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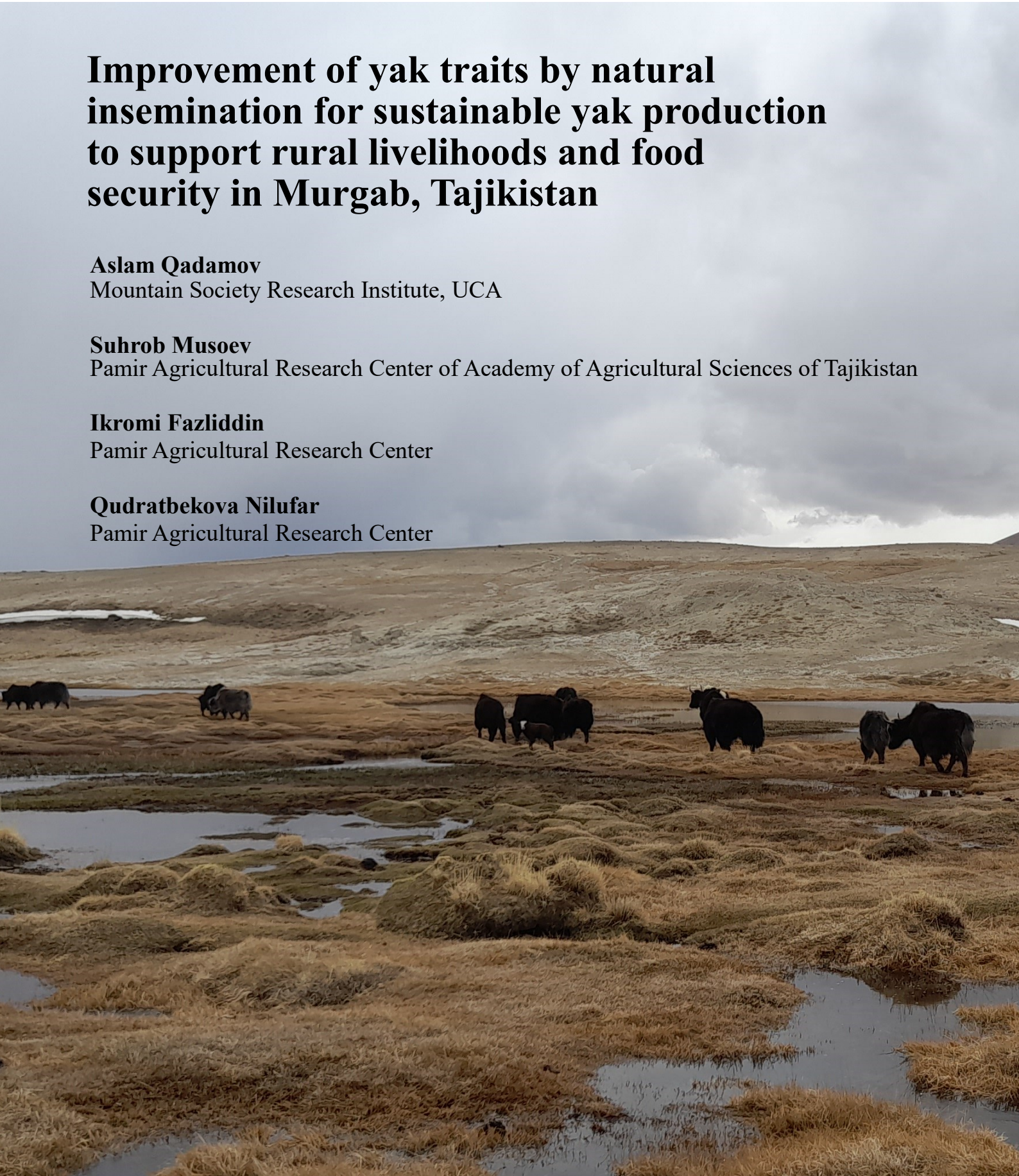

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Mountain Societies Research Institute

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Abstract

The study was conducted in the high Pamir with an experimental herd of yaks at Pamir Agriculture Research Center (PARC), Murghab (Alichul, Ok Char valley). In this study two sires of Mongolian ecotype, the best in origin and phenotypic traits were selected from Bulunkul farm for breeding with ten Pamir ecotype yak cows at PARC, using the method of intrabreed selection to prevent inbreeding and obtain more viable and productive offspring. The offspring of this mating constituted the experimental group of two bulls and three heifers. The control group consisted of two bulls and two heifers. The study aimed to find whether the experimental group outperformed the control group in terms of body parameters, mainly weight. The weights of live calves in the experimental group increased by 56.71 kg on average from 22.46 kg to 79.17 kg during the period from birth (April) to 8 months of age (December 18). In bulls, the live weight increased by 57.81 kg on average from 23.45 kg to 81.26 kg, while heifers added 55.06 kg increasing from 20.99 kg to 76.05 kg. In the control group, these figures averaged from 19.87 kg to 73.55 kg, a 53.69 kg weight gain, whereas, in bulls, the net gain was 55.03 kg (from 21.81 to 76.84 kg), and in heifers, it was 52.35 kg (from 17.93 kg to 70.27 kg). Live weight of young yaks in the experimental group exceeded weights in the control: bulls at birth by 1.64 kg (7.5%) and at the age of 8 months by 4.42 kg (5.8%), heifers at birth by 3.07 kg (17.1%) and at 8 months of age by 5.77 kg (8.2%). The average daily weight gain of yaks up to 8 months of age was 240.7 g for bulls and 229.3 g for heifers in the experimental group, while in the control group the gains were 229.2 and 219.6 g, respectively.

