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Is the Norwegian cod industry locked into a value-destructive volume logic?

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ABSTRACT

Wild cod is a scarce and valuable natural resource. However, cod fishing along the coast of northern Norway has largely been about fishing as much as possible with the least possible resource effort, and thereby at the lowest cost. This traditional volume logic is rooted in biology, meteorology, and small scale capture technology. The logic is further enhanced by new large scale capture technology and a raw fish market where quality differences essentially are not reflected in the price of the fish. The intention of this paper is to address the extent to which the institutional framework in the Norwegian cod fisheries encourage or moderate this volume logic. In the paper fishing gear usage and the post-harvest industries' product mix the last decade are analyzed. The findings show that the volume logic is still at work although this result in reduced quality of the catch landed, a product mix dominated by low-end products, and limited socio-economic value creation. This institutionalized volume logic is highly resistant to change. Moreover, the paper address how a competing and more customer-oriented quality logic can help create greater export values in Norwegian cod fisheries. Finally, implications are highlighted for how institutional measures can moderate the dominant volume logic and strengthen the emerging quality logic more in line with key policy objectives for Norwegian cod fisheries.

1. Introduction

The main focus of fisheries management has generally been to avoid overfishing. This has been essential since efficient technology enabled us to eradicate wild fish stocks [1]. The Northwest Atlantic cod, for example, has been regarded as heavily overfished throughout its range, resulting in a crash in the fishery in the United States and Canada during the early 1990s [2]. In contrast, the catch of Northeast Arctic cod, while regarded as fully exploited, has been regulated successfully jointly by Norway and Russia. The total stock has grown since 2006 and peaked in 2013 [3].

From a general perspective [4], concludes that "*Despite improvements in fish processing and distribution practices, loss or wastage between landing and consumption still accounts for an estimated 27 percent of landed fish* (p. 6)." Accordingly, FAO added reducing quality-based waste (QBW) as an important object for fishery management. This paper sets out to address the problem of QBW in the Norwegian cod industry empirically, and explore its negative impact on value adding to the cod resource. Thus, the following overall research question is raised: Is the Norwegian cod industry locked into a value-destructive volume logic?

Institutional theory (e.g. Refs. [5,6] is chosen as the primary theoretical lens to understand and explain the phenomenon. The literature review concludes that QBW is resulting from a mismatch between two opposing institutional logics; a dominant volume logic and a competing quality logic. The unbalance gives a premium for those players who embrace the volume logic, which is a result of several factors depending on setting and species studied. A case study of the Norwegian cod fisheries point out the migration pattern of the fish, the institutional environment, and economics of scale as important drivers of the volume logic and the resulting QBW problem. To assess the importance of the volume logic and its development in Norwegian cod fisheries, the study uses 10-year data on landings and fishing gear usage along with the industries' product portfolio.

The harvesting strategy chosen reveal how fishermen adapt to maximize catch per unit of effort (CPUE) (Dreyer & Hermansen, 2010). The strategy is chosen within the institutional framework society and authorities have established for the fisheries. When fishermen chose a harvesting strategy, it must be within these frames to be legal and legitimate. Accordingly, this study investigates whether one important driver for QBW in the Norwegian cod fisheries is what type of gear the fishermen choose to use. Moreover, an important result of QBW in fisheries is manifested in the product portfolios of the processing firms. If QBW is significant in a fishery, the product portfolio will be dominated by low-end products. In contrast, if QBW is low, the product

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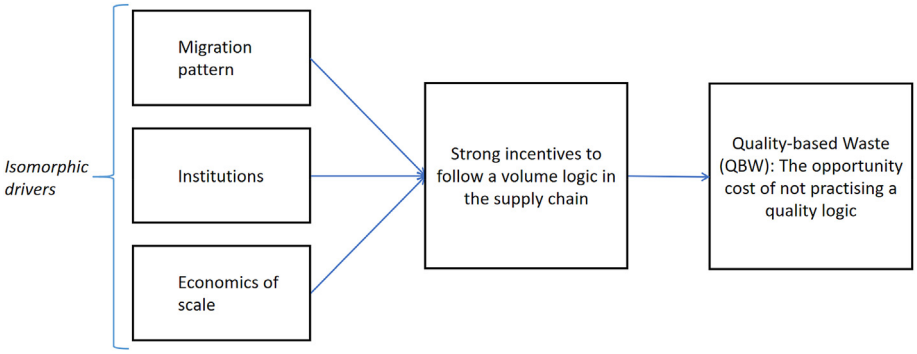

Fig. 1. Isomorphic drivers, institutional logics, and quality-based waste in the Norwegian wild cod fisheries.

portfolios are mainly expected to be dominated by high end products. To illustrate this relationship, this study examines the composition and development of the product portfolios of the Norwegian cod processing industry the last decade.

