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TOWARDS SUSTAINABLE DEVELOPMENT AND FOOD SECURITY VIA MIXED FODDER PRODUCTION*

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Abstract. One of the main strategic tasks facing the industry is to ensure the competitiveness of domestic agricultural products, which can be achieved only based on the development of highly effective innovations in producing mixed fodder. At present in the country, the mixed fodder industry is developing in two directions: the first one includes - capacity building of large enterprises, which fully provide industrial poultry farming and animal breeding with mixed fodder (poultry farms, large livestock complexes for the production of pork, beef and milk), breeding livestock and fish farming, as well as produce and supply agriculture with protein and vitamin supplements (PVS) and premixes. The second includes the production of mixed fodders and fodder mixtures for cattle and pigs in agricultural fodder shops and factories using their raw materials, mineral supplements, and premixes of the industrial output. There are three main groups of production relations: socio-economic, organizational-economic and technological, characterized by both the way of appropriation and the way of organization of agro-industrial production as a whole, hence the whole range inherent in the agro-industrial complex. Organizational-economic relations are the central link in the overall system of production relations since they are formed and function not within but at the junction of production relations and productive forces. Organizational and economic relations are most susceptible to changes in the technical and economic basis of agro-industrial production and the forms of its organization. They have to be shaped to facilitate innovative transition towards sustainable development and food security via strengthening the mixed fodder production industry.

Keywords: innovations; food security; agriculture; fodder industry; animal breeding; raw materials; feed grain; enterprises; mechanism; regulation; interaction; products; Kazakhstan

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1. Introduction

In recent years, the state of Kazakhstan's agro-industrial complex's mixed fodder industry and new, sustainable trends in its development have attracted the close attention of domestic economists. Domestic mixed fodder production belongs to the agroindustrial complex's dynamically developing and perspective sectors.

More and more Kazakhstani enterprises working in the livestock industry realize that using high-quality, balanced fodder affects the competitiveness of their products (Kaliev & Moldashev, 2021). The volume of fodder production, quality, and cost are the primary factors constraining the accelerated development of domestic livestock breeding. In addition, at the state level, the expansion of mixed fodder production is associated with the solution of the problem of import substitution of livestock products and the development of other related areas of the economy.

Such interrelation of the compound feed industry' with other spheres of agricultural production excludes the possibility of its one-sided study. It makes it necessary to conduct a more detailed analysis of the industry as part of the organizational and economic relations system. Thus, as well as in many other spheres of the economy, in these relations, it is necessary to consider the economic interests of subjects, realized through contractual, price, credit and state regulation (Zhiyentayev & Dosmukhamedova, 2019).

Specifically, in the mixed fodder industry, there are many economic problems, solution of which in conditions of increasing economic opportunities of Kazakhstan, increase of state support of mixed fodder producers, well-thought-out strategy of development of agriculture based on intensification and technological renewal can lead to such growth of mixed fodder industry, which will allow to meet internal needs of agro-industrial complex and turn the country into the largest exporter of mixed fodder and foodstuffs.

It is necessary to bring technical and organizational-technological factors in line with the institutional environment of the agro-industrial complex to achieve long-term success and sustainable economic growth in the feed industry.

The study's relevance is predetermined by scientific and practical interest in many existing research and economic problems in the structure of organizational and economic relations in producing and selling mixed fodder products as a unified system. Existing in a particular economic space, the development of organizational and economic relations in the production and sale of mixed fodder leaves open and needs to fully work out provisions in this area of the agro-industrial output.

2. Literature review

Many works of domestic and foreign scientists present theoretical, methodological and applied aspects of the study of feed industry development, structure improvement, and construction of organizational and economic mechanisms of its functioning from different positions.

There is all strand of literature devoted to problems of formation and development of grain-product subcomplex of agroindustrial complex.

In their recent paper, Omarbakiyev et al. (2023) focus on regional integration allowing to enhance sustainable agriculture practices implemented in Kazakhstan's agro-industrial complex to improve food security and reduce the environmental impact of agriculture. They emphasize food security by introducing sustainable agriculture practices, such as crop diversification, conservation agriculture, integrated pest management, and drip irrigation.

Barde et al. (2022) analyze challenges related to the rational use of resources needed for fodder production and stress the importance of production technologies. Yegorov and Batietskaya (2019) highlight a need for modern feed industry development based on expansion to the granulation process in the conditions of production intensification.

Rodionov et al. (2019) highlight the unique role of innovative development of grain products subcomplexes in enhancing food security.

Svitovyi et al. (2018) stressed that it is necessary to get the maximal added value in the grain industry by developing a grain product subcomplex when the complex development of the subcomplex and agro-industrial complex is integrated. The authors claim that particular attention should be paid to strengthening vertical and horizontal integration and developing cooperation in the grain product subcomplex facilitated by targeted state regulation.