Keywords: yak breeding, inbreeding, Pamir, yaks, Murghab, productivity, growth and development

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Introduction

Yak breeding occupies an important niche in the agricultural sector of Tajikistan (Kudratbekova et al., 2022). Natural and climatic conditions, as well as the presence of extensive high mountain pastures, contribute to the further development of yak breeding in the country (Kamolov, 2021). In Tajikistan, yaks are mainly reared in the Gorno-Badakhshan Autonomous Oblast (GBAO), which is considered the main historical zone of yak breeding (Abidzhanovich et al., 2017). In recent years, yak breeding has been practiced in Sughd region (Ayni and Kuhistoni Maschoh), Khatlon region (Baljuvan), and Lakhsh, Varzob, and Sangwork districts of Republican Subordination at altitudes above 2000 m a.s.l. (Bobokhodzhaev, 2009). However, it should be noted that, being well adapted to the harsh conditions of highlands with relatively poor vegetation, cold climate, and rarefied air, yaks adapt very poorly to other natural conditions (Radjabov et al., 2016).

In GBAO, particularly the Murghab region, with its natural and climatic conditions, yaks are considered the best farm animals (Kamolov, 2021), since other domestic animals do not tolerate the harsh winters of this region. A characteristic feature of yaks is their habitat – being exceptionally high-altitude animals, they are adapted to low temperatures, low humidity, and rugged terrain (Guo et al., 2019; Karakulov A.B., 1993). Murghab has all of these conditions. Moreover, the total area of pastures in GBAO is more than 1.2 million hectares, and despite their relatively low productivity (0.5–1.2 t/ha), they are quite conducive to raising yaks (Bobokhodzhaev, 2009).

Yak breeding is a low-cost production that require minimal expenses yak upkeep because yaks are exclusively grazing animals and can feed on natural pastures year round (Irgashev et al., 2016). Thus, there is little to no need for additional fodder procurement, construction of buildings to house yaks, or special care facilities (Kamolov, 2021). Moreover, despite the meager food, yaks produce high-fat milk, and yak meat is the main food of local residents (Mukhiddinov and Bobohodzhaev, 2016). Hence, the economic efficiency of breeding yaks is very high, and arguably no other farm animal can compete with them in this regard (Chertkov, 2013). All these characteristics increase the profitability of yak breeding in the high mountains of Murghab.

Considering the importance of the yak breeding for the economic development of the country, as well as ensuring food security, in 2009 the government of the Republic of Tajikistan adopted a program for the development of yak breeding. This was a significant step for the yak breeding in Tajikistan since the state intended to provide assistance to private farms in yak breeding and recognized this animal husbandry priority (Bobokhodzhaev, 2009). The program envisaged an increase in the number of yaks as a reserve for increasing the production of meat and wool along with the effective use of natural pastures in high mountains as well as importing yaks to other regions – i.e., from the Murghab region to Aini, Kuhistoni Maschoh, Jirgatal, Varzob, and Hissar districts (Amirshoev et al., 2016). These areas have high-altitude pastures that favor the breeding of yaks, and despite the slight difference in natural conditions compared to the Murghab region, the productivity and live weight of imported yaks were almost the same as the Pamir yaks (Bobokhodzhaev, 2009). Until 2015, it was planned to increase the number of yaks in all forms of

yak breeding farms by 23,000 heads, but by the end of the project the number increased by 26,398 heads, far exceeding the target (Mukhiddinov and Bobohodzhaev, 2016).

Despite the measures taken, it should be noted that during past decades, because local farmers did not follow proper zootechnical (veterinary, livestock-keeping) and breeding procedures, there has been a deterioration in the genetic properties and productive qualities of the Pamir ecotype yak. Unfortunately, there are no field research data regarding the inbreeding depression of yaks in conditions of the Murghab region. However, field observations suggest that animals are already getting weaker and smaller, which leads to a decrease in their fertility and productivity.

The Pamir population of yaks, in its characteristics, surpasses other yak relatives, in particular the Kyrgyz population, and it was the Pamir population that had a great influence on the increase in body measurements of animals of the Kyrgyz population (Mamatkalykov et al., 2020). However, during past decades, the opposite has occurred, i.e., a decrease in the main body parameters (length of the head, height at the withers, oblique torso length, chest depth and width in makloks) of the yaks of the Kyrgyz population, which, according to Mamatkalykov and colleagues, is the result of long-term related breeding among the closely related yaks. The same results were observed in the Murghab region because during past decades no proper zootechnical and breeding work has been conducted among local yaks. There has been no importation of yak bulls from other populations or exchanges between herds and local farmers have mainly used their own stock of yak sires.

