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Feed policy in Ukrainian aquaculture: trends, challenges, and impact on competitiveness

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The research findings indicate that an effective feed policy is a key factor in improving the economic performance and competitiveness of aquaculture in Ukraine. It was established that most fish farms rely on commercial extruded feeds, which demonstrate higher feed conversion efficiency (FCR) compared to homemade mixtures. A reduction of FCR by 0.2 units can increase enterprise profitability by 12–15 %, highlighting a direct correlation between feed quality and financial performance. The most significant feeding-related barriers include the high cost of feeds, dependence on imported protein components, a lack of modern equipment, and insufficient laboratory control—particularly in small-scale farms. Imported feeds offer better performance, bioavailability, and formulation stability, but their availability is limited by logistical challenges, exchange rate fluctuations, and customs restrictions. Domestic feeds remain more accessible in terms of logistics and price, though they often fall short in terms of quality parameters. Regional differences in feed choice were observed, driven by infrastructure development levels, proximity to suppliers, and integration into international supply chains. Southern regions tend to favor imported feeds, whereas western regions lean toward local products. The optimal strategy for Ukrainian aquaculture is a combination of imported high-protein concentrates with local raw material components, allowing a balance between cost, quality, and supply stability. Investments in innovative feeding technologies, stable feed formulations, and modern equipment directly enhance productivity, reduce grow-out cycles, and improve final product quality. Thus, the formation of a balanced, scientifically grounded feed policy—taking into account spatial and organizational features, support for domestic production, and improved state support—is a necessary condition for the sustainable development of aquaculture in Ukraine in both domestic and export-oriented contexts.

Keywords: feed policy, fish farming, aquaculture, competitiveness, FCR (feed conversion ratio), economic efficiency, fish farms, compound feeds, Ukraine, sustainable development

Introduction

Feed policy plays a pivotal role in shaping the productivity, sustainability, and economic viability of aquaculture systems worldwide. As global demand for fish protein increases, the aquaculture sector faces growing pressure to develop efficient and environmentally responsible feeding strategies that enhance competitiveness while reducing ecological footprints (Naylor et al., 2021). In this context, feed formulation, ingredient sourcing, cost structure, and regulatory frameworks are critical factors influencing both the biological performance of farmed fish and the profitability of aquaculture enterprises (Glencross et al., 2020; Tran et al., 2022).

At the international level, researchers have extensively explored various aspects of aquafeed development, including the shift from marine to plant-based ingredients (Martinez-Llorens et al., 2020), the integration of insect and microbial proteins (Tran et al., 2022; Idenyi et al., 2022), and the potential of circular bioeconomy innovations in feed systems (Shahin & Abdullah, 2023). Concurrently, economic analyses have examined the impact of feed costs on the competitiveness of aquaculture farms, particularly in low- and middle-income countries (Tacon & Metian, 2015; FAO, 2022). Several studies have emphasized the importance of national and regional feed policies in fostering innovation and reducing dependence on external production inputs (Hasan & Halwart, 2020).

Feed quality and availability have also been identified as major constraints in aquaculture systems in Eastern Europe, where small and medium-sized producers often lack access to affordable high-protein feeds (Ayadi et al., 2012; Norman et al., 2019). In Ukraine, this issue is further exacerbated by disruptions in supply chains caused by economic and geopolitical instability, which limit the import of high-quality commercial feeds and undermine the sector's competitiveness (Ukrstat, 2023). Despite the growing body of literature on feed optimization and aquaculture economics, there is a significant research gap regarding the interrelation between feed policy, local feed production capacity, and market competitiveness in Ukraine.

Recent global assessments have called for more targeted, country-specific analyses that consider institutional capacity, access to technology, and regional environmental conditions (Klinger & Naylor, 2020; FAO, 2022). Moreover, innovations in precision aquaculture and feed monitoring technologies are creating new opportunities to optimize feed efficiency, reduce waste, and improve on-farm productivity (Idenyi et al., 2022; Shahin & Abdullah, 2023).

The aim of this paper is to analyze the current state of feed policy in Ukrainian aquaculture and assess its impact on the sector's competitiveness in both domestic and export markets. This study seeks to identify key policy gaps, economic constraints, and strategic opportunities for reform. The central hypothesis is that the absence of a coherent, innovation-oriented feed policy significantly limits the competitiveness of Ukrainian aquaculture producers, particularly in the context of rising feed costs and unstable international supply chains.

