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EFFICIENCY OF STOCK MANAGEMENT IN THE FISH PROCESSING INDUSTRY

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Purpose: The purpose of this paper is to demonstrate the role of stock management in the operations of fish processing enterprises and to analyse the impact of Covid-19 and the war in Ukraine on stock management efficiency.
Design/methodology/approach: Literature studies, the document research method, the economic analysis method, and expert knowledge, were used in the paper.
Findings: The stock structure of fish processing enterprises by company size was identified, and an analysis of stock management in the years 2019-2022 and its impact on the financial efficiency of these companies was carried out.
Research limitations/implications: In the future, it would be recommended to extend/specify the studies to the types of fish processing.
Originality/value: Evaluation of the 2019-2022 stock management policy (including Covid-19, the war in Ukraine) and verification of the impact of stock management on financial performance, taking into account the stock structure.

Keywords: stock management, fish processing.

Category of the paper: Research paper.

1. Introduction

The efficient and effective operation of manufacturing companies depends on stock management strategies regarding procurement, production and distribution (Wild, 2018). Stock management policy is a key element affecting both cost and revenue levels (Bose, 2006). This issue is also relevant to the food industry and the fish processing sector, where materials and raw materials represent a significant share of costs.

In an era of continuously changing market factors stemming from, among others, the COVID-19 pandemic and the hostilities in Ukraine, which have caused disruptions in the liquidity of the supply (Dimitry, 2020) of raw fish and materials as well as a significant increase in the price of components necessary for production, fish processing enterprises are forced to

constantly look for opportunities to improve their business processes, including stock management.

The subject of this article is the evaluation of stock management policies in the fish processing industry, by company size, taking into account the complexity of the stock structure in these companies.

2. The core business of fish processing enterprises

Fish processing is a branch of food industry classified in the Polish Classification of Activities as PKD 10.20.Z – the processing and preserving of fish, crustaceans and molluscs. Fish processing enterprises are mainly engaged in processes such as freezing, smoking, salting and preserving fish (Wang, 2018).

Fish processing enterprises can deal with (Krupska, 2016):

- pre-processing,
- proper processing,
- processing of fish raw materials and fish waste into feed and technical products.

Pre-processing (initial processing) aims to prepare raw materials for further processing. It includes operations such as heading the fish, gutting, flaying, filleting, skinning, defatting and portioning. Products of pre-processing do not have a form suitable for direct consumption without further treatment (Szulecka, 2020).

Proper processing, apart from the specific nature of the fish raw materials used, does not differ from other types of agri-food processing. It includes activities such as smoking, storage, production of delicatessen products, frying and production of other non-durable products, semi-permanent preserves and permanent preserves. This processing results in final products in ready-to-eat form (Zieziula, 2002).

The third type of fish processing is the processing of fish raw materials and fish waste into feed and technical products, in the form of fish meal, liquid feed, oils, fish oil and protein preparations (Niegolewski, 1979).

Fish processing is one of the fastest growing branches of the food sector in Poland, as well as the fish processing sector of the European Union. The turnover volume of this sector in 2021 reached PLN 15.07 billion (Hryszko, 2023).

The size of an entity in fish processing plays an important role, as it largely determines its business profile and production mix. Micro and small enterprises, most often operating in local markets, are mainly engaged in the production of preparations with a low degree of processing, e.g., salting, smoking and pre-processing of fish, which require lower financial outlays. On the other hand, large production facilities with adequate financial resources for investment are involved in the production of highly processed fish products requiring advanced processes

and complex technological lines, i.e., for example, the production of canned fish, some marinades, and frozen fish (Szultka, 2015).

In 2021, sole proprietorship is the predominant form of business (42%) among establishments processing and preserving fish and fishery products. Commercial law companies represent another prevalent organisational and legal form (38%), comprising mainly limited liability and joint stock companies, with civil partnerships accounting for 15-20% of all entities (Hryszko, 2023).

The share of micro enterprises in the total employment structure according to estimates for 2021 was only 2.2% and was 65%for large enterprises. The situation is similar taking into account the value of production, where micro enterprises have a 2% share in the structure of the value of production, while large enterprises have a 75% share of the value (Hryszko, 2023).

3. Importance of stocks in the operations of fish processing enterprises

One of very important areas of management in fish processing enterprises is stock management, while the efficient and effective functioning of this group of production enterprises depends on stock management strategies as concerns supply and production as well as distribution. Indeed, stock management policy is a key element affecting both cost and revenue levels in these enterprises (Munyaka,2022).