Zghurska et al. (2022) claim substantial unused potential for land, labour, biological and other resources used in agriculture. Novel technologies and information management systems would allow to unleash that potential and enhance the sustainable competitiveness of agriculture.

Zhovnovach et al. (2023) point to the role of accomplishment of an agricultural enterprise's management system and the need for controlling to balance financial flows between all links of the agro-industrial complex.

Problems of formation and development of the grain-product subcomplex of the agroindustrial complex have been discussed in the works of many scientists, e.g. Vermel (1986), Stukach et al. (2022), Pilipuk (2022), Bogomolova & Kotarev (2019), Mizanbekova et al. (2021), Savostin et al. (2021), Gim et al. (2023). Studies in this direction in Kazakhstan are conducted by Kaliev & Moldashev (2021), Satybaldin & Zhunisbekova (2017), Iztaev et al. (2019), Tireuov et al. (2019), Akimbekova et al. (2023), Kalykova (2020), Taubayev et al. (2022).

The authors mentioned above in their studies have extensively covered the theoretical and methodological basis of the problem under consideration. However, many actual questions of the development of mixed fodder production at present, conditions and possibilities of development of connections of mixed fodder industry in grain-product subcomplex, and modern features of interaction of enterprises of mixed fodder industry with branches still need to be studied.

3. Research methodology

Organizational and economic relations should be considered fundamental in the study and analysis of the functioning of any economic system, including the agro-industrial complex because its essential content is always the links through which they are realized.

As a rule, three main groups of production relations are distinguished: socio-economic, organizational-economic and technological. They characterize the appropriation and the organization of agro-industrial production, hence the whole range inherent in the agro-industrial complex.

Organizational-economic relations are the central link in the overall system of production relations since they are formed and function not within but at the junction of production relations and productive forces (Stukach et al., 2022; Aslaeva, 2022).

It is organizational-economic relations that are most susceptible to changes in the technical and economic basis of agro-industrial production and forms of its organization and are sensitive to them and, in turn, directly affect the improvement of productive forces.

These relations are formed as a complex system of interaction between diverse subjects of economic activity (individual producers, collectives, social groups, regions, states) concerning various kinds of production resources, including the appropriation and subsequent organization of their production, exchange, distribution and consumption. In contrast, the mechanism of realization of economic relations is a system of interconnected organizational and economic levers and incentives between the co-producers, collectives, social groups, regions and states.

Organizational and economic relations in the agro-industrial complex have many features. First, they reflect and improve the interaction at all stages of the production process and thus contribute to the orientation of each industry involved to the final goals. Secondly, these ties mediate not only relations of exclusively economic order but also production organization and management relations. Moreover, this aspect of economic inter-branch ties is increasingly intensified with the division of labor, specialization and concentration deepening.

At the basic level, specialization and concentration of production determine the development of a vast and complex system between production units - agricultural, industrial, procurement, trade and others, interacting to achieve a high final result and constituting the organizational and production basis of the agro-industrial complex.

At the same time, enterprises, having economic independence and carrying out their activities in the interaction process, strive to achieve and realize internal interests. Consequently, the links between enterprises are designed to promote the realization of the whole group of production-economic relations. Economic relations of economic entities in the agro-industrial complex, by the nature of their content, can be divided into: relations of commodity producers with the state, relations between enterprises within the industry and relations between the spheres of the agro-industrial complex.

By the nature of production relations with agriculture, the feed industry is unique. Receiving from producers of agricultural products the central part of raw materials processed by it, it almost wholly directs its production to agricultural production.

The interaction under consideration can be subdivided into closed and open-ended. The first type of interaction is understood as one in which mixed fodder is fully returned to those agricultural enterprises that supply feed grain for its production.

The second type is more complicated: raw materials for mixed fodder production are supplied by some enterprises, and others receive mixed fodder. Earlier, at the centralized distribution of mixed fodders, both types of interaction took place. Raw materials were mainly centrally distributed between enterprises of mixed fodder industry and mixed fodders between farms. In conditions of a market economy, the second type of interaction prevails. In conditions of deepening of territorial specialization of agriculture, it is possible to expect, on the one hand, the formation of more specialized grain farms, commodity products of which will be not only food, and sometimes mainly fodder grain; on the other hand, deeply specialized intensive livestock farms, which do not have resources of fodder grain, but consume significant masses of mixed fodder. The problem of economic interaction between agriculture and the compound feed industry comes down to the sustainable provision of compound feed factories with grain and other agricultural raw materials and obtaining from them the necessary quantity of assortment and quality of compound feed products. An increase in the share of feed grain in the balance of fodder is characteristic of most economically developed countries of the world in specific periods of their development (Petrikov, 2018; Akimbekova et al., 2023).

