

## Deep processing – the main direction in enhancing the efficiency of fish utilization

*The article proves that the modern level of processing of catches does not correspond to the objectives of marine fishing development contained in the Concept for the development of fishery in the Russian Federation for the period until 2020 and the Russian Federation State Programme “Development of fishery complex”. The article proves that to achieve the targets set out in the documents, the following measures should be carried out: the development of coastal fishing, the introduction of innovation technologies and equipment at coastal enterprises, the creation of integrated enterprises for production and processing of aquatic organisms, the enhancement of export efficiency, the promotion of unloading fish products onto Russia’s shores.*

*Marine fishing, Northern basin, the level of processing of catches, high-tech products.*



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The Concept for the development of fishery in the Russian Federation for the period until 2020 (hereinafter – the Concept) [1] and the Russian Federation State Programme “Development of fishery complex” (hereinafter – the State Programme) [2], in particular, state the following: “The strategic goal is to achieve by 2020 the level of economic and social development of the fishing industry, corresponding to the status of Russia as the leading world power of the 21st century, occupying the leading positions in the global economic competition. The achievement of this goal requires the transition of the fishery complex from the development based on raw materials export to innovation development”.

The essence of the problem lies in the fact that it is deeply processed fish products that

should be exported and supplied to the domestic market; and it is also necessary to process fish wastes. However, at present, the situation is totally different. Ground fish species (cod, haddock, pollack, perch, halibut and other), which should be processed into a variety of products, are often subject only to minimal processing (heading and gutting). In this form they are delivered both to the domestic market and abroad for further processing and production of various kinds of fish products. Fillet is produced in limited amounts. Pelagic fish (herring, mackerel, capelin, etc.) is salted, smoked, and sold whole and frozen.

Due to a poor development of high-tech processing in Russia’s fishery, including that in the Northern basin, the value added is low and the contribution of the fishing industry in gross regional product is insignificant.

In marine fishery, the catches of fish and other marine products can be processed at sea on board the fishing vessels and factory ships, or they can be delivered to ports for production of various products at coastal enterprises.

In the pre-reform period the catches of fish in the Northern fishery basin were processed at sea to the greatest possible extent. For these purposes the trawlers, which had no freezing units, produced semi-finished products (headed and gutted fish), part of which was salted on board the ship, and the other part was delivered by contactless method to factory ships. Besides, they produced klipfish (salted cod with bones removed), chilled fish, fish packed in ice, canned food and edible fat manufactured from cod liver, fish flour from substandard fish and wastes.

Trawlers-factories and fish processing vessels produced fillet, splitted fish, frozen headed and gutted fish, various canned fish and preserves, fish flour. These fish products went for sale, as well as for further processing at coastal enterprises. At that, it should be taken into account that the products manufactured at sea or at shore-based fish factories from chilled raw fish are considered to be of higher quality and, as a rule, they are in great demand and have higher prices.

Shore-based enterprises produced mostly the types of products impossible or difficult to produce at sea: smoked, dried, structured (high-tech) products, various culinary products, canned fish and preserves, edible, veterinary and technical fish oils, fish meal from wastes, etc.

With the implementation of the above scheme, quite a high and efficient level of fish processing was achieved. For example, in 1980 and 1981, when some of the highest production volumes were achieved, the coefficients of the “depth” of fish processing (the ratio of the objects of production to the volume of production) were 0.69 and 0.71, respectively.

This means that the caught raw fish, after being processed, reduced in volume by 31% and 29.4%. The population received ready-prepared fish production and semi-finished products in significant quantities. The coefficients of the output of finished food products from the raw materials, aimed for food purpose, were 0.796 and 0.814. The production of canned fish and preserves in 1980 amounted to 189787 standard cans, in 1981 – 174141 standard cans; the production of fish meal was, respectively, 96.7 and 86.6 thousand tons [3].