Guided by the principles of financial rationality, fish processing enterprises should develop their stock management processes in order to (Kardas, 2017):

- ensure continuity of production and the relevant level of customer service while maintaining the lowest possible stock cost,
- minimise expenditure on purchasing, supplying and maintaining stocks,
- prevent the build-up of excessive and, in particular, redundant stocks,
- counteract quantitative and qualitative stock losses.

In fish processing enterprises, stocks as an organic component of economic processes are a part of all phases of the enterprise economic activity. Representing one of the main items of current assets, they can arise in three areas of activity (Fikoń, 2008):

- supplies (in the form of raw materials, e.g., tomato paste, oils, spices, packaging),
- production (stocks of work in progress),
- distribution (stocks of finished products – e.g., preserves, canned, frozen, salted, smoked fish).

In the area of supplies, stocks are created mainly in the form of fresh fish raw materials as well as frozen raw materials. Imported fish and seafood form the basis of the raw material supply, which is supplemented by fish raw materials from a firm's own fishing as well as aquaculture (Gostomski, 2022). Stocks on the supply side also include materials and

components for production, such as tomato paste, oil, spices, vegetables, sauces. Packaging is also a significant component of supply-side stocks in fish processing enterprises, and includes, for example, tin and aluminium cans, plastic containers, cartons, stretch film, labels, and Euro pallets (Krupska, 2016).

Materials and raw materials represent a significant share (73.9% in 2021) of the operating costs of fish processing enterprises. In the period of 2010-2021, these costs showed the highest growth rate (as much as a 3-fold increase) compared to other types of operating costs (Hryszko, 2023).

Stocks of work in progress do not play a significant role in fish processing enterprises. However, they can occur in the form of prepared-sauces raw material after pre-processing (Sitaram, 2021).

Due to the nature of the processing performed, stocks of finished products may be, for example, in the form of smoked fish, canned fish, preserves, and salted fish. The storage period during which fish processing products retain their quality depends on many factors, including the species and the form of raw material, the fat content of the tissue, the storage temperature, the condition of the coating, the packaging method, the type and properties of the packaging material, including the stretch film's properties as a barrier against gases and water vapour and other factors. Thus, for example, the currently accepted standard is a shelf life of 2 years for vacuum-packed fish, the shelf lives of hot-smoked and cold-smoked products packaged without atmospheric modification and stored at 2 °C to 10 °C are, respectively, 4 and 10 days, while the shelf life of canned products is the longest shelf life where the quality preservation periods under standard conditions are: 18 months for canned oil-soaked products, 6 months for canned squid products and 12 months for other product groups of canned foodstuffs. In practice, producers adopt longer storage periods for canned food, usually 2 to 3 years (Szulecka, 2020).

Maintenance of stocks in fish processing enterprises depends on the type of fish processing performed and the type of stocks. In the case of stocks of fish raw materials (seasonality of supply, perishable raw material), materials, e.g., oil, tomato paste, spices and packaging, it stems from the need to ensure the regularity of production, to achieve potential economies of scale in production as well as supply, to minimise the impact of seasonality of supply as well as seasonality of demand and to reduce risks associated with uncertainty in the delivery of the goods and the time required for delivery.

In an era of continuously changing market factors, stemming from, among other things, the COVID-19 pandemic and the hostilities in Ukraine, which have caused disruptions in the liquidity of supplies of raw fish and materials as well as significant price increases, the imperative to reduce the risks associated with supply uncertainty and price increases is particularly important with respect to the stock management of fish processing enterprises (Barman, 2021).

On the other hand, in terms of stock management in the form of finished products, it is of paramount importance to ensure continuity of sales, the lack of which negatively affects the reputation of a company and reduces profits (Shiau Wei Chan, 2017).

However, it should be borne in mind that the maintenance of stocks is an important element of current assets and is a financial burden for companies from the moment of payment for raw materials, materials, and packaging until the finished products are received by the customer. The maintenance of stocks also involves various types of costs, e.g., storage, handling, movement costs, the cost of capital (opportunity costs) or costs resulting from stock losses (Iakovou, 2016).

Thus, stock management encompasses the demand and logistics aspects as well as the financial aspects related to the need to maintain the stocks and foot the costs that they generate (Zimon, 2015).

Stock management affects both costs and revenues and, consequently, financial performance, which in turn determines the need for continuous monitoring and evaluation of the effectiveness of stock management in fish processing enterprises (Kofi, 2021).

