

UDC 636.085/087

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HIGH PROTEIN FEED MARKET: CURRENT TRENDS AND PROSPECTS FOR UKRAINE

Abstract. The research is devoted to the problem of formation of high-protein feeds market for farm animals in Ukraine in conditions of European integration processes. The problem of providing the population with high quality food is becoming more global, the demand for high protein food products of a good quality is growing as well as the need for protein-balanced feeds for livestock. The dynamics of high-protein feed production in Ukraine and EU countries has been studied. The tendencies of the high-protein feeds market formation in Ukraine are considered. By means of benchmarking, price trends in the protein feed market in the EU and Ukraine have been analyzed. Ukraine has favorable soil and climatic conditions for the production of quality, safe products as well as efficient logistic routes available. As a result of the study it was found that the key factor for Ukraine's penetration into the EU feed market is the need for high-protein feeds. The directions of solving the problem of feed protein deficiency for the needs of animal husbandry are determined. Environmental problems regarding feed quality and safety in the context of Ukraine's aspirations for European integration are substantiated. The legislative basis for ensuring the quality and safety of feed and feed resources is considered. As a result of SWOT-analysis of vegetable protein production in Ukraine, it was found that Ukraine has significant potential for the production of competitive feed protein that meets domestic needs, form high export potential and promote entry into European and Asian markets. It is emphasized that the process of Ukraine's European integration requires constant marketing research of the sectoral situation changes with account of the specific features of domestic production of high-protein feeds, highlighting key factors of Ukraine's presence and its potentialities in the EU agricultural market and outlining the prospects for its development. Increase in the performance of farm animals and margins of livestock production requires balanced diets and reduction of feed cost in the costs structure due to the use of high protein feeds. It is important for Ukraine to promote the development of the market for high-protein and bulk feeds on the industrial basis as well as the development of organic feed and livestock production. Development of the competitive feed market in Ukraine and solving of the environmental and social problems of intensive animal husbandry requires the improvement of legislation to meet the requirements of EU Directives on the production, processing and efficient use of feed resources.

Keywords: feed market, feed production, high-protein feed, protein balance, price, SWOT-analysis.

Formulas: 0; fig.: 6; tabl.: 4; bibl.: 19.

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РИНОК ВИСОКОБІЛКОВИХ КОРМІВ:

СУЧАСНІ ТЕНДЕНЦІЇ РОЗВИТКУ І ПЕРСПЕКТИВИ ДЛЯ УКРАЇНИ

Анотація. Дослідження присвячено проблемі формування ринку високобілкових кормів для сільськогосподарських тварин в Україні в умовах євроінтеграційних процесів. Проблема забезпечення населення високоякісною їжею стає все більш глобальною, зростає попит на харчові продукти з високим вмістом білка хорошої якості, а також потреба у збалансованих білками кормах для худоби. Досліджено динаміку виробництва високобілкових кормів в Україні та країнах ЄС. Розглянуто тенденції формування ринку високобілкових кормів в Україні. На основі бенчмаркінгу проаналізовано цінові тренди на ринку білкових кормів в ЄС та Україні. Потенціал України — це сприятливі ґрунтово-кліматичні умови для виробництва якісної, безпечної продукції та наявність ефективних логістичних шляхів сполучення. У результаті дослідження встановлено, що ключовими факторами присутності України на ринку кормів в ЄС є потреба у високобілкових кормах. Визначено напрями розв'язання проблеми дефіциту кормових білків для потреб тваринництва. У результаті SWOT-аналізу виробництва рослинних білків в Україні встановлено, що Україна має значний потенціал для виробництва конкурентоспроможного кормового білка для задоволення внутрішніх потреб, формування високого експортного потенціалу і виходу на європейський та азійський ринки. З'ясовано, що процес євроінтеграції в Україні вимагає проведення постійного маркетингового дослідження ситуаційних змін у секторальному аспекті з урахуванням особливостей вітчизняного виробництва високобілкових кормів, виділення ключових факторів присутності і потенційних можливостей України на аграрному ринку ЄС та окреслення перспектив його розвитку. Збільшення продуктивності сільськогосподарських тварин і рентабельності виробництва продукції тваринництва вимагає збалансованого харчування і зменшення вартості кормів у структурі витрат завдяки використанню високобілкових кормів. Для України важливо сприяти розвиткові ринку високобілкових і сипучих кормів на промисловій основі, а також розвиткові органічного виробництва кормів і тваринництва. Розвиток

конкурентоспроможного ринку кормів в Україні та розв'язання екологічних і соціальних проблем інтенсивного тваринництва вимагає вдосконалення законодавства, щоб відповідати вимогам директив ЄС щодо виробництва, переробки та ефективного використання кормових ресурсів.

Ключові слова: ринок кормів, кормовиробництво, високобілкові корми, баланс протеїну, ціна, SWOT-аналіз.

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Introduction. Modern feed production in Ukraine is characterized by the decrease in the area under forage crops, deterioration in feed quality, the decrease in production of high quality and safe feeds, and increase in the production cost. The fundamental basis for the development of sustainable animal husbandry is the supply of balanced feeding, high-quality livestock maintenance and a high level of breeding. Nowadays, feeds have become a commodity thus changing the approaches and priorities concerning the ways of developing the feed base, sources of feed supply, system of their production, preservation and their effective use for livestock and poultry feeding. In recent years, the safety and quality of feeds for livestock have become priority issues, and balanced feeding requires on-going monitoring of feed diets and conditions of livestock maintenance in accordance with EU Directives and international standards for the quality and safety of livestock products. Therefore, this research aims to evaluate the high protein feed market and to outline the prospects for its development in Ukraine.