An important institutional strategy in order to add value to a fishery is to reduce QBW. To add value to the Norwegian cod industry, the tipping point between the volume and quality logics must be changed. However, the migration pattern of cod is an important moderator. The institutional framework, which is politically designed, may on the other hand enhance a quality logic. Based on this argument, this study questions whether there is a significant potential for adding value to the Norwegian cod industry by changing the institutional framework to reduce QBW.

The paper proceeds as follows. Section 2 sets up the theoretical institutional framework that are applied in an empirical study of the Norwegian cod industry. Section 3 focuses on the isomorphic drivers supporting the dominant volume logic, that is the migration pattern of cod, the institutions embracing the cod industry, and the industry's emphasis on minimizing catch per unit effort through utilizing technology that support economics of scale. Section 4 discusses the opposing and competing quality logic of the dominant volume logic. Next, empirical results are presented, and the paper ends with a discussion and conclusion.

2. Theory

[6] argue that organizations not only compete for resources but also for political power and institutional legitimacy. In these processes, there are three forces that pull organizations into isomorphic directions and force them to become increasingly similar. It is coercive pressure, normative pressure, and mimetic behavior. Coercive pressure can originate from laws, regulations (including markets), accreditations, and broader cultural expectations. Normative pressure is associated with professional values that can be created through socialization at work, formal education, networking, and certification processes. Mimetic behavior occurs when one "organization consciously models itself after another that it believes to represent a high level of success and achievement in the public eye" [7]; s. 649). A mimetic activity refers to how organizations respond to uncertainties that may be related to their own goals or requirements from their environment. In both cases, the requirements may cause an organization to mimic others who they perceive as more legitimate or successful [6].

The term "institutional logic" was first introduced by Ref. [5] to describe contradictory practices and convictions built into modern Western social institutions. A central assumption is that appropriate behavior within the individual logic is governed by norms that guide the actions of the actors [8]. Thornton and Ocasio [9]: 804) defines an institutional logic as "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality."

A collective identity can be developed among members of a social group based on their perception of having something in common with others in the group. The identity consists of the cognitive, normative, and emotional contract between the actors. When collective identities become institutionalized, a distinctive institutional logic develop; "Institutional logics are the organizing principles that shape the behavior of field participants" [10]: 631). A key assumption is that appropriate behavior in a given institution complies with norms that prescribe how the institution's actors should act [8].

Over time, institutional logic will be developed and reinforced as a consequence of formal structures and normative constructions being reflected in each other. Such logic constitutes an important theoretical structure because they help to explain what creates a sense of "common purpose and unity" within an organizational field. Therefore, it is argued that different organizational fields are characterized by their own dominant institutional logic even if two or more logics exist simultaneously within a given field [9,11]. Different institutional logics can operate in parallel. Research shows that neither minor nor major changes in institutional settings lead to "old" logics being replaced by "new." Instead, it seems that the logics live side by side, partly as competitors and partly as complementary [12,52].

In the present study, the concept of institutional logics to the supply chain of the Norwegian cod industry is applied as it is argued that the chain is characterized by a dominant volume logic and a competing quality logic. Fig. 1 illustrates this theoretical argument. It can be argued that the Norwegian supply chain for cod is dominated by a value-destructive volume logic. The emphasis of this logic is to supply large volumes of fish to customers at low prices. However, the volume logic is challenged by a less strong quality logic that offers customers high quality fish at higher prices. If the additional price that customers are willing to pay is greater than the additional costs of improving the quality, value could be added throughout the supply chain if it was based on a quality logic. Hence, it can be argued that a supply chain dominated by a volume logic destructs values (i.e., it creates QBW). According to the model, the supply chain is locked into a volume logic by isomorphic drivers. The three main drivers are the migration pattern of the fish (see Fig. 2), institutions, and economics of scale.

3. Drivers of the volume logic

The model proposed for understanding and analyzing the volume logic include three major drivers; migration pattern, institutions and economics of scale. This section explains why these drivers are important.

