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Catch-based aquaculture in Norway - Institutional challenges in the development of a new marine industry

Signe A. Sønvisen[a,b,*], Dag Standal[b]

[a] Norwegian College of Fishery Science, UiT The Arctic University of Norway, PB 6050 Langnes, 9037, Tromsø, Norway
[b] SINTEF Ocean, PB 4762 Torgarden, 7465, Trondheim, Norway

A B S T R A C T

Catch-based aquaculture (CBA) is an important production system in many parts of the world, especially in developing countries. In Norway CBA is based on capture and storage/farming of mature, North-east Atlantic (NEA) cod (*Gadus morhua*). The objective is to reduce seasonal variations and add value, by storing/farming fish to take advantage of higher prices in low seasons. Despite numerous development programs and economic incentives, the development of the CBA business has been slow. Few actors are storing fish long enough to take advantage of high price in low season. A reason for this is that CBA is caught in between two sectors: the fisheries and aquaculture, with radically different institutional frameworks, creating entry barriers and a complex regulatory framework. Moreover, the legitimacy of the CBA is in question, as CBA intervene into the resource allocation mechanism in traditional fisheries. Still, it is too early to conclude that CBA has failed, as we are dealing with an industry in the making.

1. Introduction

According to FAO [1], catch-based aquaculture (CBA) is an important production system, especially in developing countries and rural fisheries-dependent regions.[1] Regional socio-economic spin-off effects of CBA are employment, small business development and expanded market opportunities. Although available statistics of global CBA production is limited, FAO estimated that 20% of global marine aquaculture production stems from CBA, representing a total value of US $ 1.7 billion [2,3]. Examples of CBA include tuna (*Thunus* spp.) in Australia, Japan, Canada, Spain and Mexico; milkfish (*Chanos chanos*) in the Philippines and Indonesia; eel (*Anguille spp*.) in Asia, Europe, Australia and North-America and grouper (*Epinephelus spp*.) in Asia. Demand for valuable species in high paying international markets have been the driving force for the development of CBA [1]. Although, global CBA are mostly based on capture of wild juvenile fish and fry for farming [3], Norwegian CBA of North East Atlantic (NEA) cod (*Gadus morhua*) is one example of CBA based on storage or farming of wild-caught, mature cod. In this case, CBA adds value to limited quotas in the coastal fisheries. This latter approach may also be an alternative production system to cod farming, based on hatched juveniles. The main objective of Norwegian CBA is to reduce seasonal variations in landings of cod to stabilize the supply of fresh raw material throughout the year and thereby increase the value creation in the whitefish sector. The rationale is that, cod sold outside the main winter season (Jan–April) will receive higher prices [4] (Fig. 1).

Traditionally, the large landings of cod in the winter season (Jan–April), generates lower prices, compared to the autumn season (Aug–Dec), when less cod is available. This seasonal landing pattern also challenge fish quality and capacity adaptations in both the fleet and the processing industry. Moreover, seasonality restricts employment stability and creates dependency on a few products and export markets. As the NEA cod fishery is the most valuable fishery, stable supply of fresh NEA cod has been a central fisheries political goal for decades.[2] Although small-scale CBA was established in the 1960s and 1970s in mid-Norway, modern and larger scale CBA was first launched at the end of the 1980s.[3] A decline in the NEA cod stock in 1989-1992, historically low quotas and unsuccessful traditional cod farming triggered the development of CBA, as a measure to add value to the limited quotas in the coastal fleet. The result was several CBA initiatives, primarily in the northernmost counties, particularly in Finnmark and Nordland [9]. Since then, CBA has been a political priority. The

* Corresponding author. Norwegian College of Fishery Science, UiT The Arctic University of Norway, PB 6050 Langnes, 9037, Tromsø, Norway.
E-mail address: sso003@uit.no (S.A. Sønvisen).

[1] In this work we refer to CBA as the entire process dealing with live fish; from capture, through storage and aquaculture, to processing and sales.

