IRSTI 06.71.07
UDC 338.432 https://www.jpra-kazniiapk.kz
Research Article https://doi.org/10.46666/2025-1.2708-9991.09

MILK PRODUCTION IN THE ALMATY REGION OF KAZAKHSTAN: THEORETICAL STOCHASTIC FRONTIER APPROACH

ҚАЗАҚСТАННЫҢ АЛМАТЫ ОБЛЫСЫНДА СҮТ ӨНДІРУ: ТЕОРИЯЛЫҚ СТОХАСТИКАЛЫҚ ШЕКАРАЛЫҚ ТӘСІЛ

ПРОИЗВОДСТВО МОЛОКА В АЛМАТИНСКОЙ ОБЛАСТИ КАЗАХСТАНА: ТЕОРЕТИЧЕСКИЙ СТОХАСТИЧЕСКИЙ ПОГРАНИЧНЫЙ ПОДХОД

A.R. URKUMBAEVA*
C.E.Sc., Associate Professor
G.K. JOLDASBAYEVA
Dr.E.Sc. Professor
A.T. BAKTGEREYEVA
C.E.Sc.
Almaty Technological University, Almaty, Kazakhstan
**corresponding author e-mail: u.assiya@mail.ru*
А.Р. УРКУМБАЕВА*
э.ғ.к., доцент
Г.К. ДЖОЛДАСБАЕВА
э.ғ.д., профессор
А.Т. БАКТГЕРЕЕВА
э.ғ.к.
Алматы технологиялық университеті, Алматы, Қазақстан
**автордың электрондық поштасы: u.assiya@mail.ru*
А.Р. УРКУМБАЕВА*
к.э.н., доцент
Г.К. ДЖОЛДАСБАЕВА
д.э.н., профессор
А.Т. БАКТГЕРЕЕВА
к.э.н.
Алматинский технологический университет, Алматы, Казахстан
**электронная почта автора: u.assiya@mail.ru*

Abstract. The dairy cattle breeding industry makes a large contribution to food balance of the republic, provides industry with raw materials, and the population - with biologically valuable food products. Increasing efficiency of milk production is becoming a major task for both large and small dairy agri farms. A successful solution to this problem will increase production indicators, reduce cost of production and increase its competitiveness in the Kazakhstan dairy market. *The purpose* of the study is to analyze the key criteria that determine profitability of milk production in peasant (farming) households of the Almaty region based on stochastic frontier approach (SFA) model. *Methods* - comparative analysis, generalization, statistical, SFA are used to consider general trends and patterns of development of small business entities. *Results* - using the SFA model, the relationship between costs and volumes of obtained raw materials was studied. The authors identified main factors that have a significant impact on the performance, productivity of cattle and quality of dairy farms, reducing costs of herd maintenance, labor costs and equipment. It should be noted that there is low level of investment in production processes in modernization, high feed prices. *Conclusions* - in order to expand capabilities and strengthen the potential of dairy sector, it is necessary to optimize labor costs for breeding and grazing cattle by mastering modern feeding technologies and veterinary services, organize training of highly qualified personnel, invest in modern agricultural equipment, improve livestock genetics, breeding work, introduce zootechnical innovations, and apply modern farm management systems. A comprehensive solution to these problems will ensure sustainable development of dairy cattle breeding in the Almaty region and increase its contribution to the country's food security.

Аңдатпа. Сүтті мал шаруашылығы саласы республиканың азық - түлік балансына үлкен үлес қосады, өнеркәсіпті шикізатпен, ал халықты биологиялық құнды азық-түлікпен қамтамасыз етеді. Сүт өндірісінің тиімділігін арттыру ірі және кіші сүт агроқұрылымдары үшін маңызды міндетке айналуда. Бұл мәселені ойдағыдай шешу өндірістік көрсеткіштерді арттыруға, өнімнің өзіндік құнын төмендетуге және оның қазақстандық сүт нарығындағы бәсекеге қабілеттілігін арттыруға мүмкіндік береді. Зерттеудің *мақсаты* - стохастикалық шекаралық тәсіл (SFA) моделі негізінде Алматы облысының шаруа (фермер) қожалықтарындағы сүт өндірісінің рентабельділігін айқындайтын негізгі критерийлерді талдау. *Әдістері* - салыстырмалы талдау, жалпылау, статистикалық, SFA шағын шаруашылық жүргізуші субъектілердің дамуының жалпы тенденциялары мен заңдылықтарын қарастыру үшін қолданылады. *Нәтижелері* - SFA моделі арқылы алынған шикізат шығындары мен көлемі арасындағы байланыс зерттелді. Авторлар мал басының өнімділігіне, нәтижелігіне және тауарлы-сүт фермаларының сапасына, табынды ұстауға, еңбекақыға және құрал-жабдықтардың құнын төмендетуге айтарлықтай әсер ететін негізгі факторларды анықтады. Өндіріс процестерін жаңғыртуға инвестицияның төмен деңгейін және жем-шөп бағасының жоғарылығын атап өткен жөн. *Қорытынды* - сүт секторының мүмкіндіктерін кеңейту және әлеуетін нығайту үшін азықтандыру мен ветеринариялық қызмет көрсетудің заманауи технологияларын игеру арқылы мал өсіру мен жайылымға жұмсалатын еңбек шығындарын оңтайландыру, жоғары білікті персоналды даярлауды ұйымдастыру, заманауи ауыл шаруашылығы жабдықтарына инвестиция салу, мал генетикасын, асыл тұқымдық жұмысты жақсарту, зоотехникалық инновацияларды енгізу, шаруа қожалығын басқарудың заманауи жүйелерін қолдану қажет. Бұл проблемаларды кешенді шешу Алматы өңірінде сүтті мал шаруашылығының тұрақты дамуын қамтамасыз етуге және оның елдің азық-түлік қауіпсіздігіне қосқан үлесін арттыруға мүмкіндік береді.

