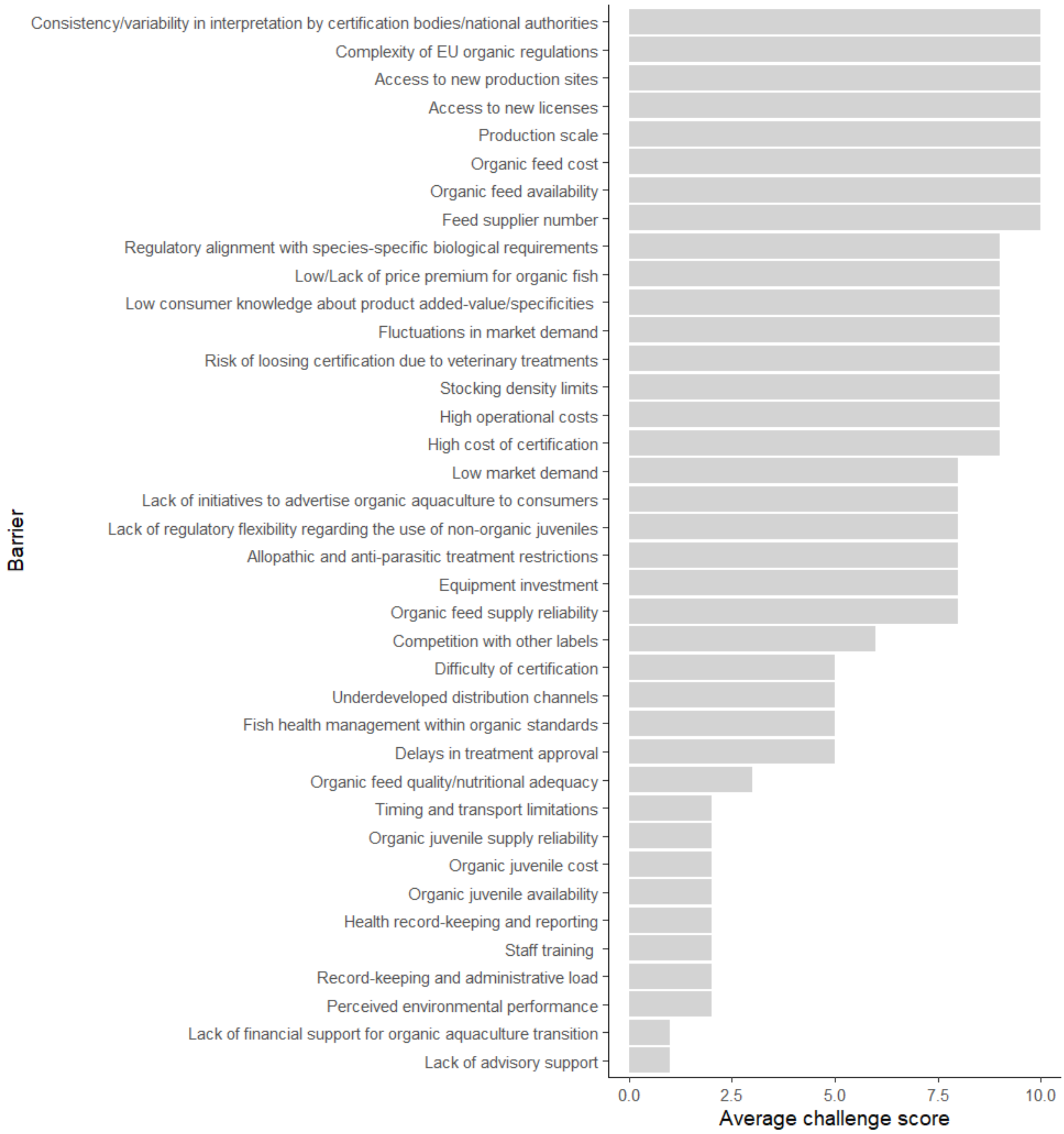


Figure S4. Challenge score obtained for organic rainbow trout (*Oncorhynchus mykiss;* N=two respondents; scores ranging from 1 [not a challenge] to 10 [strong barrier]).

