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SYMBIOMA

Technology Innovations and Business Models for Valorisation of Industrial Waste Biomass in Sparsely Located Enterprises

Circular economy cases and their business models in Norwegian fish industry

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Contents

1 Fishing industry in Norway 3
1.1 Case 1: Seafood processor in northern Norway 4
2 Future opportunities for waste handling 5
3 Bottlenecks / challenges for efficient waste handling 5
Acknowledgements 6

1 Fishing industry in Norway

According to Statistics Norway, Norwegian fishing vessels caught a total of 2.5 million tons of fish in 2019. In 2018 there was 6 018 registered Norwegian fishing vessels, 11 219 registered fishermen, and out of these, 9 514 persons had fisheries as their main occupation. In aquaculture, an estimated 1.35 million tons of seafood were sold (mainly salmon). 2 423 346 tons seafood was exported in 2019.

SINTEF made a thorough report on the waste material available from Norwegian fisheries and aquaculture production, and how this material is utilized (Richardsen et al., 2017)[1]. The report shows that in 2016 there was in total approximately 914 000 tons waste available from fish and shellfish, and that about 75% of this volume, 689 000 tons, was utilized.

We identified five main categories of streams from the Norwegian fisheries: seafood that is suitable for human consumption, waste from pelagic fish, waste from white fish, waste from aquaculture, and waste from shellfish (Figure 2).

Seafood for human consumption
The category includes all forms of fish that meet the criteria for human consumption. These volumes can either be transported to a wholesaler and then through further processing, progress to retail and final consumption, or go for other forms of processing before reaching the retail chains. In some cases, some of these volumes can be directly delivered to fresh produce markets, mostly locally.

Waste from pelagic fish
Richardsen et al. (2017) estimate that waste from pelagic fish (herring, mackerel, blue whiting, capelin, etc.) accounted to approximately 178 000 tons. Other smaller species, such as for example sandeels or Norway pout, are fully utilized in the flour/oil production and because of this, leave no waste material. The main part of the waste material from pelagic fish comes from fileting herring.

Waste from white fish
Richardsen et al. (2017) estimate that the total landed quantity of white fish (cod, haddock, pollock, Greenland halibut, ling, cusk, redfish, catfish) in Norway in 2016 was approximately 925 000 tons. Waste material is produced when the fish are gutted or processed. Waste and co-product components (heads, backbones, and guts) are estimated to 319 000 tons. From this volume, they estimate that 140 500 tons was utilized.

CYCLE (2018)[2] made its own estimation where," The Norwegian fisheries produces around 300 000 tons of whitefish co-products (heads, backbones and guts) each year. In 2015, approximately 166 000 tons of the co-products were discarded and not utilized, resulting in a significant loss in potential value creation".

Waste in aquaculture
Richardsen et al. (2017) estimate that a total of 1 255 700 tons of the species salmon and trout were slaughtered in 2016 in Norway. Waste material from these processes was approximately 401 000 tons, and about 91% was utilized.

Waste in shellfish
Richardsen et al. (2017) estimate a total of 49 200 tons of shrimps and crabs in 2016 in Norway. From this amount, 16 300 tons of waste was generated. Only 4 700 tons of this waste is currently utilized, which is about 29% of the total waste material.

1 Richardsen R., Nystøyl R., Strandheim G., Marthinussen A., (2017). Analyse marint restråstoff, 2016 - Tilgang og anvendelse av marint restråstoff i Norge, SINTEF Ocean report; OC2017 A-095, https://sintef.brage.unit.no/sintef-xmlui/handle/11250/244612
2 CYCLE 2018 - Total utilization of raw materials in the supply chain for food with a bio-economical perspective, 2013-2017. Final report 2018, https://www.sintef.no/globalassets/cycle_finalreport_2017trykket.pdf