[2] The industrialization of the cod sector, based on vertical integration between land-based fillet production and the construction of over 60 trawlers in the 1960s and 1970s, is the most prominent attempt to stabilize annual cod supply [5]. However, due to lack of economic efficiency and allocation conflicts between the trawl fleet and the processing plants, this industrial model was not able to fulfill political goals for the cod sector [6,7].

[3] CBA of cod in the 1960s and 1970s was practiced by using fish-pots. The activity was organized through the sales organization Norsk levendelagring (Norwegian live storage). Norsk levendelagring ended in 1972 when it merged with the Norwegian Fishermen's Sales Organization (NFSO) [8].

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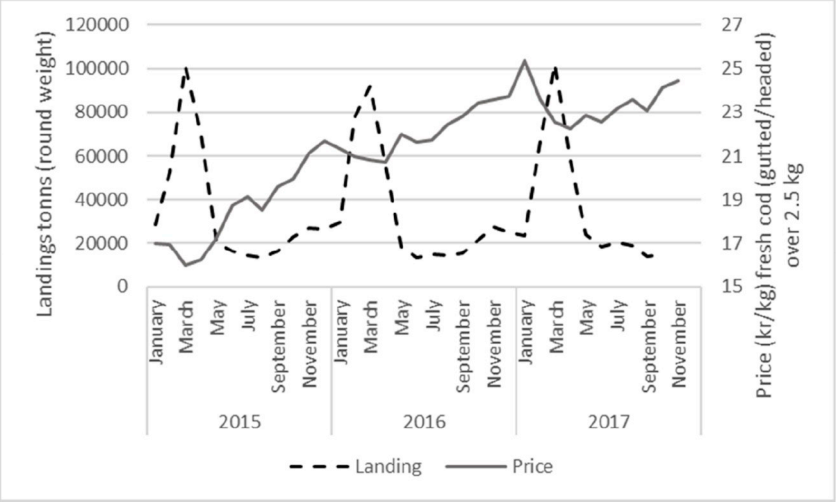

Fig. 1. Seasonality in the NEA cod fisheries showing landings (tons) and price (NOK/kg), 2015–2017 [4].

Norwegian Research Council and regional development agencies have financed numerous research and development programs with the objective to make CBA economic viable, increase value of the cod fisheries and curb seasonal fluctuations [4,10].

In addition to development programs, the government also stimulates CBA through the *quota-bonus scheme,* introduced in 2008 (to be described later). Another stimulus is the minimum price, as the Norwegian Fishermen's Sales Organization (NFSO) sets the minimum price for live cod higher than that of traditional cod [11]. However, despite significant public incentives and price differentiation, CBA has developed slower than expected. This article addresses this issue and asks the following questions:

1. What are the institutional framework for CBA and how must actors comply to conduct CBA?
2. What potential CBA business models are available and how have actors organized value chains to conduct CBA?
3. What institutional barriers should be changed to stimulate more CBA for cod?

The article is organized as follows: in section two, we give a short description of methodological approach. In section three, we give some background of the CBA, as well as outline the main elements of the regulatory framework applicable to CBA. We also introduce the theoretical framework for analyzing CBA as production system, with special emphasize on institutional aspects that regulate different models for CBA. In section four, we present the empirical findings of how actors organize CBA production systems. In section five and six, discussion and conclusion, we suggest institutional changes to the CBA framework, which may contribute to increase CBA among coastal fishers and other small-scale actors.

2. Method

This article explores regulative and institutional aspects of organizing CBA value chains. In the case of CBA for NEA cod, regulative and regulative elements, such as the *Participation Act* (PA) [12] and the *Aquaculture Act* (AA) [13], communicate imperatives of how to organize production structures. Thus, the interpretation of regulative instructions in combination with the actual results may reveal information about the strength of the management system.