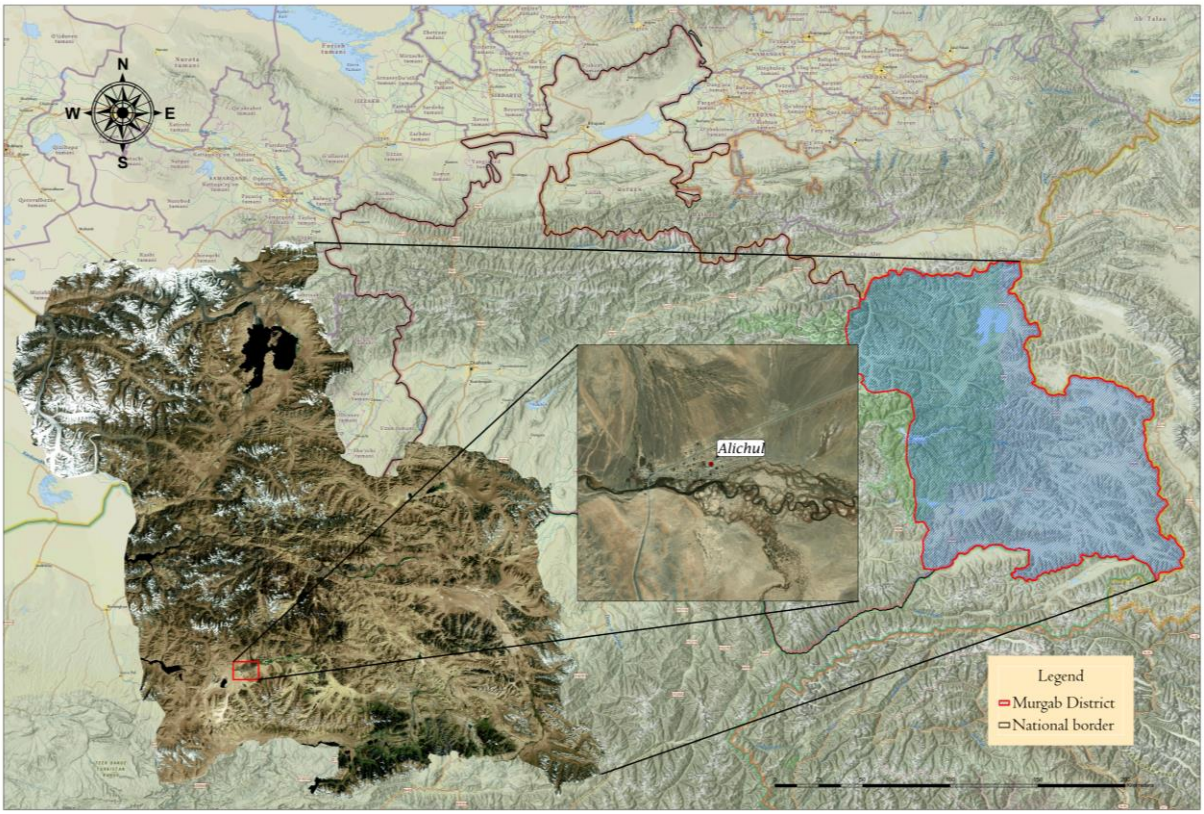

Figure 1. Study area in Alichul village in Murgab

In the highlands of Tajikistan, especially the Murghab region of GBAO, the demand for livestock products, including yak meat and milk, is growing every year because cattle (cows) are less well-adapted to local harsh conditions (Koimdodov, 1997). At the same time, it is important to improve

genetic characteristics of yaks so that their productive qualities are enhanced and the genetic pool of local herds of yaks is expanded. Therefore, research on breeding is necessary to select the best traits and improve the productivity and health of yaks in the Pamirs.

1.1 Brief literature review

Few scientific studies are devoted to the topic of yak breeding in the Pamir. The first scientist who studied the Pamir yaks in their natural environment was Prof. Sinitsyn who worked in the Pamirs in the 1930s (Sinitsyn, 1936). In subsequent years, many scientists were engaged in the study of the biological and economic characteristics of yaks. The study of meat productivity of Pamir yaks found that the slaughter yield of adult yaks is 51.4% and the taste of meat, due to coarse fiber content, is low (Padenko, 1964). Another study noted that the slaughter yield of yaks depends on the conditions of keeping and feeding, and the productivity of pastures (Chertkiev, 1975). According to these data, slaughter yields ranged from 50.6–50.7% in young yaks and was somewhat lower (49.2%) in adults. Gabrielyants (1982) found that yaks in Tajikistan showed the slaughter yields at 18 and 21 months of age were 49.2% and 54.0%, respectively with a meat index (the amount of pulp per 1 kg of bones) of 3.48% and 3.90%.

Numerous researchers noted that yaks are characterized by late maturation, but in the presence of a stable winter feed supply, they have the ability to restore lost live weight and achieve high slaughter qualities (Padenko, 1964; Zhang Rongchang, 1975; Chertkiev, 1973; Kattsina, 1993;). Live weight of Pamir yak sires is, on average, 457 kg, female yaks 269 kg, and young animals 6 months of age 50–55 kg (Padenko, 1964). However, young yaks are very responsive to improved feeding, i.e., additional feeding, and they can achieve live weight gains of up to 110–115 kg by 18 months of age. The growth and development of this ecotype of animals continues until 7 years of age. Yak cows as young as 3 years old can give birth to a calf and at age 2–3 years, males reach reproductive maturity (Lys Ya.Ya., 1930).

