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ПРОБЛЕМИ ТЕОРІЇ ТА ПРАКТИКИ**

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ЗБІРНИК НАУКОВИХ ПРАЦЬ

**FINANCIAL AND CREDIT ACTIVITY:  
PROBLEMS OF THEORY AND PRACTICE**

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#### **ALTERNATIVES FOR THE DEVELOPMENT OF THE BULKY FEED MARKET IN UKRAINE**

**Abstract.** The research is devoted to the problem of the ruminant bulky feed market formation in Ukraine in conditions of the world economic integration processes. The dynamics of bulk feed production in Ukraine, supply and demand in the domestic market have been studied. By means of benchmarking price trends in the hay market in Ukraine and England are analyzed. The study found that feeding ruminants will be complete only if all nutrients and biologically active substances are available in the diet in optimal quantities and ratios. Regression analysis proved the direct dependence of cow productivity on production and supply of bulk feed. It is established that Ukraine has favorable natural and economic conditions to meet domestic demand for bulk feed and for the formation of significant export potential. It was found that the integration process of Ukrainian agricultural producers into the world market requires constant analytical study of the sectorial market changes, considering peculiarities of domestic production of bulk feed, highlighting key factors of Ukraine's presence and potential in the agricultural market of Europe and Asia with account of safety and quality criteria of feed, environmental, social and economic sustainability of feed suppliers. Among the main factors improving the situation on the market of bulky feed are the following: introduction of new technologies for hay and pelleted feed production; creation of feed centers for the industrialized high-quality feed procurement and composing rational mixed diets for various farm animals; development of state programs to support feed production; formation of the legislative basis for the feed industry development; further standardization and certification of its products in accordance with international and European requirements, aimed at promoting integration in the world market and achieving sustainable competitive advantages.

**Keywords:** bulky feed market, export, hay, silage, price, benchmarking analysis, feed quality.

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## АЛЬТЕРНАТИВИ РОЗВИТКУ РИНКУ ОБ'ЄМИСТИХ КОРМІВ В УКРАЇНІ

**Анотація.** Дослідження присвячено проблемі формування ринку об'ємистих кормів для жуйних тварин в Україні в умовах світогосподарських інтеграційних процесів. Досліджено динаміку виробництва об'ємистих кормів в Україні, попит і пропозицію на внутрішньому ринку. На основі бенчмаркінгу проаналізовано цінові тренди на ринку сіна в Україні та Великобританії. Дослідженням встановлено, що повноцінна годівля жуйних тварин можлива лише за наявності в раціонах усіх поживних і біологічно активних речовин в оптимальних кількостях і співвідношеннях. У результаті регресійного аналізу доведено пряму залежність продуктивності корів від виробництва і забезпеченості об'ємистими кормами. Встановлено, що Україна має сприятливі природні та економічні умови для задоволення внутрішніх потреб в об'ємистих кормах і формування значного експортного потенціалу. З'ясовано, що процес інтеграції агровиробників України на світовий ринок потребує проведення постійного аналітичного дослідження кон'юнктурних змін у секторальному аспекті з урахуванням особливостей вітчизняного виробництва об'ємистих кормів, виділення ключових факторів присутності та потенційних можливостей України на аграрному ринку країн Європи й Азії з урахуванням показників безпеки та якості кормів, екологічної, соціальної та економічної стійкості постачальників кормів. Серед основних факторів поліпшення ситуації на ринку об'ємистих кормів виділено: упровадження нових технологій виробництва сіна та гранульованих кормів, створення кормових центрів для заготівлі високоякісних кормів на промисловій основі та формування раціонального повноцінного змішаного раціону для різних видів сільськогосподарських тварин, розвиток державних програм підтримки кормовиробництва, формування законодавчого підґрунтя розвитку галузі кормовиробництва, продовження стандартизації та сертифікації її продукції відповідно до міжнародних та європейських вимог, що зумовлено необхідністю сприяння інтеграції ринку у світовий простір та досягнення стійких конкурентних переваг.