3.1. Migration pattern

Historically, cod fishing along the coast of northern Norway has been an efficiency contest where the main priority has been to bring on

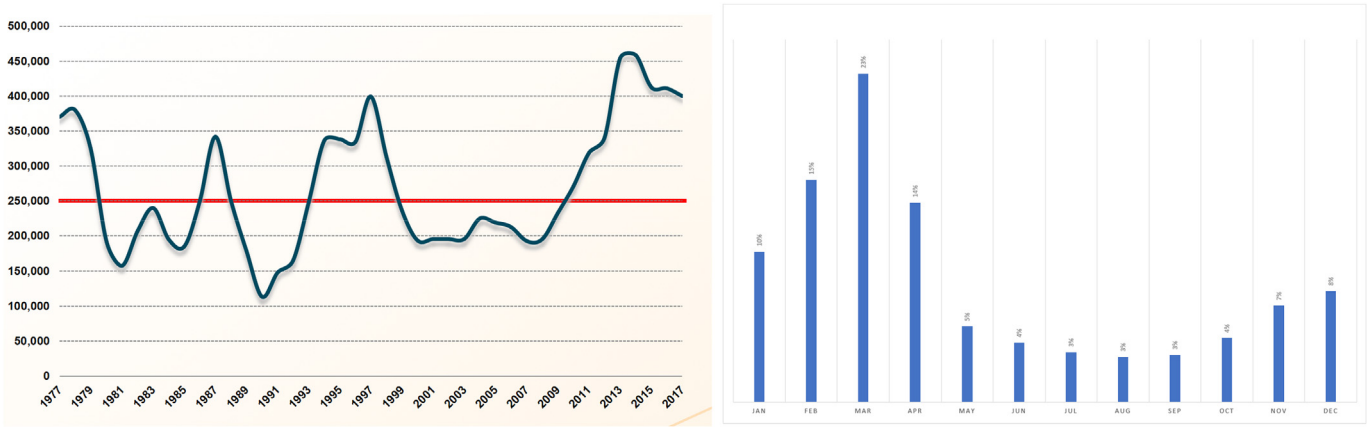

Fig. 2. Left chart: Yearly Norwegian cod catch the last 40 years (1977–2016). Chart to the right: Monthly average cod catch (2007–2016). Source: Norwegian Directorate of Fisheries.

land as large a fish volume as possible with the least catch per unit effort (CPUE). The majority of the fishing is conducted by coastal vessels with gears like jigging, long-line, gillnet, and Danish seines. The coastal fleet is allocated quotas partly as a result of historical activity and as important suppliers due to regional policy considerations [13,14].[1] In the winter (February–April), the fish gather in a limited area near the coast to spawn [15]. The Hermansen-Dreyer model is developed to explain the seasonal intensity of the Norwegian cod fishery [16]. The model includes fixed seasonal variation in CPUE as the major driver for seasonality. If the CPUE of the most valuable part of the stock is lowest in a limited area close to the shore in a period where the risk for missing other important fisheries are low, it is a recipe of concentration of fishing both in time and space. Accordingly, the harvesting strategy is adapted to the cods' migration pattern. This is an economically rational strategy especially if the limited mobility of the coastal fleet is considered. However, this harvest strategy creates logistical and quality challenges [17]. The catches are purchased by local processing plants that traditionally have solved the logistic challenges by distributing huge volume fresh and unprocessed fish to Europe or by salting or drying the cod. For the largest vessel, the major strategy has been to freeze the cod unprocessed aboard [18].

The fishing intensity during this period—in both time and space—makes it challenging to make quality considerations. Each fish must be bled and stored in a proper way to avoid quality losses. Processing plants also have to preserve and distribute large volumes within limited capacity and time [19]. This process is similar to the value destruction due to the race to fish described by Ref. [20]. Hence, the focus on CPUE, low cost based on the migration pattern of the cod and a fleet dominated by small vessels has institutionalized a volume logic in both harvesting and post-harvesting processing in the cod industry. Thus, the migration pattern can be interpreted as coercive isomorphic force in the Norwegian wild cod fishery.

3.2. Institutions

In this section, it is discussed if institutional conditions may have reinforced volume logic created by the migration pattern within the Norwegian cod industry.

3.2.1. Vertical integration

The raw fish market of cod is organized by the fishermen who by law are given a great deal of supplier power through being able to establish minimum prices (Fish Sales Act, 1938/2013). Hence, all sales take place through fishery owned sales companies with monopoly power in each region [21]. An important reason for this institutionalized skewed distribution of power between buyers and sellers is that the fishermen historically have needed protection against oligopolistic buyers as they have been vulnerable to buyer power when large quantities of fresh and lightly perishable fish have been landed in a short and hectic season [22,23]. Consequently, the post-harvesting plants have a weak institutional position in the primary market for fish. They have a fixed geographic location and they are dependent on buying fish caught on fishing areas close to their location. They are not allowed to own and operate fishing vessels (Participant Act, 1999).[2] There are no restrictions for establishing new post-harvesting plants and the establishing costs are low, contributing to slack in capacity in most part of the year and tough competition in this market [24].

3.2.2. Market failures

In a well-functioning market, one expects that quality differences will affect the prices of the fish sold [25], and there is evidence that quality do influence cod prices in the Norwegian cod market [17]. However, sampling based on objective quality measurements reveal that QBW is considerable in the cod fishing industry in the winter period [26,27], indicating that the prices do not fully reflect the quality differences. The price differences are marginal, or even nonexistent [26,27]. Thus, it seems reasonable to conclude that this market is not well-functioning when it comes to reflect the quality variations revealed when inspected objectively by public third party inspectors [19,28].