Аннотация. Отрасль молочного скотоводства вносит большой вклад в продовольственный баланс республики, обеспечивает промышленность сырьем, а население - биологически ценными продуктами питания. Рост эффективности производства молока становится важнейшей задачей как для крупных, так и мелких молочных агроформирований. Успешное решение этой проблемы позволит увеличить производственные показатели, снизить себестоимость продукции и повысить ее конкурентоспособность на казахстанском молочном рынке. *Цель* исследования – анализ ключевых критериев, определяющих рентабельность молокопроизводства в крестьянских (фермерских) хозяйствах Алматинской области на основе модели стохастического пограничного подхода (SFA). *Методы* - сравнительного анализа, обобщения, статистический, SFA использованы для рассмотрения общих тенденций и закономерностей развития малых хозяйствующих субъектов. *Результаты* – с помощью модели SFA изучена взаимосвязь между затратами и объемами полученного сырьевого материала. Авторами выявлены основные факторы, которые оказывают существенное влияние на результативность, продуктивность КРС и качество молочных животноводческих ферм, сокращают расходы на содержание стада, оплату труда и стоимость оборудования. Следует отметить низкий уровень инвестиций производственных процессов в модернизацию, высокие цены на корма. *Выводы* – для расширения возможностей и укрепления потенциала молочного сектора необходимо оптимизировать трудозатраты на разведение и выпас скота путем освоения современных технологий кормления и ветеринарного обслуживания, организовать подготовку высококвалифицированного персонала, инвестировать в современное сельскохозяйственное оборудование, улучшать генетику скота, племенную работу, внедрять зоотехнические инновации, применять современные системы управления крестьянским хозяйством. Комплексное решение этих проблем позволит обеспечить устойчивое развитие молочного скотоводства в Алматинском регионе и приумножить его вклад в продовольственную безопасность страны.

Key words: agriculture, dairy industry, dairy farms, stochastic frontier function, technical and economic efficiency, competitiveness of dairy farming.

Түйінді сөздер: ауыл шаруашылығы, сүт өнеркәсібі, сүт фермалары, стохастикалық шекаралық функция, техникалық және экономикалық тиімділік, сүт өндірісінің бәсекеге қабілеттілігі.

Ключевые слова: сельское хозяйство, молочная отрасль, молочные фермы, стохастическая граничная функция, техническая и экономическая эффективность, конкурентоспособность молочного животноводства.

Received: 13.01.2025. Approved after Peer-reviewed: 06.03.2025. Accepted: 17.03.2025.

Introduction

The dairy industry plays an important role in the national economy of the country, which provides the population with safe and high-quality food, and is crucial in the development of all related industries such as animal husbandry, the food industry, improving the diet and raising the standard of living of the population.

Within the framework of a single technological chain "production-processing-sales", the production of raw milk is the basis of the entire chain, a springboard for development and the "first workshop" in the chain of dairy production

Kazakhstan still needs to import raw milk in large quantities, as 70% of the total milk comes from the personal subsidiary farms of the population, which does not meet the standards in quality, therefore, the real base of the dairy industry is raw materials from agricultural enterprises and farms (30%) and imported powdered milk.

In Kazakhstan, in order to increase the production of raw milk that meets quality standards, it is necessary to solve existing problems such as high production costs, the predominance of small milk producers, personal subsidiary farms, despite significant amounts and tools of state support, the insufficiency of large dairy farms, undeveloped feed production, and others that do not saturate the dairy market in Kazakhstan. both in terms of volume and assortment, and do not provide new consumer trends (Joldasbayeva G.K., Baktgereyeva A.T., Gaisina Sh.) [1].

It should also be noted that the contribution of the agricultural sector to Kazakhstan's gross domestic product (GDP) decreased from 6% to 4% between 2022 and 2023, despite the fact that it ranks 5th in the world in terms of the number of natural pastures with a total area of 188 million hectares. This territory could be used to reproduce livestock of up to 30 million heads instead of the current 9.2 million heads (Bureau of National Statistics of the Agency…) [2].

One of the reasons for the low contribution of the agricultural sector to the GDP of the Republic of Kazakhstan is the overall low milk yield of Kazakhstani farmers compared to Western farmers.

The main constraint on the development of animal husbandry, especially dairy cattle breeding, is the lack of a feed base, which negatively affects the final cost of raw milk.

In order to increase the competitiveness of dairy products of domestic producers, the most important thing is to provide production with raw materials both in quantity and quality, and to reduce the share of import dependence on other countries. Therefore, it is necessary to develop and invest the primary link of the value chain, i.e. milk producers, as well as increase the efficiency of their activities.

