

Creating Fodder Basis and Methods of Improvement of Feed Nutritional Value in Central Kazakhstan

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The results of research on possibility of creating fodder basis and methods of improvement of nutritional value of feeds have been described. The essence and specific features of improving forage basis for livestock have been identified, characteristics of its basic functions has been presented, prospects of scientific developments in this area have been outlined. State of fodder basis in Central Kazakhstan has been shown, the system of improvement of feed supply in this region of the country has been presented, use of not only more nutritious but also low cost feed resources in livestock production, restoration of natural grass on lands which previously have been unreasonably cultivated for growing grain crops, that will result in the improvement of biodiversity of flora and fauna, measures on feed production development have been proposed, measures on restoration of waste lands, correct friendly land use, radical improvement of natural grassland as bases of improvement of livestock productivity in Central Kazakhstan.

Key words: Feed, fodder production, nutritious and biologically active substances, bregion, dairy cattle production, resources, animal breeds, pastures..

Current state of livestock production in regions of Central Kazakhstan requires significant improvement of fodder basis. Researches have shown shortage of energy-saturated feed (energy deficit 20-25%), high-protein (protein deficit 18-20%) and carbohydrate components of diets, vitamins, minerals and other biologically active substances (80% deficit). It's a well-known fact that if animal diet includes necessary nutrients and biologically active substances, which correspond to age, and productivity features of livestock species, it is possible to identify potential abilities of livestock. As the practice of livestock production shows, in particular in dairy cattle production, use of the effective feeding system

increases milk productivity of cows 1.5 times. Unfortunately, agricultural regions of Central Kazakhstan, occupying vast areas of agricultural lands, mainly distinguish in less productive pastures, grasslands due to insufficient soil fertility and moisture.

METHOD

These studies were conducted in Karaganda region, in particular in Zhezkazgan and Shet regions in the course of implementation of major environmental grant activity (13.5 mln. USD), with the assistance of World Bank Environment Fund on project "Management of dry lands" which was aimed at efficient use of land in dry ecosystems of livestock production area. The project is a pilot project and can serve as an example for the vast areas of the country.

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RESULTS

High level of economic development of agri-industrial sector in developed countries is determined by natural-climatic conditions, structure of land fund, state of logistics, management system and labor resource assurance^{1,2}. It should be noted that population's demand for food is being ensured in accordance with physiological norms of consumption, formation of export potential of the country, as well as conservation and protection of the environment³. Significant reduction of animal population in the area of Central Kazakhstan led to reduction of livestock production, and consequently incomplete supply of population demand for food. Current level of livestock production in farms of different forms of ownership is significantly lagging behind physiological needs of population in food, which is due to organizational form of management of commodity producers in livestock industry. On the example of Karaganda region it can be seen that a distinctive feature of livestock industry in desert and semi-desert areas is that due to insufficient land resources and elimination of livestock farms and complexes, main part of livestock has been kept in households. Currently, in the regions of Central Kazakhstan there are different forms of ownership of land and significant amount of land users. So, the division of land into plots has resulted in establishing of a large number of small-scale farms with a small number of cattle. (Cows-10 heads, young cattle - 30, pigs-50, sheep- 100 heads).

According to the existing diet of feeding animals, according to our calculations, for maintaining cattle on small-scale farms, it is needed to produce annually 257 tons of feed units and 25 tons of digestible protein, on medium farms -2379 and 240 tons, and on large-scale farms - 22,973 and 2,292 tons respectively^{4,5}.

