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**IDENTIFICATION OF LIVESTOCK DEVELOPMENT DIRECTIONS  
AND FORECAST INDICATORS IN THE REGION**

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**Abstrakt.** Mazkur maqolada Qoraqalpog‘iston Respublikasida chorvachilikni rivojlantirish tendensiyasi qarab chiqilgan. Chorvachilik mahsulotlarini ishlab chiqarish hajmi 1991-2020 yillar ma'lumotlari asosida 2025 yilga qadar prognoz qilingan. Olingan natijalar asosida chorvachilikni rivojlantirish bo‘yicha xulosa va takliflar ishlab chiqilgan.

**Kalit so‘zlar:** chorvachilik, qoramol, sigir, qo‘y, ot, go‘sht, sut, stasionarlik, “unit root” test, prognozlash, ARIMA model’.

**Абстракт.** В данной статье рассмотрены тенденции развития животноводства в Республике Каракалпакстан. Объем животноводства прогнозируется до 2025 года на основе данных за 1991-2020 годы. Разработаны выводы и рекомендации по развитию животноводства в регионе.

**Ключевые слова:** домашний скот, крупный рогатый скот, корова, овца, лошадь, мясо, молоко, стационар, “unit root” тест, прогнозирование, модель ARIMA,

**Abstract.** In this paper looked through the trends in the development of livestock in the Republic of Karakalpakstan. The volume of livestock production is forecasted until 2025 on the basis of data for 1991-2020. Developed conclusions and recommendations for the development of livestock in the region.

**Key words:** livestock, cattle, cow, sheep, horse, meat, milk, stationary, unit root test, forecasting, ARIMA model,

**Introduction.** Livestock breeding has deep historical roots and is one of the most promising areas in the development of agriculture in the Republic of Karakalpakstan, but the analysis shows that the negative externalities caused by the environmental crisis have affected the development of the sector. In particular, as a result of salinization of lands, increasing water scarcity, the fund of pastures and hayfields in the region, the efficiency of their use, changes in the composition of livestock, the existing potential is not fully used.

**Literature review.** Development of livestock and livestock production, as well as their growth rate and forecasting problem have been a key research topic beyond the researchers. Several authors conducted a research on this topic such as Petrovic, M.P. & Petrovic, M.M. & Petrovic, Caro & Muslic, Ruzic & Ilić, Zoran & Petrović, M & Pavlovski, Zlatica, who studied principles of livestock development [6], Herrero, Mario & Grace, Delia & Njuki, Jemimah & Johnson, Nancy & Enahoro, Dolapo & Silvestri, Silvia & Rufino, Mariana studied the roles of livestock in developing countries. [7], Petrovic P.M learned sustainable sheep breeding [8], Ivanovic L., Jelocnik M., Bekic B. conducted research on possibilities for increment

of livestock breeding [9], Mehrabi, Zia & Gill, Margaret & Van Wijk, Mark & Herrero, Mario & Ramankutty, Navin looked through livestock policy for sustainable development [10], D`A, Hirwa & Ebong, Cyprian & Jules, Mutabazi & Mutimura, Mupenzi & Felix, Nyirishema & Ampon, Wallace studied livestock Farming and Management [11], Megersa, B., Markemann, A., Angassa, A. & Valle Zárate, A. conducted research on the role of livestock diversification in ensuring household food security [12], Sloat, L. L. et al. studied increasing importance of precipitation variability on global livestock grazing lands [13], Hiernaux, P. & Ayantunde, A. Te Fakara leraned a Semi-arid Agro-ecosystem Under Stress [14], Ashley, S., Holden, S. & Bazeley, P. studies livestock in Development [15], Alam, J learned impact of smallholder livestock development project [16], Fraval, S. conducted research on food Security in Rural Sub-Saharan Africa. A Household Level Assessment of Crop-Livestock Systems [17], Murphy, S. P. learned animal source foods to improve micronutrient nutrition and human function in developing countries [18].