**Ключові слова:** ринок об'ємистих кормів, експорт, сіно, сінаж, ціна, бенчмаркінг-аналіз, якість кормів.

Формул: 0; рис.: 3; табл.: 3; бібл.: 18.

**Introduction.** Complete feeding of animals is possible only on condition of availability of all nutrients and biologically active substances in the diets in optimal quantities and ratios. The diet of cows consists of bulky feed and concentrates. However, the main part should be roughage (silage, haylage, hay) of the highest quality. Bulky feeds, compared to concentrated feeds, have low energy content, but more crude fiber. Every year, more and more livestock farmers around the world try to make feeding cows fully cost-effective using maximum bulky feed and adding hay, haylage and silage to their diets. Such strategy can give high productivity and maximal energy

intake. This is primarily done due to the need to reduce production costs and increase productivity of dairy cows. Quality bulky feed determine the level of milk production, health and reproductive function of cows.

The specificity of ruminant nutrition is that high level of energy consumption and optimal nitrogen supply can be achieved through the feed rich in fiber and nitrogen-containing compounds of non-protein nature, which are not known to be used effectively enough by monogastric animals. In the nearest future, task-oriented deepening and application of scientific knowledge on organization of rational feeding of ruminants with account of production technologies, is of exceptional value [1, 2].

**Analysis of research and problem statement.** Scientific interest in production of high-quality bulky feed is growing every year all over the world. American scientists studied the importance of quality diet, in particular roughage: R. Lundquist built a pyramid of feeding ruminants [3], Jim Linn and Carla Kuehn conducted a study to assess the impact of bulky feed quality on production and cost of milk [4]. Italian scholars, including G. Borreani, D. Giaccone, A. Mimosi, E. Tabacco, made a comparative analysis of the impact of different methods of preserving hay and haylage from natural permanent meadows on milk production, chemical and microbiological characteristics and quality of final products [5]. The effect of using different types of silage on cow milk productivity was studied by scientists from Brazil — L. D. da Silva, O. G. Pereira, T. C. da Silva, S. C. Valadares Filho, K. G. Ribeiro [6]. The influence of roughage fiber content on the cost of energy intake in Holstein cows is highlighted in publication of researchers from Japan [7]. Problems of formation of farm animal high-protein feed market in Ukraine in the context of European integration processes have been studied by the scientific associates of the Institute of Feed Research and Agriculture of Podillya of NAAS of Ukraine [8].

Thus, scientists from all around the world have proven that a full-value, balanced and cost-effective feeding of dairy cattle should be based on meeting the animal body's need for energy, nutrients, minerals and biologically active substances with maximum use of bulky feed.

**Methodology and research methods.** The research was carried out on the basis of a dialectical method of cognition and systematic approach, which allowed comprehensive consideration of the theoretical and methodological principles and practical aspects of the bulky feed market development in Ukraine. When generalizing the theoretical and methodological foundations of sustainable development of the feed market, the abstract-logical, analysis and synthesis, analogy and comparison methods were used. In analytical studies carried out on the example of agricultural enterprises of Ukraine, and Vinnytsia region in particular, the methods of average and relative values, benchmarking, graphical, index, regression analysis were used.

**Unresolved aspect of the problem.** However, the problem of forming the market for bulky feed to solve the problem of rational feeding of ruminants with maximum economic effect in conditions of diversified forms of industrial livestock production development has not yet been studied. This issue is especially relevant for the farmers of Ukraine and other European and Asian countries.

**The aim of the research** is to reveal the key characteristics and features of the development of the bulk feed market in Ukraine and to identify priority areas of trade and economic cooperation in the markets of Asia and Europe.

**Results of the research.** The COVID-19 pandemic has affected many industries around the world, and feed market is no exception. Currently, most farmers in different countries stock up on fodder in the face of possible shortages in the future. Besides, other industries are contributing to the feed market development as unsold expired food may also become animal feed.

