

# Chapter 3

## Organic Aquaculture: Economic, Market and Consumer Aspects



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### Background

The total fish supply around the world has shown a constant increasing trend over the last decades, with growth from less than 20 million metric tonnes in 1950 to more than 169 million metric tonnes in 2015. The main species that are captured are anchovies, Alaska pollock and skipjack tuna, while the main farmed species are finfish (mainly carp) and molluscs (mainly clams). The supply of fish for human consumption was about 142 million tons in 2013 (FAOSTAT 2017). Table 3.1 shows the highly differentiated situation for fish production and the dominant position of the Asian countries in general, where China alone accounts for just over a third of the total world production.

Fish represent an important source of food worldwide as they account for 6.9% of animal protein consumption and 3.5% of total protein consumption (FAOSTAT 2017). Also in this case, there are relevant differences according to geographic area (Fig. 3.1). Despite its high population, China is the country with by far the largest per capita availability of fish, while the availability of fish in Africa and Latin America and the Caribbean is about half of the world's average.

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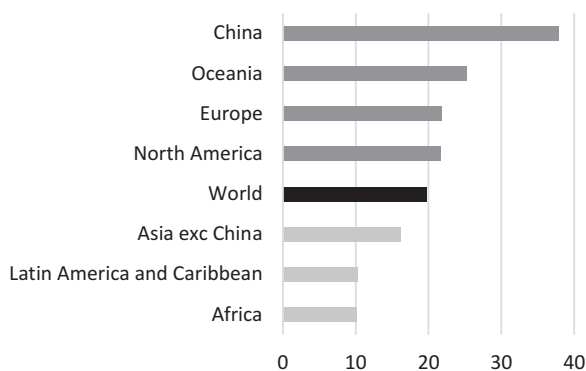
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**Table 3.1** World fish production in 2013 by area [live weight, millions of tons (share, %)]

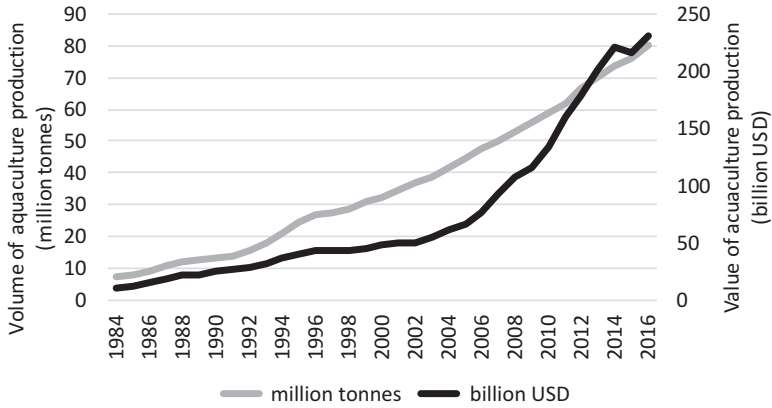
Measure	World	Africa	North America	Latin America	Asia		Europe	Oceania
				Caribbean	Total	China		
Total production of fish	162.8 (100)	9.6 (6)	7.0 (4)	15.0 (9)	113.4 (70)	59.8 (37)	16.3 (10)	1.4 (1)
Non-food fish production	21.4 (100)	0.5 (2)	1.6 (7)	7.0 (33)	9.3 (43)	3.4 (16)	2.6 (12)	0.2 (1)
Total production of fish for food	141.4 (100)	9.1 (6)	5.4 (4)	8.0 (6)	104.1 (74)	56.4 (40)	13.7 (10)	1.2 (1)
Total supply of fish for food (Including import-export)	142.1 (100)	11.2 (8)	7.7 (5)	6.3 (4)	99.8 (70)	52.4 (37)	16.2 (11)	1.0 (1)

Source: Calculated from data from FAOSTAT (2017)

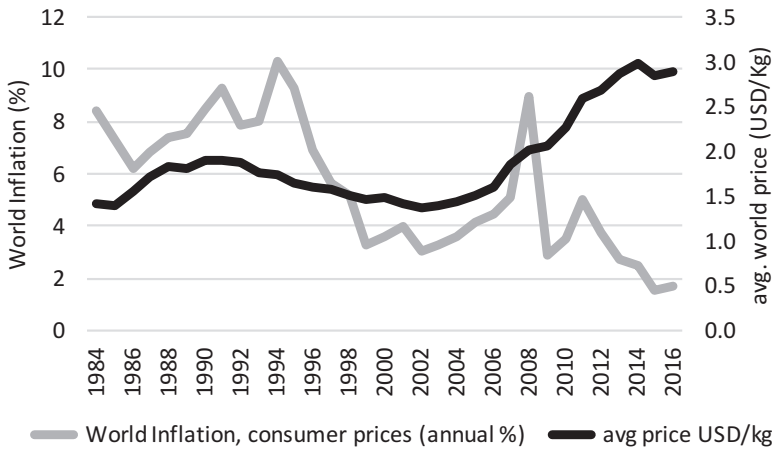
**Fig. 3.1** Per capita supply of fish (kg/year) for 2013. (Source: Calculated from data from FAOSTAT (2017))



In this context, the contribution of aquaculture to total fish production has grown constantly over more recent years. According to FAOSTAT (2017), ‘the definition of aquaculture is understood to mean the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding and protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated’. Aquaculture production has been characterised by high, although decreasing, annual growth rates that have ranged from 10.8% in the 1980s to 5.4% for 2010–2015. These growth rates are now declining (although they remain more than double those for captured fish production), and the total production from aquaculture has nearly reached that of captured fish production, accounting for 76.6 million tons and representing 45% of total fish production worldwide (FAOSTAT 2017). By far the largest share of fish production from aquaculture is again China (58%), followed by Indonesia (14.8%). Chinese aquaculture is strongly concentrated on carp farming, which accounts for about 73% of the total freshwater production, while molluscs account for 78% of the marine production (FAO 2014). Asian countries in general are among the most important producers of



**Fig. 3.2** Volumes and value of fish production from aquaculture worldwide. (Source: Calculated from data from FAO – Fisheries and Aquaculture Department – Global Production Statistics 2018)



**Fig. 3.3** Average world prices of fish from aquaculture and world inflation. (Source: Calculations from data from FAO – Fisheries and Aquaculture Department – Global Production Statistics, and World Bank)

seafood from aquaculture, while the European Union contributed 1.2% to the total world aquaculture production in 2015. Production from aquaculture has increased in terms of volumes, and even more so in terms of value (Fig. 3.2).