**Research methodology.** In the research used empirical and theoretical methods, data collection and processing, logical analysis, statistical analysis, correlation-regression analysis.

**Analysis and results.** According to the results of the study [1], an increase in the share of cattle in the livestock sector in the region, but a decrease in the number of sheep and goats, yearlings, camels, which are promising areas. One of the main reasons for this is the reduction of pastures and hayfields, which is an important factor in the development of the above areas of animal husbandry, on the other hand, the efficiency of their use remains low.

With this in mind, in the future, the government will focus on the development of livestock in the region, the establishment of specialized areas for livestock, with a focus on further increasing the capacity of existing pastures and hayfields, reducing the impact of negative externalities. As a result of the implementation of a number of such measures, it is observed that the negative trends caused by external effects are changing for the better.

In order to assess the effectiveness of these measures [2] and determine the direction of livestock development in the future, based on the data of 1991-2020, the volume of production of major livestock products in the Republic of Karakalpakstan, important and regional areas of animal husbandry We have developed forecast indicators of the number of head on. The ARIMA model, which is widely used in time series and has a relatively high level of reliability, was used to determine the forecast values.

When working with time series, it is necessary to check the data for stationary, because their non-stationary causes the model results to be inaccurate and inadequate. When the indicators are non-stationary, they are brought to a stationary form by taking their primary or secondary differences. The total value of livestock products created in the Republic of Karakalpakstan (Y), the volume of meat (Y1) and milk produced (Y2), cattle (X1), cows (X2), sheep and goats (X3), horses (X4) and we aimed to develop forecast indicators of the number of camels (X5). Therefore, we tested the above indicators for stationary based on Unit root results using EViews 7 (Table 1).

**Table 1****Unit root test results for stationary data**

Date name	ADF	P value	Date name	ADF	P value		
Y	-6.5	0.0001	I(1)	X <sub>2</sub>	-5.1	0.0016	I(1)
Y <sub>1</sub>	-6.1	0.0002	I(1)	X <sub>3</sub>	-5.5	0.0006	I(1)
Y <sub>2</sub>	-8.3	0.0000	I(2)	X <sub>4</sub>	-4.1	0.0168	I(1)
X <sub>1</sub>	-4.5	0.0068	I(1)	X <sub>5</sub>	-4.8	0.0035	I(1)

According to the root results of the unit, the first difference in the volume of total livestock products, the first difference in the amount of meat grown, the second difference in the volume of milk was found to be stationary. In addition, we checked the stationary data on the number of head in each direction of livestock. From the data in Table 1 above, it can be seen that the primary difference in the number of head of livestock in all directions was found to be stationary.

Based on the above data, we initially developed ARIMA models for livestock production and forecast values based on these models. Data from 1991-2020 and the Gretl program were used to create these models. To develop the forecast values of the total livestock production, the real values determined using the 2000s as the base year were used. As a result, let's have a model that looks like the following.

$$\begin{aligned}\Delta Y_t &= 1.18 + 0.91 * \Delta Y_{t-1} - 0.77 * \varepsilon_{t-1} + \varepsilon_t \\ se &= (0.71)(0.12) \quad (0.15) \\ se &= (1.66)(7.33) \quad (-5.07) R^2 = 0.98\end{aligned}$$

According to the results of this model, all coefficients are adequate, but the adequacy level of the coefficient determined on the free limit is appropriate in the 90 percent confidence interval. According to the results of the regression analysis on the volume of meat production, the following equation was obtained. That is, the primary difference in meat production volume has a primary autocorrelation.

$$\begin{aligned}\Delta Y_{1t} &= 0.84 * \Delta Y_{1t-1} + \varepsilon_t \\ se &= (0.091) \\ se &= (9.19) R^2 = 0.99\end{aligned}$$

We carry out a similar analysis in relation to the volume of milk production. Only the secondary difference in the data on milk production volume is stationary. As a result, we have the following ARIMA model.

$$\begin{aligned}\Delta^2 Y_t &= -0.4 * \Delta^2 Y_{t-1} - 0.92 * \varepsilon_{t-1} + \varepsilon_t \\ se &= (0.17)(0.12) \\ t &= (-2.33)(-7.73) R^2 = 0.64\end{aligned}$$

Taking into account the adequacy of all the coefficients identified in this model, on the basis of the above models we have developed forecast indicators of the cost and volume of livestock production in the Republic of Karakalpakstan until 2025 (Table 2).