Analysis of research. The main factors and consequences of globalization of the world agricultural production are the constant objects of research. Export capabilities of Ukrainian agricultural enterprises in international markets have attracted the attention of many researchers from various countries of the world: Ukraine (Kvasha, Kashuba, Kirilov), USA (Deiningner), Montenegro (Tangermann, Cramon,) and others. In the papers of S. Chadd, R. Davis and D. Koivisto (Great Britain), Julia Jouan, Aude Ridier, Matthieu Carof, Naylor et al (France). Scientific investigations of the authorities of domestic agricultural science P. T. Sabluk and of other scholars from the «Institute of Agrarian Economics» [1] and experts of the Institute of Feed Research and Agriculture of Podillya of NAAS of Ukraine [2—4] are devoted to the search for economic and organizational-technological reserves to increase the efficiency of production and use of feed.

Unsolved aspect of the problem. Given the dynamic character of the market environment and importance of the feed industry, there is an urgent need to further develop and substantiate strategic alternatives for the formation of the high-protein feed market. Trade integration of production and processing of high-protein crops of Ukraine in the world opens new opportunities for the development of the national agricultural sector which will help to increase the competitiveness of protein feeds in the market, in particular in Europe and Asia.

The purpose of the article. The purpose of this study is to assess the potential of Ukraine in the market of high-protein feeds and to outline the prospects for its development in the context of global economic integration processes.

Research results. Feed production is one of the most resource-intensive industries in the agricultural sector of Ukraine. It includes field and pasture farming, industrial production of feeds and protein-and-vitamin additives, waste from the flour-milling, grain production, sugar, alcohol, and oil industries.

In 2018, the share of forage crops in the EU-28 was 6.3% of the total cropping area, and it was 4.4% in 2010 [5]. While the EU countries experienced a sustainable increase in areas under forage crops, in Ukraine, on the contrary, there was a tendency towards the decrease (*Fig. 1*).

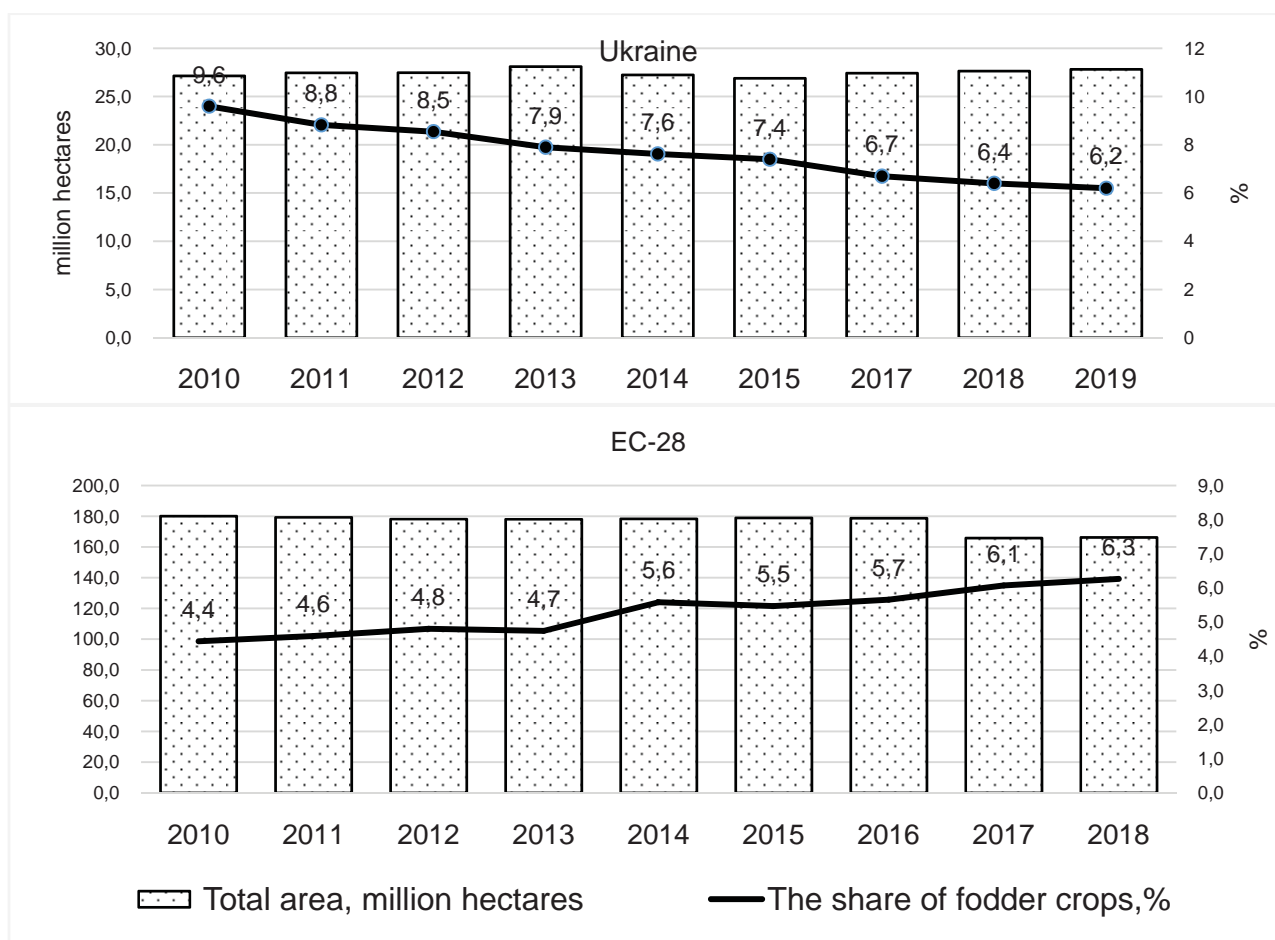


Fig. 1. Position of forage crops in the cropping areas of Ukraine and EU countries

Source: calculated by the authors [2; 6; 7].