This market failure may be caused by the market being characterized as a push rather than a pull market [16,29]. Large volume must be inspected within a short timeframe and the buyer may not have enough knowledge about the quality of the fish when a transaction takes place. Alternative inspections will induce extra transaction costs and threaten a migration pattern-driven volume logic. A third imperfection of the market may be that the buyer and seller have different negotiating power. If one of the parties (the fisher in this case) is given a dominant position, he can use his power to institutionally implement a market place that does not reflect quality variations and thus preserve a volume logic driven by for example the migration pattern of the fish.

3.2.3. Fisheries management

The cod fishery is managed to protect the stock and to contribute to adding value for the stakeholders, where several regulations' primary function is the distribution of fish between stakeholders to support the

[1] [17] show that the use of these gears in themselves lead to value destruction, as cod landed by trawlers and long-liners obtain a higher price.

[2] The Participation Act also prohibits owning a majority share in more than one vessel, although some exemptions have been given.

viability of fishery dependent communities. The Participation and Raw fish acts are examples of such regulations, and the strong preference for small coastal vessel in the quota distribution system is another such example. However, these regulations can have the promotion of a volume logic and inhibit a gentle fishery that can better contribute to catch quality as an unintended consequence.

If fishermen know that fishing will be stopped shortly, this provides a strong incentive for a "race to fish" to ensure the highest possible share of a scarce resource available only for a short period [29–31]. The short harvesting season limits the fishermen's ability to attend to quality [32]. The fishermen also have limited incentives to preserve the quality of the least valuable species when catch regulations allocate a quota bonus for valuable species (e.g., cod) against the fact that other less valuable species are also being fished such as tusk, haddock, and saithe [19].

Since 2004, the management system allowed purchases of quotas [33,34]. Consequently, there are vessel that has purchased so large quotas that there is hardly any catch time left within the quota year, focusing on good capacity utilization for the vessel and low per unit harvesting cost. Large amounts of gear in the sea and large hauls can be effective catching strategies to fish large volumes at a low cost with a boat that has large quotas [31]. However, such harvest strategies result in sea-dead fish, poor bleeding after capture and longer fishing trips, contributing to reduced quality of the fish landed. According to the Hermansen-Dreyer model (2010), a quota portfolio of several species in itself– i.e. both pelagic and ground fish - might trigger more intense harvest strategies, to avoid the alternative cost of missing an important season for other species than cod.

3.2.4. Market induced volume logic

In many countries, the consumption of stock fish (dried fish), salted fish and salted and dried fish (so-called "cliff-fish") is historically interwoven in religious rituals relating to the Lent as well as the tradition of eating fish every Friday. This applies to Spain, Italy, Portugal, Brazil and Argentina [35]. In other European countries, and especially in the UK, there has been a significant demand for fresh and frozen cod as this is the most important ingredient in the popular fish and chips meals (ibid.).

Among all these customer segments, price has been important. Norwegian (salted and dried) fish have been relatively cheap, and for Norwegian exporters it has turned out to be easier to sell fish of poor quality than pricier, first-class fish. This led to more emphasis being placed on quantity than quality among the producers [35]. Hence, the consumption of cod has been dominated by price sensitive consumer and products that are not so sensitive for raw fish quality.

3.3. Economics of scale

About 1/3 of the Norwegian cod quota is caught by large sea-going trawlers. When the catch takes place at the high sea, the costs of transportation increases. In order to reduce fuel consumption and maximize fishing time, vessels utilize load capacity as best as they can and reduce the number of fishing trips, for example by freezing the fish on board [18]. Onboard freezing reduces the potential quality, but at the same time it provides better quality than if the fish was delivered freshly after many days at sea (ibid.).

If the cost of delivering good quality is higher than the price gain achieved in the market, the actors do not have sufficient incentives to prioritize quality [36]. This can occur when a vessel must reduce catch efficiency in order to increase delivery quality. For active gear like Danish seines and trawls, there is a dilemma of large rolls or hauls that the price gain achieved in good quality may be insufficient to compensate for reduced catch efficiency and increased harvesting cost. Also for passive gears (fixed), this becomes a dilemma when choosing the amount and the length of time the gear is in sea. Large hauls (trawl and seine) and long periods of fishing (long-line and gill nets) impacts quality negatively. At the same time, it reduces catch costs [16]. In addition, it is important that the fish is treated carefully onboard to avoid damages caused by pressure and strikes if one are to preserve quality [19]. Such challenges are particularly acute when using active gears such as Danish seine and trawls because large amounts of fish are then taken on board in each haul.