This process is based on two factors. One of them is the increase in the share of grain-consuming branches of livestock breeding, pig breeding and poultry farming (Yesengalieva et al., 2021). The other factor is the intensification of all livestock breeding units, a part of which is the transition to intensive feeding. In the abundant rations of livestock and poultry, the role of grain fodder is determined by the fact that an increased content of energy and digestible nutrients per weight unit of feed characterizes them.

The volume of processed grain raw materials in the feed industry is small, a significant part of the forage grain. Utilization of production capacities in regions of the country fluctuates in limits 55 - 88 %, which specifies the presence of unused reserves on an increase of production of mixed fodders at operating enterprises. The efficiency of grain raw materials utilization at processing is caused by protein additives and the structure of raw materials allocated for processing. The structure of grain-forage raw materials used in mixed fodder needs to be more rational and correspond to the necessary animal breeding of the republic, taking into account the structure of the herd (Tireuov et al., 2020).

Thus, in the total balance of grain components, the specific weight of corn is only 6 %, leguminous crops 0.1 %, against 35 and 5 % according to the norms, which meets the need for them by 34 and 42 %, respectively (Tireuov et al., 2020).

As a result, they are usually replaced by other types of grain crops. Using high-protein Kazakhstani wheat, a valuable food raw material and export commodity, for fodder in conditions of unsatisfied demand for it seems economically unwise.

4. Results and discussion

Feed grain, being the basis of livestock production and a constituent predominant part of raw materials for the feed industry, thereby forms inter-branch proportions of agro-industrial output, determines the development of the entire grain market and has a high socio-economic significance both for the country and for its regions, regardless of whether they are producers or consumers of feed grain.

High efficiency of feed grain utilization with a simultaneous increase in the volume of its domestic consumption in economically developed countries, their active protectionist export policy contributes to the rise in their production of livestock products for their large-scale export and building up grain export potential.

The feed grain market can be characterized as a set of organizational and economic relations through which it is bought and sold. It covers all types of transactions for selling feed grain with the participation of sellers and buyers to better provide livestock grain and fodder resources by maximizing the use of its production potential of a particular territory and rational organization of feed grain promotion from the producer to the consumer.

It follows that the market of forage grain is a rather complex multifunctional, multi-purpose and dynamically developing economic system, operating primarily within the boundaries of a specific territory, on which the system of economic relations and dependencies between economic entities of the market is carried out, taking into account the characteristic regional features of economic development, grain farming, livestock and fodder production, the level of income of the population and its solvent demand for food products.

Since grain-forage crops are relatively less demanding to cultivation conditions, the area of distribution of their main species is much broader than that of food crops (Tireuov et al., 2020; Savostin et al., 2021) This determines the possibility of achieving a higher level of self-sufficiency of the regions, and, consequently, relatively less dependence of the internal regional market of feed grain on the development of interregional exchange. However, in the system of

grain production in all regions of grain cultivation, forage crops, in comparison with food crops and especially bread crops, as a rule, are assigned a secondary role. But even with this "discriminatory" position, their yields exceed many food crops' levels, indicating a relatively high potential for fodder crops. At the same time, everywhere in the sphere of commodity circulation and interregional exchange receives a significantly smaller part of the gross harvest of grain-forage crops than food crops because about one-third of grain-forage remains in farms for intra-production consumption.

The feed grain market's peculiarity is that it depends to a greater extent on implementing domestic socio-economic and agro-food policy (Tireuov et al., 2020; Radchenko et al., 2023). Demand for feed grain is derived from the need for food products of animal origin, which, in turn, unlike the demand for bread and bakery products, and hence for food grain, has a high elasticity of prices and incomes of the population. If, in conditions of a sharp decline in revenues of the population, consumption of bakery products remains relatively stable with stable demand for food grain, the need for feed grain drops significantly due to a decrease in the level of consumption of food products of animal origin, reduction of livestock and poultry. There are also many specific features of the feed grain market related to the nature of its use.

Thus, the volume and structure of grain forage consumption have a relatively well-defined sectoral specificity, which is determined, on the one hand, by the level of livestock production and biological characteristics of the animal organism, and on the other hand, by the possibilities of satisfying the needs of livestock in high-grade fodder through the development of all fodder sources. At the same time, the efficiency of feed grain utilization is in close interrelation and interdependence with the level of development of the markets of mixed fodder, cake and meal, meat-bone and fish meal, protein-vitamin mineral supplements, and premixes. Specific features of grain forage are also expressed in the system of indicators for comparative assessment of fodder qualities of certain types of grain crops and efficiency of concentrated fodder utilization.