Taking into account the existing problems facing dairy cattle breeding, the authors consider the issue of increasing the efficiency of milk production by identifying the most important factors affecting its level, based on the use of a stochastic frontier approach (SFA).

To assess the efficiency of milk production, the Almaty region was chosen as the object of research, since this region is one of the five largest regions of Kazakhstan in milk production.

Literary review

According to Gorlov I.F., Nikolaev D.V., Surkova S.A [3] the implementation of new scientific developments and intensive technologies at large dairy complexes makes it possible not only to improve the quality of the resulting dairy products, increase the productivity of animals, but also the overall profitability of industrial milk production.

The authors of Hanan M., Mahrous Y.S.M. [4] conducted a study of the factors that have the greatest impact on the productivity and economic efficiency of milk producers based on the use of the IBM SPSS Statistics 20.0 software. The results of the study showed that cow's milk production efficiency is most influenced by the amount of concentrated feed and human activity.

Atzori A.S, Valsecchi C.E., Manca M.F. at al. [5] believe that the efficiency of dairy farms is most influenced by 5 factors such as “economic efficiency", “energy use", “break-even point”, “milk-feed price ratio” and “market power farms” The results of the study were confirmed by using multidimensional factor analysis.

Yilmaz H., Gelaw F., Speelman S. [6] studied the technical efficiency of dairy production in farms using stochastic boundary analysis (SFA). 97.3% of the deviations were caused by inefficient use of resources, and only 2.7% by random factors. This shows that the average productivity can be increased by about 0.45% without using additional resources.

The most significant factors affecting the efficiency of milk production were the size of the household, the total number of cattle, the technological level, the type of cowshed and the production of corn silage.

Chavas J.-P., Läpple D., Barham B. at al. [7] are noted, that the economic efficiency of production on dairy farms is influenced by agricultural policy. Based on a production

system with multiple inputs and multiple outputs, the authors conducted an analysis of technical, distribution, and scale efficiency.

Based on the conducted research, the authors confirm that subsidies allocated by the state have a significant impact on the efficiency of farms.

The authors Bayiyana I., Hepelwa A., Rao E.J.O. [8] believe, that the profitability of production can be increased only through technical efficiency, for example, by breeding breeds with higher milk productivity, providing farmers with basic information on profitable dairy production, more advanced technologies and practices, which would improve proper planning and management, and therefore minimize unnecessary losses.

Materials and methods

The study was conducted using the methods of stochastic boundary analysis. abstract-logical, economic-statistical method.

The method of abstract-logical analysis was used to generalize and systematize the results obtained, while the economic-statistical method was used to study the dynamics of milk production.

In the study of production efficiency, the stochastic boundary approach (SFA) method was used, which allows us to determine the exact relationship between the explained and independent variables.

The stochastic boundary value analysis method was used to study cost elasticity and factors affecting milk production efficiency. The efficiency of farmers' resource allocation was studied using descriptive statistics (mean and standard deviation), as well as stochastic functions of marginal production and costs.

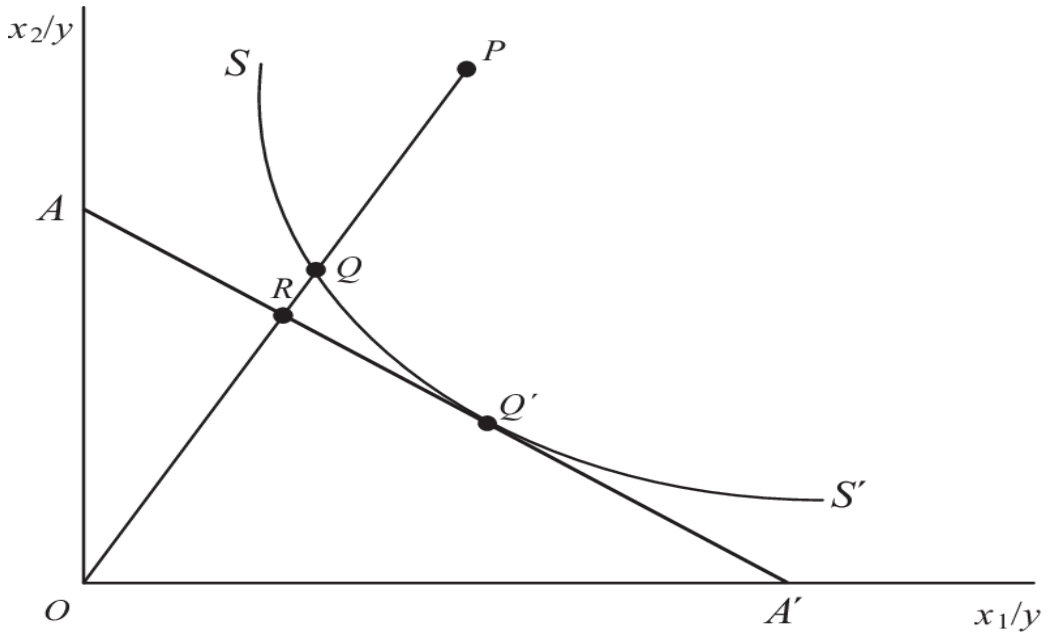
A two-stage stratified random sampling method was used to collect data related to the dairy sector. At the first stage, two random years were chosen for the Almaty region. At the second stage, the average milk production in the Almaty region for all ten years (2014-2023) was selected.