The milk of yaks is characterized by a high fat content, approximately twice that of cattle, and fat globules are much larger and the dry matter content reaches up to 22.4%, protein 9.81%, sugar up to 4.81% compared to, respectively, 12.5%, 3.0–3.7%, and 4.2–4.7% in domestic cattle (Kolesnik, 1945; Zhang Rongchang et al., 1983;). The lactation period of yak cows lasts an average of 220 days with an average daily milk yield of 1.1 liters and a fat content in milk of 6.69% (Lyubimov, 1986). An earlier study reported fat content of milk ranging from 4.9% to 7.15% (Dmitrochenko, 1930).

This brief review of the literature provides useful background information. However, most studies were conducted many decades ago and there is a paucity of more recent studies of yaks in the Pamirs. The topic of breeding and improving the quality of yaks especially needs attention.

1.2 Research problem statement

Modern global trends in the development of dairy cattle breeding are aimed primarily at improving the efficiency of breeding work, which consists of developing new and improving existing approaches in assessing the genotype, organizing the selection of animals, monitoring the structure of breeds, and developing methods for breeding improvement of dairy cattle for individual traits. At the same time, special attention is paid to the signs of productivity and reproduction of animals (Ivanova, 2021). These features are primarily due to genetic parameters and technological factors. Improvement of breeding methods plays an important role in solving issues of animal productivity (Zvereva and Muravyova, 2016).

Inbreeding (related mating) is the process of mating animals that are genetically closely related to each other. Inbreeding is aimed primarily at creating animals of the same type in which the necessary economically useful traits are fixed. There are different interpretations about inbreeding, but one thing is clear: systematic inbreeding between representatives of close relatives can lead to inbreeding depression, which is manifested by a decrease in the productivity and reproductive functions of animals (Zyryanova S., 2019). There are several degrees of inbreeding; however, with an increase in the degree of inbreeding the difference in the reproductive functions of animals increases. Therefore, at the present stage of development of zootechnical science, the use of only distant inbreeding for outstanding producers is encouraged. This approach is key to consolidating the positive results of selection and breeding work in heredity, as well as breeding outstanding sires with breeding value (Zyryanova and Lapina, 2019).

Outbreeding crosses unrelated organisms belonging to different breeds (cultivars) and even species (King and Chambers, 2015). With no common ancestors these animals, vegetativeness or the presence of different alleles of certain genes increases and therefore the level of their heterozygosity increases. Individuals obtained by outbreeding are called heterozygous, and they are in many ways superior to homozygous (obtained by inbreeding) because they have more valuable biological traits and surpass even parental organisms in a number of traits (King and Chambers, 2015). Nevertheless, to obtain animals of the same type with certain economically useful traits, it is necessary to use inbreeding. At the same time, to maintain the viability and level of reproductive qualities of inbred animals, it is necessary to strive to exclude uncontrolled inbreeding. It has been established that only “with distant inbreeding, cows in terms of milk yield have an advantage over outbred animals and are inferior to them in other variants of inbreeding” (Ivanova, 2021).

2. Goals and objectives

The main goal of the project is to employ inbreeding to improve productive qualities of yaks, their adaptation to harsh climate, and increase their productivity to meet current or prospective market demands. Specifically, the project aims to improve the main genetic traits, as well as the productivity and reproductivity of local yaks using genetic resources of Mongolian ecotypes through internal selection.

The specific tasks of the project were as follows:

- According to the characteristics of productivity and general development of physique, evaluate, select and purchase two heads of the best yak bull sires from farmers in the Murghab region for further selection work with yaks of the Pamir Agricultural Research Center (PARC);
- Conduct mating of acquired bulls with yak cows of the PARC in the breeding season;
- Study the growth and development indicators of the resulting yak offspring in the breeding group and in comparison with the control group (not the breeding part of the herd).

Improving the qualities of yak can partially satisfy the nutritional needs of the population of mountainous districts of Badakhshan in terms of meat and milk. It should be noted that yak breeding in GBAO provides a favorable basis for the development of processing and production of meat and dairy products and supplies high quality and environmentally friendly products from yak wool and hides.

3. Methodology

During the Soviet era large yak-rearing state farms and a breeding farm existed in the Eastern Pamir. Unfortunately, these state farms have been disbanded but yaks are reared by the Association of Farmers “Bulunkul”, the PARC, and the PamirEnergy farms. Mainly yaks in this region are bred by the population within Murghab region. Each farm contains several hundred animals.

In recent years, farmers have begun to use bull yaks of the Mongolian ecotype to improve breeding and productive qualities of the local ecotype of Pamir yaks. This is practiced because in many farms, due to uncontrolled inbreeding, the main parameters of the body of yaks deteriorated.

In this study Pamir ecotype yaks from PARC herd of the Tajik Academy of Agricultural Sciences at the Ok Char site were selected (Alichul jamoat, Murghab district, GBAO). Ten Pamir ecotype yak cows were selected for breeding using the method of intrabreed selection with the best yak bulls selected from other herds of farms in the Murghab district to prevent inbreeding and obtain more viable and productive offspring.