**Table 2****Forecast indicators of production of basic livestock products in the Republic of Karakalpakstan**

Years	<i>Livestock products by QR (million soums)</i>	<i>Meat (live weight), thousand tons</i>	<i>Milk, tons</i>
	<i>Y</i>	<i>Y<sub>1</sub></i>	<i>Y<sub>2</sub></i>
1991	16.5	50909	182784
2000	16.1	38980	326136
2010	30.9	58881	183553
2015	42.5	88402	322130
2016	46.0	95160	346975
2017	47.6	102299	364654
2018	48.3	104575	284675
2019	52.0	106851	386261
2020	53.3	110701	403833
<b>Forecast indicators</b>			
2021	55.1	113930	413847
2022	56.8	116639	426908
2023	58.5	118910	438740
2024	60.1	120815	451068
2025	61.7	122414	463196

According to the forecast, by 2025, the real value of total livestock production in the Republic of Karakalpakstan in 2010 as a base year will be 61.7 billion soums. In other words, the average annual growth rate will be 3%, with an increase of 1.16 times compared to 2020. Taking into account that a significant part of livestock products created in the region are meat and dairy products, and these products are considered as the main products in animal husbandry, we have also developed forecast indicators of their physical volume until 2025.

According to our calculations, the average growth rate in the next 5 years will be 2%, while meat production in the region will increase by 1.11 times. It can be seen that these figures for milk production are 1.15 and 2.7 percent, respectively. It is obvious that in recent years, the volume of milk production in the region is growing faster than meat. According to our analysis, the share and role of cattle, sheep and goats in the production of these products remains significant. The share of low-yielding horses and camels in crop production also remains low.

It was noted that the development of livestock in the region [3], the measures taken to specialize livestock in areas with pastures and hayfields, also have an impact on changes in the composition of livestock. With this in mind, we will develop forecast indicators of changes in the number of livestock in the Republic of Karakalpakstan in the next 5 years.

To perform the regression analysis, the Gretl program and the 1991-2020 data were used directly without processing the data because the indicators were presented

in physical form. As a result, the models developed and used to predict the number of head by livestock directions and the test results to verify their adequacy have the following appearance.

$$\begin{aligned} \Delta X_{1t} &= 0.95 * \Delta X_{1t-1} - 0.67 * \varepsilon_{t-1} + \varepsilon_t \\ se &= (0.07)(0.19) \\ t &= (14.35)(-3.55) R^2 = 0.99 \\ 1. \Delta X_{2t} &= 0.96 * \Delta X_{2t-1} - 0.69 * \varepsilon_{t-1} + \varepsilon_t \\ se &= (0.07)(0.15) \\ t &= (13.96)(-4.44) R^2 = 0.93 \\ 2. \Delta X_{3t} &= 0.93 * \Delta X_{3t-1} - 0.77 * \varepsilon_{t-1} + \varepsilon_t \\ se &= (0.12)(0.18) \\ t &= (7.85)(-4.18) R^2 = 0.93 \\ 3. \Delta X_{4t} &= 0.86 * \Delta X_{4t-1} - 0.58 * \varepsilon_{t-1} + \varepsilon_t \\ se &= (0.24)(0.30) \\ t &= (3.59)(-1.94) R^2 = 0.93 \end{aligned}$$

It can be seen that all of the results of the Student Criteria cited for checking the adequacy of the coefficients of the four equations are outside the critical range and that their probabilities are less than 0.05. The full form of the results obtained [4] is also given, from which it can be seen that the model is adequate and reliable in other respects as well. Given that the second coefficient determined in the model used to predict the number of years only was -1.94 by the Student Criterion and its probability index was 0.053, i.e. the probability was almost 95%, we found it appropriate to use it.