To explore CBA, we use a qualitative approach consisting analysis of secondary literature sources to describe how actors within CBA adapt to the legal framework and arrange value chains. Here, we draw on sources such as scientific reports, research articles, public policy papers, legislative publications, newspaper articles as well some statistics from the CBA industry. The literature is supplemented by some interviews carried out relation to the report *Live storage – a future business* [14].

3. Institutional framework for CBA production system

3.1. Mapping regulative aspects for CBA

As this paper examines the link between regulative institutions and policies in the development of CBA, our approach aligns well with Oliver's definition of institutions as “regulatory structures, governmental agencies, laws and professions” [15]. In addition, as Dobbin and Dowds [16], we see new policies as both institutional constraints and incentives, affecting the design of institutions, and in turn the CBA industry. In this process, the legitimacy of new institutional structures is central. Within fisheries and aquaculture, institutions have developed over decades, in which the CBA industry directly intervenes. Hence, CBA may precede institutional change and challenge existing institutions [16].

CBA is fundamentally linked to both traditional fisheries and aquaculture. Consequently, the production system operates within a complex institutional framework inherited from both sectors. In terms of capture of live fish, the vessels must have access to harvest fish. Due to the closing of the commons and the introduction of modern fisheries management, the individual vessel quota (IVQ) system was introduced in 1991 for coastal vessels. Since 2004, the original IVQ model have been subject to a strong market orientation with an objective to reduce the numbers of vessels and thus strengthen the quota-base for the remaining vessels (that is, increase quotas per vessel). Depending on the size of the vessels, coastal vessels can buy and concentrate up to five quota factors pr. vessel. Hence, within the same vessel category, coastal vessels may have different quota-bases.[4]

To increase CBA activity, the quota-bonus was implemented. The quota-bonus allows vessels that lands fish within the framework of CBA to deduct only 50% off the vessel cod quota. That is, if a vessel lands 1000 kg live cod and stores it live for a minimum of one week, the vessel is only deducted 500 kg from its cod quota [4,12,13]. In 2016, 4000 tons from the national total allowable catch (TAC) was allocated to the quota-bonus scheme, representing 8000 tons of live fish landings.[5] Moreover, cod prices favor CBA, as the average price of *live* cod

[4] For a review of the Norwegian quota system, see e.g. Hannesson [17] and Standal and Asche [18].

[5] While 2015 and 2016 were record years for CBA, there seem to be a slight

was about 26 NOK/kg in 2016, while traditional HG (headed and gutted) cod was 20 NOK/kg [20]. In the period 2004 to 2016, the absolute price difference between live and traditional HG cod has been relatively stable, at about 4 NOK/kg, in favor of live cod [21]. Regardless of the vessels' quota-bases, the CBA quota-bonus applies equally to all vessels awarded cod quotas. For coastal vessels, the CBA quota-bonus may thus add a significant value to a limited quota-base.

Besides the design of the quota regime and the quota-bonus, a number of regulations are of importance for CBA: *The regulations of vessels that shall fish and store live fish* and *The regulation of the practice of fishing in saltwater* (chapter XVIII) [22]. The first regulation secures that vessels are equipped to handle live fish in terms of animal welfare. This also requires that the Norwegian Food Safety Authority approve the vessel for CBA [23]. The second regulation ensures that fish is handled with care when captured and transported; hence, requires that workers get the necessary formal training in the methods used, including knowledge regarding animal welfare.[6]

In terms of storage, or aquaculture, CBA is separated into two distinct phases: storage less than 12 weeks[7] and storage over 12 weeks (farming/aquaculture). If the objective of the CBA is to be fulfilled, more fish needs to be stored into the fall and over 12 weeks. As storage over 12 weeks is defined as aquaculture, the CBA operations must comply with both the CBA *Regulation* [21] and the Aquaculture Act (AA) [13] and its regulations.

The CBA regulation affords permits to carry out CBA, including regulation of locality, operation, slaughter and transport. The owner is responsible for the biomass and the operation of the facility. This includes risk-based supervision in relation to environment, fish health and welfare, installations, technical facilities and production equipment. The regulation also requires formal aquaculture competence [13].