The state can use economic measures to improve the structure of raw materials for the feed industry (Tireuov et al., 2020). For example, a practical effort is the stimulation of expansion of sowing of legume-grass mixtures, rape, soybean, lupine, pea and other fodder crops. They give comparatively balanced forage in terms of protein, reducing the consumption of concentrates in the structure of the diet, exceeding the recommended norms by one and a half to two times, but increasing the marketable resources of feed grain. As the quality and cost of mixed fodders, to a great extent, depend not only on the optimum presence of vegetables but also animal protein, the granting of privileged credits or state subsidies for the construction of shops on utilization of wastes in the enterprises of meat and dairy industry and their deliveries to mixed fodder plants can become an effective measure.

An important direction of state regulation should be the strengthening of material and technical base and promoting the introduction of achievements of scientific and technological progress in producing and processing fodder grain (Zhiyentayev & Dosmukhamedova, 2019). Moreover, these measures should cover the enterprises of the first sphere of the grain-product subcomplex, supplying it with the necessary means of production for which differentiated tax and credit privileges can be provided. One of the tasks of state regulation of the feed grain market is to create conditions for grain-producing farms that would minimize the possibility of all types of risk (Kalykova, 2020).

One of the ways to solve this problem is to expand insurance of production activity, for which it is necessary to strengthen the organization of insurance state or commercial companies, which would assume part of the risk and reimbursement of losses to farms in the performance of their activities, which occurred due to the occurrence of certain adverse circumstances. The feed industry in Kazakhstan today is one of the most dynamically developing. In 2022, there was a growth of about 260% (compared to 2021) in exports of mixed fodder.

There is approximately twofold growth based on the dynamics of external supplies in January-February of this year. At that, the industry has enormous unrealized potential, first of all, on consumption inside the country. There is a vast potential for the production of mixed fodder inside Kazakhstan. Many farmers in farms try to produce fodder for animals themselves. At first glance, mixed fodder seems more expensive, but its use is much more profitable - costs are lower, and the digestibility of animals is higher; as a result, the cost of meat is lower. However, it is more profitable for farmers to sell grain and buy mixed fodder for animals; in this case, the domestic market of mixed fodder will develop more widely, and rural producers will receive sums for grain and meat (due to reduced production costs).

The most important task of the state is to promote the use of grain forage only in processed form and to reduce the cost of mixed fodder, which can be solved in two main directions: through the promotion of the organization of integrated associations and technical re-equipment and modernization of mixed fodder enterprises. The creation of integrated formations uniting producers of grain and mixed fodder, poultry farms, and livestock complexes (farms) will allow to reduce overhead costs significantly, adapt the structure of production of fodder grain to the system of needs in it, to provide guaranteed sales of products, to link payment for mixed fodder with the increase in productivity of livestock and poultry from their use. Realizing the second direction is connected with the perfection of technology in manufacturing mixed fodders, improving their quality, and increasing of payback of output of animal breeding production (Satybalidin & Zhunisbekova, 2017).

The sustainable functioning of the association requires solving the following problems: conducting marketing research; carrying out decoupling of non-payments among participants; coordinating commodity flows of production and also to stimulate production and realization of its surplus outside the association; introducing the system of the state order with the use of bills of exchange and securities, other issuers of the market; to distribute rationally the budgetary funds directed on support of agricultural commodity producers; to attract to cooperation with the agricultural producers.

The creation of such an association allows to solve more effectively the questions of increase in the volume of sale of forage grain by its producers to the fodder enterprise; expansion of raw material zone; improvement of mutual settlements between the fodder enterprise and grain-producing farms; increase of profitability of all participants of the association. However, between producers and consumers of mixed fodders, normative indicators should be worked out defining guarantees of sellers and protection of the economic interests of consumers of mixed fodders (Vermel, 1986). First, such economic relations can be established between mixed fodder enterprises and large consumers of mixed fodder - poultry farms, pig breeding complexes, fattening and breeding farms. Thus for the association of mixed fodder enterprises with large agricultural consumers, it is possible to recommend three primary variants of economic relations.

As applied to poultry farms, for example, they look as follows: a mixed fodder factory supplies full-fledged mixed fodders to a poultry farm, which uses them without finalization; an assorted fodder factory supplies unbalanced mixed fodders to a poultry farm, which has its protein raw material and finalizes them on the principle of one recipe calculation; a mixed fodder factory supplies to a poultry farm an address protein-vitamin concentrate, based on which full-fledged mixed fodders are produced in a fodder shop of a poultry farm.