4. The quality logic

If the quality of the fish is poor before preserving, this deficiency can never be repaired at later stages in the supply chain [37]. Hence, poor fish quality is propagated through the supply chain, and poor quality management at the catching stage has serious repercussions as it influences which products can be produced and which supply chains served. A basic prerequisite for a quality logic is that the fishermen and regulatory authorities have updated knowledge of what constitutes good fish quality. Although this condition is necessary, it is not sufficient. In order for the knowledge to have a practical impact, it must be applied. Still, it is not certain that an actor will apply quality knowledge if there is a lack of economic incentives to ensure good quality of the fish supplied. Inadequate normative pressure in terms of occupational pride associated with catch quality can also influence the catch behavior so that good quality is not being prioritized [38].

A quality-focused actor will not leave the gear for a long time in sea, and will not put the gear in the sea with to high concentration to ensure full trawls and seines. Moreover, quality conscious fishermen have invested in modern technology to avoid excessive catches and to treat the fish as gently as possible. On the other hand, quality-focused post-harvest processors ensures the quality of the catch they receive using new processing lines that can provide low temperature, good sorting, gentle processing and fast production [19], and they also provide the fishermen with incentives to land quality fish.

Norwegian authorities have established quality regulations that set out the requirements for equipment and behavior onboard the fishing boat to avoid QBW (in Norwegian: "Forskrift om kvalitet på fisk og fiskevarer," 2013). They have established an institutional framework for the design of processing plants, both on board and on land. Furthermore, they have established regimes for the closure of fishing areas which are protected, and they have requirements for the design of fishing gear to avoid by-catches and large hauls. The authorities have also gradually developed catch regulations that seek to avoid the race to fish. The sales organizations and the first-hand market have also undergone major changes to address market failures related to quality issues. Establishing a dynamic minimum price has helped to curb the conflict level and improve the balance of power between buyers and sellers. These have been important adjustments to facilitate better quality-based pricing in the raw material market [21]. For example, under the quality regulations, landing of fish that is not bled is illegal. Additionally, they have intensified their quality inspections.

Fisheries management and technology are key providers to influence the quality of raw materials. Better quality will increase the reputation and hence the social sustainability of wild cod fishing [39]. If the fishermen are deducted a quota volume to deliver poor quality, this can act as a strong incentive. It may be naive, however, to believe that rewards and punishment can solve the quality problem alone. Establishing professional standards through normative pressure for what is good and legitimate quality on a scarce and valuable raw material can help strengthen the quality logic of the supply chain. Probably, the most important element of a quality logic is that customers are willing to pay a price premium for good quality. This premium must be large enough to recapture the additional costs of the players by lifting the quality for the consumer. If not, the players in the supply chain will lose the economic incentives to bring quality fish to the markets.

5. Empirical analysis

To test the dominant gear usage by fishermen data for all landings of cod at vessel and gear level from 2007 to 2016 from the Norwegian Directorate of Fisheries is used. This gives us an opportunity to study in detail how important drivers of QBW have developed at the catch stage for the last decade. To investigate the main product forms produced by post harvesting plants, export data from Statistics Norway for the ten-year period 2007–2016, as more than 95% of Norwegian cod landings are exported. The numbers for processed products are converted to live-weight equivalents using the Directorate of Fisheries conversion table from product weight to live weight for cod.[3]

To get a rough indication of the value adding potential of the Norwegian cod supply chain, the export price per kilo applied cod is calculated, after having converted it to live weight. The supply of cod is the scarce factor in the industry, and in this paper the value added is defined as the export price per live kilo of cod.

Table 1 shows that gears like Gill net, Danish seine and Trawl, all of which supports a volume logic, accounts for 77–79% of the gear usage in the Norwegian cod catching industry in the period analyzed. In contrast, gears like hand- and long-lines which, support a quality logic only accounts for 21–23% of the gear usage in the Norwegian cod fleet. This distribution on various types of gear usage has been quite stable over the past decade. Based on these findings, the Norwegian cod catching industry appear to still be dominated by a volume logic.

Fig. 3 illustrates how cod was used to create different products during the last decade. The main product form is cliff-fish ("klippfisk," i.e., dried salted cod). The volume has been around 140,000 tons live weight as of 2010. Since then, the trend has been stable. Frozen whole cod has been the second largest product form from 2012 and with a strong positive trend. From a moderate start in 2007 with well 20-thousand tons, export of whole frozen fish has boomed. It peaked in 2014 when more than 140,000 tons of whole frozen cod was exported. Fresh whole cod has been the third largest product category since 2013. In 2014, Norway exported approx. 90 thousand tons of fresh whole cod. Also for whole fresh cod there is an increasing trend. Since 2014, salted fish has been the fourth largest applications in volume, and this traditional product form shows a stable trend. So, does frozen fillet in 5th place with a volume of approximately 34-thousand tons live weight in 2016. In 6th place stock fish is found. The development has been stable and at 20,000 tons live weight a year. Fresh fillet is the least exported product category in Fig. 3. Here too, the volume has been stable and at just under 20,000 tons per year from 2011. This is particularly interesting when contrasted with the strong position high value fresh fillets have obtained in the exports of Icelandic cod [40,41].