The AA requires an aquaculture license assigned to a specific operator and species, at a distinct location and phase in the lifecycle of the species. This requires that the operations are environmentally sound, and have taken spatial planning and conservation plans, as well as other stakeholders' spatial interests, into account. Moreover, an operational plan is mandatory, which includes plans for production volume and fallowing, disease emergency plan, animal welfare and escapes; as well as risk-based health examinations and daily feeding [13].

Hence, the regulatory framework that a CBA business has to maneuver is complex and tied to years of institutional development in both sectors, ultimately affecting the design and development of the nascent CBA industry.

3.2. Models for vertical coordination

Another issue, also related to the institutional framework, concerns coordination of CBA as a production system. For an actor to engage in CBA, investments in terms of material, time and knowledge must pay off. For instance, a fisher must investment in a vessel suitable for catching and carrying live fish. Fishing live fish is a more complex and time-consuming activity than traditional fisheries; thus, time is an important input factor. Consequently, the minimum price set by the NFSO must cover the various extra investments and risks involved.[8] Similarly, a fish farmer or processor entering CBA must invest in necessary technology and knowledge. For controlling the supply of live fish, an actor must be eligible to participate in the commercial fisheries [12]. The bottom line is, given the investments and risks that CBA entails, CBA must be *at least* as profitable as ordinary business activities.

As CBA combines traditional fisheries and aquaculture into a new production system, a central question is what business models are available, or chosen, and how do these affect transaction costs?[9] Transaction costs are central to our analysis, as we assume that a chosen organizational model represents the lowest rate of transaction costs. Williamson [25,26] introduces the term governance structure to characterize different actors' choice of transaction models, which includes the framework surrounding transactions. Specific governance structures include factors affecting transaction costs, such as legal aspects, communication, predictability and control of resources. The choice between free market models or full vertical integration models deals with how governance structures affect business transactions costs.

Consequently, choice of business models affects investments, including tangible and intangible assets. Tangible assets are specific investments directed towards a specific production system, such as investments in a vessel for transport and pens for storage of live cod. Intangible assets refers to human capital and contracts to stabilize relations between actors to reduce transaction costs. Human capital is especially important when transactions are technically complicated, as there is opportunism, actors do not comply with agreements or there is a need for routines. Hence, complexity and uncertainty may be barriers for rational choices and reduced transaction costs [26].

We use two ideal-type models as a point of departure: the free market competition model, in which actors are independent transaction partners and the fully integrated model, in which transactions are internalized in a vertically integrated value chain. There is also a range of models in between these two extremes (Fig. 2). In the following, we will examine possible ideal-type business models in CBA.

3.2.1. Free market competition

The theory of free market competition assumes that actors have full information regarding all possible actions and competitors. It also assumes that transaction relations only apply to the individual transaction, with no institutional binding to each other. Model 1 in Fig. 2 illustrates free market competition, in which the CBA actors in the value chain are independent decisions makers interacting on a transaction-to-transaction basis [27]. Hence, a fisher will capture the fish, sell it to an actor that stores and maintains the fish live for less than 12 weeks, or farm the fish over 12 weeks, before it is slaughtered and sold to a processing plant or exported as round fish. This model does not significantly challenge existing institutions, as transactions between the various actors are separated and the legal responsibility and risk would lie with the individual actor at each stage in the value chain. However, fishers must invest in live storage systems on vessels and actors in storage or aquaculture would have to invest in technology for transporting and storing/farming fish, as well as knowledge related to this.