For the industry to develop actively and systematically, the state must stimulate farmers' use of industrial mixed fodder for some time. It is necessary for buyers to feel the benefit and return from mixed fodder to create this market. In this regard, it is required to subsidize farmers' purchase of industrial mixed fodder.

In the Taiynshinsky district of the North-Kazakhstan region, a new feed mill with a capacity of 72 thousand tons of finished products per year is functioning. High-protein fodder and balanced ration are the basis for obtaining quality milk and meat; a new direction is being developed due to the opening of new production facilities.

Opening the new plant will provide local rural producers with mixed fodder without importing products from outside. "Karaganda-Osetr" Company 2022 operated a mixed fodder plant to produce, and process granulated enriched green fodder for fish and farm animals.

The capacity of the enterprise is 365 thousand tons of products per year. The cost of the project is estimated at 27 billion tenge for 2021-2022; up to 1 thousand jobs have been created at the plant; in Ushtobe village, the enterprise "Karaganda-Osetr" with the capacity to supply up to 5 tons of caviar and 100 tons of meat of marketable sturgeon fish per year.

By 2023 it is planned to increase the output volume to 20 tons of caviar and 300-350 tons of sturgeon meat per year. A new feed mill was opened in Yesil district (Akmola region). The main direction of activity of the partnership "Rau Agro" - is crop and livestock farming, agricultural lands are sown with oilseeds and grain crops, and the number of livestock is more than 400 heads.

The capacity of the new feed mill is 2.5 tons per hour; they produce a complete ration of mixed fodder for all types of livestock. Raw materials for production are delivered from the fields of agricultural enterprise, which significantly affects the cost of finished products; the equipment was purchased in Germany and Russia, the purchase of which was invested to the amount of more than 370 million tenge, the production of mixed fodder in a loose form, in the future transition to pelletized production.

All processes at the plant are automated, and seven people are involved in the work. Despite small volumes of production, the new mixed fodder plant is popular among the population of the Akmola and Kostanay regions of Kazakhstan.

In the North-Kazakhstan region, a new mixed fodder plant - a large enterprise in the country, its production capacity - 360 thousand tons of finished products per year - was launched. Due to the commissioning of the plant and the launch of the second line at the resumed last year "Biokhim", the region expects to process more than 1 million tons of grain this year. KAZMEAL's feed mill is located in Novoishimskoye (North Kazakhstan region).

The project was implemented entirely at the expense of private investment; the project cost amounted to 4 billion tenge. Half of the funds were invested by PRC investors, in the region of 600 thousand tons was grain processing; due to this enterprise annual volume of processing will be much higher, will be increased grain processing capacity at the plant "Biochem", launched a second line, will double the volume of grain processing. The international quality standard ISO 22000 in the field of food industry safety has been implemented at the plant, the characteristics of mixed fodder have been checked in the laboratory, trial batches have been delivered to the PRC, and they meet their requirements.

World and domestic experience show that with the population's increased consumption of food products of animal origin, the country's grain supply shifts from its food part to the feed component.

Earlier, the passport "Creation of feed mill" was added to the mechanism of subsidizing for reimbursement of part of the costs incurred by the subject of agro-industrial complex in the course of investment investments. The share of repayment of investment investments amounted to 25%. The mixed fodder plant of "BaiserkeAgro" LLP (Almaty region) produces products which are a complex, homogeneous mixture of purified and ground to the required coarseness of various fodder products, providing for an optimal combination of components, at which gluten is provided among the highest effective utilization of the nutrients contained in them.

In a mixed fodder shop, the production is produced without introducing proteins or vitamin additives into mixed fodder, which provides an opportunity to reduce the cost of production. According to the customer's requests,

pilot batches of mixed fodder (for birds, cattle) can be produced in the prescribed manner. The mixed fodders are produced as a loose mass of the required coarseness. The monthly capacity is 3000 tons.

An essential part of the relationship in the production of agricultural products is the realization of feed grain to feed mills and mixed fodder to agriculture.

The conditions of these supplies are primarily determined by the size of feed mills and their location in relation to the raw material base and consumers of mixed fodder.

In the mixed fodder industry, more than one-third of capacities fall on the share of enterprises with 300-600 t/day productivity. In the country, the enterprises of mixed fodder industry prevail, the percentage of which in production has reached almost 88%. The existing distribution of grain production and livestock supply of raw materials for mixed fodder production is carried out mainly by farms in Northern Kazakhstan, and the central part of consumers of fodder grain-mixed fodder plants are located in other zones of the republic. In this connection, significant volumes of intra-republican transportation of grain forage are inevitable.

The placement of the fodder industry does not correspond to the number of livestock in different regions, which leads to irrationality, increasing the cost of production and transportation of mixed fodder. Constant targeting of enterprises to search for the most efficient production options is the main advantage of the competitive market system. Enterprises produce what consumers demand, applying perfect technology and available product enrichments—the market system of economic management functions without state regulation (Table 1).