The study was conducted based on an experimental scheme outlined in **Figure 2**, which indicates that obtaining a pure breed is possible only in the fourth generation when the number of inherited traits is the highest.

With project funds, two purebred Mongolian yak bulls were selected from Bulunkul farm in Murghab. Also, a set of equipment for insemination, livestock breeding equipment, and large scales for weighing live weights of livestock were acquired. Two yak bulls were mated with 10 yak cows of the Pamir ecotype, and the growth and development of offspring were monitored.

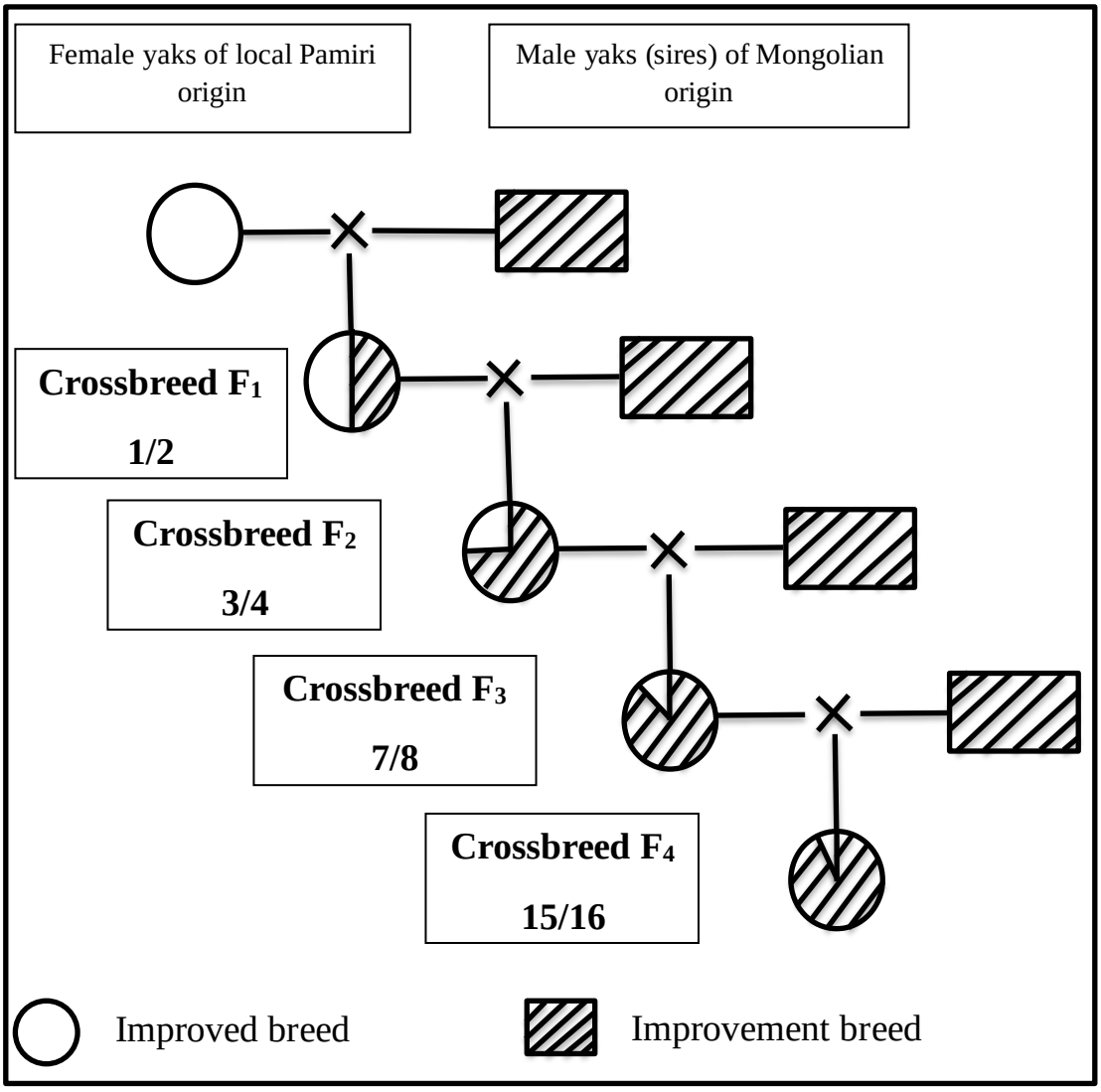

Figure 2. Selection scheme to improve the Pamir yak ecotype using sires of Mongolian yak origin

Mainly young yak cows were selected for insemination (2-3years old). To exclude uncontrolled mating of yak cows with other bulls, they isolated from one another. Other conditions, such as feeding and caring for the cows, remained the same as for the control group. After 8 months six calves were born but one of them died during the first month after birth. Therefore, only five calves were engaged in the experiment.