Currently, forage crops in Ukraine account for 1.7 million hectares against 12 million hectares in 1990. The main forage crops are annual and perennial grasses, corn grown for silage and grain-forage crops (barley, corn, soybean, and pea). The analysis shows that during the period of 2010—2019, production of corn grown for grain increased significantly, almost twice, in Ukraine (Table 1).

Table 1

Dynamics of forage crop production in Ukraine, thousand tons

Crops	2010	2015	2016	2017	2018	2019	Change, %
Cereal and leguminous crops	39,271	60,126	65,952	61,283	69,800	75,078	91.2
wheat	16,851	26,498	26,027	26,110	24,586	28,301	67.9
maize for grain	11,953	23,328	27,963	24,108	35,569	35,848	199.9
barley	8,485	8,288	9,429	8,279	7,346	8,908	5.0
oat	459	489	499	471	418	422	-8.1
millet	117	213	190	85	80	170	45.3
leguminous crops	592	502	876	1,237	954	711	20.1
including pea	452	378	746	1,096	775	573	26.8
faba bean	6.8	6.5	3.2	7.4	8.3	3.9	-42.6
vetch	33.1	24.9	23.8	11	7.4	6.1	-81.6
sweet lupine	60.4	30.8	30.4	18	14.6	10.4	-82.8
Soybean	1,680	3,931	4,279	3,890	4,461	3,699	120.2
Winter rapeseed and colza	1,470	1,738	1,152	2,195	2,747	3,274	122.7
Sunflower seed	6,771	11,181	13,604	12,171	14,162	15,268	125.5
Fodder corn	7,511	6,843	6,958	6,546	6,923	6,351	-15.4

Source: calculated by the authors [7; 8].

A growing demand for high quality protein resources is one of the long-term global trends. The population of the Earth as well as the living standards is increasing. This results in higher demand for meat, milk, eggs, fish and other products, which are the sources of food protein. The main source of feed protein is legume crops (mainly soybean). Global soybean production was 358 million tons in the 2018/2019 MY. About 82% of the world’s crop production was shared by three countries, namely, the United States (34%), Brazil (33%) and Argentina (15%). In 2018, 4.5 million tons of grain of protein crops were produced in EU countries and 5.4 million tons were produced in Ukraine indicating its high raw material potential [1; 9; 10] (Fig. 2).

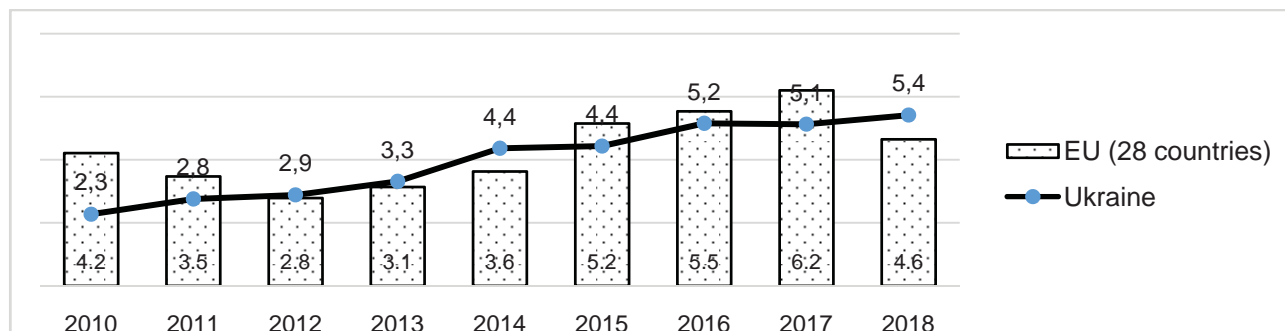


Fig. 2. Dry pulses and protein crops for grain production, million tons
 Source: calculated by the authors [1; 9; 10].

Soybean occupies an important position in the feed balance of Ukraine, and its cropping area has grown 8 times in the past 15 years. In 2019, the area under soybean occupied about 1.6 million hectares. Ukraine’s soybean production ranks 1st among EU countries and 8th in the world. It has been found out that soybean seed yield has almost doubled in 9 years, while in the EU it remains stable and amounts to 2.8—2.9 t/ha (Fig. 3).