4. Stock management in fish processing – research results

To conduct the analysis, financial data from financial statements published in the EMIS database was used. The analysis covers the years of 2019-2022, which allows for an assessment of the impact of the Covid pandemic and the outbreak of war in Ukraine on stock management activities in the fish processing industry.

48 economic operators were entered in the survey, divided into (Official Journal of the European Union):

- micro enterprises – 12 entities (number of employees <10, annual turnover or annual balance sheet total ≤ EUR 2 million),
- small enterprises – 12 entities (number of employees <50, annual turnover or annual balance sheet total ≤ EUR 10 million),
- medium-sized enterprises – 16 entities (number of employees < 250, annual turnover ≤ 2 million EURO or annual balance sheet total ≤ 43 million EURO),
- large companies – 8 entities.

A study was carried out to analyse the structure, value and efficiency of stock management of fish processing enterprises.

In order to identify the specific nature of the stocks created in the fish processing industry, a vertical analysis of stocks (structure) was carried out. The results obtained are presented in Table 1.

The structure indicators were calculated according to the following formulas:

1. Share of total stocks in total current assets (%) = total stocks/total current assets x 100%.
2. Share of raw materials in total stocks = value of raw materials/value of total stocks with 100%.
3. Share of semi-finished products and work-in-progress in total stocks = value of semi-finished products and work-in-progress/value of total stocks with 100%.
4. Share of finished products in total stocks = value of finished products/value of total stocks with 100%.

Table 1.
Structure of stocks in fish processing enterprises

stock structure	2019				2020				2021				2022			
	micro	small	medium	large	micro	small	medium	large	micro	small	medium	large	micro	small	medium	large
share of raw materials and supplies	0.30	0.31	0.68	0.56	0.29	0.16	0.71	0.54	0.57	0.16	0.72	0.61	0.63	0.48	0.76	0.56
share of semi-finished products in stocks	0.00	0.02	0.04	0.06	0.00	0.01	0.04	0.07	0.00	0.01	0.05	0.09	0.00	0.02	0.05	0.15
share of finished products in stocks	0.00	0.57	0.22	0.24	0.00	0.71	0.20	0.31	0.00	0.67	0.17	0.25	0.00	0.40	0.15	0.25
share of goods in stock	0.70	0.09	0.06	0.11	0.71	0.07	0.05	0.08	0.43	0.12	0.08	0.05	0.37	0.07	0.04	0.04
number n	11	12	16	8	11	12	16	8	11	12	16	8	12	12	16	8
share of stocks in current assets	0.05	0.39	0.35	0.44	0.14	0.36	0.34	0.44	0.10	0.46	0.33	0.42	0.07	0.47	0.37	0.50
min share of stocks in current assets	0.00	0.01	0.04	0.19	0.00	0.01	0.05	0.15	0.00	0.01	0.04	0.23	0	0.01	0.04	0.24
max. share of stocks in current assets	0.63	0.43	0.57	0.63	0.63	0.40	0.58	0.51	0.78	0.67	0.65	0.61	0.49	0.56	0.59	0.73

Source: Own studies based on financial data from EMIS database.

While conducting a vertical analysis of stocks (structure) for 2022, it can be seen that raw materials and other materials account for the largest share of stocks, with raw materials and other materials accounting for 63% of total stocks in large enterprises, as much as 76% in medium-sized enterprises, 63% in micro enterprises and 48% in small enterprises. The share of semi-finished products is low, which is due to the specific nature of production. Goods, on the other hand, account for the largest share in micro enterprises, although their share in stocks is decreasing in year-on-year terms (70% in 2019, and 37% in 2022). The share of stocks in current assets has also shown an upward trend. In 2022, stocks in large companies accounted for as much as 50% of current assets. The data presented imply that events such as the Covid-19 pandemic and the war in Ukraine, which contributed to disrupted supply chains and problems with access to raw materials and other materials, affected a change in the stock management policy, stockpiling in the form of raw materials and materials in order to protect fish processing enterprises from production stoppages and price increases of raw materials, as well as materials and components for production.