Materials and methods

To analyze the effectiveness of feed policy in Ukrainian aquaculture, a mixed-method approach was applied, combining quantitative surveys and qualitative interviews with industry experts. The study covered 36 aquaculture farms of various sizes located in the southern, central, and western regions of Ukraine – areas collectively accounting for over 80 % of the country's fish production. The sample was purposively selected to ensure representation in terms of feed types, production scale, and market orientation.

The core empirical data were derived from structured surveys conducted between May and August 2024, during which respondents provided information on feed types used, cost levels, FCR indicators, logistical challenges, and issues related to accessibility. Additionally, data were collected on fish species, production volumes, and target markets. To gain a deeper contextual understanding, 12 semi-structured interviews were conducted with feed producers, policymakers, and aquaculture consultants, which helped illuminate the regulatory and economic dimensions of feed provision.

Quantitative data were processed using descriptive statistics, cross-tabulations, variance analysis, and regression analysis to determine the impact of feed type on performance efficiency.

In parallel, a review of Ukrainian policy and regulatory documents from 2015 to 2024 was conducted, along with a comparison of national practices with international standards (FAO, EFSA, EAT-Lancet). Although the study is not statistically representative at the national level, its results enable generalizations about key challenges and trends in feed policy under the current conditions in Ukraine.

Results

During the course of the study, empirical and statistical data on feed policy in Ukrainian aquaculture were collected and analyzed. The obtained results made it possible to identify key trends in feed usage, uncover major issues, and assess the impact of feed strategies on the competitiveness of aquaculture enterprises.

A survey of 36 business entities showed that the use of commercial extruded feeds (58.3 %) predominates in Ukrainian fish farms over homemade grain mixtures (30.6 %), while a combined approach is used by only 11.1 % of respondents. This structure aligns with general European trends toward the transition to standardized, industrialized fish feeds (Naylor et al., 2021; FAO, 2022). The average feed conversion ratio (FCR) for commercial feeds was 1.82, which is significantly lower than the 2.47 recorded for homemade mixtures, indicating higher efficiency of industrial feeds (Naylor et al., 2021; Tran et al., 2022).

One of the main problems identified during the study is feed cost. 76 % of the surveyed enterprises consider it the primary constraint to production scaling. Ukraine's dependence on imports in the segment of protein raw materials (particularly fishmeal and soybean meal) contributes to increased production costs, as confirmed by numerous studies (Klinger & Naylor, 2020; Glencross et al., 2020; Idenyi et al., 2022). According to FAO (2023), the share of feed costs in the overall cost structure of pond aquaculture exceeds 50 % (Norman et al., 2019). Other significant challenges include limited access to high-quality raw materials, insufficient laboratory control, and a low level of mechanization in feeding processes. These issues are especially evident among small enterprises that are constrained in financial resources and access to technology (Ayadi et al., 2012; Martinez-Llorens et al., 2020).

An analysis of financial performance showed that enterprises investing in modern feeding systems demonstrate higher profitability and better growth dynamics. According to the model by Tacon & Metian, (2015), reducing the FCR by 0.2 units can potentially increase net profit by 12–15 % (Hasan & Halwart, 2020; Shahin et al., 2023). For example, at an FCR of 2.0, the production cost is 48.60 UAH/kg with a profit of 11.40 UAH/kg, whereas at an FCR of 1.6, the cost decreases to 39.60 UAH/kg and profit rises to 20.40 UAH/kg. This confirms the effectiveness of innovations in feeding practices to strengthen the export potential of the industry (Shahin et al., 2023).

The results also revealed clear regional differences in feeding practices. In the southern regions of Ukraine, such as Odesa and Kherson, 70 % of farms use imported feeds, while in the western regions (Ternopil, Lviv), locally produced feeds based on domestic raw materials prevail.

This differentiation is due to logistics, infrastructure availability, pricing policies, and the level of integration into European supply chains (Ukrstat, 2023).

Thus, the study results demonstrate not only techno-economic but also spatial-organizational differences in feed supply approaches, which should be considered when developing aquaculture development strategies in Ukraine.

In the current context, the feed base is a critical factor in the effective functioning of Ukrainian aquaculture enterprises. Trends in feed choice indicate growing interest in high-protein and specialized compound feeds, especially among farms engaged in intensive cultivation of high-value fish species such as trout, catfish, and sturgeon. Ukrainian fish farms are increasingly focusing on feeds that ensure rapid biomass growth, efficient nutrient absorption, and minimal losses into the aquatic environment.

