Statistical and Economic Analysis of Zonal Conditions Impact on Efficiency of Cattle Production Supply Chain Management

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***Abstract*- The article presents the results of an economic and statistical analysis of the effect of zonal conditions on the supply chain (supply chain) of products, production and cost of products for growing and fattening cattle separately from dairy and meat cows. Typological groupings of agricultural organizations of the Republic of Bashkortostan based on average annual data for 2014-2016 were used as a toolkit of analysis, which made it possible to obtain more reliable estimates compared with the grouping for a particular year. Significant differences in the supply chain between zones, as well as between areas in the context of individual zones were found, there were also identified three groups of areas in terms of costs, productivity and cost of production. There were revealed features of the cost structure, productivity level and wages in cattle breeding in the context of zones. Multiple correlation-regression models of livestock productivity and production costs for all areas and zones were built, which made it possible to determine the most significant factors. The obtained results should be used in the development of strategies and planning for organizing the management of the supply chain of products, as well as the location, production specialization, taking into account the influence of natural and climatic conditions and the availability of natural forage lands to ensure efficient production of cattle breeding.**

Key words- supply chain, analysis, grouping, cattle, wages, productivity, cost, cost structure, labor intensity.

1. Introduction

All over the world and in our country there is a growing attention to regional studies. It is connected with the necessity to control and use of territorial differences rationally in natural, material and labor resources in order to assess and level out on this basis of the regions socio-economic development. A statistical study of the spatial development of Russia for the implementation of effective supply chains is one of the new directions of socio-economic statistics and requires comprehensive study and analysis. State statistics currently focuses on the federation subjects' development, their distribution by administrative, territorial, organizational, political, demographic, social characteristics and, to a lesser extent, by economic indicators of certain types of activities [1]. In the framework of the State Program for 2008-2012 in 2007-2013 there was a reduction in cattle meat production. The reduction of livestock breeding has led to a number of negative consequences: the area of pastures and hayfields are not used, which led to the deterioration of their condition; reduction of fertilizers, most of which were obtained from cattle breeding; reduction of arable land for crops. In December 2014, an updated program "Development of dairy cattle breeding" was introduced. For a systematic analysis of livestock, it is necessary to study the features of managing the supply chain of agricultural products, a large set of factors characterizing the conditions and nature of production. The internal conditions of the industry cover the technology and organization of production, supply chain management, feed production, reproduction and quality of the animals' herd, consumption and feed quality, specialization and size of production, organization of labor, etc. External conditions in relation to enterprises are demand for livestock products in the domestic and foreign markets, ensuring rational supply chains of products, the level and disparity of prices, monopolism of customers, government support and regulation of the industry, climatic conditions, etc. [2]. It is required 8-10 years to increase the volume of livestock production. Many enterprises have production capacity to increase production volumes, but highly productive livestock is expensive and it takes at least 3 years to