To date, the composition of the fishing fleet and the range of products have changed dramatically. First, the total number of trawlers, compared with the 1980 level, decreased from 403 to 275 units (by 68.2%). Second, the number of vessels not equipped with freezer units, that had previously worked in one technological chain with coast-based enterprises decreased from 99 to 42 units (by 57.6%), out of which 31 units (73.8%) are small vessels for coastal fishing; consequently, the supply of population and coastal plants with chilled fish reduced dramatically. Thirdly, the number of vessels, capable of processing wastes and substandard raw materials into fish meal and fat, decreased to 69 units (down to 25% of the total composition), the rest of the vessels thrown waste and fish unsuitable for food production overboard. Fourth, the number of trawlers equipped with filleting machines decreased from 186 units (46.2% of the total number) to 70 units (25% of the total number) [4].

Thus, the changes in the structure of the fishing fleet do not contribute to the achievement of the goals set out in the Concept and the State Programme. Besides, throwing overboard substandard and non-target fish, as well as the waste from cutting catches contradicts the objectives of responsible fishing and reduces economic efficiency. After all, what is being thrown overboard includes small fish, the bycatch of non-target valuable fish species

and up to 67% of the amount of target fish catch, which could be used for producing hundreds of tons of food products and fish flour necessary for agriculture, and which is the main component in the production of feed for cultivating predatory fishes in aquaculture.

Such a situation results from the fact that the Northern basin uses mainly the Western-made vessels that are not equipped with fish meal plants. The productive capacity of such trawlers with regard to catches is a lot higher than that of conventional ones, and they have smaller crews. However, countries with developed fishing limit their usage in the North Atlantic, due to the development of coastal fishery using small vessels and seiner-trawlers that deliver catches to coastal enterprises for processing. They become the predominant type of vessel only in Russia, due to the great remoteness of the main fishing grounds, poor development of coastal fishing and absence of restrictions on trawl fishing. Currently, such vessels harvest approximately 1/3 of the total catch, and more than half of the total amount of ground fish species. In the medium term the Western-made trawlers will harvest about 90% of the total quota of ground fish species, allotted to Russia's Northern basin.

Changes in the structure of the fishing fleet and fish-dressing equipment (on board ships and at coastal plants) became one of the main factors in changing the assortment of fish products produced on board ships and at coastal enterprises. For instance, in 2011, the coefficient of the "depth" of fish dressing amounted to 0.862, which is worse than the results of 1980 – 0.69 and 1981 – 0.7. Fish was dressed to a lesser extent, despite the fact that the volume of caught ground fish subject to dressing, was greater, respectively, by 25.3% and 26.1%. The main types of fish products in 2011 were: frozen fish – 87.9% of the total volume, and fillet – 6% (in 1980 these types of products amounted to 80.2% and 0.8%). There were more different types of fish products of

high-tech (deep) processing in 1980 than in 2011: canned food and preserves – 16.7-fold, culinary products – 39.1-fold, smoked fish and balyk – 48.8-fold, dried fish – 7.6-fold, feed flour – 14.6-fold and fish fats – 24.4-fold. Similar situation is observed in comparison with 1981 [5].

Economic conditions also do not always contribute to the increase in the production of "deeply" processed fish, the main type of which in the Northern basin of Russia is currently fillet. *Table 1*, according to the Russian and Norwegian statements, using the example of exported cod fish products shows the revenues per 1 ton of raw fish when producing headed cod and fillet. Thus, in 2009 the economic entities of the Murmansk Oblast sold 68.250 thousand tons of cod products abroad, including 58.15 thousand tons of headed and gutted production (85.2% of the total cod exports) and 7.9 thousand tons of fillet (11.6%). Other types of products amounted to only 2.2 thousand tons (3.2%).

Approximately the same range of fish products export is observed in the other years of the decade under consideration.

The data in table 1 shows that in 2009, judging by the expenditure of raw fish, it was by 18% more profitable to export filleted cod than headed cod. In 2011, this argument was lost, and, given that the labour intensity of fillet production compared with headed cod production [4] is approximately 1.6–2 times higher, one can see the unprofitability of fillet production in some years. For this reason, some ship owners even removed the filleting units from their vessels, having decided to produce only headed cod.