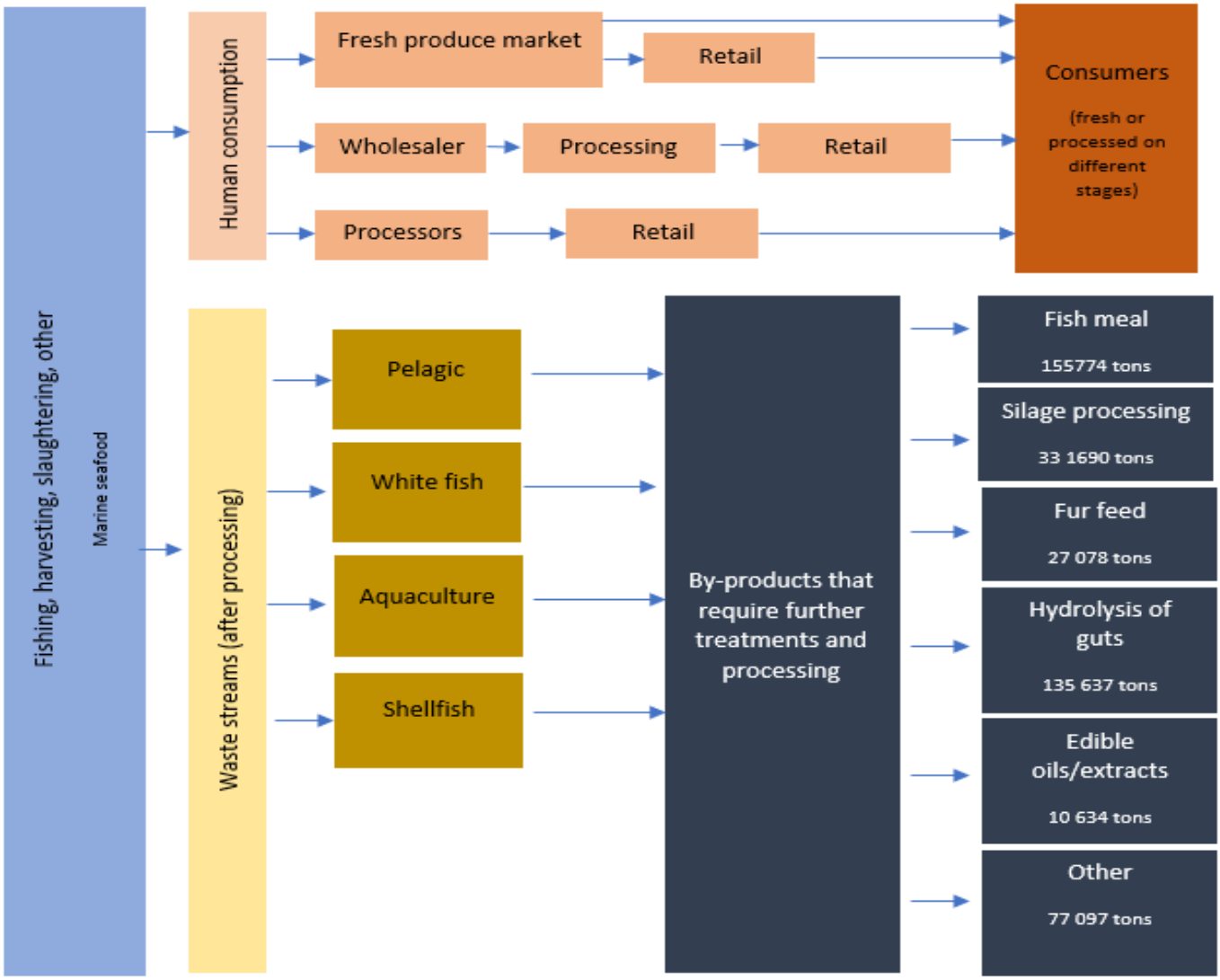

Figure 1: Value chain for fisheries in North Norway.

Utilization of the waste today

Figure 1 shows utilization of by-products in Norway in 2017 (numbers from Richardsen et al., 2017). 21 % is utilized in traditional flour and oil production, 46 % processed through silage, 20 % in oil and protein-production (this derives from aquaculture waste), 4 % goes to fur feed, and 9 % is utilized for human consumption (where 6 % as seafood products, and 3 % as oil and extracts). It is worth noting that according to Vestlandsforskning (Andersen et al., 2017): "Fishmeal, which makes up a large part of the protein source for farmed fish, is produced by fish caught in the sea. It cannot be used as feed for the same species". In addition, the same report highlights that "Waste water from fish slaughterhouse has [...] potential as a growth medium for macroalgae".

1.1 Case 1: Seafood processor in northern Norway

The seafood processor is a relatively small actor in the seafood market, producing a large variety of seafood products for the retail market, HORECA and wholesalers. They buy mainly fileted fish or round fish without head/gut, and any remaining waste components are mainly cut-offs that account to about 90 tons a year. Current waste utilization is towards mink feed, and dried fish for human consumption. They see a potential for added value to their waste by handling the processing of dried fish themselves and increasing the utilization for human consumption. Their main challenge is logistics, since the company is located far away from the large fish processing plants that have the necessary infrastructure and systems for waste handling and processing (for example, processing to oil/extracts, etc.).

2 Future opportunities for waste handling

- Feed products such as, fish feed/fishmeal, animal feed, and pet food.
- Oil/extracts.
- Bioenergy.
- The wastewater from fish slaughterhouse has the potential to be used as a growth medium for macroalgae.

3 Bottlenecks / challenges for efficient waste handling

- Fishmeal cannot be used as feed for the same species.
- No collaboration /common projects.
- Logistics; shelf life of perishable biological material.

Figure 3 Possibilities of the fishing industry by-products

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