grow. In this regard, the increase in production volumes is quite problematic. One of the most important areas for the formation of the beef cattle industry in Russia is to establish a chain supply of products of purebred pedigree cattle and its import. From the beginning of 2012 to the current date, the import of purebred breeding cattle of meat breeds to Russia, according to AB-Center estimates, amounted to 143 thousand heads, which is comparable to the increase in the total number of cattle of meat breeds in the country during this period. The largest recipient regions of purebred beef cattle are the Bryansk, Kaliningrad and Voronezh regions [3]. The main reasons of the beef cattle industry problems are the low profitability of beef production compared to other types of meat, the lack of investment, decrease of meat volume due to the violation of technologies and conditions of animals and rising prices. The problem of the beef shortage is more difficult to solve, since it is an expensive project with a long payback period. The largest meat producers in the Vologda region are agricultural enterprises of Cherepovets, Vologda and Sheksna regions [4, 5]. In the coming years, the market will focus on the production of poultry meat and pork. In the course of market saturation with these kinds of meat, the production of beef will begin to develop. However, when prices rise, this product will not be available to many consumers, and the market will remain scarce [4]. In the rural areas of the Samara region a heterogeneous level of development of meat production is observed. The natural and climatic conditions of the region, territorial proximity to large cities, where most of the consumers of products are concentrated, the level of socio-economic development of the economy and economic conditions of rural development and poorly developed supply chain have a significant influence on the production of meat products. It is known that cooperation between the focal firm and external participants (for example, suppliers) significantly increases the level of meat production [6]. The increasing influence of sustainability in supply chain management and operations practices can also be attributed to the fact that, in addition to increased demands of strong economic performance, organizations are now held responsible for the social performance by major stakeholders [7]. As such, sustainability has forced the redefinition of the operations function [8]. Additionally, sustainable supply chain management has become a strategic process enabling firms to create competitive advantage [9]. These features should be taken into account when developing a set of measures for the sustainable development of a regional meat and food sub-complex and in the implementation of regional policy [10]. In order to identify areas producing livestock products, a typologization of the level of specialization was carried out. The beef production in the Bashkortostan Republic is carried out mainly due to the implementation of over-reproduction of young cattle and culled adult cattle of black-and-white, Simmental, Bestuzhevskaya and some other breeds. In many areas of our republic there is a significant potential for the development of beef cattle, namely natural pasture land, empty livestock buildings, efficient elements of resource-saving technology which can be successfully introduced into beef cattle breeding and beef production [11]. In Tennessee, USA, local beef production is gaining popularity and preferring. Consumers are willing to pay fees for branded beef (certified beef steak). Several states have adopted state product identification programs based on geographic location. From birth, a calf is assigned a number by which it can be traced and distinguished [12]. In connection with the adoption of the law "On Mandatory Reporting on Livestock", it is necessary to study the prices for beef supply before and after implementing the law using econometric calculations [13]. Many authors are concerned about climate change, weather phenomena, as a result of which they have a negative effect on production, food security, reduced productivity, and the loss of the product supply chain [14]. Only 34% of arable land is irrigated in Sri Lanka, so the food system is vulnerable to climate variability and extreme changes [15]. In the last decades, green and sustainable supply chain management practices have been developed, trying to integrate environmental concerns into organizations by reducing unintended negative consequences on the environment of production and consumption processes [16]. Compared to most product supply chains, food supply chains are often more complex and more difficult to manage because the food product is perishable and has a short shelf life. A cold chain or temperature-controlled supply chain provides the essential facilities and methods required to maintain the quality and quantity of foods. Since foods can be time and temperature sensitive in nature, they need to be properly taken care of in terms of harvesting, preparation, packaging, transportation and handling – in other words, throughout the entire chain. Temperature is the most important factor in prolonging or

maintaining the shelf life of perishables [16]. The approach of the products supply chain that is applied in the European Commission - EU, 36) is also considered. The European Commission states that seeds, feed, energy and fertilizers belong to the main costs of intermediate consumption [17]. The organization and process of supply chain management has been studied. It is not clear that there has been a tendency to meet the needs of the public sector. Recommendations were developed to reflect the results of revaluation of economic entities in registers debt and accounts [18]. Thus, favorable climatic conditions are important prerequisites for the development of the livestock supply chain in the regions of the Russian Federation as potential suppliers of meat to both the domestic and foreign markets [19]. The above-mentioned information allows us to consider agriculture as one of the priority directions of economic development at the present time. In terms of sanctions, the country's agro-industrial complex needs to solve the problems of the effectiveness of supply chains, import substitution and providing the population with high-quality and affordable foodstuffs. This requires monitoring the climatic conditions across regions of the country to determine the specialization and direction of regions development, taking into account the peculiarities of the zonal distribution and concentration of production [20]. The aim of the research is an economic and statistical analysis of the effect of zonal conditions on the supply chains of products and the cost of products for growing and fattening cattle.