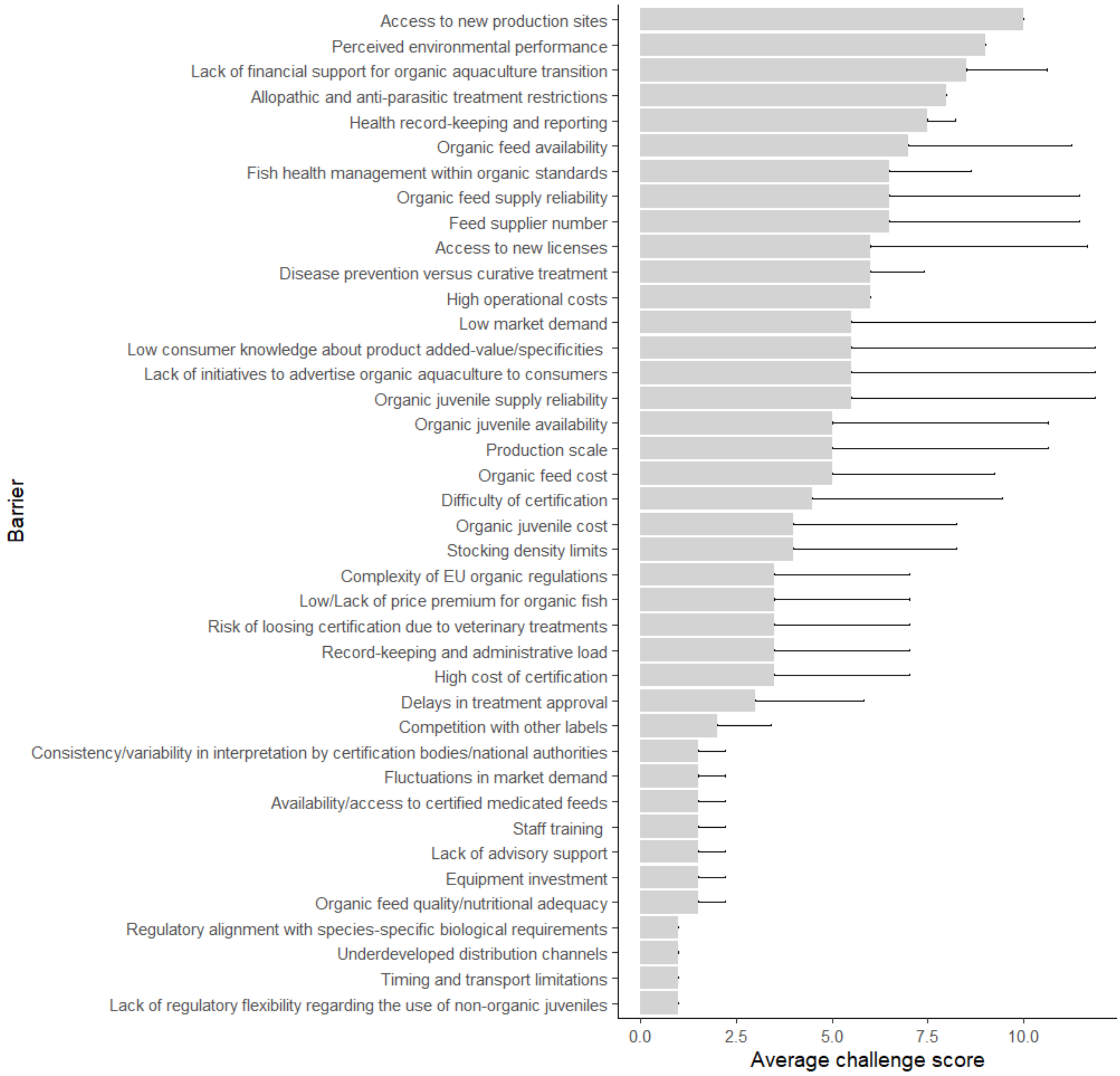


Figure S5. Challenge score obtained for the production organic sea bass (*Dicentrarchus labrax*), Gilthead seabream (*Sparus aurata*) and meagre (*Argyrosomus regius*) (N=two respondents; scores ranging from 1 [not a challenge] to 10 [strong barrier]).