3.2.2. Forward integration

The second model is where fishers integrate forward in the value chain and stores fish in a pen for up to 12 weeks (known as fish hotels), or more than 12 weeks (aquaculture) [28,29]. Besides technologies for live storage and aquaculture pens, forward integration entails investments in skills and knowledge. A scenario, where the fisher owns the production facilities and the fish, the mortality- and economic risk would lie with the fisher [30–32]. If a fisher, or a fish hotel owner, choose to integrate forward one more step and enter the aquaculture, the investments increases further in form of aquaculture facilities and

(*footnote continued*)
decline in 2017, with only 17 vessels participating. There are numbers of reasons for this, including high quotas and high prices in traditional fisheries [19].

[6] This regulation also regulates fishing depth, sorting, gear, pumps, transport, restitution and storage pens, and health checks [22].

[7] Although storage less than 12 weeks is not strictly linked to aquaculture, as it does not require an aquaculture license, in this paper we include this part of the production in what we term “the CBA business”.

[8] The NFSO sets the price for all categories of cod, including CBA cod.

[9] We define transaction cost here as 1) collection and exchange of information, 2) negotiation and termination of contracts, 3) reduction of uncertainty, 4) future developments, 5) securing loyal transaction partners, 6) specialization in location, 7) specific assets and 8) human capital [24].

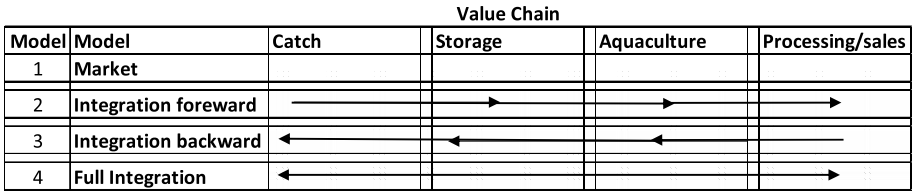

Fig. 2. Alternative (ideal-type) production models in CBA.

formal competence, in accordance with the AA [22–24]. Hence, integrating forward (model 2) requires a significant investment in tangible and intangible assets.

3.2.3. Backward integration

In the third model in Fig. 2, actors within traditional fish farming or processing/sales integrate backwards, into aquaculture (over 12 weeks), live storage (under 12 weeks) and even into capture fisheries. The objective of integrating backwards may be to gain control over the supply chain or to avoid competition with other actors for raw material, especially if integrating into capture fisheries. The availability and predictability of live cod may increase, but ownership of a fishing vessel with quotas must comply with the Participation Act (PA), which protects the legal status of the fisher [12]. This requires three years of active fishing in the last five years (c.f. § 6 in the PA). Moreover, as fishing has become a professionalized and specialized full-time occupation, is difficult to combine fishing with other occupations [33]. To qualify as a fisher would be challenging and the PA therefore effectively hinders backward integration. In addition, this model also requires investments in aquaculture and storage facilities, or even fishing vessels, as well as knowledge.

3.2.4. Full integration

The forth model in Fig. 2 shows a fully integrated business that controls the entire process from capture, via live storage or farming, into processing and sales. This model is inherently different from the free market competition model (model 1), as actors are stable transaction partners and internalized, or vertically integrated in one production system. Choice of transaction partners and conditions for transactions lead to expectations and governance structures, which in turn lead to stable long-term agreements and relations. In a fully integrated model, all legal aspects at the various steps in the value chain, such as the PA and the AA, are fulfilled within an integrated company. The level of complexity and risk, however, depends on the design of the integrated model, including the rate of capital binding and financial costs for running a fully integrated production system.

Independent of models, we assume that an actor will invest into tangible and intangible assets if the expected return on investment (RoI) of CBA compensates for the investments and increased risks involved and is higher than the RoI in traditional fishery or aquaculture.[10]

4. Findings

As with the introduction of modern trawlers in the 1960 and 1970s, CBA shall contribute to reducing seasonality in the cod fisheries. Fig. 3 shows the mass balance of live fish in 2016. Most of the fish was put into live storage between February and May, while being continuously taken out between March and July, with a peak in June. The fish was on average stored 11 weeks [21]. Thus, in 2016 CBA did only marginally affect the seasonal fluctuations in the NEA cod fishery, and did not manage to reap the benefit of the higher cod prices in the fall (Sept–Nov) [35]. The short time for live storage/feeding may also imply that the fish did not gain significant weight and value. However, due low landings in summer, CBA has had some effect in this period, as 36.5% of the landings in June 2016 were CBA cod [36]. The value creation potential still lies in keeping more fish in storage for a longer time (more than 12 weeks). However, this entails that more wild CBA fish must become aquaculture fish, with requirements to legal definition, including storage time and formal competence.

