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CONDITIONS OF THE VERTICAL SOIL ZONALITY IN PHYTOCENOSES IN THE SOUTH-EASTERN KAZAKHSTAN

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One of the key priorities in the development of the country's agro-industrial complex is the management of pasture resources, with a particular emphasis on their rational use. In Kazakhstan, characterized by its arid climate, there are two main approaches to pasture irrigation. The first relies on open water sources (streams, springs, rivers, and lakes), which can supply only 30–32 million hectares of pastureland (1/5 of the total area). The second involves the extraction and delivery of groundwater to the surface through engineering structures located near settlements.

The regulation of pasture use is particularly critical in Zhambyl region, where agricultural land covers more than 4.5 million hectares, 65% of which (2.9 million hectares) are pastures. Notably, over 5,000 agricultural entities in the region possess pastureland but keep no livestock, while most livestock is owned by the rural population, who in turn lack access to pastures. Against this background, this study aimed to develop scientific approaches to the rational use of pasture resources, using the example of remote grazing in the Kordai district of the Zhambyl region. The research was carried out on the land of the Batyr peasant farm. Its pastures are divided into five independent plots located across three geographical zones: foothill-steppe (950 ha), foothill dry steppe (1,370 ha), and foothill semi-desert (1,880 ha), with a total area of 4,200 ha.

Key words: *degradation, rotation, vertical (altitudinal) zonality, natural zone, soil moisture, yield, animals.*

ОҢТҮСТІК-ШЫҒЫС ҚАЗАҚСТАН ФИТОЦЕНОЗДАРЫНДАҒЫ ТОПЫРАҚТЫҢ ТІК АЙМАҚТЫЛЫҒЫНЫҢ ШАРТТАРЫ

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Елдегі агроөнеркәсіптік кешенді дамытудың маңызды бағыттарының бірі жайылымдық табиғатты басқару болып табылады, әсіресе оларды ұтымды пайдалану басым бөлігі болып табылады. Қазақстанда климаты құрғақ ел ретінде жайылымдарды суарудың екі тәсілі бар. Бірінші тәсіл – ашық көздерді (бұлақтар, бастаулар, өзендер, көлдер) осы тәсілдің көмегімен табиғи су көздері 30-32 млн га жайылымды (жайылымдардың барлық аумағының 1/5) ғана қамтамасыз ете алады. Екінші тәсіл – жер асты суларын жер бетіне елді мекенге жақын инженерлік құрылыстармен тасымалдау.

Жайылымдарды пайдалануды реттеу әсіресе Жамбыл облысында маңызды, онда ауыл шаруашылығы мақсатындағы жерлердің жалпы ауданы 4,5 млн гектардан асады, оның ішінде жайылымдар 65% – 2,9 млн гектарды құрайды.

Өңірде жайылымы бар, бірақ үй малы жоқ 5 мыңнан астам ауыл шаруашылығы құрылымдары бар. Бұл ретте малдың басым бөлігіне ие облыс халқының жайылымы жоқ.

Осыған байланысты осы зерттеулердің мақсаты Жамбыл облысының Қордай ауданында мал жаю әдісінің мысалында жайылымдық ресурстарды ұтымды пайдалану жөніндегі ғылыми тәсілдерді әзірлеу болды.

Зерттеулер «Батыр» шаруа-фермер қожалығының жерлерінде жүргізілді. Ол жердің жайылымдары үш географиялық аймақта орналасқан және бес дербес телімдерден тұрады: тау бөктерлі-далалық (950 га), тау бөктерлі-құрғақ далалық (1370 га) және тау бөктерлі-шөлейтті (1880 га). Бұл шалғай жайылымдардың жалпы ауданы 4,200 гектарды құрайды.