Table 2.
Stock growth ratio (value) in processing enterprises

	2022/2021				2021/2020				2020/2019				2022/2019			
	micro	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**
stocks in value terms	**1.41**	**1.20**	**1.44**	**1.63**	**0.60**	**1.41**	**1.25**	**1.19**	**2.36**	**0.88**	**1.01**	**1.02**	**2.00**	**1.48**	**1.81**	**1.94**
raw materials	1.57	3.56	1.58	1.58	1.16	1.42	1.22	1.14	0.99	0.45	0.96	1.06	1.80	2.30	1.85	1.92
semi-finished products	bd	2.08	1.27	2.61	bd	0.96	1.63	1.90	bd	0.84	0.95	0.87	bd	1.69	1.97	4.32
finished products	bd	0.72	1.27	1.77	bd	1.33	1.15	1.25	bd	1.08	1.07	1.07	bd	1.04	1.57	2.37
other stocks/goods	1.20	0.66	0.71	1.47	0.37	2.46	1.80	0.72	5.60	0.66	2.14	0.78	2.47	1.07	2.74	0.82

Source: Own studies based on financial data from EMIS database.

A horizontal analysis (dynamics) of the value of financial resources allocated to stocks showed that disruptions in supply chains caused by both the Covid-19 pandemic and the outbreak of the war in Ukraine translated into an increase in the value of stockpiling across all groups of enterprises. Over the period of 2019–2022, the value of total stocks doubled in micro enterprises, by increased by 94% in large and by 81% in medium-sized fish processing enterprises. The accumulation of stocks can protect fish processing enterprises against disruptions in the supply of raw materials and other materials as well as packaging, and consequently act as a deterrent against production downtime. In addition, it can provide a hedge against increases in the price of components required for production. In addition, the value of goods also increased in large companies in 2022, which may indicate that these companies had secured themselves against contractual penalties arising from contracts signed with food discount chains.

Another group of indicators illustrating the effectiveness of stock management are turnover ratios. The stock turnover ratio shows the number of days elapsed from the receipt of raw materials and supplies into the warehouse and the production and storage of finished products until their release to the customer (Serrano, 1994). The level of this ratio therefore indicates how long, on average, stocks wait to be sold, i.e., how long it takes for one zloty of capital employed in stocks to turn into one zloty of cash. Companies should strive to minimise this ratio (Jerzemowska, 2006). Due to the diverse structure of stocks, a deeper analysis can be performed using sub-indices, i.e., the turnover ratio of raw materials and materials or finished products and goods.

Stock management efficiency was assessed using the total stock turnover ratio and the sub-indices of material/raw material turnover, semi-finished product turnover, finished product turnover, and goods turnover. These ratios were calculated according to the following formulas (Pomykalska, 2007; Czerwińska-Kayzer, 2011):

$$\text{total stock turnover ratio} = \frac{\text{average stock level}}{\text{sales revenue}} \times 365 \text{ days} \quad (1)$$

$$\text{materials turnover ratio} = \frac{\text{average level of raw materials and materials}}{\text{operating costs}} \times 365 \text{ days} \quad (2)$$

$$\text{turnover ratio of finished products} = \frac{\text{average level of finished products}}{\text{operating costs}} \times 365 \text{ days} \quad (3)$$

$$\text{goods turnover ratio} = \frac{\text{average level of goods}}{\text{operating costs}} \times 365 \text{ days} \quad (4)$$

Table 3.
Stock turnover ratios in fish processing enterprises in 2019-2022 (in days)

	2019				2020				2021				2022			
	micro	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**
stock turnover ratio	13	49	27	48	27	44	27	42	19	54	29	43	14	48	35	58
material/ raw material turnover rate	9	15	20	27	8	7	19	27	11	9	20	27	9	15	27	32
turnover rate of intermediate products	bd	1	1	3		1	1	3	bd	1	2	4	bd	1	2	8
finished products turnover rate	bd	28	5	12		31	5	12	bd	36	5	13	bd	28	5	17
goods turnover ratio	4	5	1	6	19	3	1	4	8	7	2	3	5	5	1	3

Source: Own studies based on financial data from EMIS database.

The stock turnover ratio is the product of the ratio of the average stock (average annualised) to the sales revenue generated by the unit and a value of 365, which is a conventional number of days per year. It represents the frequency of stocks renewal by a company in days. A low value for the indicator is postulated, which is usually evaluated positively. The data presented in Table 3 shows that, on average in 2019–2022, the stock cycle ranged from 40 days in 2020 to 55 days in 2022. The analysis shows that, on average, small and large fish processing enterprises had the longest stock turnover period. In the large ones the cycle ranged from 42 days to 58 days in 2022, in the small ones from 44 days to 48 days in 2022.

The shortest stock turnover period was recorded in micro enterprises, with 13 days in 2019 and 14 days in 2022. This is due, among other things, to the specific nature of production, micro enterprises process fish products with a low degree of processing, which have a short shelf life.