Financial performance could be improved at the expense of producing fish meal and fat from the waste, which range from 33% to 67% of fish weight. However, as it was noted above, there are no fish meal plants on board the Western-made vessels, and they will be also absent in the future.

Table 1. Data on the export of cod products

Type of product	Thousand tons	Cost, million US dollars	Price per 1 kg, US dollars	Amount of raw fish used, thousand tons	Cost of products from raw fish, US dollars
2009					
From Russia (Murmansk Oblast)					
Frozen headed and gutted cod	68.25	120.2	2.07	90.0	1.335
Frozen fillet	7.9	30.3	3.8	24.1	1.576
From Norway					
Frozen headed and gutted cod	28.8	72.2	2.56	43.7	1.652
Frozen fillet	14.07	90.0	6.4	42.9	2.097
2011					
From Russia (Murmansk Oblast)					
Frozen headed and gutted cod	72.8	213.8	2.9	112.8	1.922
Frozen fillet	11.1	61.7	5.6	33.7	1.831
From Norway					
Frozen headed and gutted cod	42.7	149.5	3.5	66.2	2.258
Frozen fillet	19.2	132.7	6.91	58.6	2.264
Sources: export of fish products of the Murmansk Oblast according to the data of the Oblast Statistics Committee; export of fish products of Norway according to the data of Nofima The Norwegian Institute of Food, Fisheries and Aquaculture Research.					

In Norway, a wider range of products is exported and supplied to the domestic market, due to a different scheme of fishing and catches processing. First, all the catches in Norway, in accordance with the existing legislation, should be unloaded on the domestic coast.

Second, coastal fishing is well-developed, and about 70% of cod and haddock catches is carried out by smaller vessels. Fresher trawlers account for about a half of the remaining part of the total catch and only about 15% of the Norwegian quota of cod and haddock is caught by factory vessels.

Third, about 140 enterprises are engaged in the coastal processing of fish. They are relatively well provided with cooled raw fish and manufacture a variety of products.

The described fishery scheme allows Norway to produce a wide range of fish products mainly for export (*tab. 2*).

Comparing the range of Norwegian export of cod with the products exported by the Murmansk Oblast on the basis of the 2011 data, the following should be noted:

1. Products of “shallow” processing, into which we include frozen and salted fish (a generally accepted definition does not exist so

far), in the total volume of Norwegian export amounts to 25.8%, in the total volume of Russian export (Murmansk Oblast) – 84.7%.

2. The structure of Russia’s export lacks the most expensive type of products, klipfish, the share of which in the total Norwegian export is 27.3%, and its cost is 37.7%.

3. The cost of 1 kg of any kind of fish products exported by Norway, is higher than the unit cost of production of the Murmansk Oblast. Total (average) price of 1 kg of Norwegian export products almost twice exceeded that of Russia in 2011 (in 2010 – 2.1-fold and in 2009 – 2.58-fold).

4. The estimated losses that the Murmansk fishermen suffered due to the difference in selling prices for cod in the international market in 2011 were approximately 65 million US dollars (in 2010 – about 43 million US dollars, and in 2009 – about 50 million US dollars). The losses caused by a poorer range of export products are determined in approximately the same amounts.

The situation that will take shape in the coming years in the Northern basin, as shown above, will be characterized by the technologically and economically limited capacity for