Түйінді сөздер: *тозу, айналым, тік (биіктік) аймақтылық, табиғи аймақ, топырақтың ылғалдылығы, өнімділік, жануарлар.*

УСЛОВИЯ ВЕРТИКАЛЬНОЙ ЗОНАЛЬНОСТИ ПОЧВ В ФИТОЦЕНОЗАХ ЮГО-ВОСТОКА КАЗАХСТАНА

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Одним из важнейших направлений развития агропромышленного комплекса в стране является управление пастбищной природы, приоритетной частью является их рациональное использование. В Казахстане, как стране с сухим климатом, есть два способа полива пастбищ. Первый способ – использование открытые источники (ручьи, родники, реки, озера) с помощью данного способа природные водоисточники могут обеспечить лишь 30-32 млн га пастбищ (1/5 всей территории пастбищ). Второй способ – транспортировка подземных вод на поверхность инженерными сооружениями вблизи населенного пункта.

Регулирование использования пастбищ особенно важно в Жамбылской области, где общая площадь земель сельскохозяйственного назначения составляет более 4,5 млн га, из них пастбища занимают 65% – 2,9 млн га.

В регионе насчитывается более 5 тысяч сельскохозяйственных образований, имеющих пастбища, но не имеющих домашнего скота. При этом население области, владеющее большей частью скота, не имеет пастбищ.

В связи с этим целью данных исследований была разработка научных подходов по рациональному использованию пастбищных ресурсов, на примере метода дистанционного выпаса скота, в Кордайском районе Жамбылской области.

Исследования проводились на землях крестьянско-фермерского хозяйства «Батыр». Пастбища состоят из пяти самостоятельных участков, которые расположены на трёх географических зонах: предгорно-степной (950 га), предгорно-сухостепной (1370 га) и предгорно-полупустынной (1880 га). Общая площадь этих отдаленных пастбищ составляет 4,200 га.

Ключевые слова: *деградация, ротация, вертикальная (высотная) зональность, природная зона, влажность почвы, урожайность, животные.*

Introduction. The area of natural forage lands of the Republic of Kazakhstan is 188 million ha, it is the national heritage of the country. The largest per capita forage area is believed to be Kazakhstan, followed by Australia, Canada, Russia, Argentina, the United States and other countries [1, p.5].

According to the data of the Agency of the Republic of Kazakhstan, a total of 27.1 million hectares of pastures are moderately and severely degraded. In zonal aspect the destruction of pasture ecosystems is observed to a greater extent in the plain part, where more than 95% of all degraded pastures are located, including desert and semi-desert zones – 16.1 million ha or 60% of their area. Pasture run-down is the main consequence of changing ecological conditions and irrational human economic activity. It is manifested in the loss of valuable fodder plant species from the grass stand and their replacement by weedy, non-digestible and annual species [2, p.55, 3, p.37].

The consequence of forage lands' degradation is catastrophic for graziery and ecological condition. First, the degradation of forage lands affects the productivity of pastures. Excessive grazing of phytomass by cattle, have negative effect for the ability of phytocenoses to seed renewal, especially before the completion of the stage of seed maturation. The compaction of the root layer because of trampling by cattle greatly complicates the vegetation of the dominant steppe phytocenoses of plants of the cereal family, which is associated with the spongy type of their root systems. Accordingly, the decline of root mass and the depth of the root system penetration weaken the drought resistance of plants dramatically. Meanwhile, plants of other families with a rod-shaped root structure, for which high soil density is not a limiting factor of their growth and development, may receive benefits, but they have little feed value. All these factors affect the qualitative and quantitative indicators of pasture mass.

The decrease in pasture productivity affects the lack of feed directly. Approximately 11 million cattle are brought to pastures each year. According the Draft law on improvement of pasture infrastructure in Kazakhstan, the daily consumption of per animal is 35 kilograms of feed, and grazing time is 180 days per year. So one animal needs about 6.3 tons of dry mass, but now this figure does not exceed 4.6 tons. The shortage of hay is 30% per animal.

Secondly, the degradation of pastures not only leads to a decrease in gross forage, but also causes the formation of large foci of wind erosion. The soil areas that are trampled by cattle and stripped of vegetation are exposed to increasing winds, which leads to soil decomposition and transfer. Then a more global environmental problem occurs – desertification.