In 2016, fourteen sites along the coast stored fish (less than 12 weeks). Six of these were fishers integrating forward into storage (model 2); whereas eight were fish processors/buyers integrating backward into live storage (model 3). In general, however, few actors have integrated foreward and entered the storage business and even fewer aquaculture, indicating the existence of entry barriers and high transaction costs throughout the value chain. For fishers, the barriers are complex regulations, low minimum price, as well as high risk and uncertainty. The perceived barriers relates to high transaction costs through extra investments, higher fish mortality, lower income and more formal competence. Engagement in a live capture fishery is also a choice between alternative uses of the vessels' quota-base [37]. Capture of live fish is a more expensive endeavor, as it is more time and space consuming, than traditional fisheries [38]. Hence, the greatest barrier to entry is the relatively high profitability in traditional fisheries [16]. This is also likely to be the case for actors in aquaculture, as economic results in salmon farming has been historically high in recent years [39]. In this context, CBA does not represent a more economic viable production system than traditional cod fisheries or salmon farming.

Entry barriers and transaction costs applies to actors who consider backward integration in the value chain as well. In theory, to secure and control the supply of live cod, it may make sense for fish processors and buyers to integrate backwards into capture fisheries. As discussed above (model 3), this is difficult, as the PA effectively regulates who may own fishing vessels and quotas, with requirements to fishing activity and competence [12]. Thus, due to regulative barriers, it is difficult for actors outside the traditional fishing fleet to enter capture fisheries and thus integrating backwards past storage.

In terms of engagement in the aquaculture part of CBA, there were in 2017 seven sites licensed for CBA (storage over 12 weeks), run by five companies [40]. Four of these companies had their foundation in fish processing or sales, whereas one company was not directly related to fisheries or aquaculture. However, none of the licenses was active in 2016/2017 [21].[11] Thus, few actors are presently set up to take advantage of the potential that apparently lies in storing fish over 12 weeks.

5. Discussion

The institutional framework in which CBA actors are operating is complex and not compatible with the development of a new marine industry. Regulations from different sectors that do not harmonize, hinders new business models from developing.

However, several actors have applied for CBA licenses, but have been rejected, mainly because of distance requirements to existing aquaculture facilities or processing plants, due to infection risks related

[10] According to previous studies, the investment in redesign of a vessel is expected to be between NOK 100,000 and 400,000 [20,34] (about US $ 12,000–48,000).

[11] Five of the three companies had no operating income in 2016, and two had only marginal operating income, most likely from other activities [41].