The study used domestic and foreign sources, data from statistical collections of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, materials from the Ministry of Agriculture of the Republic of Kazakhstan.

Results

The ability of a company to produce the maximum volume of products with a certain set of resources and technologies is called technical efficiency. The efficiency of resource allocation shows how well a firm chooses ideal ratios, i.e. when for each pair of resources, the ratio of marginal products is equal to the ratio of market prices.

Cost effectiveness is the sum of distributive and technical efficiency. Using the Farrell diagram Zhao Yu., Morita H., Maruyama Yu. [9], it is possible to characterize the concepts of technical and distributive efficiency and their measurement. Figure shows Farrell's scheme for measuring technical and distribution efficiency.



Note: compiled by the authors Zhao Yu., Morita H., Maruyama Yu [9].

Figure - Farrell's scheme for measuring technical and distribution efficiency

Figure shows the horizontal and vertical axes representing the two input signals, X1 and X2, respectively. An isoquant SS' represents different combinations of inputs (X_1 and X_2) that are used to generate a specific amount of output (Y). Every point on this isoquant represents production that is technically efficient. An attempt is made to gauge a specific firm's efficiency at point P of operation. A line is drawn from the origin to the point P in order to define the technical efficiency of the observed firm. At this point (P), the specific firm produces the same level of output (Y) as produced on isoquant, SS'. At point Q, this line crosses the isoquant. When a firm is technically efficient, it produces the same amount of output (Y) with inputs (X_1 and X_2) that are determined by the point Q.

Hence,

$$TE = \frac{OQ}{OP} \qquad (1)$$

It represents the technical efficiency of the observed firm as the ratio of the distance between point Q and the origin over the distance between point P and the origin.

It is also possible to define allocative efficiency if the input prices are known. The best use of inputs is at the point Q' because it incurs the lowest cost for the output quantity produced at Q. An isocost line, AA', is drawn tangential to the isoquant, SS', at the point Q', which intersects the line OP at the point R. As a result, since the distance, or RQ (cost), can be decreased without lowering output, the point Q is not optimal. The formula for allocative efficiency is $AE = \frac{OR}{OQ}$, which is the ratio of the distance from the origin to the point Q divided by the distance from the point R.

$$TE = \frac{OQ}{OP} \qquad (2)$$

The dot product of technical and allocative efficiencies equals economic efficiency (EE) (Zhao Yu., Morita H., Maruyama Yu) [9].

$$EE = \left(\frac{OQ}{OP}\right) * \left(\frac{OR}{OQ}\right) = \frac{OR}{OP} \qquad (3)$$

Functions of Cost and Stochastic Frontier Production. The term "production function" refers to the process by which entrepreneurs, labor, capital, and land are combined to create goods and services. Because factors of production by themselves are useless to humans, demand has been generated by them. Production is the highest output a firm can achieve with hand technology from a given set of inputs, according to Deng X., Gibson J. [10], production is the highest result that a company can achieve using manual technology with a given set of resources.

The mathematical expression for a production function is

$$Y = f(X)$$

where Y is the output of the firm, whereas X represents a vector input(s) utilized in the production.

The model, known as the composite error model, or stochastic production boundary, was continued in the studies of scientists Bunker R., Natarajan R., Zhang D. [11], as well as Vasil' Yeva O. [12], who made a certain contribution to the development of this model.

For each farmer i, the stochastic production boundary for observation t is expressed as follows:

$$Y_i = f(X_i, \beta) + \epsilon_i \ (i = 1,2,3 \dots) \qquad (4)$$

where Y_i is the output gained by the farmer i, whereas X_i represents the vector of input for farmer i. β represents vector parameter to be estimated and ϵ_i is the correction parameter for farmer i. The central idea of stochastic frontier model is that the correction parameter consists of components V_i and U_i :

$$\epsilon_i = V_i - U_i \qquad (5)$$

where V_i is symmetric $V_i \, \epsilon \, (-\infty; +\infty)$ and captures the stochastic effects beyond farmers' control: weather breakdowns, natural disasters etc. It also records the observation and measures the error on the dependent variable controlled by the farmer $(U_i > 0)$ and captures the technical efficiency of the farmer t.

The term U_t represents technical efficiency as it measures the difference between the output (Y_t) and its maximum potential value given the stochastic Frontier $(f(X_t, \beta) + V_t)$. In simpler terms, technical efficiency is determined by the ratio $\frac{Y_t}{f(X_t,\beta)+V_t}$ rather than the ratio $\frac{Y_t}{f(X_t,\beta)}$ used in deterministic models.

This difference highlights the technical efficiency caused by factors independent of the manufacturer (Banker R., Natarajan R., Zhang D. [11]. It is important to note that the model resembles the deterministic boundary model when V = 0 and the Smirnov R.G., Wang K., Wang Z. [13] stochastic production function model, when U = 0.

Disturbances U and V are presumed to exist independently of one another. This

makes reasonable sense since U stands for technical efficiency that the farmer can control, and V represents the influence of factors outside the farmer's control. It is also assumed that the terms V and U are unaffected by the actual input C. Due to the possibility of correlation between the physical input X and the variable in U (management practices) in actuality, this assumption is less solid.