About 75% of the country's territory is exposed to an increased risk of environmental disaster, and the most seriously degraded has been pastures adjacent to rural settlements and wells. 26.6 million ha of degraded pastures in the Republic are estimated by the extreme degree of desertification.

According to the analysis of scientific research, to date there is no single definition of land degradation, but the processes of deterioration of land properties and reduction of its productive capacity play a predominant role in it. Rules for the rational use of agricultural landscapes define degradation as a decrease in the fertility of land caused by agricultural activity, leading to a reduction in its natural and economic significance [4].

According to the data of the Committee for Land Resources Management of the Ministry of Agriculture of the Republic of Kazakhstan as of 01.11.2023, the land fund of the Zhambyl region is 11,938.2 thousand hectares. Changes that occurred in the areas of land categories in 2023 are explained by the transfer of lands

from one category to another in connection with the provision of land plots for various purposes and clarification of their areas as a result of ongoing inventory and clarification of lands [5].

Information on distribution of utilized lands by categories in the Zhambyl region for 2022-2023 is presented in Table 1.

Table 1 – Distribution of lands for the Zhambyl region for 2020-2023 by categories, thousand ha

№	Land category	2020	2021	2022	2023
1	Agricultural land	4705,3	4693,0	4675,8	4661,6
2	Land of settlements	464,9	672,2	842,2	842,2
3	Lands of industry, transport, communication, defense and other non-agricultural purposes	174,7	175,0	174,9	176,2
4	Lands of specially protected natural territories	11,6	11,6	11,6	11,6
5	Lands of the forest fund	4429,0	4429,1	4429,1	4429,1
6	Water fund lands	356,1	356,1	356,1	356,3
7	Reserve lands	1796,5	1601,2	1448,5	1461,2
Total		**11 938,1**	**11 938,2**	**11 938,2**	**11 938,2**

**Source: Committee on Land Resources Management of the Ministry of Agriculture of the RK*

The changes in the areas of land categories in 2022 are explained by the transfer of lands from one category to another, in connection with the provision of land plots for various purposes and clarification of their areas as a result of ongoing inventories and clarification of lands. Thus, the total area of lands of residential settlements increased by 170 thousand hectares at the expense of agricultural lands and reserve lands with the expansion of the borders of rural settlements to meet the needs of the population in pasture lands.

The **purpose** of the research is to develop scientific approaches to the rational use of pasture resources, using the example of remote grazing in the Kordai district of the Zhambyl region.

Research objectives:

1) Assessment of the impact of year-round grazing on agroecological indicators of pastures;

2) Comparative characteristics of pastures in terms of productivity and feed quality;

3) Evaluate the effectiveness of seasonal and intra-seasonal crop rotation in the use of pastures in terms of ecological and economic sustainability **Research methods.**

The research was carried out on the lands of the Batyr peasant farm. Pasturelands of the farm consist of five independent sites, which are located on three geographical zones: foothill-steppe (950 ha), foothill dry steppe (1370 ha) and foothill semi desert (1880 ha). The total area of these distant pastures is 4.200 ha.

Foothill-steppe zone*. The altitude is 1350 meters above sea level, the soil is dark chestnut. Average annual air temperature is +7.4ºC Frost-free period – 164 days. Average annual precipitation is 418 mm. Of them for the cold period (XI-III) – 155 mm; for the warm period (IV-X) – 263 mm.

Foothill-dry-steppe zone. The altitude is 1200 meters above sea level, the soil is light chestnut. Average annual air temperature – +7.8ºC Frost-free period – 170 days. Average annual precipitation is 320 mm. Of them for the cold period (XI-III) – 120 mm; for the warm period (IV-X) – 200 mm.

Foothill-semi desert zone. The altitude is 800 meters above sea level, the soil is sierozem ordinary. Average annual air temperature – +8.0ºC.

Frost-free period – 142 days. Average annual precipitation – 271 mm. Of them for the cold period (XI-III) – 91 mm; for the warm period (IV-X) – 180 mm.

** annual average data from the Kordai weather station, which is located 40 km from our site*

Scientific approaches that are presented in this paper show a fundamentally new direction about the recovery of land negative affected by human impact. The research was carried out by the following scheme (Figure 1).