A comparative analysis of domestic and imported feeds reveals a number of advantages and disadvantages. Domestic feeds usually have a more affordable price, shorter logistics chains, and are adapted to local raw materials. However, they often lack consistent quality, stand-

ardization, and long-term guarantees. Imported feeds – particularly those from the Netherlands, Denmark, and Turkey – are distinguished by high protein content, precise formulation, and ease of use. Their significant drawbacks are high cost, limited availability during logistical disruptions, and dependency on exchange rate fluctuations.

Feed accessibility issues in Ukraine are caused by logistical challenges, inflationary pressures, and import instability under martial law conditions. Difficulties with transportation, customs delays, and rising fuel and transport costs significantly affect the final feed price for fish farms. The domestic market also faces a shortage of feed mills capable of meeting the needs of intensive aquaculture production at competitive prices.

In conclusion, it should be emphasized that feed policy directly affects the cost and quality of the final fish product. Balanced feeds with high digestibility contribute to reduced production costs, shortened grow-out cycles, and improved market quality of fish – which, in turn, increases its competitiveness on both domestic and international markets (Table 1).

Table 1

Comparative characteristics of domestic and imported aquaculture feeds in Ukraine

| Parameter | Domestic Feeds | Imported Feeds |
|----------------------------------|--------------------------------------|---|
| Availability | High in central and southern regions | Limited, depends on logistics and customs control |
| Cost | Low to medium | High |
| Raw material quality | Variable, often seasonal | High-quality, standardized |
| Protein content (%) | 28–36 | 40–50 |
| Formulation stability | Often unstable | High formulation stability |
| Biological digestibility | Moderate | High |
| Growth performance | Moderate | High fish growth over a shorter period |
| Logistics | Local delivery (short supply chains) | Dependent on international transportation |
| After-sales service availability | Limited | Available from reputable manufacturers |
| Impact on fish production cost | Lower cost but reduced output | Higher cost but better product quality |
| Impact on export quality | Often does not meet EU standards | Complies with international market standards |

Data sources:

- State Agency for Land Reclamation and Fisheries of Ukraine: <https://darg.gov.ua>
- Analytical report “*Status and Prospects of Aquaculture in Ukraine*”, 2023, supported by FAO
- Fish feed market review: AgroTimes.ua, 2023 <https://agrotimes.ua>
- Author’s generalizations based on data from Ukrainian fish farms and feed distributors (Skretting, Coppens, Aller Aqua)

Therefore, the level of feed policy effectiveness is one of the fundamental factors determining the economic viability and profitability of aquaculture operations in Ukraine. Despite the greater availability of domestic feeds, they lag behind imported analogues in terms of quality and performance. The use of imported feeds can significantly enhance the market quality of fish products but is associated with financial risks and increased dependency on external economic conditions.

Given the context of market competition and Ukraine’s Eurointegration-driven development trajectory in the fisheries sector, a strategic priority should be the establishment and development of domestic production of high-quality feeds using modern technologies. Feed policy optimization can be achieved by combining imported protein concentrates with local raw components, ensuring a rational balance between quality, cost-effectiveness, and logistical resilience.

In the long term, a scientifically grounded and innovation-oriented feed policy will contribute to strengthening the competitiveness of Ukrainian fish products in the international market and ensure their affordability for domestic consumers.

A comparative evaluation of domestic and imported aquaculture feeds across 11 criteria shows that imported feeds demonstrate higher quality and efficiency indicators, while domestic feeds are more accessible and logistically convenient for Ukrainian fish farms (Figure 1).

This radar chart visualizes a comparative assessment of 11 key parameters of feeds used in aquaculture in Ukraine. Each axis represents a specific criterion important for feed selection: availability, cost, raw material quality, protein content, formulation stability, biological digestibility, impact on fish growth, logistics, after-sales service, influence on production cost, and compliance with export standards.