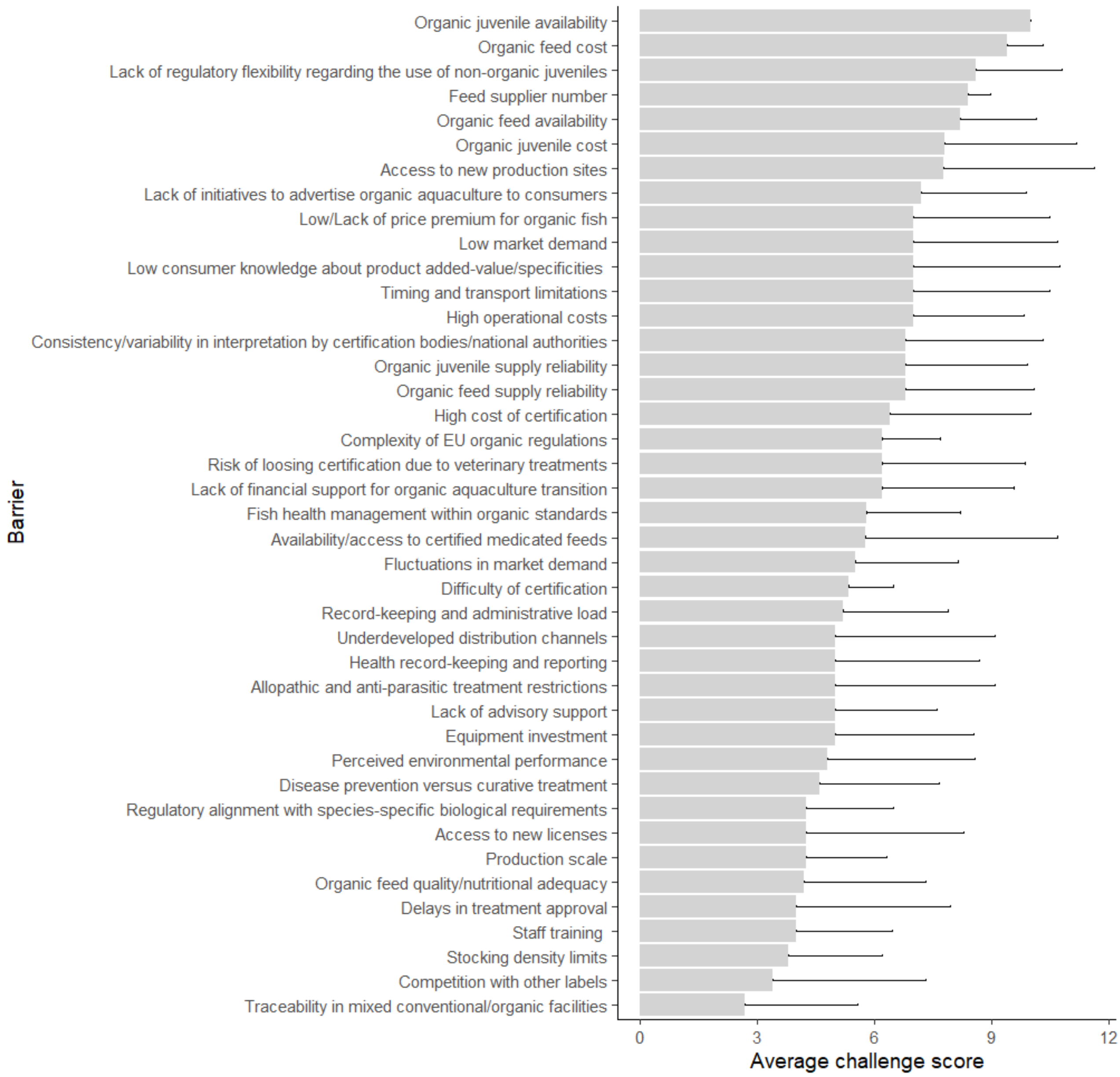


Figure S6. Challenge score obtained for the production organic common carp (*Cyprinus carpio*, N=one farmer; scores ranging from 1 [not a challenge] to 10 [strong barrier]).