Fig. 3 discloses that traditional volume oriented applications like cliff-fish and frozen cod are the leading export articles thus, it does not seem unreasonable to conclude that the Norwegian cod processing industry is dominated by a volume logic. While Fig. 3 illustrates how much of the cod raw material has been applied for different product categories, Table 2 reports the prices that the various supply chains obtain per kilogram of live-weigh equivalent cod.

It is apparent from Table 2 that fresh fillets have yielded the highest export price per kilogram of live cod, with an average of 21.80 in the period. Next is stock fish, with an average kilo price of 19.61. In third place, fresh whole fish with is found with an average price of 17.08. Subsequently, frozen whole fish (14.07 per kilogram), cliff-fish (14.01 per kilo), salted fish (13.94 per kilo) and finally frozen fillet (13.70 per kilogram of live cod) follow. The development of the prices has been slightly different for all product categories in Table 2. Apart from stock fish, prices for the different applications are significantly different from the highest price category, which was fresh fillet ($p < 1\%$).

[3] Ingrid Kristine Pettersen, Analyst Codfish at the Norwegian Seafood Council, has provided the raw data for this study.

Table 1
Catch of cod supplied by different gears in Norway at three different times. Source: Norwegian Directorate of Fisheries.

	2007		2012		2016	
Gill net	67 374	31%	100 801	28%	94 945	23%
Danish seine	37 443	17%	59 290	17%	93 140	23%
Trawl	63 993	29%	116 956	33%	135 013	33%
Hook	48 769	22%	80 440	23%	89 191	22%

The results indicate that the use of fresh fillets creates the highest values with an average price per kilo live weight of NOK 21.80 in the 10-year period 2007–2016 (see Table 2). However, with an average output of less than 20,000 tons a year, this product category has the lowest volume in the period (see Fig. 3). An implication of this finding is that stakeholders in the supply chain should apply a larger proportion of their live cod resources to fresh fillets in order to increase value creation, as has been done at Iceland [42,43].[4] However, it is a significant problem that the central agents (fillet processing plants) historically have had considerable problems with profitability and survival (e.g. Ref. [23], related to high production cost.

Stock fish added second highest value with an average price of NOK 19.61 per kilo of live cod in the ten-year period. However, in volume stock fish was the second least used category with its 20,000 tons a year. Like fresh fillets, the stock fish volume has been stable during the period. Export of fresh whole fish yielded the third highest value added per kilo with NOK 17.08. This is the only one of the three most value adding products that shows volume growth. Production of fresh whole fish quadrupled during the period and landed at 80 thousand tons in 2016. This growth can to a certain degree be due to the large-scale marketing of the brand "Skrei" in recent years [44]. It has been exported approximately 5-thousand tons "Skrei" a year at an average price of 36 NOK/kg in the last three years.[5]

The findings further show that cliff-fish, salted fish, and frozen fish (whole and fillet) provide the lowest value creation per kilo scare production factor. Average export price per kilo of live cod is around NOK 14 for all these product categories. The most significant volumes go to cliff-fish (about 140,000 tons a year on average) and to frozen whole fish (about 75,000 tons a year).

6. Discussion and conclusion

The present study address whether the Norwegian cod supply chain is locked into a value-destructive volume logic. The research question was theoretically anchored in a tentative model which was derived from institutional theory (Fig. 1). If the additional cost of landing high quality fish is lower than the additional earnings resulting from better priced end products that require high raw material quality, inadequate quality will hamper value creation in the remaining supply chain [19]. describes this as QBW due to actors being unable to exploit the potential added value of a wild fish. Similar waste takes place if, later, the additional revenue in the supply chain is not able to cover the additional cost of the fisherman by delivering high quality on the quayside (ibid.). If the quality of the fish is poor before preserving, this will never be repaired [37]. Thus, poor fish quality is propagating throughout the supply chain of the industry.

Based on the present study, there may be a potential for adding value in the Norwegian cod supply chain by reducing the high-volume products' share of the product mix in favor of fresh products (Table 2). The lost added value in the supply chain by investing in frozen

[4] It is of interest to note that in Norwegian salmon aquaculture, where the control with the production process is even stronger, fresh is the dominant product form making up more than 85% of the exports [49].