2. Research methods and methodology

The studies were carried out using statistical, econometric, computational and constructive research methods and comparative forecasting based on the models obtained. To take into account the influence of the cattle breed composition peculiarities, the analysis was carried out separately from dairy and meat cows. At the first stage, a study was conducted in order to select an effective supply chain management strategy, the influence of zonal conditions based on a typological grouping of agricultural organizations of the regions and for effective supply chain management in the context of 6 zones of the Republic of Bashkortostan according to 2013 data [21]. Further research was continued according to the average annual data for 2014-2016 to obtain more reliable estimates and eliminate the influence of weather conditions of individual years. At the final stage, there were constructed multiple correlation and regression models according to the average annual data of the Republic of Bashkortostan for 2014-2016. They were separately highlighted by dairy and meat herd in three versions: 1) in all districts of the republic; 2) in areas included in the northern forest-steppe, north-eastern forest-steppe and mountain-forest zone; 3) in areas located in the southern forest-steppe, pre-Ural steppe and trans-Ural steppe. At first, the following models were built: 1. Productivity models with dependent variable that means production of growing and fattening products per year per one head of livestock in centners. As factors were selected:

X1 - the proportion of feed costs, %;

X2 - cattle population for growing and fattening, per head;

X3 - direct labor expenditures per 1 head, person per hour;

X4– payment for 1 person per hour, rub.

2. Cost model of 1 centner weight gain with factors:

X1 is the inverse indicator of productivity (the number of cattle needed to produce 10 centners of weight gain) per head;

X2 - the proportion of feed costs, %;

X3 - direct labor expenditures per 1 head, person per hour;

X4 - payment for 1 person per hour, rub.

Calculations are made according to the summary reports of agricultural organizations of Bashkortostan Republic districts.

3. Results of research

The results obtained in 2013 were mainly confirmed in 2014-2016. Let us briefly consider the results of typological groupings according to the average annual data for 2014-2016. (Table 1).

Table1. The effect of zonal differences on the production of growing and fattening cattle from dairy herd cows in the Republic of Bashkortostan, on the average for 2014-2016

Zones	Number of districts	Weight gain production, c		Average daily gain, g	Expenditure per 1 head, rub.	Cost of 1 c gain, rub.
		per district	per head			
1. Northern forest-steppe	14	3980	1,29	355	12479	9639
2. North-eastern forest steppe	5	3755	1,53	420	17566	11450
3. Southern forest steppe	11	9569	1,73	473	20737	12003
4. Pre-Urals steppe	17	6724	1,68	461	18286	10856
5. Trans-Ural steppe	4	2072	1,50	411	23361	15572
6. Mountain-forest zone	3	134	1,62	445	16105	9920
On the average	54	5606	1,59	437	17855	11196

* Calculations are made according to the summary reports of agricultural enterprises of the Republic of Bashkortostan

From the grouping data we can conclude that more than 37.7% of the gain was produced in agricultural organizations in the areas of the pre-Ural steppe zone, under concentration of 35.7% of cattle population in the same zone on growing and fattening. In the southern forest-steppe zone, 34.8% of the gain was obtained and 32.1% of the livestock was found. In these two zones out of six, more than 72.5% of the weight gain was produced and 67.8% of the cattle livestock was concentrated on growing and fattening. In the pre-Ural steppe zone, the largest areas in terms of livestock concentration and production are agricultural organizations in the Sterlitamak, Meleuz and Tuymazinsky districts. It should be noted that the Sterlitamak district is the largest because it has 16.4 thousand heads of livestock, which accounted for 19% of the livestock throughout the pre-Ural zone; 31.2 thousand tons for the production of weight gain, which was 23.4%. Average daily weight gain exceeded 520 g, and was higher than the average for the republic by 25.8%. In the southern forest-steppe zone, the three districts namely the Ilishevsky, Dyurtyulinsky and Chekmagushevsky are about the same in terms of the livestock concentration they have 11 thousand heads of livestock each. At the same time, 18.3 thousand centners of weight gain was produced in the agricultural enterprises of the Ilishevsky district, 22.2 thousand centners of weight gain in the Dyurtyulinsky region, and 25.8 thousand centners of the Chekmagushevsky region. Note that in the agricultural organizations of the Chekmagushevsky district, the average daily weight gain was 641 g., Dyurtyulinsky - 521 g, Ilishevsky - 418 g. Thus, it was found that the pre-Ural and southern forest-steppe zones are distinguished by a high level of concentration, production intensification and productivity. All this contributed to the formation of a lower level of prime cost of 1 centner of growth in the pre-Ural steppe zone compared to the average for the republic. Based on the level of costs per 1 head of cattle, the areas of the northern, north-eastern forest-steppe and mountain-forest zones can be attributed to the zones of extensive development of dairy cattle breeding. They are characterized by a low level of livestock productivity and production costs. In the trans-Ural steppe only 2.7% of the production is produced and 2.9% of the livestock is kept. The main producer in this zone is the Uchaly district, which is the leader in the republic in the implementation of supply chains in terms of costs - more than 28.000 rubles per 1 head, and the cost of weight gain amounted to 19.4 thousand rubles for 1 centner. In the trans-Ural zone, the cost of growth is almost 1.38 times higher than the average in the republic. This is also due to the cost structure. In this zone, the smaller share of costs is occupied by the main items, like wages and feed. On the other hand, there is a high proportion of the cost of maintaining fixed assets (table 2). In the northern forest-steppe, 22.6% of the livestock is concentrated, in the northeast zone is 6.4% and in the trans-Ural steppe is 2.9%. These zones have a relatively low level of productivity and concentration of the livestock. They have large reserves for increasing the production of growing and fattening products by increasing the productivity of livestock and increasing the number of livestock.