Effective development of the livestock industry in Central Kazakhstan in general, in terms of transition to market economy is possible only in terms of integrated solution of organizational - economic, technological and technical issues aimed at establishing scientifically justified feed production systems and land cultivation systems as a whole [5,6]. Forage production system as a set of organizational, economic, agronomic and

livestock activities is aimed at maximum amount of forage production of high quality at lowest labor costs and production means per produced feed unit. Consequently, possibilities of solution of this problem in the regions of Central Kazakhstan in current economic conditions remains complex and insufficiently studied. This issue is directly related to the specifics of agricultural development of the Republic, i.e. during 1991-2013 there was a significant change in correlation between crop production and livestock production in favor of the first^{7,8,9}

In this connection there was a large-scale reduction of animal population, especially cattle, resulting in decreased volume of livestock production. As we know the level of economic development of fodder production system is determined by internal and external factors, first of all, effective introduction of scientific and technological developments and increase of economic efficiency of agricultural production in general. Fodder production systems with high economic efficiency, maximally promote development of livestock industry, increase of livestock production volumes and high profitability of livestock industry and farms in general. The main sources of fodder in the existing systems of forage production in the region of Central Kazakhstan include natural hayfields and pasture forage crops, which productivity is conditioned by intensification level, existing processing technologies, harvesting and storage of fodder, as well as preparing and delivering them to livestock farms^{10,11}. Failure to comply with these requirements, use of extensive fodder production systems leads to significant decline in production, especially dairy and beef cattle production. This is primarily due to insufficient production of fodder by farms for the needs of livestock industry, because in total production costs structure, fodder production costs are 55,0-60,0%¹². Therefore the extremely important issue in terms of central Kazakhstan is the effective functioning of forage production industry, which has formed after division of land resources. It should be noted, that currently farms of various forms of property use imperfect structure of sown areas, which is characterized, first of all, by incompliance of placement of crops with soil and climatic conditions of the zone, as well as insufficiently

effective specialization. The main form of animal feeding in private farms is grazing of livestock, but due to the lack of highly productive pastures, the livestock is grazing along protection zones of the highways, irrigated main channels, inter-farm irrigation systems and cut field protection forest belts. Forage crops in small households, are usually grown in non-irrigated land. Therefore, in most cases, owners of livestock feed animals with fodder which is unbalanced in digestible protein during growing season (April-September), and in autumn and winter periods. This has a negative effect on the development of private livestock production and leads to a sharp decrease in its productivity and livestock production volumes in general^{13,14,15,16}. Rational organization and increase of efficiency of feed production will lead to low cost production. Therefore, livestock development based on field crops and all year round pastures with periodic change of grazing plots should be the priority. Fodder production in different soil-climatic zones of the republic has its own characteristics. In the dry steppe zone most of feed is produced from pasture crops, and also summer planting of annual grasses (oats, canola) for winter grazing. In the steppe zone main feed is produced on natural lands, corn and sunflower for silage are grown in fields, vetch-Sudan and vetch-oat mixes-for hay, oats and barley – for grain^{17,18}. Basic indices of forage production are the area and productivity of available forage plots and arable land. The essence of this approach to fodder production is that production volumes and fodder structure are determined based on natural potential of the area¹⁹. High yield crops and varieties have been selected, growing technologies are being improved, and then livestock specialization, animal population, productivity and production are justified taking into account expected feed volume. Analysis of the state of fodder production in Central Kazakhstan shows that in recent years there was a decrease of the areas of sown crops and increase of spontaneously conserved arable land. According to forage production concept in arid zones of the republic, all lands in steppe area should be used as pastures. Due to low and unstable precipitation, rainfed agriculture from year to year in current economic conditions becomes inefficient and unprofitable²⁰

As mentioned above, the efficiency of livestock production is largely dependent on capabilities of fodder resources in specific areas and balanced feeding of livestock. If animal diet has necessary nutrients and biologically active substances, which complies with age, productivity and specific features of livestock species, it is possible to identify potential opportunities of animals.

For example, as evidenced by practice of animal breeding, in particular, in dairy cattle production, implementation of improved system of feeding diet development increases milk production of cows 1.5 times²¹. Unfortunately, agricultural regions of Central Kazakhstan, occupying a vast agricultural areas, due to their low productivity and lack of moisture cannot yet effectively use available opportunities of increasing of livestock production. Therefore, in these regions, in addition to cultivation of drought-resistant plant varieties for fodder, it is important to develop a system of increasing the productivity of pastures and hayfields, in particular search of possibilities of using non-traditional forage crops, as well as ways of improving soil fertility is very important²². For example, according to Zhezkazgan branch of the Institute of Botany of the Academy of Sciences of the Kazakh SSR, the work on improvement of productivity of wormwood grasslands in the region has increased its productivity to 8-15 c/ha., versus 2-3 c/ha.