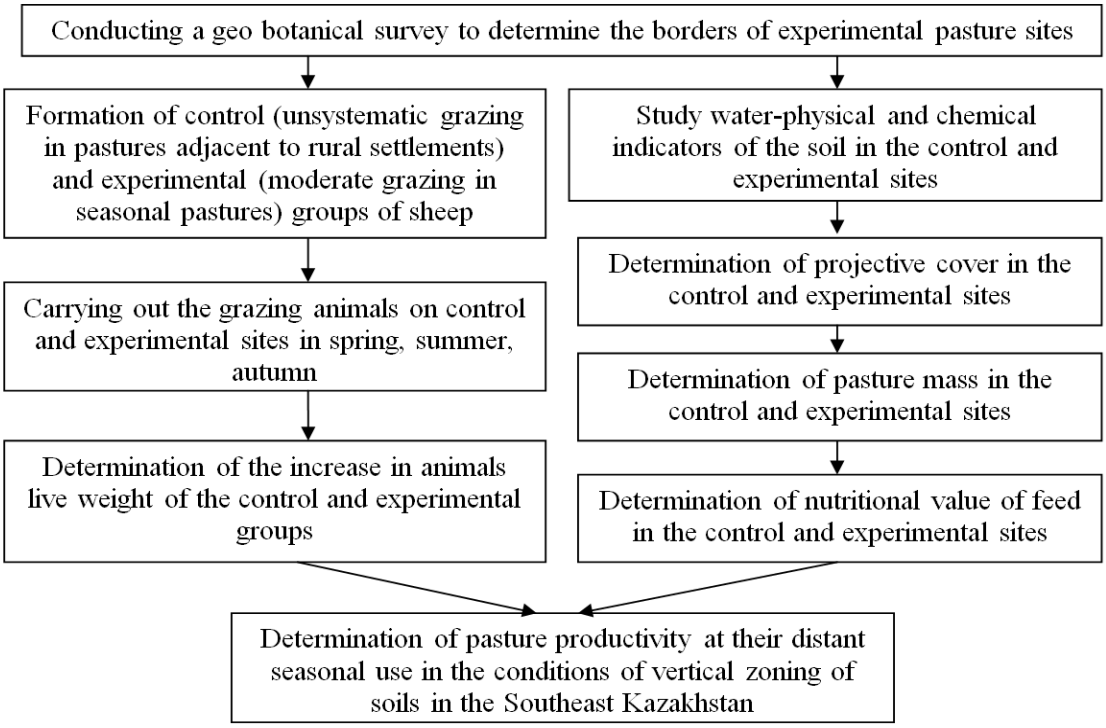


Figure 1 – Scheme of research

The development presented by us is a fundamentally new direction for the restoration of land resources that have undergone negative changes from anthropogenic impact. The studies were carried out in according to the following scheme [6, p.248]. List of completed work on accounting and observations:

1) Determination of the soil water-physical indicators: reserves of productive moisture were determined by thermostatic-weight method. Soil samples used to determine moisture in the field were taken using a special drill, immersing it in the soil to a predetermined depth. The soil samples were selected from each 10 cm of soil layer, then placed in a pre-weighed aluminum cups. In the laboratory, it was weighed on electronic scales with an accuracy of 0.01 g. Then the cups with soil were placed in a drying cabinet and dried to a constant mass at a temperature of 105 °C. Determination of the volume mass of soil was carried out on 4 fixed plots, in layers of 10 cm to the depth of 50 cm [7, p.416]. Determination the soil moisture reserves in 4 points, by drilling up to 0. 5 m in 10 cm by thermostatic-weight method according to seasons: spring, summer and autumn in triplicate; determination of green mass yield on specific plots of 10 m^2 plant outlines for the grazing period [8,p.272, 9, p.13].

The agrochemical soil analysis included: cation-anionic composition of aqueous extract [10], content of humus – by Tyurin [11], content of mobile mineral forms of phosphorus and potassium -in carbon ammonium extract by Machigin (Central Institute of Agricultural Chemical Services) [12], content of nitrates' nitrogen – by ionometric method [13].