The average world price of aquaculture products for farmers ranged from 1.4 to 2.0 USD/kg for about 20 years and then showed substantial growth from 2008. The price trend does not appear to be conditioned by any particular relationship to inflation and might instead be due to growth in the demand for aquaculture products (Fig. 3.3).

## Organic Aquaculture Production

The adoption of an organic system for aquaculture requires compliance with general principles of organic farming, which include specific regulations and certification schemes. The general standards for organic aquaculture were defined by IFOAM (2006). Provisions for organic standards for aquaculture were also defined in Regulation (EC) N° 834/2007, with more detailed regulations in Regulation (EC) N° 889/2008 (amended by Regulation [EC] N° 710/2009) and respective Annexes. European Union regulations define the guidelines and requirements on fish origins, husbandry, breeding, feeding, veterinary treatments and disease prevention.

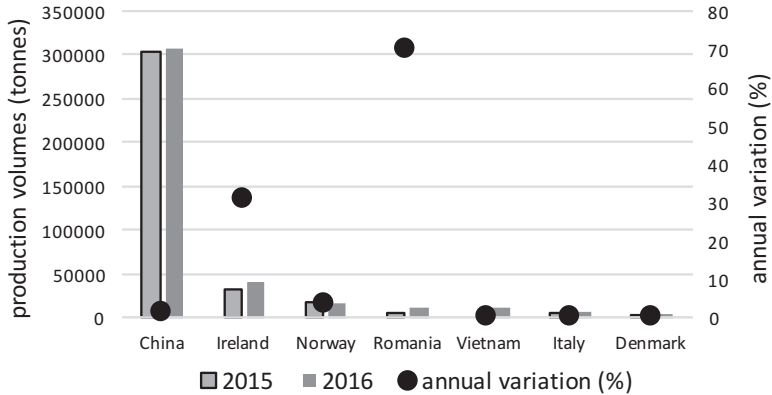
About 80 different private organic aquaculture standards have been defined, many of which relate to the European countries (Prein et al. 2012). A description of the evolution of certification standards for organic aquaculture is available in Bergleiter et al. (2009). Although organic standards share common principles, some differences are however encountered (Mente et al. 2011). The main aspects to consider at the farm level relate to the conditions for the aquatic environment, breeding, nutrition, husbandry practices (e.g. stocking density requirements) and animal welfare (e.g. veterinary treatments).

Production from organic aquaculture has grown rapidly over recent years but remains at relatively low volumes at the world level. Data on volumes of organic aquaculture production worldwide are available from 2017 (Lernoud and Willer 2017 2018). Total world production from aquaculture in 2016 was 415,554 mt, with an increase of 8.2% with respect to 2015. Despite the relevant growth rates, the share of organic aquaculture with respect to total aquaculture remains at around 0.5%. It is necessary to specify, however, that data on organic aquaculture are still very sparse and are missing for many countries. Therefore, these data need to be interpreted with caution.

Figure 3.4 summarises the situation for organic aquaculture production in the world in 2015–2016 and shows the highly differentiated situation both in terms of volumes and growth rates. Despite the limited share for China for organic aquaculture (0.5% in 2015), it still maintains the dominant position for volume of organic aquaculture production, with over 74% of total organic aquaculture products. European countries account for about 20% of the world organic aquaculture. Ireland is the most relevant producer in Europe, with 40,873 metric tonnes produced in 2016, and with an annual growth rate of 31% from 2015 to 2016.

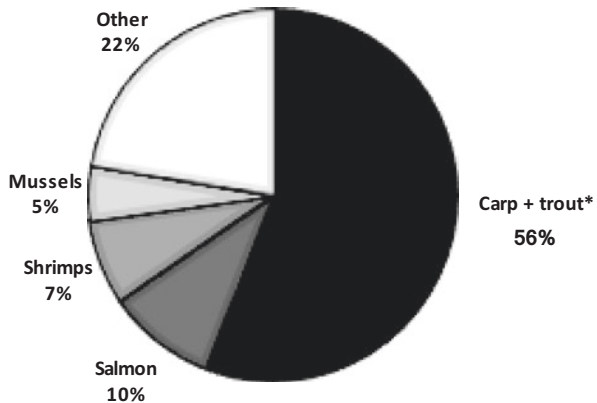
Information concerning the type of species farmed organically is particularly scarce, with any sort of detailed breakdown of data from the main statistical sources only available for 17% of the total organic aquaculture production. These data also refer mainly to the European countries. Details concerning the relative weights for organic aquaculture in China are available from Xie et al. (2013). We have used these data to provide an estimate of the organic aquaculture volume per species in 2016 (Fig. 3.5).

Detailed information of the economic aspects of organic aquaculture in Europe is available from EUMOFA (2017), and from reports of the OrAqua project



**Fig. 3.4** Organic aquaculture production, as the main producers\* and the annual variation. (Source: Calculated from FiBL data; \*95% of total organic world production; Vietnam: 2015 not available)

**Fig. 3.5** Estimated organic aquaculture production by species in 2016. (Source: Calculated from Lernaud and Willer (2018) and Xie et al. (2013))



([www.oraqua.eu](http://www.oraqua.eu)) for an economic analysis (Prins et al. 2015). Despite the general positive trend for organic aquaculture in Europe, production is not evenly distributed, and some countries have even reduced their production over recent years, particular for Belgium, Croatia, Germany and the UK. The share of organic aquaculture is very variable across the European countries, with Ireland and eastern European countries showing the highest values (Table 3.2). Surveyed data from EUMOFA and EUROSTAT in some cases are different, with the latter showing in general higher values for organic aquaculture volumes. The main organically farmed species in Europe in terms of volumes are salmon (strong concentration of production in Ireland), mussels (mainly produced in Italy and Ireland), trout (mainly produced in France and Denmark), carp (mainly produced in Hungary, Poland and Romania), sea bass and sea bream (mainly produced in Italy and Greece) (Fig. 3.6).