In general, the global market for animal feed is quite stable, and its projected growth between 2020 and 2024 is 4% annually. Growth rates may be affected by coronavirus problems, but the market as a whole could grow by \$ 90 billion over the next few years. Current increase in demand will benefit producers, but problems associated with working in social distancing and maintaining sanitary conditions may reduce the farm animals feed supply and, consequently, reduce its sales.

Serious water shortages in Asia and the Middle East and global growth in demand for animal protein have stimulated global trade in alfalfa hay and grass over the recent 20 years. In 2016, global demand for alfalfa hay amounted to 6 million tons, and trade volume amounted to 2.7 billion US dollars.

The leading alfalfa-producing countries are the United States, the European Union, Argentina, Russia, Canada and Australia, which cultivate 32 million hectares. Alfalfa occupies more than 4 million hectares in Latin America, namely — about 4 million ha in Argentina, 170 thousand — in Chile, 120 thousand — in Peru, 70 thousand — in Uruguay and 40 thousand hectares in Brazil [9].

The top alfalfa-importing countries are Saudi Arabia, the UAE, China, Japan and South Korea, which account for 84% of the world demand. The largest exporters are the USA, Spain, Canada, Italy and France. Farmers around the world are buying up stocks of animal feed amid growing fears that COVID-19 could disrupt the supply chain and, as a result, deprive them of the ability to feed livestock adequately. Along with the risk of rundown and closure of production, farmers are concerned that they may need to slow down or even stop the slaughtering operations due to low demand. As a result, the period of keeping and fattening animals will be increased. Declining demand for fuel also affects the supply of animal feed: for example, oilseed meal is a by-product of ethanol production and a key ingredient in livestock feed.

Ukraine has a huge potential for the development of both livestock and feed production, in particular, consolidating its position in the foreign market of bulky feed, namely baled hay and alfalfa pellets.

Rapid decline in the number of live-stock in Ukraine, which was caused by rising keeping costs, reduced consumption of livestock products by the population led to a significant reduction in forage crops sown areas. Over the 2010—2020 period, the area under fodder corn decreased by 45%, annual grasses — by 48%, perennial grasses — by 33% (*Table 1*).

Table 1

**Fodder crops sown areas in Ukraine, thousand hectares**

Name	2010	2016	2017	2018	2019	2020	2020 against 2010, %
Fodder corn	472.7	284.4	286.1	256.6	243.1	261.7	55
Annual grasses	582.5	373.1	353.3	336.8	312.3	301.5	52
Perennial grasses	1128	995	955.1	917.7	920.9	868.6	77

Source: based on [10].

According to the results of 2020, farms of all categories consumed 27.8 million tons of feed units of various feeds. Analysis of feed use data by species shows the increase of concentrated feed consumption in agricultural enterprises. During the 2015—2020 period it amounted to 17.9%, including 41.2% of compound feeds [10].

Gross harvest of bulk feed in Ukraine is declining, but since 2014 there has been an upward tendency in hay production (*Table 2*).

Table 2

**Gross production of bulky feeds in Ukraine, thousand tons**

Types of feed	2010	2016	2017	2018	2019	2020	Variance, %
Fodder corn	7511.0	6958.2	6546.2	6922.7	6373.0	6620.8	-11.9
<i>Annual grasses</i>							
hay	953.4	1018.3	992.1	940.6	903.7	821.1	-13.9
green fodder, haylage, silage, grass meal	1996.1	1274.7	949.1	982.2	913.5	877.2	-56.1
<i>Perennial grasses</i>							
hay	3237.7	3440.3	3164.0	6922.7	3242.9	2983.0	-7.9
green fodder, haylage, silage, grass meal	3592.5	3051.9	2318.2	2153.4	1967.7	1609.0	-55.2
<i>Hayfields</i>							
hay	1653.5	926.1	1227.4	988.1	1095.4	816.9	-50.6
green fodder, haylage, silage, grass meal	142.7	88.2	70.2	99.7	52.2	46.7	-67.3
<i>Cultivated pastures</i>							
hay	14.2	15.3	8.2	9.4	10.1	11.6	-18.1
green fodder, haylage, silage, grass meal	143.3	65.4	40.1	47.1	30.4	39.8	-72.2

Source: based on [10].