2) Measuring the projective cover of plants and weighing the pasture mass of herbage: for each plot, the design coverage is calculated by applying a ‘Ramenskij grid’ to the grass and by calculating the percentage of filled cells. Determination of the pasture mass was carried out by the Method of accounting for the harvest of yield hayfields and pastures in stationary experiments [14]. Mowing of grass was carried out in a continuous way with a mower which harvesting width was 2.1 m and height – 6-7 cm. Drying, weighing of mowed grass was carried out directly on the sites (10 m^2).

3) Determination of nutritional value of feed: determination of the chemical composition of feed by seasons was determined in the laboratory of the “Kazakh Scientific Research Institute of Animal Breeding and Forage Production”. That included the definition of content of moisture, crude protein, fat, ash, fiber, phosphorus, calcium, as well as digestible protein, metabolic energy and feed units.

4) Determination of the increase in animals' live weight: measurement of live weight gain of animals was carried out weighing selected animals in control and experimental groups.

The gain of live weight of animals was established by weighing of the 10 sheep from different age groups in the spring and in the autumn. The value of the relativity of mass gain (growth intensity) was calculated by the Schmalhausen and Brody method [15].

5) To conduct a statistical analysis of the experimental data, the methods of the Dospekhov variance analysis [16, p.352] were used using the SNEDECOR program. To calculate the average values and standard errors, the ANOVA software in Microsoft Excel was used, and the significance of probabilities was estimated using the Student t-test [17].

Discussion and results.

Based on the results of geo-botanical studies, distant pastures were divided according to their use time: pastures located in the foothill steppe area should be used in autumn, the foothill dry steppe pastures – in summer, foothill semi desert pastures in spring. In all these remote areas, there was carried out the normalized grazing of experimental animals, where the degree of grazing was less than 70% of the total herbage mass (Figure 2).

On the control site, the projective cover by grass was between 30-35%. In the distant spring pasture, this indicator was at the level of 50-55%, in summer and autumn pastures – 70-80%. At the end of studies, on the distant sites the projective cover increased by 8-10% due to the appearance of young shoots of growing plants, while in the control sites this indicator remained almost unchanged.

Foothill semi-desert zone (control)

Foothill semi-desert zone (spring pasture)

Foothill steppe zone (autumn pasture)

Foothill dry steppe zone (summer pasture)

Figure 2 – Pasture lands of “Batyr” farm

During the work, on selected botanical associations in all geographical areas there were carried out different studies, starting with the measuring of soil moisture, including the determination of pasture mass and ending with the weighing of live weight of animals because of the grazing.

The research we carried out, concerning the determination of the total moisture reserve in soil, showed that all types of pastures in the springtime had a sufficient level of humidity suitable for the initial growth of grasses.

In this context, in the foothill semi desert zone with ordinary grey soil (control), the moisture accumulated in winter and early spring periods is used not only for the growth and development for the grass, but also spent on physical evaporation from the soil surface.

The maximum content of the soil moisture shows the foothill steppe zone with Poa, Onobrychis, Festuca, Carex, Alyssum plants, compared with other variants of experience, and it is logical. It is because of the fact that in the piedmont-steppe zone more precipitation falls, for the proximity of the mountains, and in the regions located at an altitude of 1350 meters above sea level, snow comes off the surface of pastures only in mid-April (Table 2).