Table2. The cost structure for the production of growing and fattening dairy cattle by Republic of Bashkortostan zones on the average 2014-2016, %

Zones	Wages with social contributions	Feed, total	Their own production	Electricity	Oil-products	Fixed assets	Other expenditures
1. Northern forest-steppe	20,6	55,3	48,7	2,7	3,8	6,2	11,4
2. North-eastern forest steppe	20,0	50,8	39,7	3,4	4,6	5,7	15,5
3. Southern forest steppe	21,2	51,8	43,8	2,6	4,8	6,6	13,0
4. Pre-Urals steppe	19,0	53,3	45,5	2,7	5,0	7,3	12,7
5. Trans-Ural steppe	18,6	52,7	39,6	2,8	3,6	9,6	12,7
6. Mountain-forest zone	25,8	45,8	44,6	2,9	5,8	4,2	15,5
On the average	20,1	52,9	44,8	2,7	4,6	6,9	12,8

* Calculations are made according to the summary reports of agricultural enterprises of the Republic of Bashkortostan.

A high level of labor productivity was found in the trans-Ural and pre-Ural steppe zones, as well as in the north-eastern forest-steppe, in which the southern forest-steppe reached a high level of livestock productivity. The mountain-forest zone is characterized by a relatively low level of productivity and wages (table 3). The results of the groupings also confirmed the fact that there are significant differences between the areas within the individual zones. The analysis made it possible to identify three groups of areas. Group 1 - areas with high costs: ranging from 15.000 to 28.000 rubles per 1 head of livestock, with an average daily weight gain of more than 500 g and a relatively low level of cost less than 10.000 rubles for 1 centner weight gain. This group includes the Chekmagushevsky, Dyurtyulinsky, Kuyurgazinsky, Burayevsky, Duvansky and Kiginsky districts, which are located in the southern and north-eastern forest-steppe zones;

Table3. Labor intensity and wages in dairy cattle in the context of the Republic of Bashkortostan zones, on the average for 2014-2016.

Zones	Direct labor expenditures, person per hour		Wages per 1 hour, rub.
	per 1 c of weight gain	per 1 head	
1. Northern forest-steppe	26,1	33,8	78,6
2. North-eastern forest steppe	26,0	39,9	88,3
3. Southern forest steppe	25,1	43,3	105,6
4. Pre-Urals steppe	24,5	41,3	85,9
5. Trans-Ural steppe	20,4	30,7	142,6
6. Mountain-forest zone	39,1	63,4	66,2
On the average	25,0	39,9	92,7

* Calculations are made according to the summary reports of agricultural enterprises of the Republic of Bashkortostan.