It should be noted that the results of research conducted in Zhezkazgan Regional Agricultural Research Station showed the efficiency of use of drought-resistant plant varieties in the region: dry steppe wheatgrass, drought-resistant species of Isen, five-star wormwood, zhuzgen, terisken.

In addition, it was found that plant tarlau increases the productivity of pastures and hayfields several times, and is suitable for long-term pasture rotations. It should be noted that results of conducted work testified about the effectiveness of using varieties of alfalfa, Karagandinskaya-1, Sainfoin sandy, Dolinsky-1 in the regions, and as consequence it was recommended to establish several reproduction seed farms on production of seeds of these plants.

The research on specifics of using irrigated pastures for dairy cattle production, for

example, planting of alfalfa varieties: Semirechenskaya, Karagandinskaya-1, arpabas, Subetegi, Grazing ryegrass - and their mixtures showed good growth of rangeland plants.

In particular, the results of this work showed the possibility of bringing the yield of irrigated pastures to 5000-6000 conditional fodder units per hectare, in the summertime it would ensure full value feeding of 3-4 dairy cows, with average productivity of 12-14 kg. of milk per day. It should be noted that in the first year of formation of irrigated pasture, for strengthening the crops, is not recommended to graze animals, ie only prepare hay. For example, if on farm average milk yield of dairy cows is 4200 kg, daily gain of calves - 600 g, yield capacity of sown areas - 3100 conventional feed units per hectare, then 142 hectares of cultivated pastures and hayfields are necessary for keeping 100 dairy cows. For preparing juicy fodder such corn varieties have been widely grown in the region: Dneprovsky-56TV, average maturity, Dneprovsky 246M, Kazakhstanskaya B, with yield capacity in irrigated areas 400-500 c per hectare and often mixed planting of corn with high protein legume crop-soy beans was done, in order to increase nutritional value of corn silage.

Besides, the combined planting of drought resistant crop "Sorghum" with high content of sugar, with beet varieties "Semi sugar white", "Ekkendorf yellow", "Osterzundom", "Kuusiku", carrot "Chantenay 2461" significantly improved digestion of juicy fodder.

In terms of Central Kazakhstan, along with perennial grasses it is possible to use unconventional forage crops as green fodder and raw materials for preparation of succulent fodder, as stated above.

In particular, in order to improve nutritional value and reduce costs of nutrition diet of livestock, we carried out a research on nutritional value of perennial crop Spinach-Rumex of English origin, by feeding dairy cows, which was widely advertised in the country, called "Green Revolution in Kazakhstan". In this case, main value of this crop was its drought resistance, deep root system, high yield capacity, ie, 120 tons of green mass per hectare can be harvested per one mowing. In this regard, on recommendation of Kazakh Research Institute of meadow-pastures, 2 kg of

seeds of this plant were sown by planting alfalfa per 1 ha in late May, specially prepared, fenced area in Zhezkazgan regional agricultural research station.

In the first year the plot was irrigated twice a month, and in the autumn of the second year 111 tons of green mass was harvested. Due to deep penetration of plant root system into soil, in the future there was no need for irrigating the plantation. Therefore, to study the effectiveness of feeding with green mass of plants "Spinach-rumex", two groups of dairy cows 20 heads of red steppe breed in each have been formed, based on analogy principle, ie, first - control group was fed a diet of juicy feed corn silage and second - experimental group, instead of juicy feed - green mass "Spinach-rumex" approximately equal in weight equivalent.

As for the rest part, animals were fed in accordance with the norms of feeding cattle recommended by USSR Academy of Agricultural Sciences (1985). In this three-month experiment we took into account the dynamics of daily milk yield, milk quality indicators, as they more fully reflect the overall health condition and nutritional value of animal nutrition diet.