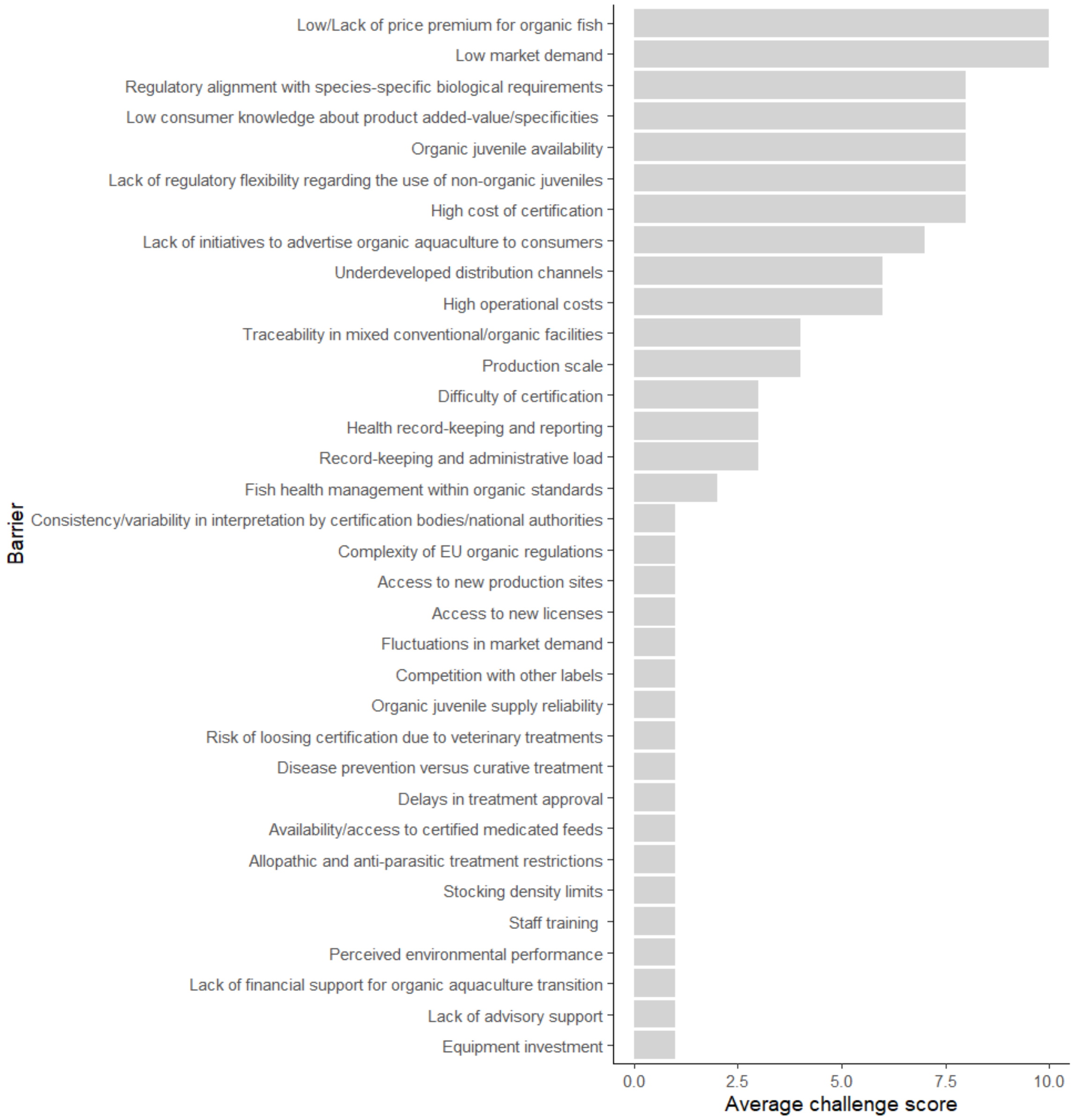