However, the efficiency (precession) of estimates of production coefficients decreases if management methods are directly integrated into the production function, as this adds more variables to the work. In particular, if there is a strong correlation between physical costs and management methods, this can lead to multi-collinearity. Banker R., Natarajan R., Zhang D**.** [11] suggested a random and independent model of frontier production that is independent of X.

Due to this assumption, problems with simultaneous displacement of equations are eliminated, incorrect specification can lead to biased estimates of the boundary production function.

The explanation of technical efficiency 'U' with factors under the farmers control does not prevent even simultaneous equation bias. Therefore, if management variables are taken into account in the estimation process, there may be serious issues with both the frontier production function and the direct production function.

Socioeconomic characteristics, technical efficiency, and producer allocation efficiency were studied using descriptive statistics (mean and standard deviation) as well as stochastic production and cost functions at the boundary. The Cobb-Douglas boundary production function is discussed in Mahaboob A., Ajmath K.A., Venkateswarlu B. et al. [14], which is defined as:

$$\ln Y_i = \ln\beta_i + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + V_i - U_i \quad (6)$$

where,

Y – total value of milk (Rs)
X_1 – herd Size (Number)
X_2 – labor (Number)
X_3 – quantity of Green fodder (Kg)
X_4 – quantity of Dry fodder (Kg)
X_5 – health cost (Rs)
X_6 – cost of utensil (Rs)

It was assumed that farmers would use production technology, while their economic efficiency was calculated as the product of technical and distributive efficiency.

The economic efficiency of production is calculated using the formula:

$$\ln C = \alpha_0 + \alpha_1 \ln P_1 + \alpha_2 \ln P_2 + \alpha_3 \ln P_3 + \alpha_4 \ln P_4 + \alpha_5 \ln P_5 + V_i + U_i \ ...$$

where,

C – total cost of milk production (tenge)
P_1 – cost of labor (tenge)
P_2 – cost of feed (tenge)
P_3 – cost of veterinary services (tenge)
P_4 – other operating expenses (tenge)
P_5 – cost of implements use in (tenge)

The technical (μi) and distributive efficiency (δn) are defined as follows:

$$\mu_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 \ ... \quad (7)$$

The level of education, agricultural experience, and age of farmers are indicated for the values Z_1, Z_2, and Z_3, respectively. To show their potential impact on farmers' technical efficiency, they are included in the current model. Estimates are needed for scalar parameters β and σ using the STATA program.

STATA is used to simultaneously obtain estimates for each parameter of the efficiency model and the stochastic boundary production function.

Summary statistics on the variables used to evaluate the efficiency of milk production by dairy farmers and the cost of milk produced are shown in table 1.

The relationship between the variances of random errors, σ_v^2, the effects of technical inefficiency and resource allocation inefficiency, σ_u^2, and the overall variance of the model, σ^2, is as follows: $\sigma^2 = \sigma_v^2 + \sigma_u^2$, and the ratio $\gamma = \frac{\sigma_u^2}{\sigma^2}$ measures the total deviation of output from the boundary, which can be explained by technical efficiency or resource allocation (Sartori P. J., Schons S.Z., Barrett S.) [15].

Table 1 provides a statistical overview of the variables used to estimate farm milk production and the value of milk production.

Table 1 - Summary statistics of variable indicators for milk production on average per 1 farm based on the stochastic boundary approach

Variables	Unit of measurement	Mean	Standard Deviation
The average amount of milk produced per cow per year	Liter	2 460	175.28
The cost of veterinary services per cow	Tenge	132 587	210.7
The cost of 1 ton of feed	Tenge	8 2830.3	759.3
The cost of technical equipment for 1 cow	Tenge	20 750.1	6 030.6
Average monthly salary of 1 staff	Tenge	250 121.1	52 395.3
The cost of 1 ton of milk	Tenge	104 115.2	13 836.4
Note: compiled on the basis of statistical data from the Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan			

The average value of the total volume of milk produced from one cow is 2 460 liters with a standard deviation of 175.28. A wide range of standard deviations indicates that milk yields from one cow in farms in the Almaty region fluctuate, which affects the level of milk production in the Almaty region as a whole, as well as the efficiency of milk production. The average salary of 1 staff was 250 121.1 tenge with a standard deviation of 52 395.3. The average cost of feed is 82 830.3 tenge with a standard deviation of 759.3.

Table 2 shows the stochastic cost function of frontier production to estimate the cost of milk production in the Almaty region.

Table 2 – Results of a study of factors affecting the efficiency of milk production in the Almaty region based on a stochastic boundary approach

Variables	Parameters	Model 1	Model 2
Constant	B_0	24.027 (33.591)	14.31 (25.431)
The cost of veterinary services per cow (No)	B_1	3.600 (6.75)	3.600 (9.60) *
Average monthly salary of 1 staff (No)	B_2	6.321 (8.49)	4.290 (9.30) *
The cost of 1 ton of feed (Kg)	B_3	5.22 (7.50)	0.180 (5.31) *
The cost of technical equipment for 1 cow (Rs)	B_5	6.54 (8.61)	0.363 (6.36) *
Note: calculated by the authors, Figure in parenthesis is t-ratio; * Statistically significant at 5% level			

The calculated coefficients of the parameters B_1, B_2, B_3, B_5 of the production process are positive, which means that the total volume of milk production increases in accordance with the value of each coefficient B_1, B_2, B_3, B_5, when the value of each variable increases by one. Indicators such as the cost of veterinary services per cow, the cost of maintaining a herd, personnel costs and the cost of technical equipment are significant at the level of 5%.