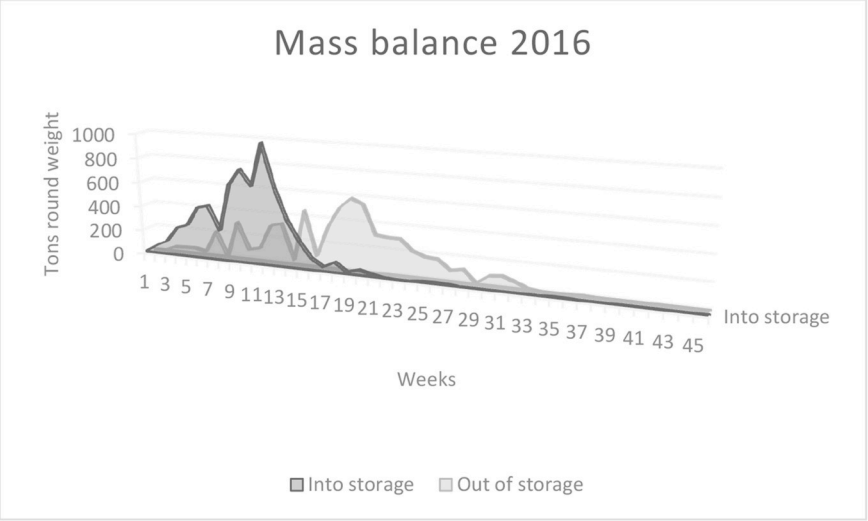

Fig. 3. Mass balance of stored live NEA cod in 2016 [36].

to these [42]. As increased distance between fishing grounds, processing facility and CBA pens is a matter of increased logistics and costs, distance requirements increase transaction costs and are perceived by some industry actors as unreasonable. As an actor said: "Localities and licenses represent severe barriers, especially the distance requirements are challenging" [16]. In addition to risk of infectious diseases, animal welfare and hygiene are central to all regulations related to CBA [22,23,43,44]. Consequently, the Norwegian Food Safety Authority is a central institution controlling the development of CBA. In other words, the development of CBA spans two different sectors, as well as several ministries and directorates – complicating the matter further.

Independent of chosen production model, the higher minimum price of live fish is presently not enough to compensate for the extra investments, risk and time involved. In the capture fisheries, without the quota-bonus, CBA actually represents a negative value creation, compared to a more profitable use of the quota in the traditional fisheries [21,38]. Similarly, for fish processors, and especially fish farmers, the alternative costs are perceived too high for CBA to become attractive.

In choice of business models, economic incentives, through the quota-bonus, is a central feature of the present CBA system. However, ever since its inception, it has been controversial, and the legitimacy of the quota-bonus and the CBA has been questioned. Proponents are arguing that the CBA and the quota-bonus are fulfilling the intentions, whereas opponents see the quota-bonus as a subsidy to an unprofitable industry. The Norwegian Seafood Federation and the Fish Buyers' Association argues that the CBA and the quota-bonus have fulfilled the intentions, as it has moved sales of fresh fish from winter to June–July. For instance, in the fishing hamlet of Båtsfjord, the sale of 800 tons of fresh fish was moved from May to September [45,46]. It argued for the success of CBA and the quota-bonus, as cod has been stored in cages in fourteen different places in Northern Norway, that 24 different vessels landed live cod in 2016, and landings have increased from about 2000 tons in 2013 to 6000 tons in 2016 [47,48]. The full utilization of the quota-bonus has also been argued as a success.

On the other side, actors question the success of the scheme and whether the objectives are met. As the quota-bonus is deducted from the national TAC, many stakeholders claim that the quota-bonus is a subsidy of a new business and reallocation of quotas from the commons to CBA fishers.[12] The quota-bonus negatively affects the quota allocation in all fleet groups [49], but benefit only a few selected vessels, in particular Danish seine vessels [48]. The quota-bonus also disturb the geographical landings, as the counties of Finnmark and Troms receives significant larger landings of live fish than Nordland [21]. An entrepreneur in the CBA business also questioned the legitimacy of the quota-bonus scheme, as he said:

> *"the quota-bonus does not work as intended, as there is no CBA fish in pens in the fall, and too many actors are in the business only to obtain extra cod quotas from the quota-bonus scheme. Thus, the entire industry is missing the overall idea of CBA: predicable and large supplies of fresh fish to higher-paying markets outside the peak seasons"* [50].