Table 2 – Soil moisture in seasonal pastures, %

Year	Season	Depth of sampling, cm	Pastures according their use			
			Control (all-year grazing) Foothill semi desert	Spring grazing Foothill semi desert	Summer grazing Foothill dry steppe	Autumn grazing Foothill steppe
1 year	spring	0-10	4.8	6.1	10.3	14.1
		10-20	5.2	6.3	10.7	14.1
		20-30	5.2	7.1	11.2	14.1
		30-40	7.3	7.6	11.7	14.7
		40-50	8.6	8.2	12.3	15.5
	summer	0-10	3.7	3.5	5.7	3.0
		10-20	4.3	6.1	7.4	7.4
		20-30	4.7	6.1	9.2	7.9
		30-40	5.3	6.2	9.7	7.7
		40-50	5.6	5.8	8.6	6.3
	autumn	0-10	1.6	2.1	4.1	4.8
		10-20	1.9	2.8	3.2	5.6
		20-30	2.1	3.2	4.6	5.8
		30-40	4.5	4.7	5.9	6.1
		40-50	5.3	5.1	7.3	6.1
2 year	spring	0-10	11.5	12.6	22.2	24.1
		10-20	12.2	12.6	20.5	25.3
		20-30	12.1	13.6	19.8	22.7
		30-40	11.2	13.2	18.1	22.2
		40-50	10.7	12.6	18.1	22.1
	summer	0-10	3.6	4.2	6.9	8.1
		10-20	3.9	4.8	7.1	8.4
		20-30	4.2	5.3	7.8	9.1
		30-40	4.8	6.0	7.0	8.7
		40-50	5.5	5.8	6.4	7.4
	autumn	0-10	2.6	2.8	4.4	5.3
		10-20	2.9	3.7	4.6	6.6
		20-30	3.1	3.6	4.8	7.1
		30-40	3.8	4.3	5.2	6.9
		40-50	4.1	4.8	5.7	7.3
3 year	spring	0-10	11.2	12.2	16.8	22.4
		10-20	11.9	13.3	14.0	23.4
		20-30	10.2	14.4	13.3	19.4
		30-40	11.8	14.6	13.7	18.3
		40-50	10.5	13.3	13.2	19.6
	summer	0-10	2.9	3.5	5.0	7.5
		10-20	3.7	4.8	5.4	8.1
		20-30	4.0	5.2	5.9	8.3
		30-40	5.2	5.6	6.8	8.4
	autumn	0-10	2.2	2.7	4.1	5.1
		10-20	2.6	3.6	4.2	5.8
		20-30	3.0	3.7	4.6	6.1
		30-40	3.4	4.0	5.0	6.5
		40-50	3.7	4.6	5.6	6.8

In addition, they are located on a dark chestnut soil, and the wetting of the soil along the moisture profile is more than 100 cm in the spring.

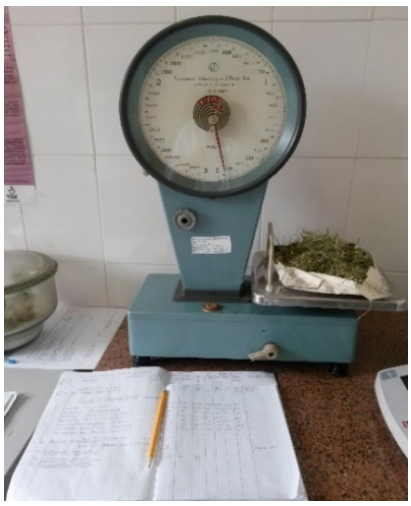
In order to identify feed capacity of the used pastures, we have determined the yield of pasture herbage in the selected plant associations according to seasons.

Studying the yield of pasture mass of natural grass on average for three years, showed that the most productive was the site of spring use pastures was the Ephemerae-Artemisia type of pastures – 1.55 t/ha in spring. In the area of summer use pastures, the highest yield of pasture mass was noted in the Festuca-Artemisia-variiherbetum type – 1.97 t/ha in summer. In the autumn use region, the productivity of pasture was higher on the vegetation contour consisting of Onobrychis-Bromopsis-Festuca vegetation – 2.59 t/ha in the autumn.

At the same time, despite seasonal use, the peak yield on all types of pastures falls on the summer periods. The lowest productivity of pasture mass was obtained in the control variant of the experiment with year-round use. In this variant, the grass yield was 0.79 t/ha in spring, 0.41 t/ha in summer, and 0.39 t/ha in autumn. Moreover, it decreased by the end of the study compared to the beginning of the experiment, amounting to 0.52 t/ha, 0.35 t/ha, and 0.38 t/ha in 2017, respectively.