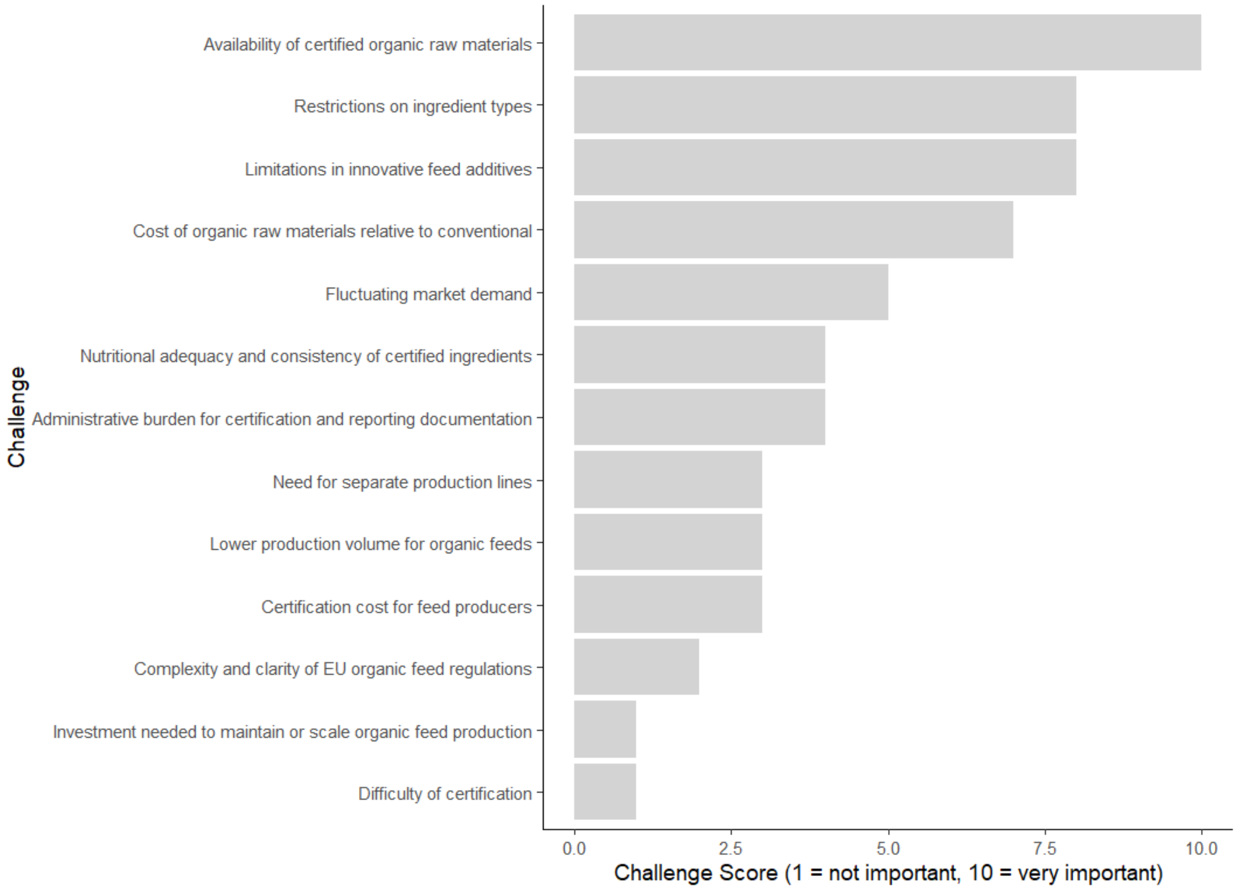