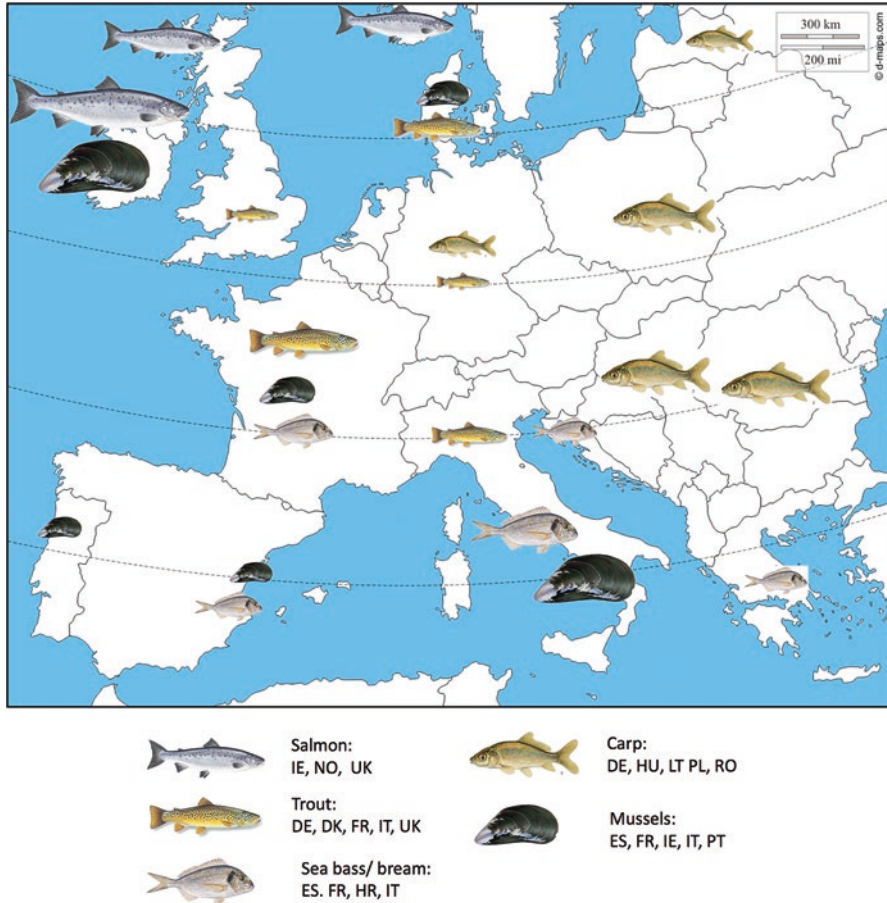
**Table 3.2** Organic aquaculture: volumes and share of the main European Union producers (2015)

Country	Total aquaculture (tons)	Organic aquaculture (tons)			Main species
	(FAO)	(EUROSTAT)	(EUMOFA)	Share (%)	
Ireland	39,650	31,227	22,000	55.5–78.9	Salmon, mussels
Italy	148,763	5492	8500	3.7–5.7	Sea bass/bream, trout, mullet, mussels
Hungary	17,337	3498	3498	20.0	Carp
UK	206,834	n.a.	3382	1.6	Salmon
France	206,800	n.a.	3000	1.5	Salmon, trout, sea bass/bream, mussels
Denmark	35,867	2934	2864	8.0–8.2	Trout, mussels, sea bass/bream
Romania	11,042	6384	2042*	18.5–57.8	Carp
Spain	289,821	2709	1353	0.5–0.9	Trout, mussels, sea bass/bream
Portugal	9322	1300	1300	13.9	Mussels
Lithuania	4450	1300	1117	25.1–29.2	Carp
Germany	29,909	621	621	2.1	Carp, trout
Greece	106,118	720	400	0.4–0.7	Sea bass/bream
Croatia	15,572	300	300	1.9	Sea bass, mussels
Austria	3503	n.a.	120	3.4	Carp
Bulgaria	13,537	80	80	0.6	Mussels
Slovenia	1607	32	32	2.0	Mussels
Poland	36,971	18	19	0	Carp, trout
Latvia	863	7	9**	0.8–1.0	Carp
<b>Total</b>	<b>1,177,966</b>	<b>56,622</b>	<b>50,637</b>	<b>3.9–4.4</b>	

Source: Calculated from EUMOFA (2017); \*2014; \*\* 2016

## The Economics of Organic Aquaculture

Conversion to organic aquaculture is a complex process that involves a multidimensional approach that covers social, economic and environmental issues (Bellon and Lamine, 2009). Any decision to convert is of course influenced by context-specific issues that can be extremely different for different countries. Following Padel (2001) and Stofferahn (2009), we can argue that reasons to convert to organic aquaculture might be mainly classified as farming aspects, such as technical and production issues, economic and financial evaluations, and personal motivation of farmers, such as personal health. Motivation to convert to organic aquaculture in Asian countries, for instance, might include the need for alternative trade opportunities that are more oriented towards sustainability and social inclusion (Omoto and Scott 2016; Ahmed et al. 2018) or the possibility to exploit economically efficient integration



**Fig. 3.6** Main organic aquaculture producers in Europe (icon sizes are approximately proportional to volumes of production). (Source: Adapted from Prins et al. (2015) and EUMOFA (2017))

with other farming production (Nair et al. 2014). Organic aquaculture is considered an opportunity for rural development and poverty reduction in developing countries (Prein et al. 2012). In the western context, obstacles to convert to organic aquaculture might also depend on the perception of organic farming practices as not oriented to efficient production systems (Home et al. 2018). For the particular economic motivations to convert to organic aquaculture production, the main aspects to take into consideration are those of production at the farm level, the processing and marketing and market conditions and demand and consumer attitudes.

The requirements for organic aquaculture have specific consequences according to the following economic aspects:

- *Stocking density*: Organic standards might require reduced stocking rates (see, e.g. Naturland 2017), which will result in higher average fixed costs per unit of output.

- *Livestock/juveniles*: Availability of organic juveniles might be limited, which will lead to higher prices.
- *Feed*: This represents the main production costs in aquaculture in general, and it is particularly critical for organic aquaculture.
- *Labour*: Labour units per output might increase due to lower stocking rates and longer growth periods.
- *Welfare*: The extensive nature of organic aquaculture might increase the fish welfare and reduce the necessity for treatments. However, specific standards might significantly constrain the use of antibiotics and chemical treatments.
- *Investments and general costs*: Ponds and cages are mostly used in organic aquaculture. A stocking density constraint might require increased production capacity, which will result in higher fixed costs. Certification costs might also be an issue for smallholders.
- *Processing and distribution*: Processing requires dedicated facilities or the interruption of processing of conventional products, which will reduce the economy of scale when the organic volumes are not adequate.