This reduction in yield due to the fact that in recent year the number of grazed animals on the village lands has increased. The increase in livestock was caused by the great interest of meat producers due to rising meat prices.

The study of the chemical composition of plants in the project area showed a decrease in protein from spring to fall. On the contrary, the composition of cellulose increases as the grazing period ends and reaches the index in September. This is because plants complete growth and development, dry out and accumulate. As a result, the amount of protein decreases and the amount of cellulose increases. These dynamics are related to natural seasonal changes in plants. When plants enter the dormancy or drying phase, they accumulate few nutrients in the form of proteins and many structural components in the form of greens (*Figure 3*).



Forage processing in the Laboratory of Zootechnical Analysis of the Kazakh Research Institute of Fodder Production and Animal Husbandry
Results of fodder sampling. The study of chemical composition of plants in different regions for three years showed the following results of crude protein content: in the control variant (pastures around the village) in spring 7.4%, in summer 6.6%, in autumn 5.6%; in the foothill semi desert zone in spring 8.1%, in summer 7.3%, in autumn 6.1%; in the foothill dry steppe zone in spring 8.8%, in summer 7.9%, in autumn 6.8%; in the foothill steppe zone in spring 9.1%, in summer 8.2%, in autumn 6.9%. Cellulose content: in the control variant (pastures around the village) spring 25.8%, summer 27.3%, fall 28.7%; in the foothill semi desert zone spring 8.1%, summer 7.3%, fall 6.1%; in the foothill dry steppe zone spring 8.8%, summer 7.9%, fall 6.8%; in the foothill steppe zone spring 9.1%, summer 8.2%, fall 6.9%.

Figure 3– Results of the study of chemical composition

For conducting an economic assessment of seasonal use of pastures the researchers selected two groups (experimental and control) of animals-analogues, including three age groups – stud ram, ewes of the third year, and lambs of the current year of birth (Table 3). The breed of sheep was the Kazakh fine-wool sheep. Assessment was conducted twice a year – in spring and in autumn. The difference in starting indicators of animals' live weight (every year before the start of grazing) on average for three years did not exceed 1.5 kg. The control group was grazed in the foothill semi desert zone on the lands of the Kenen settlement, free year round in one place. The experimental group was grazed on seasonal pastures.

Thus, it can be seen from the obtained data that a higher gain of live weight was demonstrated by the experimental group of animals, experiencing a rational seasonal grazing system. According to the results of seasonal use for three years of research, the weight gain of stud rams was 3.370 kg/head, ewes – 8.020 kg/head, and lambs of the current year of birth – kg/head kg more than the control groups of animals that grazed unsystematically.

Table 3 – The live weight gains of animals, kg/head

Season		The live weight, kg/head					
		Stud ram (n=10)		Ewes (n=10)		The lambs of the current year of birth (n=10)	
		experimental group	control group	experimental group	control group	experimental group	control group
spring		83.520	81.690	51.120	49.840	17.940	16.970
		± 1.64	± 1.53	± 1.26	± 1.25	± 2.21	± 2.18
autumn		85.300	82.120	58.450	54.700	36.300	27.400
		± 1.47	± 1.46	± 0.75	± 0.81	± 0.58	± 2.72
spring		81.340	81.410	48.320	49.100	14.80	14.600
		± 0.67	± 0.72	± 0.83	± 1.03	± 2.46	±2.60
autumn		86.370	83.740	59.100	55.000	38.800	31.950
		± 0.60	± 0.81	± 0.67	± 0.39	± 0.72	± 1.12
spring		79.300	80.100	49.200	49.800	15.800	15.400
		± 0.64	± 0.73	± 2.05	± 1.44	± 1.99	± 1.93
autumn		87.700	83.400	63.300	56.100	43.000	32.800
		± 1.25	± 1.24	± 1.23	± 2.02	± 1.98	± 2.01
Average	spring	83.380	81.060	49.550	49.580	16.180	15.650
	autumn	86.450	83.080	60.280	52.260	39.360	30.720

During the pasture period, the increase of the experimental group's live weight was higher than in previous years of the study. The increase in live weight gain in experimental group's animals is due to the fact that, when animals were grazing on seasonal sites, there was used an intra-seasonal pasture rotation. It reduced almost three times unproductive (idle) movement of animals in search of food and grazing area and trampling vegetation, which led to the elimination of degradation of pasture lands.