To determine the rate of growth and development during the study, the following indicators were captured for 3 bulls and 2 heifers in the experimental group and 2 bulls and 2 heifers in the control group:

- Live weight was determined individually at birth (April) and at six (October) and eight (December) months of age by weighing (scale accuracy 0.1 to 0.5 kg);
- Measurements were made of individual body parts at birth, 6, and 8 months of age, including: height at the withers, chest girth, oblique torso length, height at the sacrum, and pastern girth using accepted zootechnics methods (measuring stick, measuring tape, compasses, scales).

In the future, it is planned to study the quantity and quality of milk yield, as well as other indicators of the productivity of yaks. However, it must be clarified that these studies can be conducted after yaks reach reproductive maturity, i.e., normally after they reach the age of three.

The data was input and processed in MsExcel, where descriptive statistics as well as tests of significance were also produced. Statistical analysis was conducted according methods used by Plokhinsky (1969).

4. Characteristics of the study area

4.1 Climatic conditions

The climate of the study area is severe alpine and sharply continental. The average January temperature according to the Murghab weather station is about -18°C (**Figure 3**). Winters are long and last from October to April. The absolute minimum temperature in Murghab was recorded in the Bulunkul area, which was -62°C.

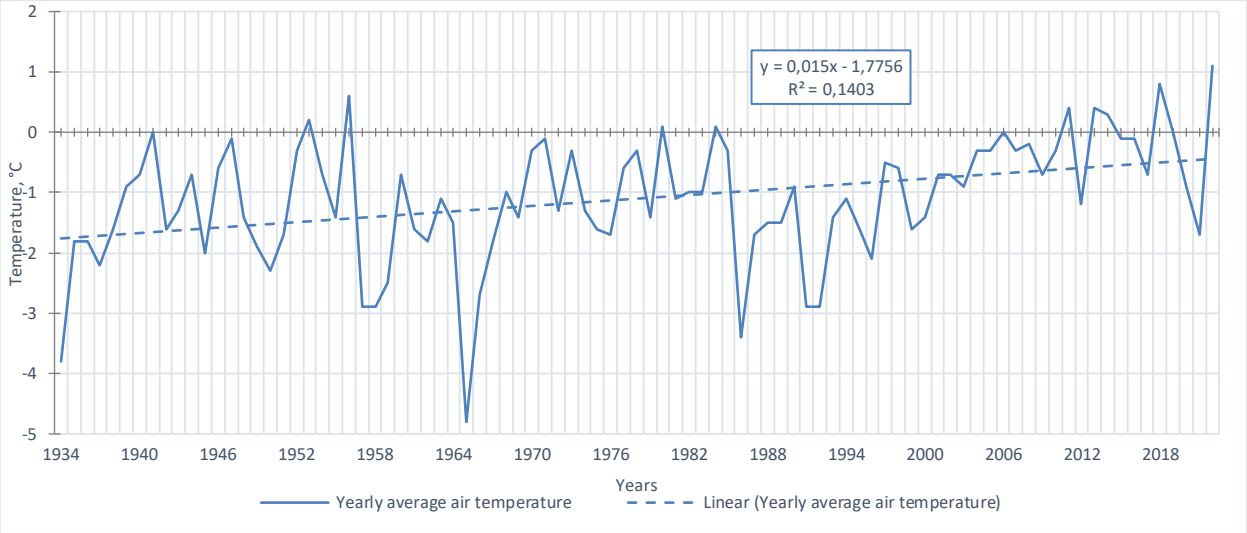

Figure 3: Average annual air temperature at the Murghab weather station

The long-term annual mean atmospheric air temperature has increased during the past nine decades with high interannual variability. During this period, the air temperature increased by about 0.8°C, which may affect the development of yak breeding to some extent in the future. However, average annual temperatures do not provide a comprehensive picture of environmental conditions for yaks and seasonal changes are more important. For yaks, the most detrimental temperatures are winter minima, since it is during these months that animal losses occur. Yaks die mainly due to abnormal cold weather or high precipitation during the winter months (December-February). Therefore, it was important to consider changes in the temperature regime of these months.

The data show a positive trend for all winter months, but trends are not statistically significant (**Figure 4**). There has also been a marked decrease in the number of years with minimum mean monthly temperatures below -18°C in December and February during recent decades, but the same

is not true for January. January continues to be the coldest month in the study area, and the number of years with a minimum average monthly temperature below -20°C has not decreased during past decades. Thus, January remains the most unfavorable time for yak breeding. During this month, the air temperature drops to the minimum values, which leads to an increased risk for yak survival.