Few studies have report detailed cost analyses for organic aquaculture (Bergleiter et al. 2009; Disegna et al. 2009; Prins et al. 2015). The cost of organic feed is usually higher than conventional feed (Prins et al. 2015), particularly due to extensive organic practices (Prein et al. 2012). Lower amounts of feed and reductions in feed wastage can be considered in organic systems (Mente et al. 2011), but these do not compensate for higher purchase costs. Better growth performance for organic aquaculture might be considered (Di Marco et al. 2017) and might contribute to reduction in feed costs.

Figure 3.7 shows a synthesis of the main results from case studies regarding production costs at the farm level. The countries considered in the analysis are among the main producers in the respective fish species: Norway, the UK and



**Fig. 3.7** Cost-price structure for selected organically farmed species in selected European countries (average values, % of total costs) (Source: Calculated from Prins et al. (2015))



Ireland for salmon; Denmark, France and Italy for trout; France, Italy and Spain for sea bass and sea bream; and Romania, Poland and Germany for carp. Simple arithmetic averages across the countries have been calculated to summarise the data on the cost share. While such averages might be conditioned by specific conditions for an individual country, these results provide an initial insight into the value chain of organic aquaculture. Although differences in the cost structures are evident across species, the feed share is predominant in all cases. Other costs (e.g. general costs, energy, maintenance, financial costs) and labour costs have relevant but differentiated importance according to the type of species, while the livestock (e.g. cost of juveniles) is particularly relevant for sea bass/bream.

Table 3.3 shows a comparison of the costs and other relevant economic factors for organic aquaculture with respect to conventional aquaculture. The increase in the general costs is particularly disadvantageous for organic salmon production, given the need for larger facilities as a consequence of reduced stocking rates. Similar or lower requirements for feed are observed for all species. The reduction in the quantity is, however, more than compensated for by the price differences, particularly in the case of organic carp. Given the relevance of the share of feed to total costs (Fig. 3.7), 65% of the total difference in cost for organic carp farming with respect to conventional systems is a result of the feed costs. About 35% of the higher production costs for organic sea bass/bream are due to the price difference for organic juveniles (Prins et al. 2015). The purchase prices for organic feed and juveniles are also relevant for sea bass/bream farming. An extra cost of 60% for sea bass

**Table 3.3** Main productivity and cost categories for selected species in Europe<sup>a</sup>: relative changes (%) of organic vs conventional aquaculture where not differently specified

Factor	Measure	Change in costs from conventional to organic aquaculture (%)			
		Salmon	Trout	Sea bass/bream	Carp
Stocking density		-40	-15	-15	=
Daily growth		-35	=	-20	-10
Feed	Quantity	-15	=	=	-10
	Price	+12.5	+30	+50	+100
Livestock	Quantity	=	=	=	+50 to +100
	Price	=	=	+50	=
Labour		+15	+15	+15	+10
Mortality rates		=	=	=	=
Health costs		=	=	=	=
Other costs <sup>b</sup>		+150	=	=	+7
Certification		(€3000/year)	(€600/year)	(€600/year)	(€600/year)
<b>Overall cost difference</b>		<b>+23 to +40</b>	<b>+15 to +18</b>	<b>+29 to +42</b>	<b>+31 to +81</b>

Source: Prins et al. (2015)

<sup>a</sup>Salmon, Norway, the UK, Ireland; trout, Denmark, France, Italy; sea bass/bream, France, Italy, Spain; carp, Romania, Poland, Germany

<sup>b</sup>Depreciation, maintenance, financial costs

= no difference

organic farming was also reported by EUMOFA (2017). The combination of these factors leads to a generalised increase in the production costs for organic aquaculture with respect to conventional systems, which will normally range between 15% and 81% across the different species and countries.

The cost differences reported in Prins et al. (2015) are lower for trout production, while they are particularly high for organic carp production in Romania. For organic trout farming in Italy, Disegna et al. (2009) consider 20–30% cost increase compared to conventional aquaculture, which was mainly due to higher costs for feed and monitoring, and to an increase in the unitary fixed and general costs due to lower stocking density. Higher cost differences (35%) were reported by EUMOFA (2017) for a case study in France.

While the general consensus can be considered as higher production costs for organic aquaculture, a more differentiated picture emerges in terms of yields. Prins et al. (2015) showed a generally negative situation for productivity of organic aquaculture, due mainly to reductions in the stocking rate, which is particularly relevant for salmon, and the daily growth, which might be related to lower feed conversion rates. Stocking rates are 40% lower for organic salmon farming, and 15% lower for trout and sea bass/bream. The reductions in daily growth have been reported as 35% for salmon, 20% for sea bass/bream and 10% for carp, with no significant reduction for trout (Prins et al. 2015). Disegna et al. (2009) also considered yield reductions for organic trout farming in Italy due to the lower stocking rates. However, Di Marco et al. (2017) carried out a comparison of organic and conventional farming of sea bass in Italy and indicated good performance for the organic system. In particular, the growth of organic sea bass was more rapid, mainly due to their higher feed intake, an improved protein/fat ratio and higher protein availability in the organic feed. For prawn and shrimp farming, organic systems appear to obtain higher yields than conventional farming. Paul and Vogl (2012) reported comparatively higher average yields for organic shrimp farming in Bangladesh, particularly for small farms where animal welfare is better due to more frequent water exchange and better quality of feed. Reported yield improvements ranged from 80 to 260 kg/year/ha in Bangladesh and India. Nair et al. (2014) analysed an integrated rice-prawn system in India that provided lower rice yields, which were compensated for by 10% higher prawn yields.

The general picture that is emerging from this analysis of the production process shows higher costs and a differentiated situation in terms of productivity in organic aquaculture. This implies that overall profitability is strongly conditioned by the higher prices obtained. These premium prices at the farm level are positive and range from 20% to 200%, depending on the farmed species and the country (Table 3.4). Higher prices for farmers are reported for China, which is particularly relevant given that Chinese production of organic trout and carp is the largest around the world. Conversely, price premiums for European countries are generally lower and are not always sufficient to ensure adequate profitability for the organic sector.