Group 2 - areas with a high level of costs and an average level of productivity - (400-500 g) and a cost price of 1 centner overweight over 10.000 rubles for 1 centner weight gain. In this group there are Uchalinsky, Ufa, Blagovarsky, Chishminsky and Burzyansky districts, representing respectively trans-Ural, southern forest-steppe, pre-Ural steppe and mountain-forest zones. Group 3 – areas with low costs ranging from 7 to 17.000 rubles, with an average daily gain of 300-400 g and a cost of 6.000 to 11.000 rubles. This group includes Ilishevsky, Abzelilovsky, Bizhbulyaksky, Kiginsky, Ishimbaysky, Bakalinsky and Iglinsky districts. A comparison of the three groups of districts allows us to conclude that the districts of the 2nd group, despite the high level of costs, have not yet achieved a high level of productivity - these are the so-called reserve areas with a large unused

potential, one of the problems is the ineffectively chosen supply chain management strategy. The influence of zonal conditions on the development of beef cattle in the Republic of Bashkortostan was further studied. The carried out grouping showed that more than 71.8% of the production and growing of beef cattle is produced in the pre-Ural steppe zone, 8.6% in the southern forest-steppe, 4.6% in the northern forest-steppe, 7.3% in the trans-Ural steppe, 5. 3% in the north-eastern forest-steppe. In the pre-Ural steppe zone in all areas there are beef cattle. The largest number of meat cattle is in the Meleuz district (3275 heads) and in Tuymazinsky district (1388 heads). The production of weight gain amounted to 7315 centners and 3954 centners, respectively, and the average daily weight gain was 611 and 780 g. In 11 districts of the southern forest-steppe, only in 8 districts breed meat cattle is kept. The experience of Aurgazinsky district is interesting, where 308 heads were kept with the 18.7 thousand rubles level of expenses per 1 head with an average daily weight gain of 758 g and a cost price of 1 centner of weight gain of 6730 rubles. The greatest average daily weight gain is more than 1000 g reached in Chekmagushevsky district with a livestock of 75 heads. Beef cattle is kept in all areas of the northeast zone with a small number of cattle from 100-300 heads and low average daily gain of 330 g. In the northern forest-steppe of 21 districts, only 5 districts keep 1218 head of livestock. In this zone, the Tatyshlinsky district can be attributed to areas of intensive beef cattle production with a cost level of 31.000 rubles per 1 head, with an average daily weight gain per 1 head of 978 g and cost price of 8414 rubles for 1 c weight gain. The experience of Karaidel District deserves attention, where, at the cost level of 19.8 thousand rubles they get 800 g of average daily gain with a cost of 6785 rubles. It has been established that the level of concentration of weight gain per area varies significantly and is characterized by a higher value in the pre-Ural and trans-Ural steppe zones. A higher average daily weight gain of cattle was obtained in the northern and southern forest-steppe due to the high level of production costs per cattle head (Table 4).

Table 4. The effect of zonal differences on production of breeding and fattening meat cattle in Bashkortostan Republic areas, on the average for 2014-2016

Zones	Number of districts	Weight gain per 1 district, c	Weight gain per 1 head, c	Average daily gain, g	Expenditures per 1 head, rub.	Cost of 1 c of weight gain, rub
1. Northern forest-steppe	8	190	2,03	556	17874	8815
2. North-eastern forest steppe	5	608	2,19	599	13973	6394
3. Southern forest steppe	8	361	2,20	602	19755	8992
4. Pre-Urals steppe	16	1500	2,08	569	23664	11399
5. Trans-Ural steppe	4	447	1,42	390	9801	6886
6. Mountain-forest zone	2	90	1,45	398	11478	7907
On the average	43	777	2,04	558	21111	10358

* Calculations are made according to the summary reports of agricultural enterprises of the Republic of Bashkortostan

With the lowest cost, they produce weight gain in the northeast, trans-Ural steppe zone and in mountain-forest zones. The highest cost of weight gain in the pre-Ural steppe zone. A special feature of beef cattle is the high level of labor-intensive production and the low level of payment for 1 person-hour worked in the industry (Table 5).