An increasing stock turnover ratio is not a favourable situation for the company, as it freezes cash for a longer period of time as well as incurs additional storage costs.

The rate of stock turnover is determined by the sub-cycles, i.e., the rotation of materials, semi-finished products, finished products and goods. The data presented in Table 3 shows that in fish processing enterprises, the stock holding period was mainly determined by the length of storage of raw materials and materials and, to a lesser but significant extent, finished products. The storage period of raw materials in large enterprises increased from 27 days to 32 days. Finished products, on the other hand, are stored longest in small enterprises, as long as 28 days in 2022.

Financial efficiency was also assessed using the return on sales and return on assets ratios, the levels of which were calculated according to the following formulas (Bieniasz, 2012; Sierpińska, 2004):

$$\text{ROS operating return on sales} = \frac{\text{EBITDA}}{\text{revenue from sales of products, goods and materials + other operating income}} \times 100 \quad (5)$$

$$\text{ROA} = \frac{\text{net profit}}{\text{average assets}} \times 100 \quad (6)$$

A preliminary assessment was performed of the impact of stock management on the financial performance of fish processing enterprises (e.g., reduction in stock cycle length), as measured by operating profitability of sales and return on assets. It was decided to examine the relationship between stock productivity and financial performance, taking into account their structures.

Table 4.
Selected financial indicators for 2019-2022

	2019				2020				2021				2022			
	micro	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**	**micro**	**small**	**medium**	**large**
ROS	b/d	4.6%	5.1%	3.4%	b/d	4.8%	7.0%	4.0%	b/d	5.2%	9.2%	3.8%	b/d	5.1%	6.7%	2.7%
ROA	0.0%	1.4%	2.0%	1.2%	1.9%	–1.3%	5.3%	3.0%	3.6%	3.0%	10.6%	6.6%	1.4%	4.4%	7.2%	5.9%

Source: Own studies based on financial data from EMIS database.

The studies show that there is an impact of deteriorating stock management efficiency on the financial performance of the fish processing industry as measured by the operating return on sales and the return on assets. The lengthening of the stock turnover cycle affected the deterioration of financial performance in 2022, where the turnover ratio increased from 42 days in 2021 to 55 days, which translated into a reduction in the operating return on sales from 4% to 3.3% and the return on assets from 11% to 7%. In 2020, on the other hand, a reduction in the total stock turnover cycle from 45 days to 40 days resulted in an improvement in operating return on sales from 3.7% to 4.4% and ROA from 7% to 9%. The analysis showed that maintaining higher levels of stocks of both raw materials, finished products and goods in large fish-processing enterprises results in a longer rotation cycle of these stocks and translates into a deteriorating level of financial efficiency calculated using the operating return on sales. In the case of medium-sized enterprises, only a significant extension of the stock turnover cycle, i.e., by 6 days (year-on-year) with a simultaneous increase in the value of stocks by 44%, translates into a drop in operating return on sales from 9% in 2021 to 7% in 2022, and in return on sales from 3.4% in 2021 to 2% in 2022. In micro enterprises, where the rotation cycle is generally the shortest, the decrease in the stock turnover cycle in 2022 translated into a decrease in the sales deficit ratio, while in 2021 the lengthening of the material/raw material turnover ratio translated into a deteriorating of the deficit to 7%, and in 2022 the lengthening of the stock turnover ratio also resulted in an increase in the sales deficit.

5. Summary

Stock management is a key area in the management of fish processing enterprises, affecting the operational area of activity, its efficiency and effectiveness as well as the financial area, thus determining the level of financial results achieved, but also the marketing area, determining the timeliness and quality of finished product deliveries, and thus influencing the level of customer service and the competitiveness of the enterprise in the market.

The research conducted showed that events such as Covid-19 and the war in Ukraine had a significant impact on stock management in fish processing enterprises. A preliminary analysis of the relationship between stock management efficiency and financial performance showed a link between these economic categories. Deterioration of efficiency in the area of stock management, e.g., lengthening of the stock turnover cycle, translated into deterioration of financial results, i.e., the return on sales and return on assets. High stock levels mean high stock management costs. However, in a situation of a dynamically changing environment and uncertainty in terms of continuity of supplies and price stability, a high level of stocks means operational security, i.e., the possibility of maintaining continuity of production, but also a high readiness of supply (an important factor in the competitive game) where supply chains are again disrupted by a pandemic or warfare.

It can be concluded that efficient stock management is important for the financial situation of fish processing enterprises. Fish processing enterprises need to redefine their stock management strategy determining optimal economic performance.

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