Production of cheap high-quality roughage and succulent feed is one of the important factors in improving economic efficiency of livestock production.

An illustrative example of the dependence of the cow milk productivity on the volume of production of bulk feed can be a study conducted in agricultural enterprises of Vinnytsia region, which is a leader in milk production in Ukraine in recent years. In 2020, in agricultural enterprises of the region perennial and annual grasses in the structure of fodder crops reached 66%, and the annual milk yield per cow made up 7306 kg. Analysis of the relationship showed that there is a strong correlation between those indicators. The results of regression analysis confirmed the hypothesis of a direct relationship between gross hay and green mass of annual and perennial grasses production, corn for silage, on the one hand and the average annual milk yield — on the other (Table 3).

Table 3

**Results of regression analysis of the relationship between bulk feed production and cow productivity, in MS Excel**

DISPLAY OF THE RESULTS								
Regression statistics								
Multiple R	0,93124							
R-square	0,86721							
Adjusted R-square	0,81030							
Standard error	166,28054							
Observations	11							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	3	1263951,1	421317,04	15,237	0,001881137			
Residual	7	193544,53	27649,218					
Total	10	1457495,6						
	Coefficients	Standard error	t-statistics	P-Value	Lower95 %	Upper95 %	Lower95, 0%	Upper 95,0%
Y-intersection	5321,63	635,68	8,37	0,0001	3818,4	6824,79	3818,46	6824,79
Hay	2,28	1,04	2,18	0,06	-0,19	4,75	-0,19	4,75
Haylage grasses	-3,25	0,74	-4,39	0,003	-5,012	-1,503	-5,01	-1,50
Silage corn	-0,53	0,83	-0,64	0,54	-2,50	1,44	-2,503	1,44

Testing of the model shows a close relationship — signification of  $F = 0.001881137$  ( $F < 0.05$ ). The economic interpretation of this model allows to state that if the use of hay increases by 1 ton, the average annual milk yield will increase by 2.28 kg; if the laying of perennial and annual grasses on haylage increases by 1 ton, milk yield will increase by 3.25 kg. The coefficient of determination is close to 1, so it approximates the data well and demonstrates a significant level of explanation of the causal relationships of the proposed model.

The market for bulky feed has emerged in Ukraine as a result of the small farms and households, and it continues to grow every year due to the growth of domestic demand for hay and silage (Fig. 1).