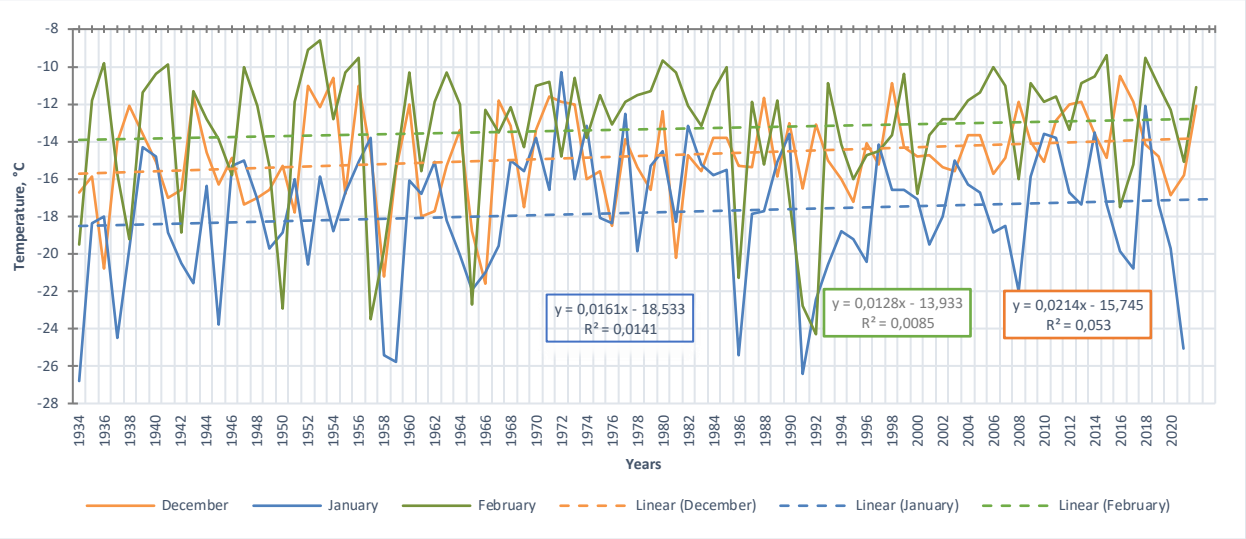

Figure 4. Average long-term air temperature in the winter months at the Murghab weather station

As for summer months, average air temperature showed a positive but insignificant trend for June while it remained generally stable for July and August **(Figure 5)**. An increase in summer monthly temperatures, to a certain extent, will favor the development of yak breeding in Murghab, since more favorable hydrological and biological conditions will be created. The main condition for breeding yaks is the availability of food throughout the year. Currently, the most productive pastures are located mainly around streams and lakes. However, it should be noted that the climate of Murghab is arid, so plants desiccate by mid-summer. Therefore, only xerophytic plants can grow on gravel deposits on mountain slopes with hydrophytes growing along watercourses and water bodies.

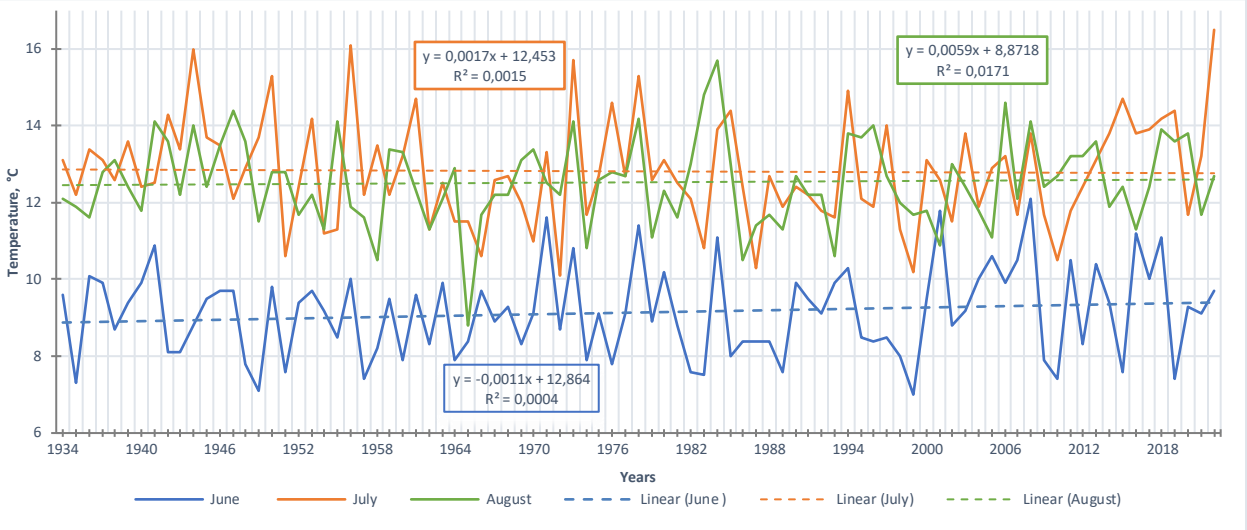

Figure 5: Average long-term air temperature in the summer months at the Murghab weather station

Little precipitation fall in Murghab; average annual precipitation is about 80 mm in this arid alpine area. In the highlands and on mountain slopes the amount of precipitation increases. The maximum precipitation falls in May-June and August (**Figure 6**). Average annual precipitation at the Murghab station has significantly decreased in recent years with a reduction of about 35 mm during the past nine decades. This decline will increase in aridity of the study area and may adversely affect regional water supplies.