Table 5. The cost structure for the production of breeding and fattening cattle meat by Bashkortostan Republic zones on the average of 2014-2016,%

Zones	Wages with social contributions	Feed, total	Their own production	Electricity	Oil-products	Fixed assets	Other expenditures
1. Northern forest-steppe	11,9	53,0	44,3	3,3	7,8	4,4	19,6
2. North-eastern forest steppe	21,6	55,2	40,0	1,9	4,1	10,5	6,7
3. Southern forest steppe	23,2	51,5	49,3	2,8	4,0	6,6	11,9

4. Pre-Urals steppe	14,1	49,5	36,8	2,2	5,4	14,8	14,0
5. Trans-Ural steppe	17,0	64,5	59,8	2,1	3,5	7,8	5,1
6. Mountain-forest zone	23,9	40,6	29,6	2,3	5,6	5,6	22,0
On the average	15,3	50,6	39,0	2,2	5,2	13,2	13,5

* Calculations are made according to the summary reports of agricultural enterprises of the Republic of Bashkortostan

With the lowest cost, they produce weight gain in the northeast, trans-Ural steppe zone and in mountain-forest zones. The highest cost of weight gain is in the pre-Ural steppe zone. A special feature of beef cattle is the high level of labor-intensive production and the low level of payment for 1 person-hour worked in the industry (Table 5).

Table 6. The labor intensity and wages in beef cattle productions in the context of Bashkortostan Republic zones, on the average of 2014-2016.

Zones	Direct labor expenditures, person per hour		Direct labor expenditures, person per hour
	per 1 c of weight gain	per 1 c of weight gain	
1. Northern forest-steppe	18,9	38,2	58,2
2. North-eastern forest steppe	14,7	32,2	94,8
3. Southern forest steppe	28,7	62,9	73,8
4. Pre-Urals steppe	21,7	44,9	74,9
5. Trans-Ural steppe	18,6	26,5	63,5
6. Mountain-forest zone	27,8	40,4	68,9
On the average	21,4	43,6	74,8

* Calculations are made according to the summary reports of agricultural enterprises of the Republic of Bashkortostan

In the models of livestock productivity in the dairy herd in all regions of the republic, the important factors were: payment for 1 person-hour and direct labor costs for 1 head of cattle. In the areas of the northern forest-steppe, the north-eastern forest-steppe and the mountain-forest zone, a generally significant model of productivity and high efficiency of the product supply chain was obtained with three significant factors:

$\tilde{y}_x = 0{,}4804 + 0{,}0005x_1 - 0{,}000037x_2 + 0{,}0082x_3 + 0{,}0098x_4$ (1)

(1,3) (0,10) (-3,1) (3,9) (5,4)

($R = 0{,}869$, $F_{fact} = 13{,}2$, under $F_{tabl.} = 2{,}96$)

The factor X_1 is the share of the feed cost was in this model (1) insignificant for the t – Student's criterion. After excluding this factor, the multiple model became adequate in all respects:

$\tilde{y}_x = 0{,}512 - 0{,}000037x_2 + 0{,}0081x_3 + 0{,}0098x_4$ (2)

(3,3) (-3,18) (4,27) (5,84)

($R = 0{,}869$, $F_{fact} = 18{,}6$, under $F_{tabl.} = 3{,}16$)

The signs of the coefficients of the regression equation indicate an increase in productivity with an increase in direct labor costs, the level of pay and a decrease in it with an increase in livestock. In terms of the level - the beta-coefficients in the first place is the factor of the level of remuneration, in the second - the direct cost of labor per 1 head of livestock, and the third is livestock, characterizing the level of concentration of production.

A significant cost model of 1 kg of weight gain with two significant factors was also obtained X_3 - direct labor costs per 1 head, person per hour; X_4 - payment for 1 person per hour, rub.; in the northern regions of the republic, as well as with three factors (X_1 is the inverse indicator of cattle productivity, heads; X_3 - direct labor costs per head, person-hour; X_4– payment for 1 person per hour, rub. in the southern forest-steppe, pre-Ural and trans-Ural steppe zones).

Next, a cost model of 1 centner of weight gain along the dairy herd was developed, with three significant factors in all regions of the republic:

$\tilde{y}_x = -3092{,}4 + 444{,}54x_1 + 37{,}67x_2 + 83{,}97x_3 + 59{,}84x_4$ (3)

(- 1,03) (2,41) (1,14) (4,71) (10,33)

(R= 0,844, F_{fact} = 30,4, under $F_{tabl.}$ =2,58)

Similar models were developed to the meat cattle, but these models turned out to be mostly insignificant. Only in the areas included into the northern forest-steppe, north-eastern, forest-steppe and mountain-forest zones a significant cost model of 1 centner of weight was obtained with the opposite signs of regression coefficients:

$$\tilde{y}_x = 27275{,}06 - 53{,}63x_1 - 236{,}17x_2 - 43{,}49x_3 - 57{,}23x_4 \quad (4)$$