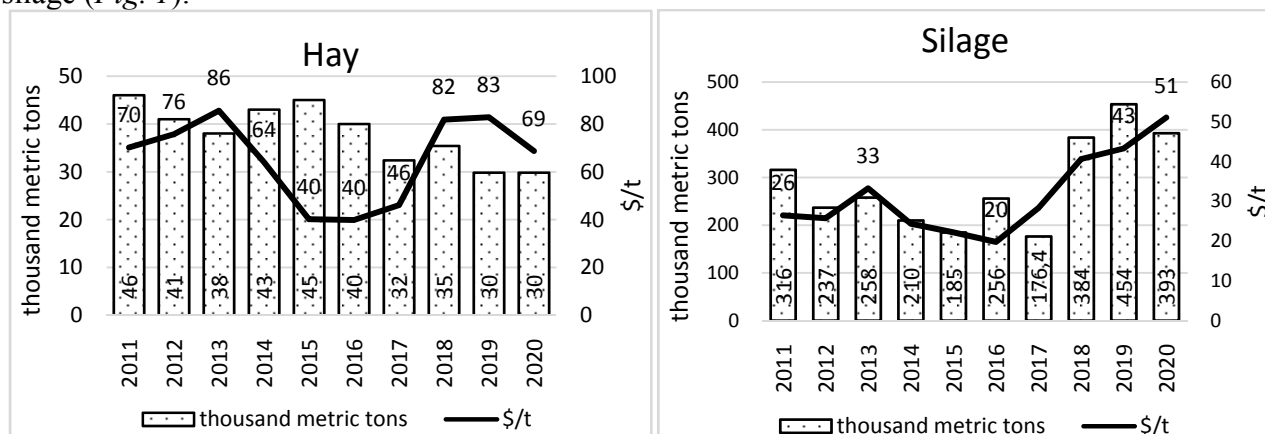


Fig. 1. Demand and prices for roughage in the domestic market of Ukraine

Source: calculated by the authors [10].

Demand for hay is growing on the world market as well. Hay is a valuable type of feed, which should make up at least 15—20% in the diet of cattle. It has been proven that this type of feed can in no way be replaced by other feeds. Alfalfa hay is in the greatest demand. World production of alfalfa hay in 2020 amounted to 235.7 million tons, and is expected to grow by 6.1% over the projected period (2021—2027) [11—13]. North America is forecasted to become the largest market for alfalfa hay. China, the UAE, and Saudi Arabia are the main importers of alfalfa exported from the United States [14].

World exports of hay (both of natural and artificial drying) in value terms is estimated at \$2.5—3 billion/year, in actual measurement — is about 9.5 million tons. Most of this volume (4.1 million tons in 2020 according to the USDA) is supplied to the global market by the USA. Ukraine is a small part of roughage exporters in this segment despite the fact that the country, with the provision of appropriate technologies, could potentially produce a significant amount of hay and pelleted feed, demanded by importers, in particular, the nearest region — the countries of the Eastern Europe. Ukraine exports hay and alfalfa pellets to the European countries (Great Britain, Poland, Greece), Asia (Turkey, Korea, Israel, Lebanon) and Africa (UAE, Egypt, Saudi Arabia) (Fig. 2).

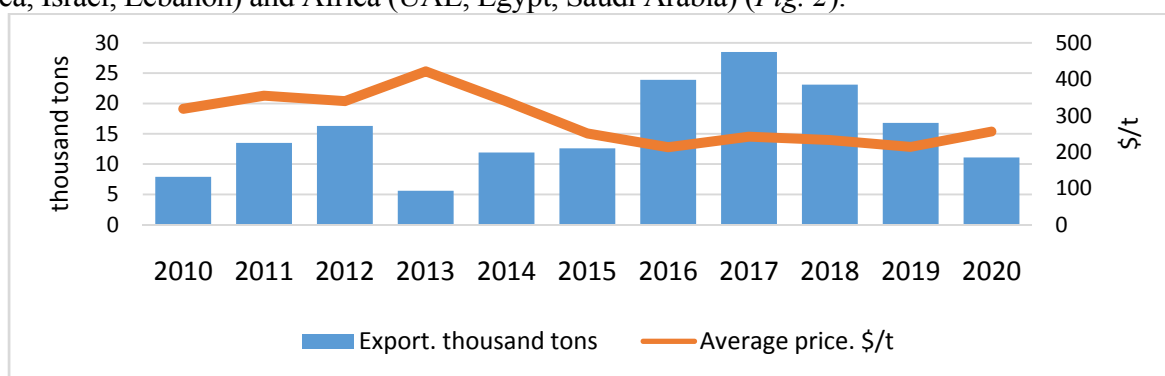


Fig. 2. Exports of hay and granulated alfalfa in Ukraine, 2010—2020

Source: based on [10].

Analysis of the data shows that the dynamics of exports of hay and granular alfalfa varies depending on natural and climatic factors, world market conditions and government policy to support the industrial production.

Bulky feeds should make up to 40% of a dairy herd diet to balance its nutrition value [15]. In conditions of limited land resources, economical use of material, technical and labor resources, small farmers are recommended to buy ready-made high-quality feed of industrial origin. A comparative analysis of price trends showed that domestic prices in Ukraine are lower than, for example, in England and Wales (Fig. 3).