[5] Source: The Norwegian Seafood Council.

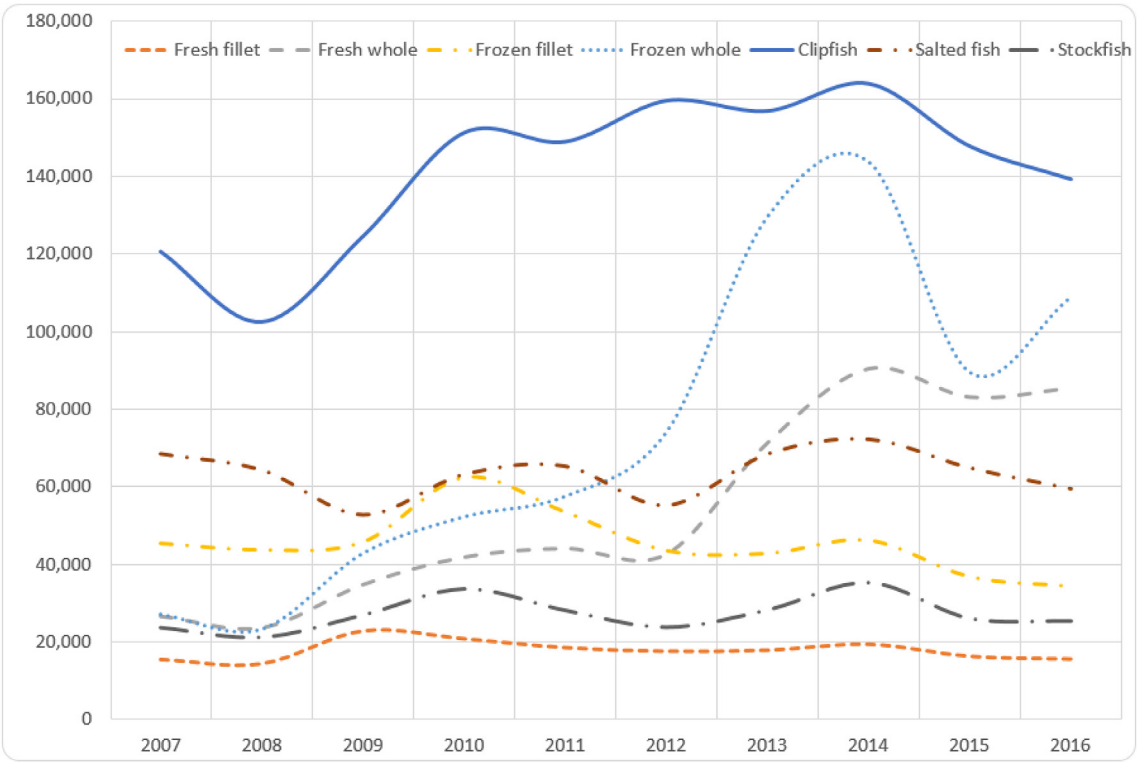

Fig. 3. Application of cod converted to live weight in tons in the period 2007–2016.

Table 2
Export price per kilo applied cod converted to live weight (2007–2016).

	Fresh fillet	Fresh whole	Frozen fillet	Frozen whole	Salted and dried	Salted fish	Stockfish
2007	26,56	21,96	16,42	18,21	17,03	17,90	23,19
2008	26,41	21,15	15,68	17,19	16,74	17,67	23,55
2009	20,57	16,49	12,34	10,70	13,37	13,18	18,04
2010	20,70	15,70	10,97	11,85	12,88	11,92	15,24
2011	21,71	16,98	11,94	12,96	14,01	13,53	18,30
2012	18,94	15,30	12,88	11,50	12,50	12,46	19,73
2013	17,10	12,31	11,36	10,24	10,25	9,63	16,03
2014	18,79	13,21	11,85	12,32	11,66	11,12	15,06
2015	22,59	17,82	15,15	17,25	15,34	15,22	22,52
2016	24,60	19,85	18,43	18,52	16,34	16,72	24,45
Mena	21,80	17,08	13,70	14,07	14,01	13,94	19,61
SD	3,24	3,19	2,53	3,31	2,30	2,84	3,61
Sign.[a]	***	***	***	***	***	***	–

[a] Two sided *t*-test assuming equal variance. ***p < 1%.

products, salted fish, and cliff-fish is an opportunity cost of these applications. This implies that a portion of the supply chain's potential added value is used to subsidize products that generate low socio-economic values. Since the regulator has limited control of the agents in the supply chain, it cannot optimize the production as a privately held company would have done. This is due, among other things, to the fact that the agents have made major irreversible strategic investments in boats and post-harvest processing plants based on a historically established distribution regimes of raw fish. Against this backdrop, it is understandable that there is a struggle between the agents to ensure the greatest possible share of the profits associated with exploiting a common scarce and valuable wild natural resource.