Prins et al. (2015) showed a critical situation for carp and sea bass/bream farming in particular. For some countries (e.g. Poland for carp; Italy, Spain for sea bass/bream), total costs exceeded the farm gate prices, which resulted in negative margins. Where available (e.g. France for sea bass/bream; Germany, Romania for carp),

**Table 3.4** Reported relative increases in prices obtained and profitability from organic aquaculture as compared to conventional aquaculture

Factor	Source	Country/ area	Increased price obtained/profitability from conventional to organic aquaculture (%)							
			Salmon	Trout	Sea bass/ bream	Carp	Mussels	Shrimp/ prawns	Seafood/ others	
Increased price obtained (farm level)	Ankamah-Yeboah et al. (2017)	Denmark		33						
	EUMOFA (2017)	Europe <sup>a</sup>		73				20		
	Prins et al. (2015)	Europe <sup>b</sup>	30	30	35	30				
	Xie et al. (2013)	China		75 to 117			75 to 117		50 to 87	18 to 200
	Ankamah-Yeboah et al. (2016)	Denmark	20							
	Asche et al. (2013)	UK	25 (frozen fillet)							
Increased price obtained (consumer level)	Disegna et al. (2009)	Italy		46						
	EUMOFA (2017)	Europe <sup>a</sup>		20 to 25				20 to 25		
	Olesen et al. (2010)	Norway	15							
	Paul and Vogl (2012)	Bangladesh							14 to 20	
	Prins et al. (2015)	Europe <sup>b</sup>	40 to 50 (smoked/frozen)	50 to 60 (whole)	50 (frozen/ whole)		50 (frozen/ whole)	13 to 25		
	Ankamah-Yeboah et al. (2017)	Denmark		-6 to 8 <sup>c</sup>						
	Prins et al. (2015)	Europe <sup>b</sup>	0 to 40 <sup>d</sup>	10 to 35 <sup>d</sup>	-12 to 9 <sup>d</sup>		-1 to 31 <sup>d</sup>			
	Nair et al. (2014)								117	
	Prins et al. (2015)	Europe <sup>b</sup>	-9 to 8 <sup>d</sup>	12 to 13 <sup>d</sup>	-8 to 1 <sup>d</sup>		-52 to -1 <sup>d</sup>			

<sup>a</sup>Trout, France; mussels, France, Bulgaria (consumer price only)<sup>b</sup>Salmon, Norway, the UK, Ireland; trout, Denmark, France, Italy, sea bass/bream, France, Italy, Spain; carp, Romania, Poland, Germany<sup>c</sup>Net return on asset<sup>d</sup>Margin on cost price<sup>e</sup>Calculated from Prins et al. (2015)

positive margins are however entirely dependent on the subsidies that are available, which represent the main condition for farm profitability. While conventional carp farming provides adequate profitability, the premium prices for organic aquaculture are still not sufficient to compensate for the extra costs.

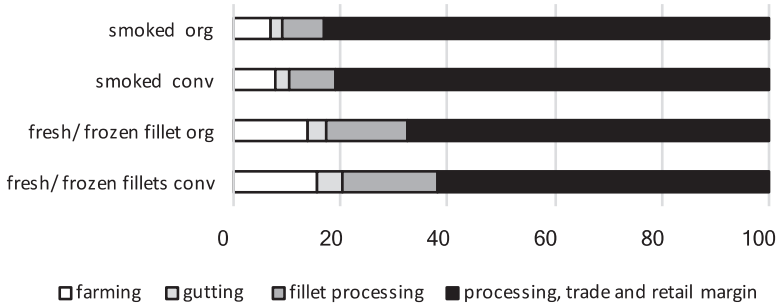
Salmon and trout production are characterised by better economic performances. Here, the margins are positive for all species, even without considering the subsidies, with the exception of an Irish case study that showed a slightly negative margin, excluding subsidies.

Comparing the profitability of organic aquaculture with the conventional system, the differences in the relative margins relating to total costs (including subsidies) for organic and conventional systems are shown in Table 3.4. Conversion to organic production is particularly critical for carp, while the differences for sea brass/bream margins are more limited, also due to the scarce profitability reported in the conventional case studies considered for these comparisons. For salmon, the comparisons of the profitability indicate a better performance for UK organic farming only and negative differentials particularly for the Irish case. Organic trout farming provides the best performance if compared to the conventional aquaculture. These data were confirmed by Ankamah-Yeboah et al. (2017), who analysed the profitability of organic farming of trout in Denmark by measuring the rate of profitability based on the net return (operational profit, i.e. owner remuneration) on assets over 3 years. For 1 of the 3 years considered, they reported negative results for profitability, which was attributed to the specific inclusion of investment costs. A comparison with the profitability of conventional aquaculture, and for conventional dairy and agriculture farming, showed a globally positive performance for organic trout farming.

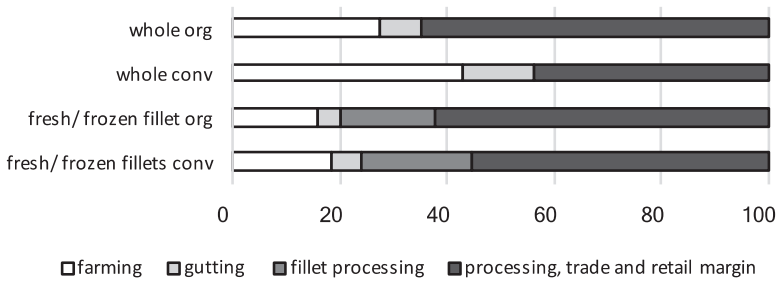
Nair et al. (2014) showed some considerable increases in profitability for organic farming, such as the combination of rice and prawn organic production. This system is particularly effective for prawns, where the net margin increased by 117% with respect to the conventional system.

For the distribution costs, Figs. 3.8, 3.9, 3.10 and 3.11 show the make-up of price, i.e. unitary revenue, along the main stages of the supply chain in relative terms. These data are based on Prins et al. (2015), based on a calculation model including production and processing costs, yields and losses, revenues for nonedible parts and sale prices. As a general consideration, the component of price obtained by farmers is always lower in relative terms for organic aquaculture, although this is counterbalanced by higher gains at the distribution level. Conversely, the costs of gutting and fillet processing are higher for the conventional system. In absolute terms, the distribution margins are highest for salmon, which is considered a luxury product, and particularly as smoked salmon. Indeed, the distribution margins for smoked salmon are the highest both in relative and absolute terms, while they are the lowest for carp fillets.