Table 2. The assortment of exported cod fish products from Norway

Type of product	2009			2010			2011		
	Volume, thousand tons	Cost, million US dollars	Price for 1 kg, US dollars	Volume, thousand tons	Cost, million US dollars	Price for 1 kg, US dollars	Volume, thousand tons	Cost, million US dollars	Price for 1 kg, US dollars
Cooled	14.9	58.4	3.92	17.5	64.8	3.7	25.5	114.8	4.5
Frozen	28.2	72.2	2.56	34.9	102.6	2.94	42.7	149.5	3.5
Cooled fillet	5.9	63.6	10.78	5.95	66.4	11.16	-	-	-
Frozen fillet	17.1	90.0	6.4	18.8	112.0	5.96	19.2	132.7	6.91
Salted fillet	0.9	6.8	7.56	0.65	4.2	6.53	-	-	-
Dried	4.2	78.1	18.0	5.1	83.5	16.38	4.0	94.8	23.7
Salted	20.8	112.3	5.4	25.0	126.0	5.04	29.1	180.4	6.2
Klipfish	34.3	267.5	7.8	41.3	319.2	7.73	45.0	407.3	9.05
Dried heads	1.7	6.3	3.73	2.8	9.6	3.44	-	-	-
Minced fish	1.03	2.7	2.62	1.4	4.0	2.88	-	-	-
Total	126.0	757.9	6.01	153.0	892.3	5.81	165.5	1079.5	6.6

producing high-tech fish products on fishing vessels. The analysis of this situation indicates that the transition of the fishery complex from the export of raw materials to the innovation type of development, as stipulated by the Concept, is possible only by means of a large-scale involvement of coastal fish processing enterprises in the solution of this issue. We think that it can not be achieved through the implementation of market-based measures alone; the solution essentially requires governmental interference.

The main reasons for this situation lie in the above mentioned transformations that took place in the structure of the fishing fleet and in the reorientation of deliveries of benthic fish products in foreign markets. This led to the change in production ideology. Formerly, catching fleets depended on the coastal enterprises, and the latter could affect the prices of raw materials and semi-finished products; at present, however, coastal enterprises are faced with the necessity to purchase ready-made frozen products from the fleets for further processing, which is, clearly, more expensive, and the products of these enterprises become unprofitable.

Institutional measures of government authorities in the past years of reforms were focused on the development of fishing alone, and they did not contribute to an increase in the deep processing of biological resources. The leadership of the Federal Agency for Fishery still declare that, in accordance with the rights and responsibilities, coastal processing is not included in the scope of their interests. In the end, the Concept proposes to fix the existing situation, but it does not specify how exactly it should be done.

The research into the economic efficiency of the complex “fishing vessels – fish processing plants”, conducted in Vladivostok by TURNIF (Pacific Department of Fish Survey and Research Fleet) shows that in the case of deep processing of primary commercial object – pollack – that is delivered to the external market mostly ungutted and salted in a special way, the overall profitability of products, compared with sales from vessels is somewhat reduced, but there is a significant increase in sales and in value added per 1 ton of harvested biological resources [6]. This is what the rational use of biological resources should be. Based on the research results, a conclusion has been made

that the development of the coastal deep fish processing in Russia brings the greatest profit to the country, while the fishing enterprises themselves may not have it.

Thus, the issue of increasing the production of products with high added value is connected with the fact that deep-sea fishing vessels belonging to the suppliers of raw fish to coastal plants suffer a reduction in the profitability of sales. It is possible to find a solution to this issue at the governmental level either by providing fishing organizations with more preferences, or by creating a stimulating mechanism. For example, it is proposed to subsidize raw materials supplies for coastal plants, which, in our opinion, is inexpedient, as it concerns mainly aquatic organisms, the harvesting of which is connected with gaining significant rental income. In order to reduce prices for raw materials and semi-finished products, they can be somewhat reduced [7].

There exist certain methodologies of providing the owners of fishing vessels with quotas that stimulate deep cutting on board the vessels. One of the options that takes into account raw materials supplies for coastal plants at effective prices, has been developed at G.P. Luzin Institute of Economic Problems of Kola Scientific Centre of RAS.

It should be noted that the receipt of quota shares for the long-term perspective is very much satisfactory for ship owners, and it is conceivable that, on the basis of certain calculations, they can reduce prices for the fish intended for onshore processing. The drafting and approval of contract prices should be done by the associations of fishermen and fish processing enterprises under the supervision of government authorities, like in Norway, where such practice has been implemented for many years.

It is necessary to upgrade the system of external trade in fish. The creation of unnecessary competition, which can be observed nowadays, leads to substantial financial losses.