Possible production relations and interrelations of grain-producing farms and large feed milling enterprises serving them are developed. These industrial relations have found specific realization in the practical activity of the enterprises. In prospect, in the process of improvement of mechanisms, the appearance of new technical means of production, and expansion of raw material base for the production of protein-vitamin additives (PVA), these offers should receive broader development and provide needs of industrial animal breeding and poultry farming for all age groups and species.

One of the strategic tasks facing the industry is to ensure the competitiveness of domestic agricultural products, which can be achieved based on mastering highly effective innovations in the production of mixed fodders, which account for up to 70% of the costs in the cost of poultry and livestock production (Mizanbekova et al., 2019, 2022). Table 1 shows the recommended possible variants of using fodder grain of farms for processing into mixed fodder in modern conditions.

Table 1. Proposed main directions of the utilization of fodder grain of farms for mixed fodder production

Forms of attraction of fodder grain of farms for processing into mixed fodder at large specialized feed mills (shops)	Possible options of using fodder grain of farms for the production of mixed fodder, or exchange for mixed fodder
1. Purchase of feed grain from farms for mixed fodder production	1. Grain processing at in-house feed mills using enrichment mixtures
2. Exchange of mixed fodder for fodder grain of farms	2. Processing of farm grain at inter-farm feed mills
3. Processing of grain of farms on tolling terms	3. Grain processing at large specialized feed mills (shops) on tolling terms
4. Production of enrichment mixtures and their supply to feed mills of farms	4. Exchange of grain for mixed fodder at large specialized feed mills (shops)
5. Sale of mixed fodder to other farms	5. Realization of grain and purchase of mixed fodder at feed mills (shops) or through intermediaries

Source: Compiled by the authors

At present in the country, the mixed fodder industry is developing in two directions: The first one is capacity building of large enterprises, which fully provide industrial poultry and livestock farming (poultry farms, large livestock complexes for pork, beef and milk production), pedigree livestock breeding and fish farming with mixed fodder, as well as produce and supply protein and vitamin supplements (PVS) and premixes to agriculture; the second - production of mixed fodders and fodder mixtures mainly for cattle and pigs in agricultural fodder shops and factories using own raw materials, mineral supplements, premixes of the industrial output.

Quality resource support is the component of the proportionally-balanced development of economic entities of grain-processing and livestock farms as constituent structural elements of grain and meat-product subcomplexes. It should be noted that the connecting link of these subcomplexes along the line of the functional-technological chain is feed production.

Different raw materials are used to manufacture mixed fodders: vegetables, animals, and minerals, based on the production of microbiological, chemical and organic synthesis. The primary raw material for mixed fodder production in Kazakhstan is fodder grain.

In recent years, Kazakhstan actively develops dairy cattle breeding and poultry farming, so the need for fodder will grow. A significant share of mixed fodder is consumed by the poultry industry (53%), pig breeding (39%), cattle (Cattle) and small cattle (5% and 2%, respectively) (Tireuov et al., 2020).

However, the prospects of the feed industry in Kazakhstan are more comprehensive than the domestic market. Among the opportunities for industry development are supplies to China, Central Asian countries, Iran, and Turkmenistan.

As tools for the development of these markets - substitution of raw material exports (wheat, barley, corn) in the importing countries by ready mixed fodder through the return of subsidies for transportation costs, obtaining permission from the state services of China for the import of mixed fodder, the development of appropriate infrastructure (pelleting) and diversification of formulas. (Mishurov et al., 2019). Increasing livestock production is one of the main tasks of Kazakhstan for the next decade. The main in its fulfilment is the organization of industrial livestock breeding based on strengthening of fodder base and mixed fodder industry.

More than 70 kinds of raw materials are used to manufacture mixed fodders. This level of mixed fodder production does not satisfy the needs of livestock in quantitative and qualitative terms. Their specific weight in the total consumption of concentrated fodder does not exceed 20%, while about 3 million tons of grain are used in milled form or as grain mixtures.

The basis of mixed fodder is grain raw material, about 60-65%. Grain crops it is wheat, barley, corn, oats, and millet and; the peculiarity is high content of carbohydrates - 70%, and low content of protein - 10-15%; use grain legumes: peas, beans, soybeans, lupine - high-protein crops - 25-45%. Oilseeds are used: sunflower, cottonseed, rape, mullein, and ginger, introduced into mixed fodders in the form of their waste (cake, meal). The composition of recipes can also include waste from grain processing into groats and flour, food industry wastes, animal fodder, rough fodder (Tireuov et al., 2020).