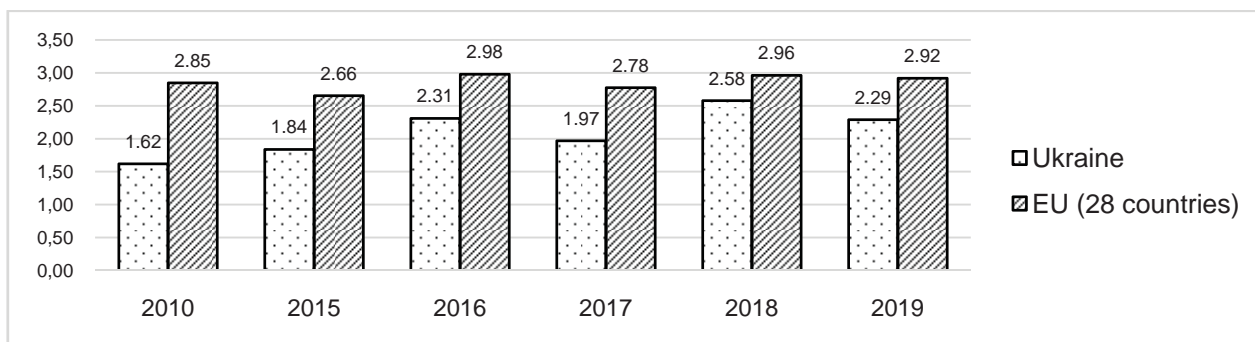


Fig. 3. Dynamics of soybean yields in Ukraine and EU countries, t/ha
 Source: calculated by the authors [3] and <https://ukrstat.gov.ua>.

The main source of feed protein in animal husbandry is the products of oilseed processing. Unlike cereals, these crops are used mainly for forage purposes. Due to its biological value, soybean protein is used more efficiently than other plant proteins when feeding livestock. Moreover, roughages are generally suitable only as the feed for ruminants.

Over the last few years, the oil market has been experiencing high development rates due to the changes in the market. In 2019, the world oil market has been shaken by natural and climatic conditions. Delayed planting in the US, droughts in Argentina and Europe resulted in the decrease in rapeseed and soybean yields. The trade war between the US and China led to a collapse in prices. A comparative analysis of soybean production and structure of use shows that its production and processing have increased in the world over the last three years, but exports have decreased. At the same time, there can be observed an increase in processing in the world by 2.6%, in EU countries by 16.8% [7] and in Ukraine by 68% (Table 2).

Table 2

Production and distribution of soybean in Ukraine and in the world, million tons

Indicators	Region, country	2017	2018	2019	Change, %
Production	World	341.9	358.3	337.7	-1.2
	EU-28	2.67	2.83	2.87	7.5
	Ukraine	3.9	4.5	3.7	-5.1
Export	World	153.1	149.2	149.2	-2.5
	EU-28	0.293	0.158	0.167	-43.0
	Ukraine	2.8	2.5	2.2	-21.4
	<i>% to production</i>	<i>71.8</i>	<i>55.6</i>	<i>59.5</i>	<i>-12.3</i>
Imports	World	153.27	145.95	147.97	-3.5
	EU-28	14.1	15.1	14.8	4.8
	Ukraine, thousand tons	9.8	5.3	3.2	-67.3
Processing	World	295.2	299.8	302.83	2.6
	<i>% to production</i>	<i>86.3</i>	<i>83.7</i>	<i>89.7</i>	<i>3.3</i>
	EU-28	13.96	15.8	16.3	16.8
	<i>% to production</i>	<i>522.8</i>	<i>558.3</i>	<i>567.9</i>	<i>45.1</i>
	Ukraine	0.878	0.987	1.475	68.0
<i>% to production</i>	<i>22.5</i>	<i>21.9</i>	<i>39.9</i>	<i>17.4</i>	

Source: calculated by the authors [7] and <https://ukrstat.gov.ua>.

Thus, Ukraine has got the potential to increase protein production, primarily due to intensification of the production of high protein crops. EU countries are crucially dependent on soybean and soybean meal imports. In 2020, EU countries imported 14.8 million tons of soybeans and produced only 2.9 million tons, which met 14.5% of their needs (Table 3).

Table 3

EU-28 Feed Protein Balance 2020, thousand tons

	Rapeseed	Soybean	Sunflower	Total
Oilseed				
Beginning stocks	1,520	2,140	891	1,520
Usable production	16,716	2,874	10,077	16,716
<i>Area (thousand ha)</i>	5,570	984	4,319	5,570
<i>Yield (tons/ha)</i>	3.0	2.9	2.3	3.0
Imports (from the third countries)	6,000	14,800	600	6,000
Total supply	24,236	19,814	11,568	24,236
Domestic use	23,136	18,546	10,240	23,136
Exports (to the third countries)	22,297	16,279	9,143	22,297
Total use	100	167	503	100
Self-sufficiency rate, %	69.0	14.5	87.1	69.0
Oilseed Meal				
Beginning stocks	50	343	100	493
Usable production	12,709	12,860	5,029	30,598
Imports (from third countries)	350	19,000	3,500	22,850
Total supply	13,109	32,203	8,629	53,941
Domestic use	12,659	31,548	8,230	52,438
Exports (to third countries)	400	314	298	1,013
Total use	13,059	31,863	8,529	53,451
Ending stocks	50	343	100	493
Self-sufficiency rate, %	96.9	39.9	58.3	56.7

Source: EU oilseeds balance sheet (2015-16 to 2019-20 overview). URL: <https://ec.europa.eu/info/food-farming-fisheries/farming/facts-and-figures/markets/overviews/balance-sheets-sector/oilseeds-and-protein-crops>.

The analysis shows that EU countries process 5.6 times more soybean than they produce, while Ukraine processes only about 40% of domestic soybean.