For example, due to various reasons, in July 2011 the average actual price of Russian fish exports was only 53% of the level of import prices [8]. This article shows that the prices for export products from Norway are considerably higher than those from Russia. In addition, excessive export leads to a deficit of raw materials and fish products, and contributes to the maintenance of high prices in the domestic market.

The facts and observations above, as well as the research into the situation concerning the development of onshore processing in the Soviet Union and abroad, allow us to say that the development of coastal fishing with the use of refrigerated vessels (without freezing installations) is the most affordable and efficient method of supplying raw fish to coastal enterprises. For these purposes, the countries with developed fishery use mainly the vessels with the length up to 30 meters for catching benthic fish. Along with trawls, other fishing gear is widely used, such as long-lines, nets, Danish seines, which help to save fuel, reduce production costs, and carry out selective fishing. Large amounts of pelagic fish are harvested using mainly seiner-trawlers that are equipped with refrigerating tanks and use highly efficient purse seine nets. The vessels without freezing installations are, as a rule, tied to specific coastal plants; this enhances their performance on a contractual basis, improves the catches processing efficiency, and helps to redistribute the natural resource rent. All the countries engaged in fishing in the North Atlantic promote the development of coastal fishing. For these purposes, the government limits the construction of factory trawlers; vessels that supply factories with whole fish are given large quotas of bioresources; coastal communities are provided with quotas of valuable bioresources, “first-hand” prices are regulated with the participation of fish harvesting enterprises, fish-processing enterprises and the government.

The efficiency of using seiner-trawlers for catching pelagic fish is proved by an example of Norway, which has no difficulties with harvesting any aquatic organisms in an unlimited amount. A high performance of fishing allows the Norwegians to supply Murmansk enterprises with raw fish at mutually beneficial prices. For example, the amounts of supplied fresh capelin are limited by the handling capacity of receiving facilities in the Murmansk fishery port and processing capacities of its enterprises. Due to the fact that Murmansk ship owners have no such vessels, and also due to the backwardness of port infrastructure and coastal processing capacities, Russia has already lost one third of total allowable catch of capelin; shrimp and cod are not harvested to the necessary extent.

Coastal fishing, carried out in the Barents Sea, does not fully correspond to its purpose, because the regulations allow freezer vessels to develop quotas as well. Due to this fact and other reasons, more than half of the catches do not reach processing enterprises.

In our opinion, the creation of integrated harvesting and onshore processing enterprises is an efficient measure in the development of high-tech production [9]. It is done by most of the countries with developed fishing in the Northern Atlantic coast. Fishing companies in the Northern basin are not willing to carry out onshore processing, because it requires solving many problems, including those connected with investing in new technologies. It is possible to streamline this process by redistributing quotas in favor of innovation enterprises.

### Conclusions

The implementation of the provision of the Concept and State Programme of the Russian Federation concerning "...the transition of

development of the fishery complex to the innovation type of development..." can be facilitated by the following activities.

1. Creation of the Export Council, funded by harvesting enterprises. The Council should develop the export strategy, study the world market of fish products, develop recommendations to exporters. The activity of the Export Council should result in the increase of export revenues due to the growth in the prices for fish products.

2. The increase in the scale of coastal fishing and the improvement of its organization. By implementing the suggested measures with regard to coastal fishing, the provision of population and coastal plants with raw fish and semi-finished products will be improved, the assortment of output products will be expanded, and export revenues will increase.

3. Creation of integrated enterprises specializing in harvesting and processing aquatic resources. These enterprises should become crucial for expanding the range of products, including high-tech, innovation products, and also for establishing trade without intermediaries.

In conclusion, it can be noted that the Northern fishery basin has a significant backlog of innovation technologies that remain non-demanded by the industry. And one of the reasons lies in the absence of a stable system for providing raw materials to the coastal enterprises and their underdevelopment. Only the complex development of the fleet and the shore enterprises will facilitate the implementation of the Concept for the development of fishery in the Russian Federation for the period until 2020 and the Russian Federation State Programme "Development of fishery complex".

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