The assortment of mixed fodders in foreign countries is extensive; up to 50 and sometimes more recipes are circulated at some large enterprises. The productivity of feed mills and their location are closely connected with assortment. Large plants producing 100 to 400 thousand tons of mixed fodder per year are built where cheap transportation can be found for raw materials and shipment of finished products and in areas with large livestock and poultry farming (Nekrasov et al., 2018).

Feed mills have laboratories to determine the quality of raw materials, the coarseness of grinding ingredients and the quality of finished products. At large plants, laboratories are equipped with appropriate devices and equipment for determining moisture, ash content, protein, fat, crude fibre, starch, calcium, phosphorus, vitamin A, antibiotics, acidity, amount of mould, degree of grinding and other indicators.

Developing the compound feed industry in different countries could have been more balanced. This is because the feed industry, as a new production branch, began to develop in some countries a little earlier and in others later. Thus, in the USA, Canada, partly in England and some other countries, the compound feed industry by 1957 already created; therefore, compound feed production growth was the least (accordingly 25, 27 and 45%). On the contrary, in the countries where before 1957 there was almost no compound feed industry, the growth of compound feed production was maximum (Spain-1767%, Greece - 550%, Japan - 391%, Colombia - 339%, Venezuela - 307%). Significant increase in compound feed production was in Italy - 202%, Mexico - 176%, FRG - 120%, and France - 111% (Tireuov et al., 2020).

In England and the USA, the percentage of mixed fodders for cattle is noticeably higher than in other countries, as intensive fattening of young calves is applied on a large scale. In the Netherlands, with a large export of pork, a significant specific weight is occupied by mixed fodders for pigs. Japan stands out by the specialization of mixed fodder production for poultry, although in other countries, this branch of mixed fodder production is much more developed than others.

Feed volumes are increasing annually in all countries while resources for this purpose decrease. Many components of compound feeds have become scarce, and some are used for other purposes (for ethanol, biogas production, etc.). Search for new types of fodder products and creating rational technology to utilize raw material resources effectively are urgent.

Many problems of fodder grain production and its market development, which accounts for about one-third of the gross harvest of grain crops, still need to be solved. The production volumes, quality and assortment of produced grain forage needed to meet the needs of livestock in nutritious and affordable concentrated fodder. The low quality of the fodder base leads to a decline in production volumes and worsens the provision of the population with food of animal origin (Savostin et al., 2021).

The multifactor complex of problems of the grain and fodder market development is supplemented by the growing need to improve the population's nutrition in many countries and transition to biofuel energy resources. Under these conditions, feed grain production, a source of concentrated fodder for livestock, becomes the most important branch of agriculture. Subjects of this industry should be subjected to intensive measures of regulation of development processes, building competitiveness at regional and national levels.

Forage crop is one of the leading products to support agricultural needs (Petrikov, 2018). Fodder products have the necessary microelements in their composition, allowing them to maintain a proper diet of agricultural and domestic animals.

Fodder occupies a significant cost (over 50%-80%) in the cost of livestock production. Kazakhstan has its production of mixed fodders and additives, but high-tech additives (amino acids, vitamins) that increase the efficiency of fodders are imported from abroad. Animals of imported breeding are susceptible to feeding conditions and compliance with the required ration.

The main sown areas for fodder crops are in the country's north - Kostanay, Akmola, and SKO. The presence of chestnut, chernozem, forest loamy soils, and temperate climate characterizes these regions. Production and technical base of farms is increasing, work on improvement of irrigated lands is being carried out.

The average annual growth of gross output of fodder crops in the Republic of Kazakhstan for 2012-2020 amounted to 9.7%. In 2020, the gross production of fodder crops will reach 967.6 million USD. The share of fodder crops in the country's GDP will equal 0.6% by the end of 2020. In 2020, investment in agriculture, forestry and fisheries increased by 12.6% over the previous year, amounting to USD 1.4 million. The average annual growth rate for 2016-2020 is 22.8% (Figure 1).