Cod can be included as an element in different products with different requirements of raw material quality. Highly paid products, such as fresh fillets, make the strictest demands on raw material quality [19]. Other product variants, such as frozen block products and conventional products such as salted fish and salted and dried fish, impose somewhat less requirements on raw material quality (ibid.). Products that require low raw material quality may in some cases give the firms the highest contribution margin [45]. However, it is important to note that high quality raw material, gives the processing plants more options when choosing which end product to make (ibid.). If the end products are not sensitive to raw material quality, the willingness to pay a premium price for high quality will be limited in the first-hand market. If this is the case, waste because of poor quality is being reinforced by high catch rates, high costs of ensuring good quality, and production of end products that are not sensitive to raw material quality. This will of course be strengthened if the suppliers have strong market power and the buyers have substantial available free production capacity, thus enforcing a volume logic throughout the supply chain.

The supply of fresh raw materials is the foremost competitive advantage of the Norwegian supply chain for cod. Consequently, the largest possible proportion of the scarce and valuable fish should be landed and distributed to product options that benefit from the freshness of the fish and delivered to customers that are willing to pay the necessary price premium. However, about 1/3 of the cod is frozen at sea

(Table 1). Most of this volume is exported to central cold stores where domestic adding of value only amounts to a few cents per kilo [46]. The cod then ends up as raw material for so-called “commodities” (i.e., as low-end products in shop shelves).[6] These cheap products can help push down the price of high end products that are manufactured in Norway. In sum, this reduces the export value of the Norwegian cod stock, and it removes the basis for Norwegian industrial sites in rural areas and the socio-economic spillover effects that follow from this activity.

Accordingly, a key question is why the authorities allocate quotas to the players who have a catch pattern that demotes quality and the lowest value creation potential throughout the supply chain (Tables 1 and 2; [36]. The volume logic is hardly in line with the intentions of the Marine Resources Act (2008) since it leads to QBW in the Norwegian cod industry. Apparently, it is a paradox that fishing boat owners and their crew are making super profit and super wages even though they to a great extent are producing low quality and low priced products based on a volume logic. Frozen fish has given the trawlers extraordinary profitability over time, despite the fact that such production contributes modestly to the socio-economic value adding in the post-harvest part of the supply chain.

[46] sees some signs that fishing gear that provides good raw material quality is replaced by gear that provide poorer quality in some fisheries. An example of this is when line fishermen switch to gillnets or Danish seine. But the loss of quality a fisherman experience can easily be compensated economically by increasing the volume when the catch cost is low. Increased knowledge about drivers for financial performance among vessels is important to prevent unfortunate design of catch regulations to help boost the economic incentives for reducing QBW [16].

Some of the coercive isomorphic drivers discussed are completely beyond human control in the wild cod industry. This applies, for example, to migration pattern and meteorology. Accordingly, the business activity must adapt to such factors. However, live catching and seasonal campaigns like the “Skrei”-campaign may help increase the demand and price for cod temporarily during the year [44].

An important policy implication of this study is to promote a policy that distributes quotas to fishermen based on the opportunities of the later stages in the supply chain to jointly create export values of the precious raw material. This implies less freezing on board (trawling must be gradually stepped down), smaller quotas for Danish seine and gill nets, and larger quotas for long-lines and hand lines.

The model proposed in this paper has proven to be promising in explaining QBW. However, there are some methodological and empirical shortcomings in the study. The external validity should be challenged in other empirical settings. For example, an obvious study would be to test the model in an empirical setting with the same species but another institutional framework than the Norwegian. Promising candidates would be Iceland and the Faro islands. This will be needed to further understand how institutional frameworks impact QBW.

Another approach to test external validity is to compare QBW in different fisheries within the same institutional framework. An interesting observation is that the QBW problem is not as challenging in the Norwegian pelagic sector as in the cod industry. Purse seines dominate the pelagic fisheries, but are banned in the cod fisheries. When it comes to QBW and efficiency, the purse seins perform well. Thus, a comparison of the two sectors within the same institutional framework would be important to reveal the importance of biology and technology when addressing the QBW problem.

The internal validity of the model should also be addressed in further research. Vertical integration of the harvest and post-harvest operation is a promising path for reducing QBW. However, some companies in the Norwegian cod fisheries have been vertical integrated in the period studied. These companies have proven to perform poorly both financially and in producing high-end products [47]. This observation indicates that QBW problem is not only related to external factors, like biology, technology and institutional framework, but also how well firms exploit their internal firm resources [48].

[6] The commoditization of seafood has received significant attention recently in general [50] and for cod [51].

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