In addition, the experimental data showed that during the pasture period the highest increase in live weight was provided by lambs of the current year of birth. For three years of research during the grazing period, the increase in live weight of lambs from spring to autumn in the experimental group was 23.180 kg/head, and in the control group it was 15.070 kg/head on average. Such high rates of live weight gain of lambs during the pasture period were mainly due to the increase of muscle mass.

Rational use of natural pastures allows increasing the grazing capacity of forage land, and getting a full valuable and cheap livestock product. Rational pasture maintenance of livestock not only reduces the cost of fuel by 6-7 times, equipment, labor and total costs of produced feed by 2-3 times compared to stall maintenance, but also improves metabolic processes and reproductive functions of animals. This determines the big advantage of pasture feeding in the economy of important livestock products.

It is important to remember that, the rational use of pastures has a huge impact on improving soil fertility, creating the conditions for the restoration of vegetation, eliminating the land degradation, and increasing the productivity of pastures.

In carrying out the calculation of economic efficiency were accepted only basic expenses for maintenance and grazing of pasture period. Comparing the slaughter weight of sheep in two different groups of animals showed that in the experimental group it was more than in the control group. Considering that the slaughter weight of animals is 50%, we received the following data: in experimental group, slaughter weight of stud rams amounted to 41.540 kg/head, ewes to 26.130 kg/head and lambs to 15.360 kg/head, while in the control group it was 43.225 kg/head, 30.140 kg/head, 19.680 kg/head, accordingly.

Thus, the live and slaughter weights of sheep were higher in the experimental group of animals were grazed in seasonal pastures than in control group were grazed in year-round pasture pastures. The difference was significant – 3.180 kg/head of stud rams, 3.750 kg/head of ewes, and 8.900 kg/head of lambs. Accordingly, grazing sheep in seasonal pastures was more cost-effective.

Conclusions. The lowest reserve of soil moisture was observed in a year-round used control variant with the Artemisia herbage. The lowest productivity of pasture mass was obtained in the control variant too. A study of the chemical composition of plants on average over three years showed the same dynamics in protein content for all pastures – the peak in protein content occurred at the beginning of the growing season and decreased from spring to autumn, but the lowest crude protein content at the peak yield in summer was found in plants from the control variant. In comparison with seasonal pastures, the live and slaughter weights of sheep were significantly lower in control pasture, where the animals were grazed in year-round system.

Thus, it can be concluded that the year-round used pastures located near the villages in Kazakhstan are less provided with moisture in the soil due to the low projective cover, less productive in the pasture mass and less valuable in forage qualities. So we strongly recommend the grazing on distant pastures in order to promote rational using, including the seasonal and intra-seasonal rotation, it is more efficient, profitable and environmentally friendly.

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MATHEMATICAL MODEL OF FURROW FORMATION BY AN ELLIPTICAL BLADE OF AN ACTIVE ROTARY TILLAGE TOOL

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Machines and implements equipped with actively driven rotary tillage tools are widely used in surface tillage operations. However, the process of furrow formation by such tillage tools has not been sufficiently investigated. This study proposes a mathematical model to describe furrow formation and analyzes the technological process involving an elliptical blade of an active rotary tillage tool. The study is conducted under specific operational parameters: angle of inclination of the tool from travel direction was 40°, and a kinematic parameter ranging from 0.8 to 2.2.

The tillage blade is characterized by a inclination angle from the axis of rotation and is designed as an elliptical blade oriented along the major semi-axis of the ellipse. This elliptical blade, functioning as the executive operating element of the rotary tillage tool, forms a groove with a parallelogram-shaped geometry when viewed from above, and an elliptical segment in cross-section. At sharp angles of inclination of the tool