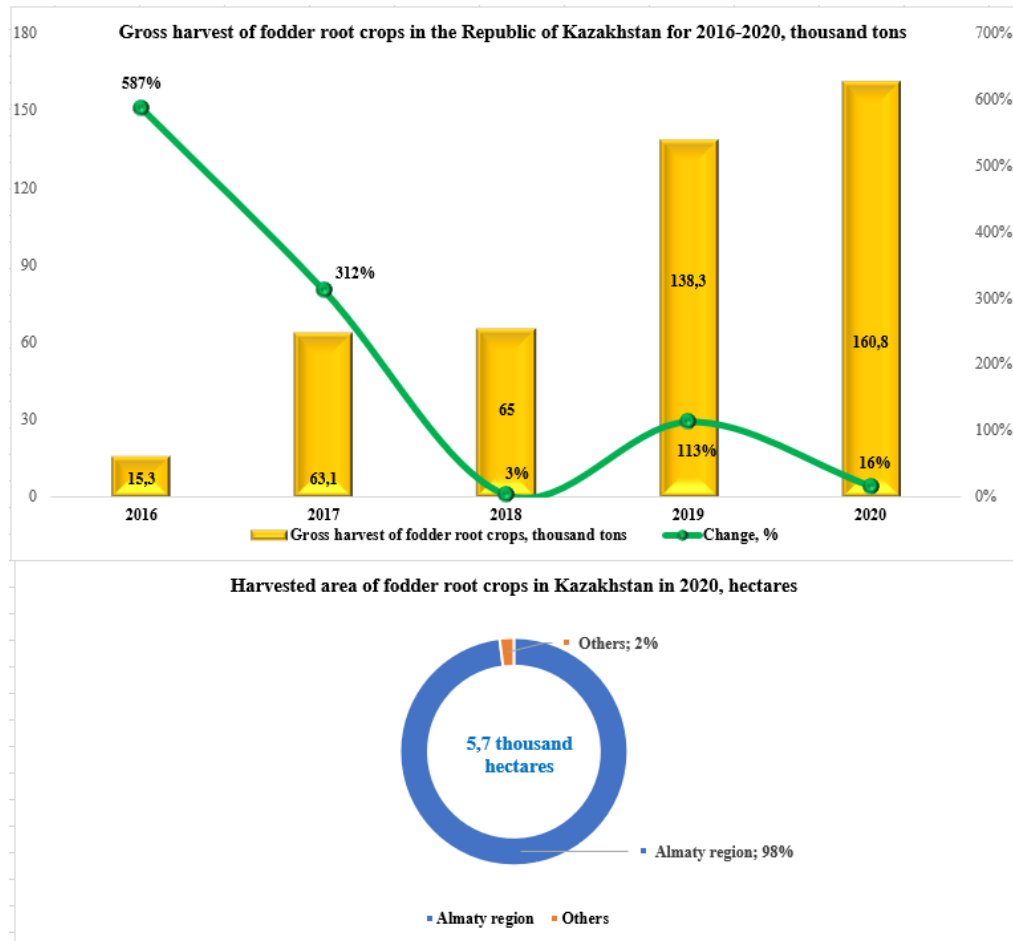


Figure 1. Production of forage root crops in the Republic of Kazakhstan

Source: CEIC <https://www.ceicdata.com/en/kazakhstan/agriculture-production-annual/agricultural-production-forage-crops-all-enterprises-hay-ow-one-year-grasses>

The central grain-growing regions of North Kazakhstan, Akmola and Kostanay regions directed 585.4 million dollars to the industry, which amounted to 42% of total investment in agriculture, forestry and fishery. This amounted to 42% of agricultural, forestry and fishery investments. 88% of investments in fixed capital of agricultural, forestry and fishery enterprises were directed to cultivating one- or two-year crops (CEIC, 2020).

Conclusions

Quality resource support is the component of the proportionally balanced development of economic entities of grain-processing and livestock farms as constituent structural elements of grain and meat-product subcomplexes. It should be noted that the feed industry is the connecting link of these subcomplexes along the line of the functional-technological chain.

In the production of mixed fodder, use types of raw materials: vegetable, animal, and mineral, based on products of microbiological, chemical and organic synthesis and others. Forage grain is the primary raw material for mixed fodder production in Kazakhstan.

An increase in livestock production is one of the main tasks of Kazakhstan for the nearest decade. The main in its fulfilment is the organization of industrial livestock breeding based on strengthening of fodder base and mixed fodder industry. The basis of mixed fodder is grain raw material; it makes approximately all mixed fodder 60-65%.

In laboratories of mixed fodder, plants are engaged in defining the quality of raw materials, coarseness of grinding of ingredients and quality of ready production. At large plants, laboratories are equipped with appropriate devices and equipment for determining moisture, ash content, protein, fat, crude fibre, starch, calcium, phosphorus, vitamin A, antibiotics, acidity, mould amount, grinding degree and other indicators.

Low quality of fodder base entails a drop in production volumes with deterioration of provision of the population with food of animal origin. The growing supplements the multifactor complex of problems of grain and fodder market development problems would improve the population's nutrition and accelerate countries' transition towards biofuel energy resources.

Under these conditions, forage grain production, a source of concentrated feed for livestock, becomes the most important branch of agriculture. The subjects of this industry should be subjected to intensive measures of regulation of development processes, building competitiveness at regional and national levels, which ultimately would lead to sustainable competitiveness and enhanced food security.

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