As research results showed, the level of average monthly milk yield of experimental group of animals, fed with green mass of Spinach-rumex, beginning with the first month of feeding was higher than 30 kg. per one cow, and no difference in fat and protein content in milk, although at the end of the experiment the decrease of difference on monthly milk yield has been observed in experimental groups of animals. Nevertheless, findings suggest that inclusion of green mass in the diet of dairy cows, harvested from non-traditional crop Spinach-rumex had a stimulating effect on the growth of productivity of dairy herds, which implies a certain nutritional value of the studied plant. It should be noted that in equal nutritional value of these forages (Corn silage for haylage from Spinach-rumex), low cost of harvested forage from perennial plant Spinach-Rumex due to low costs of growing is effective for feeding animals, in comparison with other types of juicy fodder.

Similar to this research, the research on nutritional value of wild plant "Shaiyr" inherent only to the regions of Central Kazakhstan, also

has special significance for us.

Therefore, we investigated the efficiency of feeding young animals with green mass of this plant, including mixtures with legumes for dairy cows, as well as herbal flour mixed with feed supplements. For the experiment, three groups of dairy cows, 15-20 animals each, were formed, i.e. first - control group, which included corn silage in diet as succulent fodder, second experimental group - shayir-alfalfa hay, and third - shayir hay, in equivalent on physical weight, duration of experiment was 5 months.

The milk yield of animals of the second group, fed with shayir-alfalfa haylage, was higher than in the first and third groups, i.e. on yield - 311 and 267 kg. or 23% and 19%, respectively, as well as advantages of the 3- group (shayir haylage), with respect to group 1 to 44 or 3.3% respectively. Tested animals fed with shayir-alfalfa mixture are characterized by relatively high indices of milk major components, particularly fat content, compared to the respective indices of the groups 1 and 3 of animals to 0.16 - 0.12%, protein - 0.09 - 0.05% ($P < 0.05$), respectively. Results of feeding young cattle, especially in dairy season with Shayir granular herb flour in mixture with different feed additives, distinguished in efficient increase of safety and intensive growth of young animals.

Issues of effective rain fed land management are essential in achieving aims of sustainable use of natural resources, competitiveness of rural producers and access of Kazakhstan to the WTO.

The main focus should be aimed at conservation of genetic breed resources of livestock in the region, since zoned domestic breeds of livestock are the basis of livestock production in severe natural and climatic conditions, taking into account breeding values of the desired type of livestock.

Therefore, in Shet district of Karaganda region of Kazakhstan was implemented the activity on development and restoration of waste lands in eleven rural districts of the region in which the lands are located in desert and semi-desert areas where annual rainfall rate is less than 300 mm, and climate is sharply continental with cold winters and hot summers. The region is characterized by strong winds, causing intense soil erosion and blowing of snow in winter, which reduces

absorption of moisture by soil. Arable lands are generally less productive for crop production, total area of agricultural lands in the region is more than 6 mln. ha., in which according to the project it was envisaged to cover 1.3 mln. hectares, including a large part of degraded lands which is due to improper use and frequent steppe fires.

Soils in project area range from light chestnut with low content of organic matter to dark chestnut soils which are relatively fertile and have good structure and ability of keeping moisture, they are suitable for planting wheat grass, alfalfa and sainfoin. It should be noted that most of light, less fertile soils are waste lands or used unsystematically for livestock grazing and fodder preparation and almost all districts have waste and abandoned lands, and were interested in restoration of fodder crops, as the process of natural renewal lasts for many years. Increasing of productivity of pastures and hayfields will enhance the increase of the reserves of hay for winter period, number of livestock population and livestock productivity. The most important issue is that young animals will not be sold at early age in a low price, and there will be the possibility of raising them, feeding, grazing, in order to bring them to the desired condition, as well as getting profit from sale of surplus feed in other regions. Revenues from sale of livestock products will be more stable and less dependent on external factors. In addition, restoration of natural grass on lands which were previously unreasonably ploughed for grain cultivation will lead to the improvement of biodiversity of flora and fauna and return of saiga who previously inhabited those areas in great herds.

20 farms from 11 rural districts were selected to participate in the project, including 5 LLP, and other private farms with status of a legal entity. The main herd of animals was concentrated in 10 farms. Selected farms fully met the selection criteria, and are the owners of production, have in balance deposits, waste lands and appropriate agricultural machinery.