Similarly, Vestvågøy Fishermen's Association in Nordland County argues that profitability should be a result of the CBA cod being sold at a higher price, and questions whether this is the case and demands the scheme to be discontinued [45]. Hence, due to diverging views among stakeholders, the legitimacy of the quota-bonus and CBA is brought onto the political agenda. The legitimacy of the quota-bonus scheme accordingly links to the fragile, political compromises that maintain stable resource allocation keys among different gear- and vessel groups and regions. As the quota-bonus have been at work since 2008, with little effect, the national council of the Norwegian Fishermen's Association (NFA) is negative to prolong the scheme. Nevertheless, members of the NFA are engaged in CBA and the organization is reluctant to oppose their own members, especially in the most fisheries-dependent northernmost regions. In addition, a strong sub-organization of the NFA, the deep-sea Vessel Owners' Association (Fiskebåt), is especially negative to the quota-bonus. According to them, the CBA is not a viable business and only reallocate cod quotas from all fishers (including own members) to members of the coastal fleet group.

Moreover, CBA actors question the legitimacy of the 12-week rule, as it is perceived as arbitrary. Hence, it has been suggested an expansion of the rule, so fish can be store more than 12 weeks without an aquaculture license [51]. This would allow CBA actors to store fish into the fall and thus adapt and utilize production capacities in long-term strategies – not only to earn short-term benefits of the quota-bonus.

The bottom line is that, although the quota-bonus is intended as an incentive to stimulate the CBA-business, it is not sufficient as long as the institutional framework is constraining the development of the new industry.

6. Conclusion

From the results and the discussions above, we can conclude that few actors are engaged in the CBA-business, and even fewer in the

[12] For 2017, the bonus-quota of 4000 tons is about 1% of the total TAC [21].

aquaculture-phase of CBA. It is a business in the making and business models are still developing. Despite public incentives, the institutional framework acts as a barrier to the development and expansion of CBA. In general, in their present forms, the fisheries and aquaculture institutional frameworks do not seem congruent with the development of new marine industries – which is a political objective [52]. Contradictory governance structures and policies is not new. Jentoft and Chuenpagdee [53] argued that fisheries and coastal governance is complex and a "wicked" problem, leading to governance failure. Wicked problems have no single solutions and tend to resurface and be redefined and reframed by stakeholders. Similarly, Osmundsen et al. [54]) studied the wickedness of aquaculture governance and points to the dynamic nature of aquaculture production that creates uncertainty and knowledge gaps, making governance complex.

CBA has proven more difficult than expected. It is perceived as risky and uncertain. Thus, actors involved in CBA-business have suggested liberalizing the regulations, particularly those related to aquaculture and competence. However, except for the quota-bonus, little has changed. Therefore, the institutional frameworks described here, are examples of regulative institutions that are wary of radical changes, offering solutions that are only incremental and only marginally deviate from the *status quo* [55,56]. As a result, CBA regulations become *ad hoc* and radical regulative changes, which will facilitate the development of CBA, are unlikely.

A main difference between the two lines of production, traditional fisheries and aquaculture, is the degree of control of the production cycle [57]. According to Asche [58], increased control of the production process has enabled productivity-enhancing innovation and growth in aquaculture. However, CBA regulations *per se* do not allow actors the full control of the production cycle. Hence, present regulations are likely to limit the potential for innovation and productivity increase in the new business [59–61].

Although CBA has only marginally reduced the seasonality of the cod fisheries, to conclude that CBA has failed may be premature. The main institutional challenges is the development of an institutional design and a regulatory framework tailor-made for CBA and small-scale business structures. However, future institutional changes to facilitate CBA development is also a framing process related to type of stakeholders involved, who has the power to define problems and suggest future solutions. Hence, several ministries and directorates should cooperate to design a less complex institutional framework, but the CBA-business also have to convince powerful stakeholders such as the NFA and the Vessel Owner Association that this is a business worth investing in.

Besides the complexities discussed above, a removal of the quota-bonus may negatively affect on-going CBA activities. Recently, in the national Regulatory Council, where quotas for 2019 are allocated, the Director of Fisheries suggested a gradual reduction in the CBA quota-bonus, with only a 20% quota-bonus in 2023 [62]. With continued existence of the institutional barriers, this decision is likely to have a decisive effect for the future status of CBA.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.marpol.2019.02.039.

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