Today, Ukraine is considered to be Europe's feedstock for soybean production, although in recent years there has been observed a tendency towards the increase in its processing and use for the development of intensive industries. According to the estimates conducted by the scientists from

the Institute of Feed Research and Agriculture of the Podillia of NAAS, Ukraine loses about \$ 77 per ton of soybean, or about \$ 172 million, provided that there are all the necessary conditions for processing on a mutually beneficial basis for all participants of the agricultural market in Europe [11; 12]. The balance of protein crop use by EU countries in 2020 identifies the trends mentioned above [7].

Assessment of the rate of self-sufficiency with protein resources shows that in 2019 the EU met its needs for rapeseed meal by 100%, soybean meal by 41.5%, and sunflower meal by 61.3%. At the same time, the needs for oilseeds were also partially met, i.e. rapeseed by 69%, soybean by 14.5%, sunflower by 87.1%. At the same time, price trends in the world oil market were stable, although Ukraine had the lowest price (Fig. 4).

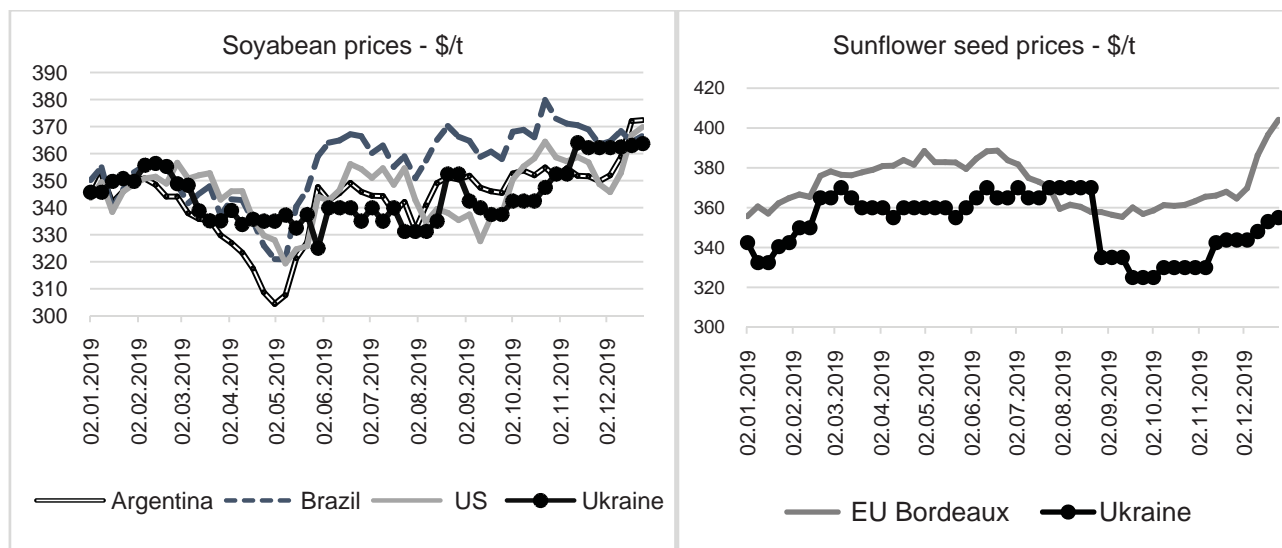


Fig. 4. Soybean and sunflower seed prices, \$/t

Source: calculated by the authors [5] and (European Commission (EC). Eurostat Data. Database. URL: <https://ec.europa.eu/eurostat/data/database>; European Commission (EC). Trade Helpdesk. URL: <https://trade.ec.europa.eu/tradehelp/statistic>).

Processing plants are the key players in the Ukrainian oil market. In 2019, processing plants of Ukraine produced about 1.2 million tons of soybean meal, including 66.7% that were exported (Fig. 5).

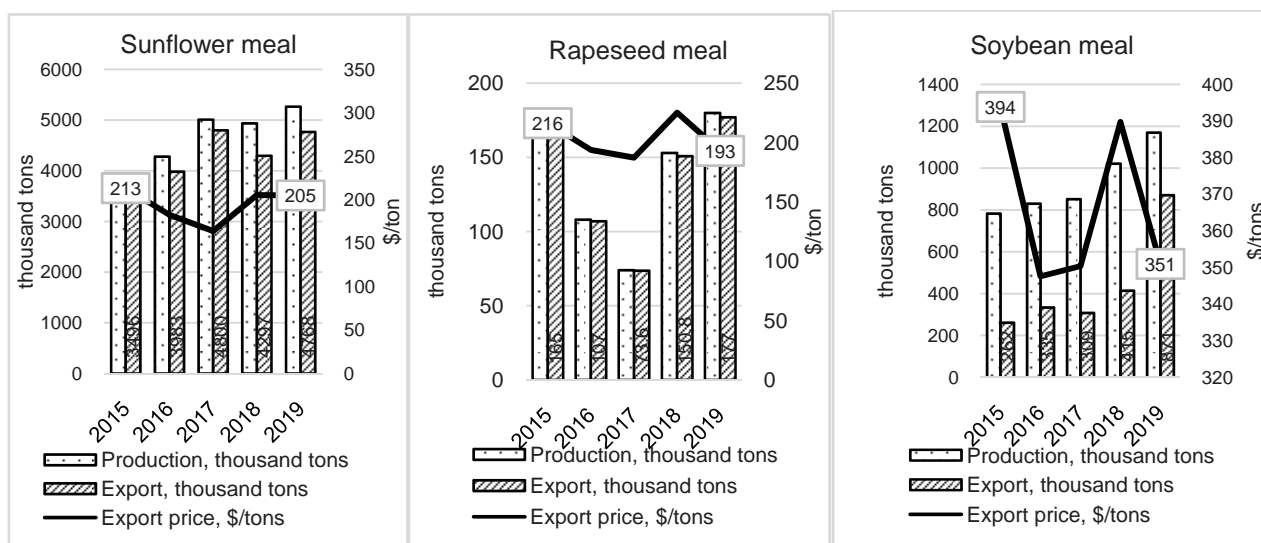


Fig. 5. Production and export of protein meal in Ukraine, thousand tons

Source: calculated by the authors (<https://ukrstat.gov.ua>).