Figure S7. Challenge score obtained for the production of organic feeds (N=one feed producer; scores ranging from 1 [not a challenge] to 10 [strong barrier]).



<u>Annex 1:</u> Initial questionnaire sent to companies

<u>Section 1: General Information</u>

1. Name of your company/farm: Click or tap here to enter text.

2. Location/Country: Click or tap here to enter text.

3. Main species farmed/produced (select all that apply):
   ☐ Seabass
   ☐ Seabream
   ☐ Carp
   ☐ Rainbow trout
   ☐ Atlantic salmon
   ☐ Other(s): Click or tap here to enter text.
   ☐ Not applicable

4. Annual production volume (tonnes):
   ☐ <50
   ☐ 50-200
   ☐ 200-500
   ☐ >500
   ☐ Not applicable

5. How long has the aquaculture farm/feed company been operating?

   Click or tap here to enter text.

6. If you are a fish producer, how many years have you been certified organic? If you are a feed producer, how many years have you produced organically certified feeds?

   Click or tap here to enter text.

(**OR**) How long have you been trying to obtain organic certification?

   Click or tap here to enter text.

(**OR**) For how many years were you certified before you stopped producing organic fish/feed? Please specify the year in which you stopped.

   Click or tap here to enter text.

7. Is your entire production organic? *If not applicable, proceed to the next question.*

   ☐ Yes ☐ No → What % is organic? Click or tap here to enter text.

8. Please rate how important each of the following barriers is in stopping you from adopting organic aquaculture in line with the EU regulations (1=not important, 5=very important). Tick as appropriate.

Barrier/Challenge	**1**	**2**	**3**	**4**	**5**
High cost of certification	☐	☐	☐	☐	☐
Difficulty of certification	☐	☐	☐	☐	☐
Lack of public-funded financial support	☐	☐	☐	☐	☐
Lack of public-funded initiatives to advertise organic aquaculture	☐	☐	☐	☐	☐
Lack of private-funded initiatives (e.g. supermarkets) to advertise organic aquaculture	☐	☐	☐	☐	☐
Limited or unreliable availability of certified organic feed	☐	☐	☐	☐	☐
Limited or unreliable availability of certified organic fry	☐	☐	☐	☐	☐
Complexity of EU organic regulations	☐	☐	☐	☐	☐
Lack of technical knowledge	☐	☐	☐	☐	☐
Lack of advisory support for organic practices	☐	☐	☐	☐	☐
High operational costs	☐	☐	☐	☐	☐
Risk of selling organically reared stock at conventional prices due to veterinary treatments applied to unhealthy stock	☐	☐	☐	☐	☐
Uncertain market demand	☐	☐	☐	☐	☐
Low price premium for organic fish	☐	☐	☐	☐	☐
Limited consumer awareness or interest in organic seafood	☐	☐	☐	☐	☐
Limited availability of new production sites/Licences	☐	☐	☐	☐	☐
Unavailability of particular ingredients for feed manufacturing	☐	☐	☐	☐	☐

9. Could you briefly explain why you chose these barriers? Are there any other important barriers you would like to add?

Click or tap here to enter text.

10. In your view, how does organic aquaculture compare with other sustainable production systems in terms of cost, environmental performance, and market access?

Click or tap here to enter text.

11. How do you see the future of organic finfish production in the next 5-10 years in the EU?

Click or tap here to enter text.