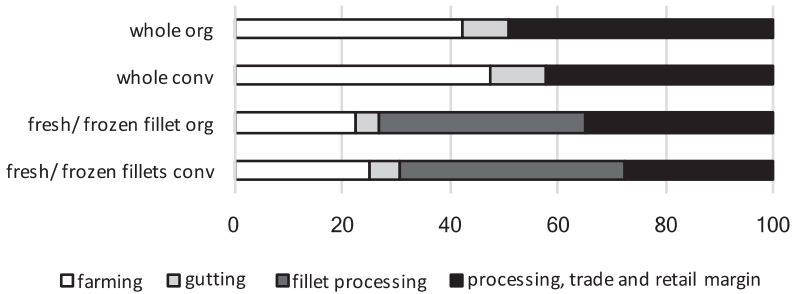
The highest processing and distribution costs for all organic cases provides an indication of the effects of diseconomies of scale, due to the limited market size for organic aquaculture. Higher costs at the processing and distribution levels are the main source for the premium consumer prices for organic aquaculture, which appear not to be distributed proportionally to the farmers.



**Fig. 3.8** Make-up of price for farmed fish along the supply chain (% of total unitary price at consumer level): salmon. (Source: Calculated from (Prins et al. 2015))



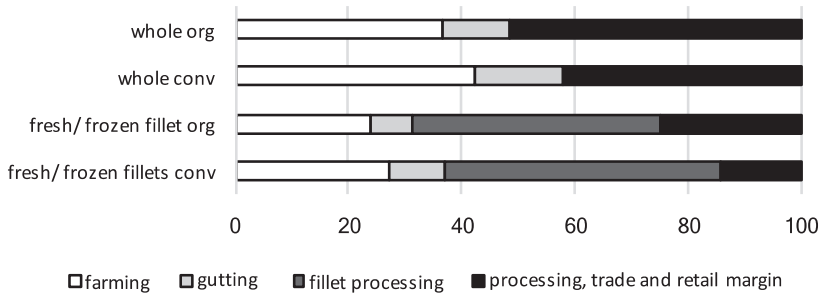
**Fig. 3.9** Make-up of price for farmed fish along the supply chain (% of total unitary price at consumer level): trout. (Source: Calculated from (Prins et al. 2015))



**Fig. 3.10** Make-up of price for farmed fish along the supply chain (% of total unitary price at consumer level): sea bass/bream. (Source: Calculated from (Prins et al. 2015))

### Consumer Awareness and Product Knowledge

Products from organic aquaculture have only recently gained importance in the market. This is why little attention has been directed so far towards consumer knowledge and perception of organic aquaculture (Schlag and Ystgaard 2013). However, in the policy actions to define organic aquaculture, consumer perception



**Fig. 3.11** Make-up of price for farmed fish along the supply chain (% of total unitary price at consumer level): carp. (Source: Calculated from (Prins et al. 2015))

is mentioned as ‘the key factor that policy makers should take into account when defining the regulatory framework of organic aquaculture’ (Lembo et al. 2018).

Before considering consumer perceptions further, it should be noted that consumers are mostly unfamiliar with aquaculture (Aarset et al. 2004; Arvanityannis et al. 2004; Verbeke et al. 2007; European Commission Directorate-General for Maritime Affairs and Fisheries 2009; Altintzoglou et al. 2011; Schlag and Ystgaard 2013; Gutierrez and Thornton 2014; Feucht and Zander 2015; Zander et al. 2018). Many consumers are even not able to distinguish between wild-caught fish and fish from aquaculture (Zander et al. 2018). Consumer knowledge about the sustainability in aquaculture production is even lower. This limited knowledge can result in a ‘romanticised’ and misleading image of aquaculture, and it gives room for the potential to influence consumer ideas and concerns about intensive terrestrial animal husbandry (Honkanen and Ottar Olsen 2009; Stubbe Solgaard and Yang 2011; Vanhonacker et al. 2011; Pieniak et al. 2013; Zander et al. 2018). Due to this lack of knowledge and awareness, the consumer perception of aquaculture can be driven more by emotions than by reason (Verbeke et al. 2007; Vanhonacker et al. 2011; Feucht and Zander 2015).

Interestingly, this lack of consumer knowledge does not automatically mean that consumers are asking for more information. Feucht and Zander (2015) reported that some consumers are aware of their lack of knowledge and want more transparency and information concerning aquaculture in general. They ask for standardised and comprehensible information on the packages. In contrast, other consumers do not wish to know more about the fish farming because they fear that more information might be confusing, as they already have information overload; it might even cause them to stop consuming these organic aquaculture fish altogether.

### ***Labels and Label Knowledge***

Labels are an important means for communicating the various attributes of a product to the consumer. These are of particular relevance in the case of ‘credence goods’, where the specific characteristics cannot be verified during or after purchase

and even during consumption. Several labels exist in European markets that indicate the use of sustainable aquaculture practices. These include the Aquaculture Stewardship Council (ASC), the Friends of the Sea (FOS), and also European and national organic labels. The low consumer knowledge of (sustainable) aquaculture also corresponds to low knowledge of sustainability labels in general. Consumer confusion is generally enhanced by the proliferation of too many ‘eco-labels’ (Langer et al. 2007), and this also applies to organic aquaculture products (Altintzoglou et al. 2010; Feucht and Zander 2015; EUMOFA 2017). However, consumer knowledge about organic labels is relatively high, as these are used on all food products, and not only on farmed fish, like for the ASC and FOS labels (Grunert et al. 2014; Zander et al. 2015, 2018; Ankamah-Yeboah et al. 2016).

Similar data have been reported relating to consumer trust: organic labels are trusted more compared with other sustainability labelling of products, although some consumers have low confidence in the certification process and compliance with respect to organic standards (Feucht and Zander 2015; Ankamah-Yeboah et al. 2016). Indeed, trust in a logo is an important mediator between labels and consumer choice (Zanoli et al. 2015). Distrust of organic labels and certification has, however, been reported for all categories of organic products, especially by the occasional consumer (Zanoli and Naspetti 2002; Zander et al. 2015). According to Feucht and Zander (2015), the consumer who is interested in sustainability issues appears to prefer organic aquaculture products and products from sustainable wild fisheries, even though a general lack of label knowledge has been reported.

According to EUMOFA (2017), organic aquaculture needs to be clearly differentiated from other competing schemes, such as eco-labelled or ‘sustainable’ aquaculture. Therefore, the ‘credibility and readability of organic labels in front of eco-labels’ should be increased by improved communication, with stressing of the ‘high-level principles of sustainability and animal welfare (in addition to food quality objectives)’ (EUMOFA 2017).