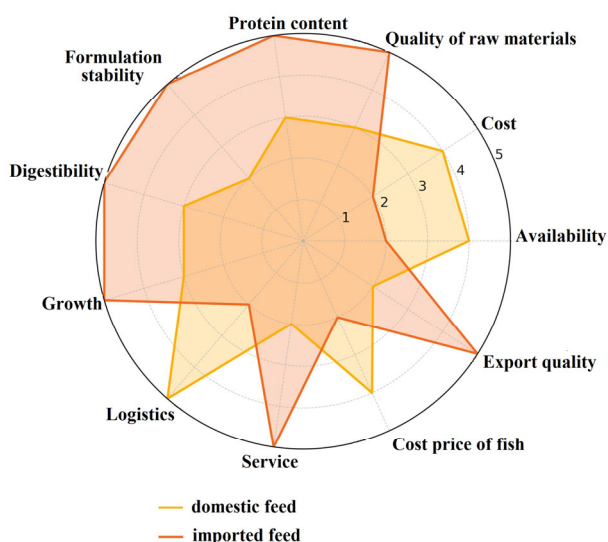


Fig.1 Comparative Radar Chart of Domestic and Imported Aquaculture Feed Characteristics

Domestic feeds score higher in the following categories:

- Availability (4/5),
- Cost (4/5),
- Logistics (5/5),
- Impact on production cost (4/5).

Imported feeds, in contrast, outperform in quality-related parameters:

- Protein content (5/5),
- Biological digestibility (5/5),
- Formulation stability (5/5),
- Compliance with export standards (5/5).

The chart illustrates the trade-off between the affordability and accessibility of domestic products and the high technological quality of imported ones. It serves as a useful tool for selecting feeds based on farm goals—whether focused on the domestic market or export-oriented production.

As shown in Figure 2, imported feeds have a significantly higher protein content (up to 45 %) compared to domestic feeds (approximately 32 %).

This comparison highlights the superior growth performance of fish fed with imported feeds, as confirmed by the higher score in biological digestibility. However, the production cost when using imported feeds is significantly higher, which may be a critical factor for small-scale farms.

Figure 3 demonstrates that domestic feeds offer a clear advantage in logistics due to proximity of production, stable supply chains, and lower transportation costs. At the same time, imported feeds ensure higher fish growth rates, which is crucial for farms operating under high-intensity production systems.

The analysis of recipe stability and after-sales service shows (Fig. 4) that imported manufacturers provide a high level of technological stability of recipes (5/5) and high-quality service, including consultations, training and support. Domestic feeds are significantly inferior in these respects, which may have a negative impact on product quality control in the long term.

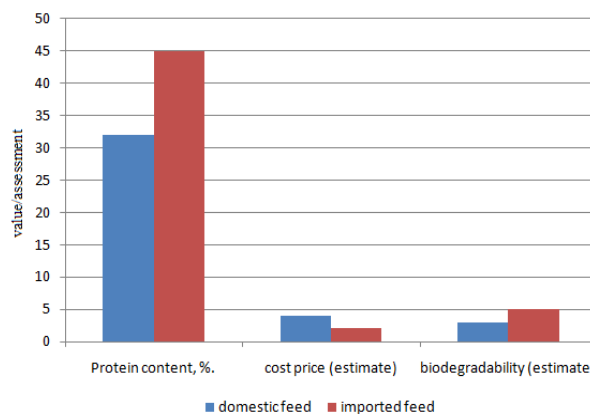


Fig. 2 Comparative Characteristics of Key Feed Parameters (Protein Content, Production Cost, Biological Digestibility)