Selection of farms was carried out with participation of governors of rural districts, viewing basic information on territory, availability of farmland, livestock, breeding characteristics, productivity indicators, methods of keeping and feeding, feed stocks. Unfortunately, as might be

expected, bred cattle mostly was not bred, crossed animals with red steppe and Kazakh white head breeds.

Milk yield per forage cow per lactation was about 2000 kg of milk, average daily gain of young cattle - no more than 300-400 g, wool shearing -1,5-1,7 kg in physical weight, although milk production potential of most wide spread breed- the red steppe breed in the region was 5000 kg of milk per lactation. Livestock products are partially used for own consumption, and surplus products are sold to processing companies in the region, sheep fleece is sold at very low prices to intermediaries due to lack of demand.

The significance of this project is not only changing of current approach to agricultural land management by restoring lost natural livestock resources, but also substantial difference from other projects. It's complexity provides importance in addressing issues of sustainable agricultural development, competent environmental land use, as well as provides effective assistance to farmers on arranging important economic conditions.

It should be noted that for implementation of mentioned project aims, best scientific and industrial capacities have been involved. This project in steppe ecosystem has been implemented for the first time, t.e. obtained results in any case allow to draw appropriate conclusions about the possibilities of restoration of degraded lands for the interests of livestock production and in this direction Kazakhstan will occupy a leading position, the results can be effectively used in the regions and CIS countries with similar natural and climatic conditions. Implementation of this project has become the first attempt to solve the problem of dryland degradation not only in the region but also in CIS countries, especially its most important task was to find methods of accelerated land restoration, after intensive plowing of fragile soils for grain production for several decades. Main activity is planting of perennial grasses, shrubs, which is an effective measure in addressing main objectives of the project, i.e., on improving fodder basis, in particular, during five years more than 30 thousand hectares of waste land have been planted with fodder crops. It should be noted that wheatgrass plots planted in the framework of the project, provided 9 c. of hay per hectare versus 1.5-2.0, as

was previously, thus, farmers have been ensured receiving of net income of \$ 33 only due to preparing fodder per hectare.

Cost of planting wheat grass per hectare does not exceed 3000 tenge, and hay fields are used up to 20 years, ie it should be emphasized that in the future the project area may become one of the leading regions on production of seeds of perennial grasses.

In course of project implementation, modern tillage, seeding equipment, seed cleaning equipment, slaughterhouse in modular design, dairy and laboratory equipment have been purchased, also 21 wind energy devices in remote locations of livestock wintering, 5 generator water-pumps for watering livestock herds in remote summer pastures have been installed.

Implementation of this project has positive impact on activities of 130 private farms, including their integration into 9 rural consumer cooperatives, by concentrating funds of production into one large limited liability partnership, achieved improvement of the efficiency and effectiveness of solving production problems, marketing of agricultural products.

At district level livestock population of all kinds has increased more than twice in a short time, which became possible due to radical solution of issues of efficient use of agricultural land, including remote pastures, improvement of fodder preparation, scientifically justified rotational grazing, grazing of livestock outside settlements, providing animals with water in remote areas using wind energy to lift water from restored wells. Over the past four years, meat production increased by 359 tons, or nearly doubled.

Increase of livestock population number has been observed in all categories of the explored groups and most notable was in the pilot farms, particularly in cattle production - 36.5%, horses-14.9% , sheep - 47.9% and 1.9 respectively. Compared with control group, which data has been taken from randomly selected farms in neighboring Aktogay district, and had different situation, ie in control group there was a significantly lower growth of cattle, while the number of other types of livestock has increased, as compared to other farms participating in the project, and it is probably due to the fact that the farms in Aktogay district are located far from large

settlements, so perishable products are mainly produced in a limited volume and used for own needs.

Besides, sheep and horses as animals adapted to year-round grazing on pastures don't need feed stocks for the winter period and therefore in terms of Aktogay district such kinds of livestock are kept who need minimum amount of rough feed in winter months, ie their keeping is low cost. As a result of restoration of pastures and hay plots by planting perennial grasses the livestock population of all types has increased significantly.