We would like to cite the forecast figures for the number of head of livestock developed on the basis of these models (Table 3).

**Table 3**

**Forecast indicators of production of basic livestock products in the Republic of Karakalpakstan**

Years	Cattle	Of which: cows	Sheep	Horses
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>
1991	373198	145305	529991	13805
2000	379814	161819	559724	16579
2010	715792	163779	460905	15137
2015	871735	219079	653912	17218
2016	955011	224015	674659	17778
2017	1009333	237796	730276	18302
2018	1057947	254117	764276	18529
2019	1110586	320904	1115059	24476
2020	1148622	332596	1154006	25912
<b>Forecast indicators</b>				

2021	1188050	353048	1218310	27366
2022	1225740	372611	1278370	28615.2
2023	1261770	391324	1334490	29688.4
2024	1296220	409223	1386910	30610.4
2025	1329160	426345	1435890	31402.5

According to the analysis, the average annual growth rate of cattle in the coming years will be 3.7%, and by 2025 the total number of cattle in the region will reach 1329,160, an increase of 1.19 times compared to 2020.

The forecast of the number of cows was carried out separately, because the above analysis shows that although the number of cows has an indirect and indirect effect on meat and milk production, in both cases there is a high correlation between the number of head and the volume of production. In addition, according to the forecast values, the highest growth rate in the next few years will be the number of cows, ie the average annual growth rate will be 1.38 times over the next five years, while the average annual growth rate will be 5.8%.

There will also be a high increase in the number of sheep and goats, ie the average annual growth rate of their number will be 5.2%, while the figure for the number of horses will be 5.1%. As a result, the number of heads in both directions will increase 1.29 and 1.28 times, respectively, over the next five years. According to the comparative analysis, these changes are the result of measures taken in the first years to eliminate the structural changes caused by soil salinization, depletion of pastures due to aggravation of drought, mitigation of external effects, livestock development in the region. found to be directly related to the achievement of positive results.

In order to illustrate this process on the basis of exact figures and to assess the effectiveness of the measures taken, we focused on a comparative statistical analysis of the results obtained for the study period and forecast indicators (Table 4).

According to the results obtained, as a result of the impact of external factors [5], an increase in the share of cattle, sheep and goats, a decrease in the share of horses was observed. According to the comparative analysis, over the next 5 years, the average annual growth rate of large horned cattle will decrease from 3.95% to 3.66%, i.e. sheep and goats, horses will increase their share as a result of increasing the average annual growth rate.