<u>Section 2: Feed Ingredients</u>

12. Do you produce your own feed or purchase from suppliers?
    ☐ Produce own feed

☐ Purchase from suppliers – Specify the number: Click or tap here to enter text.
☐ Both

13. How easy is it to source certified organic feeds for your main species?
    ☐ Very easy
    ☐ Easy
    ☐ Moderate
    ☐ Difficult
    ☐ Very difficult
    ☐ Not applicable

14. If applicable, please describe any technical or economic challenges you face in feed formulation for organic aquaculture.
    Click or tap here to enter text.

15. If applicable, which organic feed ingredients are most difficult to source?
    Click or tap here to enter text.

16. What improvements or policy changes would facilitate better access to organic feeds?

    Click or tap here to enter text.

Section 3: Provision of Juveniles

17. Do you use organic-certified juveniles?
    ☐ Always – Own production
    ☐ Always – Provisioning from an external supplier
    ☐ Partly (with derogation for the use of conventional juveniles)
    ☐ Not applicable

18. What are the main barriers to sourcing organic juveniles?
    ☐ Lack of supply
    ☐ Unreliability of supply
    ☐ High cost
    ☐ Transport limitations
    ☐ Other(s): Click or tap here to enter text.
    ☐ Not applicable

19. How does the availability of organic juveniles affect your production planning?

Click or tap here to enter text.

20. What improvements or policy changes would facilitate better access to organic juveniles?
Click or tap here to enter text.

Section 4: Fish Health Controls

21. How would you rate your ability to manage fish health under organic regulations?
☐ Very good
☐ Good
☐ Adequate
☐ Poor
☐ Very poor
☐ Not applicable

22. Which health issues are most challenging to control organically?
Click or tap here to enter text.

23. How often did you need to use allopathic and/or parasite treatments that are restricted under organic rules in the last five years?
☐ Never
☐ Rarely
☐ Occasionally
☐ Frequently
☐ Not applicable

24. What support or changes would help you better manage fish health under the organic regulation?

Click or tap here to enter text.

Section 5: General Farm Management

25. Which of the following are significant challenges for your organic operation? (Select all that apply)
☐ Stocking density limits
☐ Water quality management
☐ Environmental impact monitoring
☐ Record-keeping and administrative load
☐ Staff training
☐ Certification costs

☐ Equipment investment
☐ Other(s): Click or tap here to enter text.

26. What is your main motivation for organic production?
    ☐ Price premium
    ☐ Market demand
    ☐ Environmental reasons
    ☐ Personal/Corporate beliefs
    ☐ Other(s): Click or tap here to enter text.

27. Please describe any significant investments made to comply with organic standards.
    Click or tap here to enter text.
28. Have you experienced inconsistencies in how organic rules are interpreted by certification bodies or national authorities? Please describe.
    Click or tap here to enter text.

<u>Section 6: Policy and Technical Recommendations</u>

29. If you are a fish producer, do you think that the current organic regulations (e.g. those relating to stocking density, feed and health) accurately reflect the biological requirements of the species that you farm? Please explain.

    Click or tap here to enter text.

30. Overall, which articles of the EU Organic Regulation (EU) 2018/848. are most difficult to comply with? [Add link to the regulation]

    Click or tap here to enter text.

31. Which specific rules in Regulation (EU) 2018/848 (e.g. on stocking density, treatments, feed inputs) would you propose to amend? Please describe how and why.

    Click or tap here to enter text.

32. Do you have data, case studies, or other evidence to support your proposed changes or highlight technical constraints under organic rules?

    Click or tap here to enter text.

33. What technical innovations or research would most benefit your business?

Click or tap here to enter text.

34. Are there any other specific support measures you would recommend to policymakers?

    Click or tap here to enter text.

35. Please let us know if there is any further information you would like to share about your experience with organic aquaculture or organic feed production.

Click or tap here to enter text.