As livestock population increased, also farmers' income from sale of livestock products and sale of surplus of rough feed has increased, which obviously increase the priority of these activities.

In practice, main thing in the development of stable fodder basis for livestock production is increasing of fertility of agricultural lands. In this connection, on the basis of Zhezkazgan Regional Agricultural Research Station was conducted the research on production efficiency and use of fertilizers "Biohum" using California red worms.

The attractiveness of this activity – is simplicity, low cost, and possibility of preparing environmentally friendly products. 8 million of California red worms with nutrition medium have been delivered from Almaty, and agricultural wastes, including cattle manure have been used as raw material for procurement of fertilizer. The essence of technology of preparation of fertilizers lies in the fact that Californian worms passing all kinds of agricultural residues through digestive tracts, excreted them as a mass in form of small granules which are rich in humic acid.

For 90 days, California red worms processed agricultural raw materials in volume of 240 square meters. m., which were placed in 10 cells, 6 m long and 4 m wide, and 0.5 m high.

The obtained product has been purified through a sieve, dried, and put in 2 kg plastic bags with label which indicates method of use, data on producer and were sold at price of 50 tenge per bag. As research results showed, the main feature of this fertilizer was in the fact that the humic acid in its composition, activates metabolism in soils and enriches it with nutrients, thus, about 3 tons of biohumus is required per hectare of agricultural land.

Based on research results, Zhezkazgan Regional Agricultural Research Station hosted a seminar-workshop on promoting this activity with participation of the governors of rural areas, heads of agricultural units. Results of feeding young cattle, with Shaiyr granular flour, especially in dairy period, in mixture with different feed additives showed efficient increase of growth of young animals and safety.

RESULTS AND DISCUSSION

In relation to pasture economy in Central Kazakhstan a series of scientifically justified technologies on improvement of use of grazing land and cultivation of certain fodder crops on the basis of careful, rational management of natural resources can be developed and used, which in the future will enhance not only improvement of yield capacity, quality of pasture grasses, and possibilities of forage basis of the region, but also increase livestock production.

In particular, mentioned project "Management of arid, waste lands in steppe ecosystem" has been implemented for the first time, and obtained positive results can be effectively used in similar natural and climatic conditions of the region and the CIS, which aim at finding methods of accelerated rehabilitation of soils, after vigorous plowing of fragile soils for grain production for several decades.

Research on fodder features of non-traditional forage crops, search for the ways to improve fertility of agricultural land in the region have shown positive results due to cost reduction and improvement of nutritional value of feed. For example, feeding dairy cows with juicy fodder, prepared from fodder crops "Shaiyr" and "Spinach-Rumex", resulted in milk production from 15 to 20%, and the use of organic fertilizer "biohumus" prepared using California worms increases productivity of agricultural lands (fertility) to 30% and attractiveness of this activity – is simplicity, low cost and possibility of preparing environmentally friendly product.

Livestock population in a short period has increased more than twice as a result of solving the issues of efficient use of agricultural lands, remote pastures, improvement of fodder production system, supplying of animals with

water using wind energy to lift water from wells.

During four years, meat production has increased by 359 tons, or almost doubled.

In the context of Central Kazakhstan, along with perennial grasses, it is possible to use unconventional forage crops as green fodder and raw materials for preparation of juicy fodder.

CONCLUSION

Increasing of productivity of pastures and hayfields will increase the reserves of hay for the winter period, livestock population and livestock productivity. As the livestock population increased, the farmers' incomes have increased from the sale of livestock products, which significantly increases the priority of these activities.

The obtained results indicate the possibility of restoration of degraded lands for the benefit of livestock production. Kazakhstan will take leading position, and the results can be effectively used in regions and countries of CIS countries with similar natural and climatic conditions.

Zoning of domestic livestock breeds is the basis of livestock production in difficult natural and climatic conditions. Animal breeding values are taken into account. The efficiency of production of fertilizer "Biohumus" using California red worms has been explored.

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