## Consumer Attitudes

As a consequence of the relative lack of knowledge, many consumers do not clearly distinguish between sustainable and organic aquaculture (Feucht and Zander 2015; EUMOFA 2017). Indeed, the two terms are frequently mixed or used synonymously. Sustainable aquaculture is expected to avoid drug use as far as possible and to work without artificial additives and hormones (Stubbe Solgaard and Yang 2011; Kalshoven and Meijboom 2013; Almeida et al. 2015; Feucht and Zander 2015; Zander et al. 2018). Consumers believe that sustainable aquaculture should be a ‘natural’ way of production that respects the fish welfare and the environment (Schlag and Ystgaard 2013; Feucht and Zander 2015). ‘Mass production’ is not perceived as sustainable, and fish feed should also be sustainable and species-appropriate (Zander et al. 2018). Moreover, full transparency along the supply chain and outstanding quality are demanded by the consumer. This would imply greater

collaboration along the supply chain (Naspetti et al. 2017), although organic systems do not appear to perform better than other systems in this respect (Naspetti et al. 2011). With regard to closed recirculation systems, there are some associations with ‘mass animal husbandry’. The welfare of the fish is not generally believed in these systems, and the ecological advantages with respect to nutrient run-offs are frequently outweighed by the lack of naturalness and the assumed deficiencies towards fish welfare (Feucht and Zander 2015). A lack of product knowledge might also be the reason for the unclear attitudes of the consumer (EUMOFA 2017).

Despite a general lack of knowledge, some consumers have relatively clear conceptions and expectations of organic aquaculture. Whereas sustainability is a more or less vague term with an unclear definition for most consumers, on the other hand, organic is perceived as a fixed term that is familiar to many consumers. Some consumers (mainly those who regard themselves as organic consumers) know that there is a regulatory framework that defines organic aquaculture (Feucht and Zander 2015). Those who know about organic aquaculture perceive it to be the ideal aquaculture practice, and they appreciate seafood from organic aquaculture. They argue that all sustainable aquaculture should follow organic standards in order to avoid misunderstandings (Feucht and Zander, 2015; Risius et al. 2017; Zander et al. 2018).

Consumer perceptions of what the product attributes are that make farmed fish organic aquaculture are mostly in line with current organic aquaculture practices. Organic fish farming is perceived as a natural production method that combines eco-friendliness with fish welfare: ‘[...] *organic, the fish is happy* [...]’ (Feucht and Zander 2015). The following summary defines the attributes that consumers associate with organic aquaculture:

- Exclusive breeding of native fish species (Feucht and Zander 2015)
- Pesticide-free (O’Dierno and Myers 2006)
- Medication-/antibiotics-free (O’Dierno and Myers 2006; Feucht and Zander 2015)
- Environmentally friendly (Aarset et al. 2001; O’Dierno and Myers 2006)
- Better taste (O’Dierno and Myers 2006)
- Better animal welfare (Aarset et al. 2001; O’Dierno and Myers 2006)
- Safer (O’Dierno and Myers 2006)
- More nutritious (O’Dierno and Myers 2006)

Organic aquaculture is meant to be a more traditional aquaculture (the term ‘fish farming’ might apply better to this kind of production), with a low level of technical input. According to these expectations, organic aquaculture should use earth ponds or flow-through systems, and not closed recirculation systems, as these were perceived as too technical and artificial. In the case of sea species, open-sea cages are preferred (Stefani et al. 2011). Sometimes, organic fish farms are assumed to be small to medium sized, as larger production is often associated with industrial livestock farming, which contradicts the idea of organic production (Feucht and Zander 2015). These product attributes and farm characteristics might explain why certified organic seafood has been reported to be preferred by consumers who are particularly concerned about sustainability in their food choices (Zander et al. 2018). In



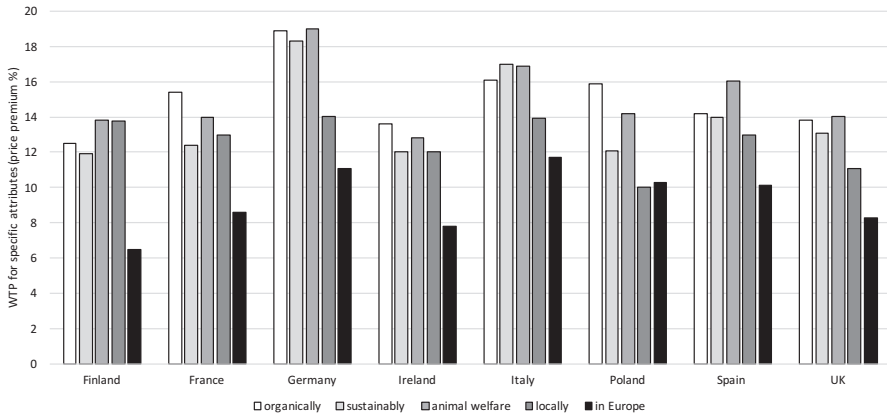
agreement with the findings of Aarset et al. (2004) and Zanoli and Naspetti (2002), among the motives for buying organic fish, there is the avoidance of potential negative consequences associated with the production and consumption of conventional products. However, in most studies, compared to the attributes such as origin, and even relatively unspecific (sustainability) claims, organic certification turns out to be less important (O'Dierno and Myers 2006; Stefani et al. 2011; Mauracher et al. 2013; Zander and Feucht 2017; Zander et al. 2018).

## Consumer Preferences and Willingness to Pay for Organic Seafood in Europe

Preferences and willingness to pay are of crucial relevance when defining market opportunities for organic food and seafood. A number of studies have analysed consumer preferences and their willingness to pay (WTP) for seafood with different sustainability attributes (Budak et al. 2006; Olesen et al. 2010; Stefani et al. 2011; Mauracher et al. 2013; Ankamah-Yeboah et al. 2016; Risius et al. 2017; Zander and Feucht 2017; Zander et al. 2018). Ankamah-Yeboah et al. (2016) showed that in Denmark, consumers are willing to pay a price premium of almost 20% for organic salmon compared to conventional salmon. They used real market data from a household panel and carried out a hedonic price analysis. They reported that consumer WTP was higher for seafood with the organic logo than for seafood labelled with the MSC logo. Olesen et al. (2010) reported additional WTP of 15% on average for organic salmon as long as the fish colour was comparable. By using experiments based on consumer choice, they analysed this WTP. According to Risius et al. (2017), smoked trout labelled with the organic 'Naturland' logo was preferred over products with the ASC label.