**Table 4**

**The results of the assessment of the impact of changes in subsequent years on the basis of forecast indicators**

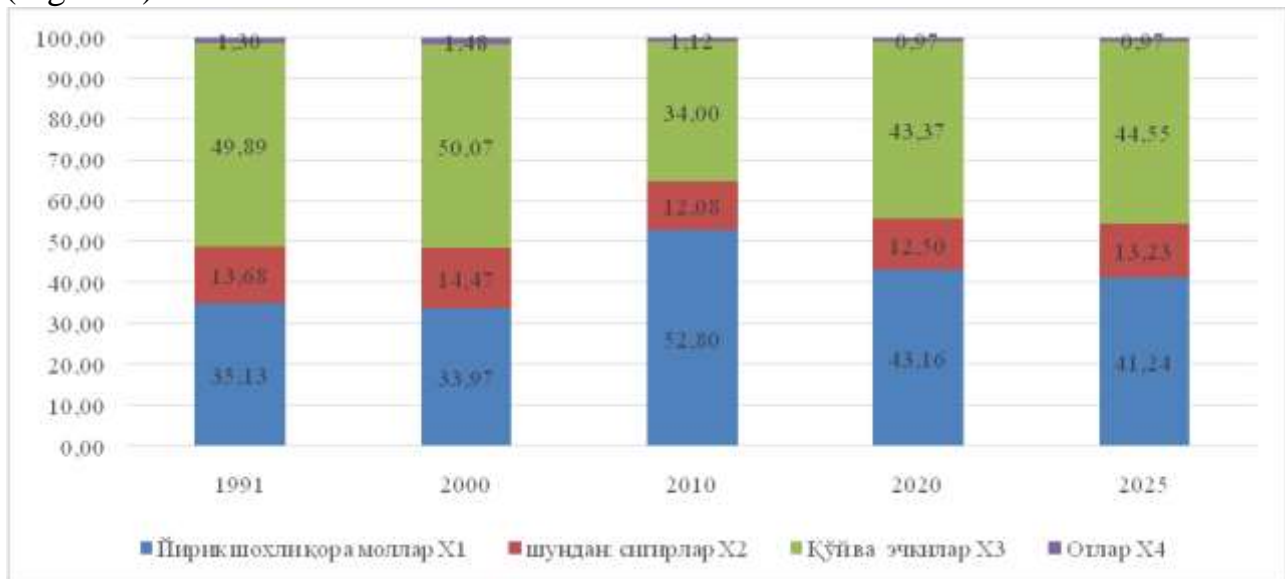
	Changes from 202 to 19912020	Average annual growth rate for 1991-2020	Change from 2025 to 2020	Average annual growth rate for 2020-2025
<b>Cattle X1</b>	3.08	3.95	1.20	3.66
<b>of which: cows X2</b>	2.29	2.90	1.33	5.85

<b>Sheep X<sub>3</sub></b>	2.18	2.72	1.29	5.19
<b>Horses X<sub>4</sub></b>	1.88	2.20	1.28	5.11

**Discussion.** We would like to focus on the number of cows, which is a component of large cattle, because despite the decline in the total number of cattle, an increase in the growth rate of cows from 2.9% to 5.85% will increase the share of cows in the number of cattle.

If we directly compare the values of the average annual growth rate of the number of sheep and goats in the two periods, the average annual growth rate of this indicator will increase from 2.72% to 5.19% and the average annual growth rate will increase by 1.9 times. In terms of number of horses, these figures are 2.20, 5.11 and 2.32, respectively. It can be seen that the change in the average annual growth rate of the number of horses has a higher value than the others.

It was found that the effects of external influences and its consequences were reflected in changes in livestock composition. Changes in livestock composition are directly related to the average annual growth rate of head count. According to the results of the above comparative analysis, the average annual growth rate by livestock has changed, which in turn leads to a change in the composition of livestock. Continuing the analysis, we would like to focus on changes in livestock composition (Figure 1).



**Figure 1. Dynamics of changes in the composition of livestock and its forecast values**

According to the results, a sharp change in the composition of livestock in the Republic of Karakalpakstan occurred in 2010. According to the findings of the study, the drought in the region in 2008 served to exacerbate the effects of external shocks caused by the drying up of the Aral Sea, resulting in a decrease in the number of livestock grazed on pastures and hayfields. This has led to a 52.8 per cent share of large horned cattle whose numbers are less dependent on pastures and hayfields. However, in the subsequent period, reducing the impact of these negative externalities, the work on the development of animal husbandry in the region has

yielded results, provided a positive change in the proportion of sheep and goats in the total livestock in accordance with the potential of the region.

In particular, by 2020, their share increased by 9.37 units compared to 2010, reaching 43.37%, and the forecast confirms that this change will continue in subsequent years. According to the forecast, in the next 5 years, the total share of cattle will decrease, the share of cows will increase, and the share of sheep and goats will also increase. Although an increase in the number of horses has been observed, their share remains unchanged as they are very small in quantity.

**Conclusion.** According to the analysis, the development of livestock in the Republic of Karakalpakstan, including increasing the efficiency of the use of pastures and hayfields is one of the promising areas. However, this requires addressing the issue of reducing the impact of negative externalities resulting from environmental crises. Based on the results of the analysis to find a solution to this problem, we can conclude that one of the most effective areas is the government's special attention to the development of various programs for livestock development, improving the economic and legal framework to support the sector.

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