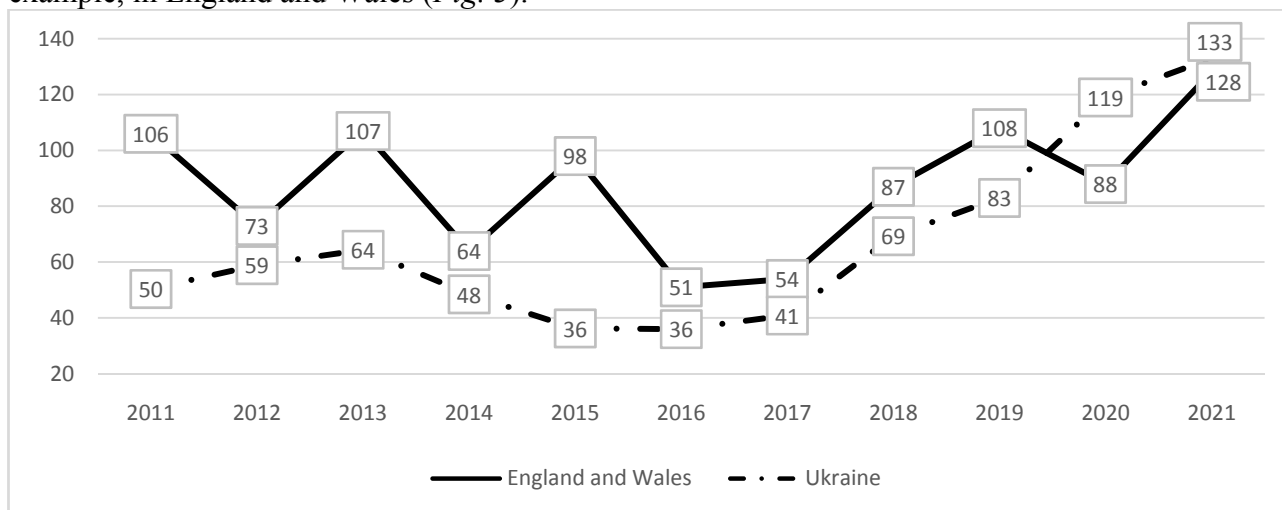


Fig. 3. Benchmarking analysis of hay prices in the domestic market in Ukraine and England (England and Wales, Ukraine), \$/t

Source: calculated by the authors [10, 16].

The price of hay usually fluctuates at the beginning of the calendar year — this applies mainly to different types of hay and assessment of its quality. In the US, the cost of hay feed, such as alfalfa, ranges from \$1—1.15 per product RFV. As a result, the most expensive alfalfa hay is large round bales, which cost about \$200 per ton. The cheapest feed, such as Sudan grass and wheat straw, is usually sold for about \$55—75 per ton [10,16].

In the present-day conditions, production of roughage is not profitable for the European and Asian producers, as there are cheaper sources of imported hay and hay silage. Therefore, support of Ukrainian producers is an important component of sustainable development of the European agricultural area, aimed at ensuring the development of crop production and improving self-sufficiency in protein in the EU, while maintaining competitive feed expenditures in the livestock sector.

Highly developed socially oriented market economy of intensive type requires radical changes in terms of strategy for the development of feed production. First of all, the strategy of socio-economic development of Ukraine provides for the growth of agricultural and industrial potential of the country. At the present stage of development of the Ukrainian economy, more and more companies are trying to establish integrated structures based on a combination of technological stages of production, processing, marketing and sale of products or savings on transactions. The expediency of integration relations development is due to a number of factors, among which is the achievement of high stability in providing processing enterprises with agricultural raw materials; development of specialization and concentration of production, providing a reduction in labor costs; reduction of production costs; more efficient use of production capacity in both industry and agriculture.

Feed production is the largest, multifunctional and system-forming branch of agriculture, which ties it together. This significantly affects not only the solution of key problems of agriculture, but also the rational use of nature, increasing the resilience of agricultural ecosystems and landscapes to climate and negative processes, soil fertility restoration, improving the ecological condition of the territory and environmental protection.