We have noted that price trends of the market were declining for all oilseeds in 2019. Thus, the price for soybean decreased by 22%, sunflower seed by 11.6%, while it was somewhat less for

rapeseed, in particular, 4.6%. The price factor may play a negative role in the next marketing year, which will lead to a decrease in oilseed production. Over the past 5 years, prices for soybean meal on the European market have declined. In 2018, EU-28 countries imported soybean meal from the US at a price of 354 €/t, Brazil — 346 €/t, Argentina — 341 €/t and Ukraine — 331 €/t [13—16] (Fig. 6).

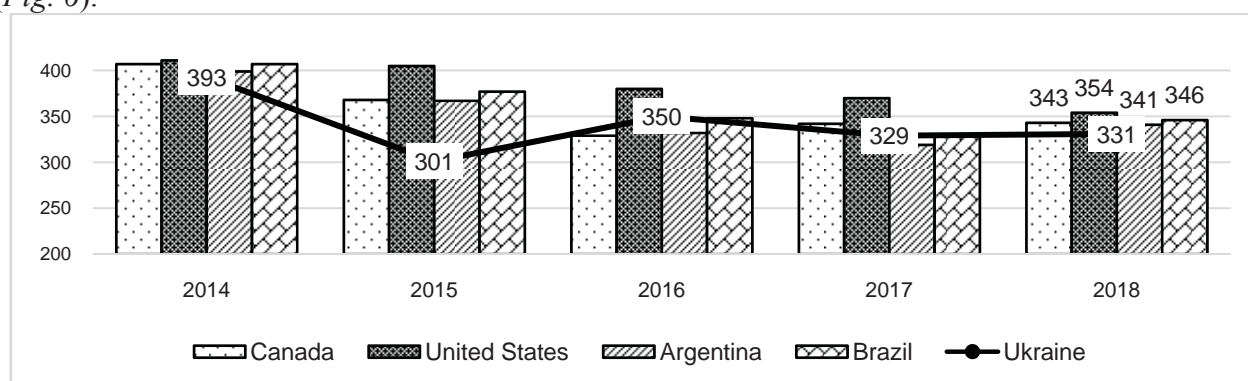


Fig. 6. Price trends for soybean meal imports by EU countries, €/t

Source: calculated by the authors (European Commission (EC). Eurostat Data. Database. URL: <https://ec.europa.eu/eurostat/data/database>; European Commission (EC). Trade Helpdesk. URL: <https://trade.ec.europa.eu/tradehelp/statistic>).

It should be noted that the fall in prices was influenced by several factors, including the world market conditions associated with the harvest forecast at the level that would not be lower than in 2018. The optimal way out for the agricultural sector of Ukraine’s economy is to increase the volumes of oilseed processing. Ukrainian agribusiness can reduce economic losses caused by adverse market conditions, primarily due to intensification of oilseed production, which will reduce the cost of production and compete more effectively not at the price of sales, but at costs. The real export potential of increasing foreign currency earnings can be fulfilled due to reorientation of the oil industry from using raw materials to using products having different degrees of processing and added value.

Nowadays, the development of oil industry in Ukraine is characterized by certain instability of production during some years (rapeseed, soybean), insufficient application of mineral fertilizers, depletion of soils and gradual decrease in their fertility [16—19]. It becomes obvious that these problems can be solved through the introduction of modern intensive and innovative technologies using high-quality seeds, science-based crop rotations, fertilizers, plant protection agents, etc.

SWOT-analysis of plant protein production in Ukraine shows that Ukraine has a significant potential to produce competitive feed protein to meet domestic needs, generate high export potential, and enter the European and Asian markets (Table 4).

Table 4

SWOT-analysis of plant protein production in Ukraine

Strengths	Weaknesses
Favorable natural and climatic conditions for the cultivation of protein crops	Lack of competitiveness without direct price support through related payments
Contribution to reducing protein deficiency in the EU (strategic aspect)	The need for the most efficient allocation of land resources
Positive environmental effect (N-fixing crops)	Reduction of the area under forage crops
Real demand in the market niche of meal (soybean, rapeseed)	Expanding of the area under market-determined crops
Lack of GMO cultivars in Ukrainian soybean breeding	
Opportunities	Threats
Combining high quality protein sources with the physiological needs of animals to ensure their high performance	Degradation of land resources as a result of anthropogenic factors
Development of feed production and animal husbandry	Competition with foreign companies as for varietal seed production
Formation of the feed market	Market dependence on the import

Source: author’s development.

Feeds hold a leading position in the system of factors affecting the competitiveness of livestock production. Adequate livestock feeding balanced by all macro- and micro-elements ensures high productivity and quality of products, contributes to reduced feed consumption per unit of production and reduces the cost of daily diets. It is estimated that protein deficiency increases the cost of 1 kg of milk at least by 10—12% [4].