The efficiency of milk production increases as the value of each variable increases. All the variables considered are important for overall production efficiency. The significance of technical and distributive efficiency is confirmed by the t-coefficient test at a significance level of 5%.

Discussion

Based on data on the cost and output of raw milk for the period from 2014 to 2024, this article assessed the efficiency of raw milk production. Then, the relationship between costs and output and the factors affecting the efficiency of raw milk production were studied using the SFA model.

According to the results of the study, dairy farmers are not fully exploiting their potential. Their activities were characterized by inefficient resource allocation and technical inefficiency. According to the average values of technical efficiency and resource allocation indicators for dairy farmers in the Almaty region, it should be noted that technical efficiency (TE) is a more serious problem than resource allocation inefficiency. Farmers who produce milk do not face a serious problem of inefficient distribution, since the efficiency of distribution for them is a more important source of resource conservation than the profitability of production. In other words, milk producers can produce a certain amount of product at a cost ratio that minimizes costs.

Given the growing profitability of production obtained during the study, farmers, despite their small scale and lack of resources, used the resources they had quite effectively, and any expansion of such use would lead to

an increase in production, which would be more than proportional.

It has been found that producers face many production problems that negatively affect the efficiency of milk production in one way or another. Analyzing the relative importance of these issues, the results of table 2 showed that the main factors affecting the efficiency of milk production in the Almaty region are the problems of high herd maintenance costs, labor costs and insufficient investment in equipping farms with new technology and equipment, high prices for cow feed and a shortage of feed.

Conclusion

Increasing the efficiency of dairy cattle breeding is possible through the implementation of the following measures:

1. State support for the development of enterprises producing feed additives containing minerals, trace elements, vitamins and enzymes necessary to improve nutrition efficiency, which will help increase milk yields and improve milk quality. One of the most important factors for the effectiveness of feeding, as well as increasing the productivity of animals, is the introduction of various feedings and preparations into their diet.

2. Timely implementation by milk producers of veterinary measures for the prevention and diagnosis of the health status of cows, preventive vaccination in order to ensure food safety, compliance with the necessary technological techniques in the process of feeding, milking cows, animal husbandry, milk storage, as well as state support. veterinary services, veterinary market, veterinary medicine, digitalization of veterinary services.

3. Technological modernization of farms of various sizes, i.e. the introduction of modern milking machines, milking robots, a non-connected cow keeping system, improvement of approaches to organizing breeding work and herd reproduction, affecting the overall efficiency of milk production.

4. Conducting master classes, improving staff skills in the field of cow husbandry and calf care, technological training, mastering best practices in the field of dairy cattle breeding, developing and implementing motivating remuneration systems for dairy cattle personnel.

5. The authors recommend that, in addition to those listed above, work should be done to solve all the problems faced by milk producers, since they are equally a priority for producers.

Contribution of the authors: Urkumbayeva Assiya Rakhimzhanovna: collection and analysis of milk production data, development of methodology, mentoring in conducting research at all its stages, confirmation of research results; Dzholdasbayeva Gulnar Karimovna: writing an abstract, introduction, hodology of the article, development of practical recommendations, verification, analysis and generalization of data; Baktygereeva Alma Taganovna: collecting statistical data on milk production in the Almaty region, writing a short conclusion summarizing the results of the study, key-words, and design of literature.

Conflict of interest: The authors declare that there is no conflict of interest.

Reference

[1] Joldasbayeva, G.K. Milk and dairy products market: creation of dairy clusters / G.K. Joldasbayeva, A.T. Baktgereyeva, Sh. Gaisina//Problems of AgriMarket.- 2024.-No 3. – P.65-175.

[2] Бюро национальной статистики Агентства по стратегическому планированию и реформам РК. Статистика сельского, лесного и охотничьего хозяйства. Основные показатели развития животноводства в РК [Электронный ресурс].-2024. -URL: https://www.stat.gov.kz/ru/ (дата обращения: 11.12.2024).

[3] Gorlov, I.F., Nikolaev, D.V., Surkova, S.A. Economic efficiency of innovative developments aimed at to increase milk production [Electronic resource].- 2023. Available at: https://www.researchgate.net/publication/380120619 Economic_efficiency_of_innovative_developments_aimed_at_to_increase_milk_production (date of access:06.01.2025).

[4] Hanan, M. Productive and economic efficiency of milk production in the Arab Republic of Egypt: Case study in Sharkia governorate / M. Hanan, Y.S.M. Mahrous //International Journal of Health Sciences. -2022.-No 6(1). -P.1590-1614.

[5] Atzori, A.S. Assessment of feed and economic efficiency of dairy farms based on multivariate aggregation of partial indicators measured on field / A.S. Atzori, C.E. Valsecchi, M.F. Manca, A. Cannas, A.Gallo // Journal of Dairy Science. -2021. –Vol. 104.- Issue 12.-P. 12679-12692.