In present-day economic conditions, three main factors determine the feed safety program, namely, the legislation that establishes the optimal hygienic requirements for feed; consumer demand for quality feed for livestock; requirements for technological processes of production, harvesting, storage and disposal of feed. Today, the main business requirements in the field of feed production are the following: safety and quality of feed, environmental, social and economic sustainability of feed suppliers. That is why production of organic feed is becoming a priority issue in the EU.

Introduction of the HACCP system at the level of feed producers will facilitate current control and management of feed and feed resources. At the state level, the audit should be conducted by the system of certification and standardization in accordance with European and international directives.

In the European Union, feed safety is regulated by three areas of legislation, in particular, by the EU Regulation 178/2002 on general principles of food (and feed) legislation, EU Regulation on feed hygiene (183/2005), National rules implementing the above mentioned [17; 18].

In Ukraine, organizational and legal principles of feed safety are regulated by the following laws of Ukraine:

- «On safety and hygiene of feed», which establishes requirements for hygiene of feed, labeling, packaging and presentation in the process of their production, circulation and use, regulates the relevant social relations between market operators and government agencies;
- «On state control over the observance of food, feed, animal by-products, animal health and welfare», which defines the principles of state control of feed market operators;
- «On the basic principles and requirements for organic production, circulation and labeling of organic products», which defines the requirements for the production of organic feed.

At the same time, it should be noted that practical implementation of the provisions of legislative acts will largely depend on the timely adoption of a number of regulations provided by these laws. This is reasoned by the quite broad feed legislation in the European Union. Ukrainian laws need to be amended in line with EU regulations.

**Conclusions.** Analytical studies of the state of production, supply and demand of bulk feed in Ukraine indicate the potential opportunities for the development of domestic and foreign markets. The study confirmed that the productivity of a dairy herd is directly dependent on the use of bulky feed in the diet of cows. Natural, climatic and economic conditions of Ukraine are favorable for meeting domestic demand for bulky feed and acquiring access to the world market. Foreign trade turnover between Ukraine and the countries of Asia and the EU has grown significantly. Ukraine's foreign trade is characterized by an excessive share of primary goods and a low level of intellectualization of trade relations, which marginalize its role in the world economy development.

Based on the analysis of feed exports from Ukraine, one of the most promising areas for the export of roughage is European (Poland, Greece, Spain) and Asian countries (Turkey, Republic of Korea, Lebanon, Saudi Arabia, Egypt, Israel, Kuwait). According to the research, climatic conditions in those countries do not allow growing feed to fully meet their own needs in feeding farm animals.

Today, there is a number of problems in the bulky feed market activity in Ukraine. This negatively affects the qualitative and quantitative characteristics of both the state of the industry and development of the agricultural sector as a whole. Further improvement of the situation in this segment can be observed at the following conditions:

- introduction of new technologies for growing and harvesting hay, production of granulated feed;
- control of the safety of feed resources in order to ensure the ecological safety of feed (together with the analysis of nutritional value). Control of the content of nitrates, heavy metals in the soil, water and feed, taking into account the maximum allowable concentrations, should be mandatory;
- creation of feed centers for procurement of high-quality feed on an industrial basis and formation of a rational full-fledged mixed diet for different species of farm animals;
- development of state programs to support feed production in Ukraine;
- opening new export opportunities for fodder products of Ukrainian origin.

The primary task in forming a bulky feed market now is to create a legal basis for the feed industry development, continue standardization and certification of its products in accordance with international and European requirements. This is necessitated by the need to promote market integration in the world and achieve sustainable competitive advantages, adaptation of formal institutions to the external and internal changes. It is important to investigate a systematic approach that can ensure the synergy of scientific, natural, economic factors in combination with the necessary organizational and technological measures and provide conditions for satisfying the interests of all actors in the domestic market of bulky feed.

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