Conclusion and recommendation. The world market for high protein feeds is characterized by the steady development trends. The problem of providing the population with high quality food is becoming more global, the demand for high protein food products of a good quality is growing as well as the need for protein-balanced feeds for livestock.

A modern feed market is characterized by reorientation of production of high-protein crops to solving problems of food and feed protein and a stable tendency towards the development of agricultural technologies, production and processing.

Increase in the performance of farm animals and margins of livestock production requires balanced diets and reduction of feed cost in the costs structure due to the use of high protein feeds. It is important for Ukraine to promote the development of the market for high-protein and bulk feeds on the industrial basis as well as the development of organic feed and livestock production.

Development of the competitive feed market in Ukraine and solving of the environmental and social problems of intensive animal husbandry requires the improvement of legislation to meet the requirements of EU Directives on the production, processing and efficient use of feed resources.

Література

1. Саблук П. Т., Перегуда В. Л., Білоусько Ю. К. та ін. Економіка виробництва та використання кормів в Україні. Київ : ННЦ ІАЕ, 2010. 288 с.
2. Petrychenko V. F., Kobak S. Ya., Chorna V. M. (et al.). Formation of the Nitrogen-Fixing Potential and Productivity of Soybean Varieties Selected at the Institute of Feeds and Agriculture of Podillia of NAAS. *Microbiological Journal*. 2018. Vol. 80 (5). P. 63—75.
3. Корнійчук О. В., Воронецька І. С., Рибаченко О. М. Виробництво та використання кормового білка в Україні. *Економіка АПК*. 2014. № 8. С. 26—31.
4. Концепція розвитку кормовиробництва в Україні на період до 2025 року. Вінниця : ІКСГП НААН, 2014. 12 с.
5. Oilseeds and protein crops statistics. Information on prices, EU production and trade. 2020. URL : <https://ec.europa.eu>.
6. Bilan Yu. V., Nitsenko V. S., Samoilyk Iu. V. Conceptual modeling of agri-food market development under economy's globalization. *Scientific bulletin of Polissia*. 2017. Vol. 3 (11). P. 54—61.
7. World Agricultural Supply and Demand Estimates. 2020. URL : <https://usda.gov/oce/commodity/wasde1219.pdf>.
8. Yatsenko O. M., Yatsenko O. V., Nitsenko V. S., Butova D. V., Reva O. V. Asymmetry of the development of the world agricultural market. *Financial and credit activity: problems of theory and practice*. 2019. Vol. 30 (3). P. 423—434.
9. Петриченко В. Ф., Лихочвор В. В., Іванюк С. В. та ін. Соя : монографія. Вінниця : Діло, 2016. 400 с.
10. Ostapenko R., Herasymenko Y., Nitsenko V., Koliadenko S., Balezentis T., Streimikiene D. Analysis of Production and Sales of Organic Products in Ukrainian Agricultural Enterprises. *Sustainability*. 2020. Vol. 12 (8).
11. Bazaluk O., Havrysh V., Nitsenko V., Balezentis T., Streimikiene D., Tarkhanova E. Assessment of Green Methanol Production Potential and Related Economic and Environmental Benefits: The Case of China. *Energies*. 2020. Vol. 13 (12).
12. Bazaluk O., Yatsenko O., Zakharchuk O., Ovcharenko A., Khrystenko O., Nitsenko V. Dynamic Development of the Global Organic Food Market and Opportunities for Ukraine. *Sustainability*. 2020. Vol. 12 (17).
13. Jouan J., Ridier A., Carof M. (et al.). Synergy: A regional bio-economic model analyzing farm-to-farm exchanges and legume production to enhance agricultural sustainability. *Ecological Economic*. 2020. Vol. 175.
14. Ma B. Value Shaping of Ecological Man: External Standard and Internal Idea. *Future Human Image*. 2020. Vol. 13. P. 57—65.
15. Ushkarenko Yu., Soloviov A. World Economic Order: Evolution of the Cooperative Sector. *Philosophy and Cosmology*. 2020. Vol. 25. P. 139—152.
16. Baliuk S. A., Solovey V. B., Zakharova M. A., Kucher A. V., Truskavetskyi S. R. Analysis of information support for the condition of soil resources in Ukraine. *Agricultural Science and Practice*. 2015. Vol. 2. № 2. P. 77—84.
17. Kucher A. Soil fertility, financial support, and sustainable competitiveness: evidence from Ukraine. *Agricultural and Resource Economics*. 2020. Vol. 6. № 2. P. 5—23. URL : <http://are-journal.com>.
18. Andriushchenko K., Kovtun V., Shergina L., Rozhko O., Yefimenko L. Agro-based Clusters: A Tool for Effective Management of Regional Development in the ERA of Globalisation. *TEM Journal*. 2020. Vol. 9 (1). P. 198—204.
19. Osaulenko O., Yatsenko O., Reznikova N., Rusak D., Nitsenko V. The Productive Capacity of Countries Through the Prism of Sustainable Development Goals: Challenges to International Economic Security and to Competitiveness. *Financial and credit activity: problems of theory and practice*. 2020. Vol. 2 (33). P. 492—499.

Статтю рекомендовано до друку 26.01.2021 © Петриченко В. Ф., Лихочвор В. В., Воронецька І. С., Федоришина Л. І., Петриченко І. І.