[6] Yilmaz, H., Gelaw, F., Speelman, S. Analysis of technical efficiency in milk production: a cross-sectional study on Turkish dairy farming //Animal Production Systems and Agribusiness [Electronic resource]. -2020. Available at: https://www.scielo.br/j/rbz/a/TbM9Dfg7t33YG9ryvk4jN4L/?lang=en (date of access: 08.01.2025).

[7] Chavas, J.-P. An economic analysis of production efficiency: Evidence from Irish farms / J.-P. Chavas, D. Läpple, B. Barham, E. Dillon // Canadian journal of agricultural economics. – 2020.-No 2(70).-P.153-173.

[8] Bayiyana, I. Hepelwa, A., Rao, E.J.O. Economic Efficiency of Dairy Farmers Participating in Dairy Market Hubs in Tanga and Morogoro Regions, Tanzania // Tanzania Journal of Agricul-

tural Sciences [Electronic resource].- 2019. Available at: https://www.ajol.info/index.php/tjags/article /view/192516 (date of access: 07.01.2025).

[9] Zhao, Y. The measurement of productive performance with consideration for allocative efficiency / Y. Zhao, H. Morita, Y. Maruyama. – Omega.-2019. - Vol. 89. - P.21-39.

[10] Deng, X. Improving eco-efficiency for the sustainable agricultural production: A case study in Shandong, China / X. Deng, J. Gibson //Technological Forecasting and Social Change. - 2019. – No144. –P. 394-400.

[11] Banker, R. Two-stage estimation of the impact of contextual variables in stochastic frontier production models using Data Envelopment Analysis: Second Stage OLS versus bootstrap technologies/ R. Banker, R. Natarajan, D. Zhang // European Journal of Operational Research. - 2019. -No 12 (278). – P.368-384.

[12] Vasyl'Yeva, O. Assessment of factors of sustainable development of the agricultural secor using the Cobb-Douglas production function / O. Vasyl'Yeva // Baltic Journal of Economic Studies. -2021. –No 2 (7). – P.37-49.

[13] Smirnov, R.G., Wang, K., Wang, Z. The Cobb-Douglas Production Function for an Exponential Model // Advances in Econometrics, Operational Research [Electronic resource]. -2022. Available at: https://www. ideas.repec.org (date of access: 28.12.2024). https://doi.org/10.1007/978-3-030-85254-2_1

[14] Mahaboob, A. On Cobb-Douglas production function mode / A. Mahaboob, K.A. Ajmath, B. Venkateswarlu, C. Narayana, P.C. Praveen // Recent Trends in Pure and Applied Mathematics. - 2019. -No 1. - P. 321-334.

[15] Sartori, P.J. Stochastic Production Frontier Analysis of Factors That Affect Productivity and Efficiency of Logging Businesses in Virginia / P. J. Sartori, S.Z. Schons, S. Barrett // Journal of Forestry. -2024. -No 4 (122). -P.327–334. https://doi.org/10.1093/jofore/fvae006

Reference

[1] Joldasbayeva, G.K., Baktgereyeva, A.T., Gaisina, Sh. (2024). Milk and dairy products market: creation of dairy clusters. *Problems of AgriMarket*, 3, 165-175 [in English].

[2] Byuro nacionalnoj statistiki Agentstva po strategicheskomu planirovaniyu i reformam Respubliki Kazahstan. Statistika selskogo, lesnogo i ohotnichego hozyajstva, Osnovnye pokazateli razvitiya zhivotnovodstva [Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, Statistics of agriculture, forestry and hunting, Key indicators of livestock development] (2024). Available at: https://stat.gov.kz/ru (date of access: 10.04.2024) [in Russian].

[3] Gorlov, I.F., Nikolaev, D.V., Surkova, S.A. (2023). Economic efficiency of innovative developments aimed at to increase milk production. Available at: https://www.researchgate.net/publication/380120619_Economic_efficiency_of_innovative_developments_aimed_at_to_increase_milk_production (date of access: 06.01.2025) [in English].

[4] Hanan, M. & Mahrous, Y.S.M. (2022). Productive and economic efficiency of milk production in the Arab Republic of Egypt: Case study in Sharkia governorate. *International Journal of Health Sciences*, 6(1), 1590-1614 [in English].

[5] Atzori, A.S., Valsecchi, C.E., Manca, M.F., Cannas, A., Gallo, A. (2021). Assessment of feed and economic efficiency of dairy farms based on multivariate aggregation of partial indicators measured on field. *Journal of Dairy Science*, 104(12), 12679-12692 [in English].

[6] Yilmaz, H., Gelaw, F., Speelman, S. (2020). Analysis of technical efficiency in milk production: a cross-sectional study on Turkish dairy farming. *Animal Production Systems and Agribusiness*. Available at: https://www.scielo.br/j/rbz/a/TbM9Dfg7t33YG9ryvk4jN4L/?lang=en (date of access: 08.01.2025) [in English].

[7] Chavas, J.P., Läpple, D., Barham, B., Dillon, E. (2020). An economic analysis of production efficiency: Evidence from Irish farms. *Canadian Journal of Agricultural Economics*, 70(2), 153-173 [in English].