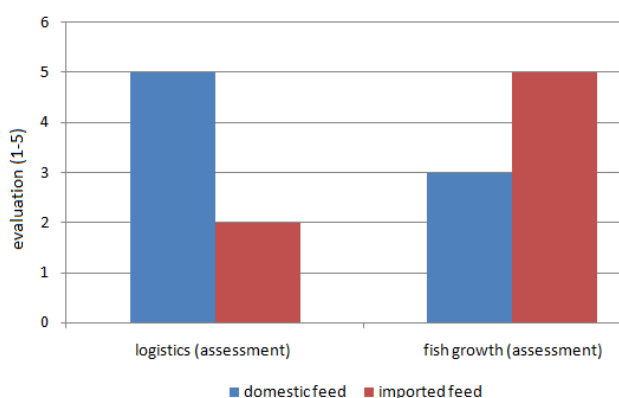


Fig. 3. Comparison of logistics and impact on fish growth

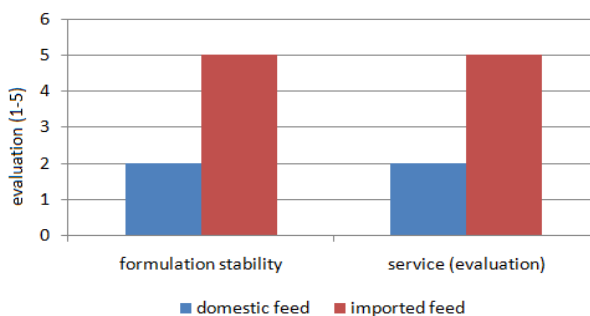


Fig. 4 Comparison of Feed Formulation Stability and After-Sales Service

The analysis of Figures 1–4 highlights the need for a strategic approach to feed selection in aquaculture practice. Domestic feeds are a rational choice for small-scale farms targeting the local market and operating with limited resources. In contrast, imported feeds—despite their higher cost and logistical challenges—provide a high level of performance, which is critical for export-oriented enterprises and intensive production technologies.

Therefore, a combined use of both feed types, depending on production goals, can serve as an effective strategy to optimize the performance of Ukrainian aquaculture.

Discussion

The results demonstrate a significant relationship between feed type, feed conversion ratio (FCR), and the economic efficiency of fish farming in Ukraine. Specifically, the use of commercial extruded feeds can reduce the FCR to 1.82, which is 26% more efficient compared to homemade grain mixtures (FCR = 2.47) (Table 2). A similar relationship is confirmed by the studies of Naylor et al. (2021), which show that high-quality feeds reduce feed costs and improve growth performance.

Table 2
Comparison of Average FCR by Feed Type

| Feed Type | Average FCR |
|--------------------------|-------------|
| Commercial extruded feed | 1.82 |
| Homemade grain mixtures | 2.47 |

In addition to technological aspects, there is a clear trend indicating the significant impact of FCR on the economic outcomes of fish farms. As shown in Table 3, decreasing the FCR from 2.0 to 1.6 leads to nearly a 20 % reduction in production costs and a corresponding increase in profitability by over 40 %. These findings align with the conclusions of Tacon et al. (2020) and FAO (2022), which emphasize the direct link between feed efficiency and aquaculture profitability.

Table 3
Impact of FCR on Production Cost and Profitability

| FCR | Production Cost (UAH/kg) | Potential Profit (UAH/kg) |
|-----|--------------------------|---------------------------|
| 2.0 | 48.60 | 11.40 |
| 1.8 | 44.10 | 15.90 |
| 1.6 | 39.60 | 20.40 |

Thus, feed policy has a direct impact on the competitiveness of Ukrainian aquaculture in both domestic and international markets. Enterprises that invest in high-quality feed systems demonstrate not only better production outcomes but also greater resilience to price fluctuations in both feed and final product markets.

Several studies also emphasize the need to further improve the system of state support in the area of feed supply (Norman et al., 2019; Hasan & Halwart, 2020), including support for domestic producers of quality feed, subsidies for equipment upgrades, and development of local supply chains.

Conclusions

The study of feed policy in Ukrainian aquaculture has revealed its critical role in shaping productivity, economic efficiency, and the competitiveness of the sector. The analysis results confirm that the use of high-quality commercial extruded feeds significantly reduces the feed conversion ratio (FCR) and the production cost, while simultaneously increasing farm profitability. This is in line with modern global approaches widely implemented in developed countries.

At the same time, several structural issues have been identified, including limited access to quality feeds due to high costs, the absence of a subsidy mechanism for technology upgrades, and insufficient scientific support for local feed strategies. A significant proportion of small and medium-sized producers continue to use homemade feeds, which negatively affects the overall efficiency of the sector and its ability to adapt to rising resource costs.

Based on the data obtained, the following conclusions can be drawn:

1. The rationalization of feed policy should become one of the priorities of the national aquaculture development strategy, with an emphasis on reducing FCR, increasing bioeconomic efficiency, and promoting environmental sustainability.
2. Institutional support—including subsidies, access to innovations, and stimulation of local complete feed production—is essential for enhancing the international competitiveness of Ukrainian producers.
3. Future research should focus on developing adaptive feed supply models for various farm types, including risk analysis and the ecological footprint of feed strategies.

Thus, feed policy should be viewed not merely as a production tool, but as a strategic factor in the long-term development of Ukraine’s fisheries sector. Its modernization requires a comprehensive approach, incorporating scientific, economic, and regulatory solutions adapted to market conditions and the natural environment.

Conflict of interest

The authors declare that there is no conflict of interest.

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