References

1. Sabluk, P. T., Perehuda, V. L., & Bilousko, Yu. K. (et al.). (2010). *Ekonomika vyrobnytstva ta vykorystannia kormiv v Ukraini [Economics of feed production and use in Ukraine]*. Kyiv: NNTs IAE [in Ukrainian].

2. Petrychenko, V. F., Kobak, S. Ya., & Chorna, V. M. (et al.). (2018). Formation of the Nitrogen-Fixing Potential and Productivity of Soybean Varieties Selected at the Institute of Feeds and Agriculture of Podillia of NAAS. *Microbiological Journal*, 80 (5), 63—75. <https://doi.org/10.15407/microbiolj80.05.063>.
3. Korniichuk, O. V., Voronetska, I. S., & Rybachenko, O. M. (2014). Vyrobnystvo ta vykorystannia kormovoho bilka v Ukraini [Production and use of feed protein in Ukraine]. *Ekonomika APK — Economics of agro-industrial complex*, 8, 26—31 [in Ukrainian].
4. *Kontseptsiiia rozvytku kormovyrobnystva v Ukraini na period do 2025 roku [The concept of development of feed production in Ukraine for the period up to 2025]*. (2014). Vinnytsia: IKSHP NAAN [in Ukrainian].
5. Oilseeds and protein crops statistics. Information on prices, EU production and trade. (2020). Retrieved from <https://ec.europa.eu>.
6. Bilan, Yu. V., Nitsenko, V. S., & Samoilyk, Iu. V. (2017). Conceptual modeling of agri-food market development under economy's globalization. *Scientific bulletin of Polissia*, 3 (11), 54—61. [https://doi.org/10.25140/2410-9576-2017-1-3\(11\)-54-61](https://doi.org/10.25140/2410-9576-2017-1-3(11)-54-61).
7. World Agricultural Supply and Demand Estimates. (2020). usda.gov/oce. Retrieved from <https://usda.gov/oce/commodity/wasde1219.pdf>.
8. Yatsenko, O. M., Yatsenko, O. V., Nitsenko, V. S., Butova, D. V., & Reva, O. V. (2019). Asymmetry of the development of the world agricultural market. *Financial and credit activity: problems of theory and practice*, 30 (3), 423—434. <https://doi.org/10.18371/fcaptop.v3i30.179821>.
9. Petrychenko, V. F., Lykhochvor, V. V., & Ivaniuk, S. V. (et al.). (2016). *Soia [Soy]*. Vinnytsia: Dilo [in Ukrainian].
10. Ostapenko, R., Herasymenko, Y., Nitsenko, V., Koliadenko, S., Balezentis, T., & Streimikiene, D. (2020). Analysis of Production and Sales of Organic Products in Ukrainian Agricultural Enterprises. *Sustainability*, 12 (8). <https://doi.org/10.3390/su12083416>.
11. Bazaluk, O., Havrysh, V., Nitsenko, V., Balezentis, T., Streimikiene, D., & Tarkhanova, E. A. (2020). Assessment of Green Methanol Production Potential and Related Economic and Environmental Benefits: The Case of China. *Energies*, 13 (12). <https://doi.org/10.3390/en13123113>.
12. Bazaluk, O., Yatsenko, O., Zakharchuk, O., Ovcharenko, A., Khrystenko, O., & Nitsenko, V. (2020). Dynamic Development of the Global Organic Food Market and Opportunities for Ukraine. *Sustainability*, 12 (17). <https://doi.org/10.3390/su12176963>.
13. Jouan, J., Ridier, A., Carof, M. (et al.). (2020). Synergy: A regional bio-economic model analyzing farm-to-farm exchanges and legume production to enhance agricultural sustainability. *Ecological Economics*, 175. <https://doi.org/10.1016/j.ecolecon.2020.106688>.
14. Ma, B. (2020). Value Shaping of Ecological Man: External Standard and Internal Idea. *Future Human Image*, 13, 57—65. <https://doi.org/10.29202/fhi/13/6>.
15. Ushkarenko, Yu., & Soloviov, A. (2020). World Economic Order: Evolution of the Cooperative Sector. *Philosophy and Cosmology*, 25, 139—152. <https://doi.org/10.29202/phil-cosm/25/12>.
16. Baliuk, S. A., Solovey, V. B., Zakharova, M. A., Kucher, A. V., & Truskavetskyi, S. R. (2015). Analysis of information support for the condition of soil resources in Ukraine. *Agricultural Science and Practice*, 2 (2), 77—84. <https://doi.org/10.15407/agrisp2.02.077>.
17. Kucher, A. (2020). Soil fertility, financial support, and sustainable competitiveness: evidence from Ukraine. *Agricultural and Resource Economics*, 6 (2), 5—23. Retrieved from <http://are-journal.com>.
18. Andriushchenko, K., Kovtun, V., Shergina, L., Rozhko, O., & Yefimenko, L. (2020). Agro-based Clusters: A Tool for Effective Management of Regional Development in the ERA of Globalisation. *TEM Journal*, 9 (1), 198—204. <http://doi.org/10.18421/TEM91-28>.
19. Osaulenko, O., Yatsenko, O., Reznikova, N., Rusak, D., & Nitsenko, V. (2020). The Productive Capacity of Countries Through the Prism of Sustainable Development Goals: Challenges to International Economic Security and to Competitiveness. *Financial and credit activity problems of theory and practice*, 2 (33), 492—499. <https://doi.org/10.18371/fcaptop.v2i33.207214>.

The article is recommended for printing 26.01.2021

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