[8] Bayiyana, I., Hepelwa, A., Rao, E.J.O. (2019). Economic efficiency of dairy farmers participating in dairy market hubs in Tanga and Morogoro Regions, Tanzania. *Tanzania Journal of Agricultural Sciences*, 18(1), 1-12 [in English].

[9] Zhao, Y., Morita, H., Maruyama, Y. (2019). The measurement of productive performance with consideration for allocative efficiency. *Omega*, 89, 21-39 [in English].

[10] Deng, X., Gibson, J. (2019). Improving eco-efficiency for the sustainable agricultural production: A case study in Shandong, China. *Technological Forecasting and Social Change*, 144, 394-400 [in English].

[11] Banker, R., Natarajan, R., Zhang, D. (2019). Two-stage estimation of the impact of contextual variables in stochastic frontier production models using Data Envelopment Analysis: Second Stage OLS versus bootstrap technologies. *European Journal of Operational Research*, 278(2), 368-384 [in English].

[12] Vasyl'Yeva, O. (2021). Assessment of factors of sustainable development of the agricultural sector using the Cobb-Douglas production function. *Baltic Journal of Economic Studies*, 7(2), 37-49 [in English].

[13] Smirnov, R.G., Wang, K., Wang, Z. (2022). The Cobb-Douglas Production Function for an Exponential Model. *Advances in Econometrics, Operational Research*. Available at: https://www.ideas.repec.org (date of access: 28.12.2024). https://doi.org/10.1007/978-3-030-85254-2_1 [in English].

[14] Mahaboob, A., Ajmath, K.A., Venkateswarlu, B., Narayana, C., Praveen, P.C. (2019). On Cobb-Douglas production, function model. *Recent Trends in Pure and Applied Mathematics*, 1, 321-334 [in English].

[15] Sartori, P.J., Schons, S.Z., Barrett, S. (2024). Stochastic Production Frontier Analysis of Factors That Affect Productivity and Efficiency of Logging Businesses in Virginia. *Journal of Forestry*, 122(4), 327–334. https://doi.org/10.1093/jofore/fvae006 [in English].

Information about authors:

Urkumbayeva Assiya Rahimzhanovna – **The main author**; Candidate of Economic Sciences, Associate Professor; Associate Professor of the Department of Economics and Management; Almaty Technological University; 050012 Tole bi str., 100, Almaty, Kazakhstan; e-mail: u.assiya@mail.ru; https://orcid.org/0000-0002-5153-6900.

Joldasbayeva Gulnar Karimovna; Doctor of Economic Sciences, Professor; Professor of the Department of Economics and Management; Almaty Technological University; 050012 Tole bi str., 100, Almaty, Kazakhstan; e-mail: gulnara_00@mail.ru; https://orcid.org/0000-0002-5757-3083

Baktgereyeva Alma Taganovna; Candidate of Economic Sciences; Senior Lecturer of the Department of Economics and Management; Almaty Technological University; 050012 Tole bi str., 100, Almaty, Kazakhstan; e-mail: alma.taganovna@mail.ru; https://orcid.org / 0000-0002-7445-7797.

Авторлар туралы ақпарат:

Уркумбаева Әсия Рақымжанқызы - **негізгі автор**; экономика ғылымдарының кандидаты, доцент; «Экономика және менеджмент» кафедрасының ассоциированный профессор; Алматы технологиялық университеті; 050012 Төле би көш., 100, Алматы қ., Қазақстан; e-mail: u.assiya@mail.ru; https://orcid.org/0000-0002-5153-6900.

Джолдасбаева Гүлнар Кәрімқызы; экономика ғылымдарының докторы, профессор; «Экономика және менеджмент» кафедрасының профессоры; Алматы технологиялық университеті; 050012 Төле би көш., 100, Алматы қ., Қазақстан; e-mail: gulnara_00@mail.ru; https://orcid.org/0000-0002-5757-3083

Бақтгереева Алма Тағанқызы; экономика ғылымдарының кандидаты; «Экономика және менеджмент» кафедрасының сениор-лекторы; Алматы технологиялық университеті; 050012 Төле би көш., 100, Алматы қ., Қазақстан; e-mail: alma.taganovna@mail.ru; https://orcid.org/ 0000-0002-7445-7797.

Информация об авторах:

Уркумбаева Асия Рахимжановна - **основной автор;** кандидат экономических наук, доцент; ассоциированный профессор кафедры «Экономика и менеджмент»; Алматинский технологический университет; 050012 ул.Толе би, 100, г.Алматы, Казахстан; e-mail: u.assiya@mail.ru; https://orcid.org/0000-0002-5153-6900

***Джолдасбаева** Гульнар Каримовна*; доктор экономических наук, профессор; профессор кафедры «Экономика и менеджмент»; Алматинский технологический университет; 050012 ул.Толе би, 100, г.Алматы, Казахстан; e-mail: gulnara_00@mail.ru; https://orcid.org/0000-0002-5757-3083

Бактгереева Алма Тагановна; кандидат экономических наук; сениор-лектор кафедры «Экономика и менеджмент»; Алматинский технологический университет; 050012 ул.Толе би, 100, г.Алматы, Казахстан; e-mail: alma.taganovna@mail.ru; https://orcid.org/ 0000-0002-7445-7797.