(6,07) (-0,56) (-4,34) (-1,78) (-2,67)

(R= 0,861, F_{fact} = 7,19, under $F_{tabl.}$ =3,48)

In model (4), the factors significant according to Student's t-test (t_{tabl} = 2.13) were the following: the share of feed costs and the level of payment per person-hour. With the increase of all factors in these areas, the cost decreases. Therefore, it is necessary to expand the cultivation and fattening of mixed bred cattle in the northern forest-steppe, and beef cattle in the northern, north-eastern, and mountain-forest zones.

4. Discussion

In the paper with the use of multiple regression we rely on the data selected by random sampling and questioning [22]. In our study, for the first time typological groups were used according to the data of agricultural organizations on the average for 2014-2016. In our opinion, this increases the credibility of the study and establishes significant zonal and inter-district differences in the main indicators characterizing the indicators (production of cattle growing and fattening products) that affect the supply chain. In addition, the tools developed take into account the complex influence of zonal differences, the level of production concentration, the number of livestock, and productivity, taking into account the directions of cattle breeding development. It should be noted that in works by different authors [23] the costs are investigated in energy units, not in monetary terms. For the profitability of zonal livestock production, an effectively chosen supply chain management strategy is of no small importance. A failure of any one element in a supply chain, in fact, causes disruptions for potentially all partnering companies upstream and downstream. When a disaster occurs, major business disruptions follow. Both internally and externally induced supply chain disruptions can significantly and negatively influence the financial bottom line of a firm, determining its profitability and survival [24, 25]. Hence, appropriate strategies are needed to manage these uncertain events, also for maintaining profitability and enhancing the competitive position of companies [26]. This is due to the fact that the production of cattle weight gain is less energy-intensive compared to greenhouse production of fruits and vegetables, including the cost of fertilizer, diesel fuel, irrigation water and labor. In the work of Narges Banaeian, Mahmoud Omid, Hojat Ahmadi, the Cobb-Douglas function was used to determine the distribution of energy resources, and in our study, additive multiple regression models of production costs were constructed, allowing us to determine not only elasticity coefficients, but also coefficients of the multiple regression equation. The impact of ecology on production was also analyzed, and this in its turn determines the mechanisms of supply chain management [27]. For example, in the areas of the northern forest-steppe, the north-eastern forest-steppe and the mountain-forest zone, an overall productivity model was obtained, with three significant factors: the number of cattle in growing and fattening per head; payment for 1 person-hour and direct labor costs for 1 head of cattle. In our livestock productivity models for the dairy cattle in the context of all regions of the republic, the significant factors were the following: payment for 1 person-hour and direct labor costs for 1 head of cattle.

4.1. Practical application and recommendations

As a result, for the identified significant factors, we made a forecast on the dairy cattle growth productivity in two ways: 1 - where the value of the factor under consideration is the maximum; the second option is the minimum (table 7).

Table7. Forecast of cattle productivity in agricultural organizations of the northern forest-steppe, north-eastern forest-steppe and mountain-forest zones of Bashkortostan Republic

Forecast variants	Expectation factor values			Forecasted productivity	
	x_2	x_3	x_4	centner	in % to the average
1 - max	14090	39,26	79,08	1,084	71,7
2 - min	235	39,26	79,08	1,596	105,6
3 - max	2524	90,00	79,08	1,923	127,2
4 - min	2524	13,20	79,08	1,301	86,0
5 - max	2524	39,26	142,70	2,135	141,2
6 - min	2524	39,26	52,40	1,250	82,7
On the average	2524	39,26	79,08	1,512	X