In a recent contingent valuation study, more than 4000 consumers in 8 European countries were asked about their WTP for different sustainability attributes of farmed fish (Zander and Feucht 2017). The consumers were asked for their additional WTP for seven different product attributes, all of which were related to sustainability: 'sustainably produced', 'organically produced', 'locally produced', 'produced according to higher animal welfare standards' and 'produced in Europe'. On average across all countries, the additional WTP was highest for 'organic production' (+14.8%), followed by 'sustainably produced' (+14%), 'produced with higher animal welfare standards' (+14%), 'locally produced' (+12.6%) and 'produced in Europe' (+9.4%). Thus, organic and sustainable production and also higher animal welfare standards appear to be the most promising attributes with respect to product differentiation in the European fish market.

Consideration of these results by country, which were particularly variable, is more interesting than the overall average (Fig. 3.12). The highest overall level of additional WTP was in Germany, followed by Italy. In Finland, Germany, Spain and the UK, WTP was highest for higher animal welfare standards, while 'organic production' was the most important attribute in France, Ireland and Poland. 'Local origin' was particularly important in Finland, while in all other countries, 'local



**Fig. 3.12** Average additional willingness to pay (in%) for organic fish production compared to the other sustainability attributes indicated. (Source: Adapted from Zander and Feucht (2017))

origin’ was outperformed by specific production practices, such as ‘sustainably’, ‘organic’ or ‘animal welfare’ aspects.

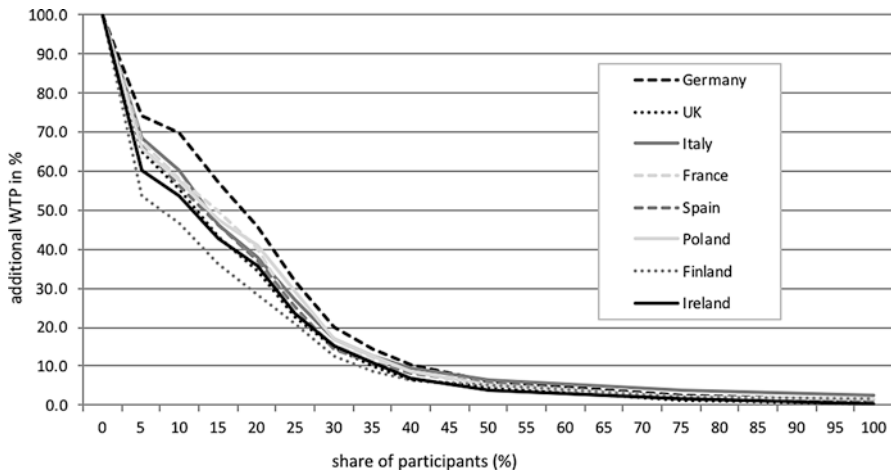
These data confirm earlier studies that stressed the importance of animal welfare considerations for consumer demand (O’Dierno and Myers 2006; Kupsala et al. 2013; Feucht and Zander 2015). The preference for local or domestic aquaculture products, which was also reported for previous studies (Stefani et al. 2011; Claret et al. 2012; Mauracher et al. 2013; McClenachan et al. 2016; Risius et al. 2017), is confirmed only for Finland and France. The low additional WTP for ‘European origin’ confirms earlier data from Pieniak et al. (2013) on consumers in the Czech Republic, Germany, Greece, Italy, Portugal, Romania, Sweden and the UK, although this contradicts Altintzoglou et al. (2010), who reported that indications of European origins enhanced the image of fish.

Figure 3.13 shows the distribution of the consumer WTP in the eight study countries indicated. A very small share of the participants have an additional WTP as high as 100%, as those who would be willing to pay double the price for organic seafood. Some differences become obvious when looking at the share of participants who are willing to pay 50% more: this share is about 10% in Finland but nearer 20% in Germany. About 25% of the Finnish participants and 30% of the German participants were willing to pay a price premium of 20%.

## Concluding Remarks

The context of organic aquaculture is very diverse worldwide. Relevant macro-trends indicate:

- Aquaculture production is nearly reaching yields of wild-caught fish.
- A strong positive trend in aquaculture production over the last 10 years.



**Fig. 3.13** Distribution of consumer willingness to pay (WTP) for 'organically produced' seafood according to country. (Source: own calculations)

- Consumption of organic food is expanding rapidly, particularly in Europe, and organically farmed fish are more in demanded, again, particularly in Europe.
- Organic aquaculture appears to be particularly suitable for developing countries under specific climate conditions, which provides positive stimulus in terms of rural development.

This framework might suggest positive expectations for the expansion of organic aquaculture. However, substantial limitations must be taken into consideration. The data available on the economics of organic farming in Europe show an ambiguous situation, where real profitability relative to conventional aquaculture is dependent on the fish species and the country. Profits are not always guaranteed, and conversion to organic might be an opportunity only for already established farms. The regulatory framework for organic aquaculture appears to be particularly complex, with over 80 national and private standards, and producers from developing countries might face difficulties in marketing their products in western countries. From an economic perspective, the very limited size of the sector implies obstacles for operators, such as diseconomies of scale, limited availability and high prices for purchased inputs, major limitations for processing and high costs of distribution.

The growing demand for organically farmed fish is of course the main solution in the medium term. However, given the potential consumer confusion between wild-caught and organic fish, and between organic labels and other eco-labels, increasing consumer awareness and knowledge through improved marketing and communication is paramount to sustain the growth of this demand. Also, increased supply should result in a decreased price premium (Ankamah-Yeboah et al. 2016). However, as long as the demand for organically farmed fish continues to grow, the price premium is likely to remain relatively high. The limited market size is often

associated with low product differentiation and limited product range, which might represent major obstacles for consumers (Castellini et al. 2012).

According to various studies, consumers associate organic aquaculture with small-scale, natural production methods, as preferably in natural ponds and lakes or open-sea cages. Studies show that most consumers do not consider closed recirculation systems to be ‘organic’. Although this is sometimes far from the reality, their concerns and expectations need to be considered carefully when designing organic production systems. As the consumer knowledge of these products and their labelling is low, communication is again very important, to avoid consumer cognitive dissonance. Also, it is important that the organic aquaculture sector maintains and improves its high production standards and aligns these further with consumer expectations.

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