From the above mentioned data in the table it follows that the maximum productivity can be achieved by increasing the level of wages, direct labor costs by 1 head of cattle. The increase in livestock led to a decrease in productivity by 28.31% (with average values of factors). The average productivity in the areas of the northern forest-steppe, the north-eastern forest-steppe and the mountain-forest zone will be 1.512 centners. Therefore, to increase productivity, the features of zonal conditions should be taken into account. It should also be noted that the productivity of animals is determined by the complex of morphological features of the organism, which are formed and manifested as a result of the interaction of the hereditary basis and paratypic factors [28]. This indicator is estimated even during life on live weight, growth intensity and a number of other indirect signs. However, the most complete characterization of meat productivity, especially its formation, can be made only by the quantity and quality of meat products obtained during slaughter of animals [20]. Our cost models for 1 centner of weight gain in the dairy cattle in all regions of the republic (54 districts) and in the areas of southern forest-steppe, pre-Ural and trans-Ural steppes (32 districts) turned out to be mostly insignificant. To develop the models, we calculated and applied such significant factors as: X_1 is the inverse indicator of cattle productivity, head; X_2 is the proportion of feed costs,%; X_3 is direct labor costs per 1 head: person-hour; X_4 is payment for 1 person per 1 hour, rub. A significant cost model of 1 centner of weight gain in the meat cattle was obtained for the whole areas of the northern forest-steppe, northeast forest-steppe, and the mountain-forest zone. In order to reflect the significant factors, we gave a forecast of the cost of 1 centner of weight gain in the meat cattle in the following ways: 1 - where the value of the factor under consideration is the maximum; the second option is the minimum (table 8).

Table 8. Forecast of the cost of 1 centner weight gain of cattle in agricultural organizations of the northern forest-steppe, north-eastern forest-steppe and mountain-forest zone of the Republic of Bashkortostan

Forecast variants	Expectation factor values				Forecasted productivity of 1 c of weight gain	
	x_1	x_2	x_3	x_4	rubles.	in % to the average.
1 - max	13,90	53,703	36,523	71,807	8148,67	94,5
2 - min	3,60	53,703	36,523	71,807	8701,06	100,9
3 - max	5,07	76,700	36,523	71,807	3191,02	37,0
4 - min	5,07	21,700	36,523	71,807	16180,37	187,7
5 - max	5,07	53,703	107,9	71,807	5518,03	63,9
6 - min	5,07	53,703	14,3	71,807	21003,70	243,6
7 - max	5,07	53,703	36,523	164,8	3300,23	38,3
8 - min	5,07	53,703	36,523	18,3	11684,42	135,5
On the average	5,07	53,703	36,523	71,807	8622,22	X

From the data of table 8 it we can see that the average cost of 1 weight gain in the meat cattle will be 8.622.22 rubles. The increase in the share of the feed cost contributes to reducing the cost of 1 c gain by 63.0%, and an increase in the level of payment for 1 person per hour will reduce costs by 61.7%. In-depth studies and approbation of the results were reviewed and approved at a meeting of the Scientific and Technical Council section for the Economy and Organization of Agrarian Production of the Ministry of Agriculture of the Republic of Bashkortostan [21]. The recommendations developed by us show that in beef cattle breeding it is necessary to raise the level of mechanization and wages, the strategy of supply chain management, eliminate the existing imbalances between the presence of livestock and forage base, between dairy and beef cattle. It is necessary to purposefully and systematically expand the proportion of breeding cattle. Along with the development of specialized meat cattle breeding, it is necessary to increase the productivity of growing and fattening young stock, obtained from dairy cattle cows of black-and-white and Simmental breeds which are planned for the Republic of Bashkortostan. As shown by research scientists, when creating an optimal level of feeding, animals of these breeds exhibit high meat productivity. It is also necessary to consider in more detail the data for individual areas and agricultural organizations that have achieved low labor costs for servicing one head, and the advantages that open up the use of advanced technologies. The results can be used in the direction of investment, the development of strategies and development plans for the future.

5. Conclusions

Comparison of the results of typological groupings led to the following conclusions:

- production of growing and fattening cattle from dairy cows exceeds the amount of products produced from specialized meat breeds by almost 9 times;
- the livestock of dairy cattle exceeds the livestock of beef cattle by 11.6 times, and the productivity of beef cattle exceeds the productivity of dairy cattle by 1.28 times;
- the cost of keeping beef cattle breeds compared to the dairy direction is higher by 1.18 times, and the cost price of the weight gain of beef cattle is lower by 7.5% compared to dairy cattle
- it is necessary to choose an effective supply chain management strategy.

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