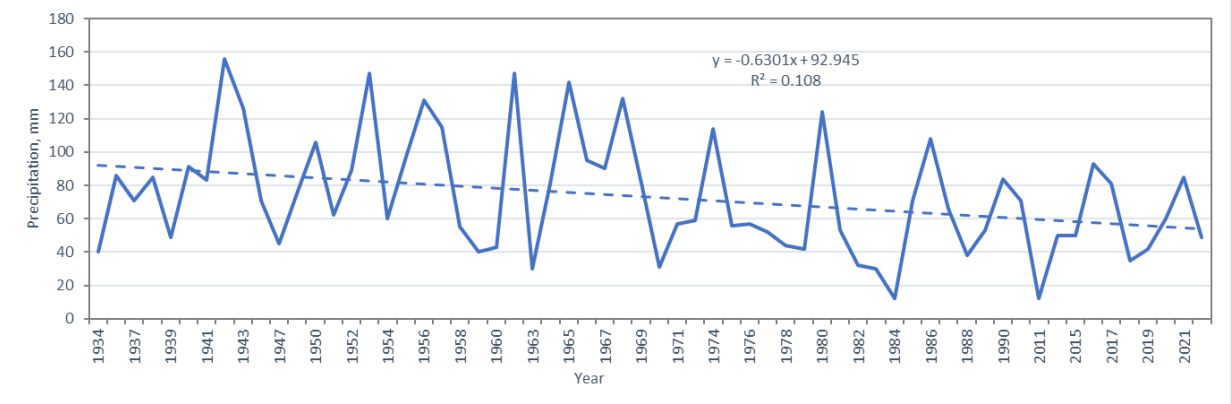

Figure 6. Average long-term precipitation at the Murghab weather station

However, for the development of yak breeding, it is necessary to consider the dynamics of precipitation within the year since shifts in seasonal precipitation may occur. For Murghab, precipitation is unevenly distributed throughout the year. It is important to understand these changes during recent decades because, according to some authors, precipitation declines were

projected (Reyer et al., 2017; Yu et al., 2022). For comparison, monthly precipitation for two intervals are given: 1970–1980 and 2013–2022 (**Figure 7**).

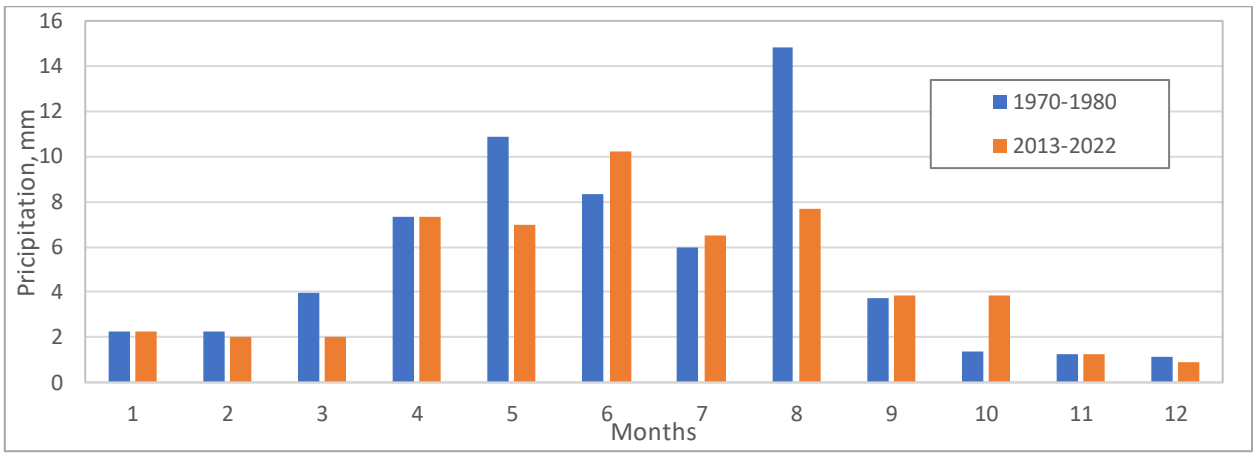

Figure 7. Average monthly precipitation at the Murghab weather station

Several intra-monthly changes in precipitation occurred between the two periods, with notable deviations in March, May, June, and October, and the largest in August (Figure 7). These data show that during the past decade, changes have occurred mainly from spring to early automn. No significant changes in winter month precipitation were recorded. The absence of deviations in precipitation in winter months is good for yaks, as they graze year-round and very heavy precipitation (snow) in winter affects their survival.

It should be noted that the requirements for the living conditions of domestic yaks are very similar to the characteristics of the life of their wild relatives. All of these live in the harsh highland climates where the frost-free period lasts only 50–60 days and minimum air temperature often drops to -53°C, the amplitude of seasonal air temperature fluctuations exceeds 70 degrees (the difference between absolute minimum and absolute maximum). Blizzards and strong winds are often observed here. In such harsh conditions, yaks can live year-round in the open air on pastures (Kudratbekova et al., 2022).

4.2 Vegetation

The soil and vegetation cover in Murghab is strongly xerophilic in all belts: lower areas contain gray soils with sagebrush, saltwort, cousinia, and ephemeral vegetation in spring; upper areas have desert-steppe soils with wormwood, feather grass, fescue, and prickly grass; and along ridgelines pads (from acantholimons) and patches of meadows with sedges and cobresia exist. Along river banks groves of willow, poplar, and Russian olive exist, while on hillslopes there are rare thickets of juniper. Level areas have high-mountain desert soils with rare bushes of teresken and cushion plants with sporadic marshy lowlands. Mountain slopes on the slopes have stony-gravelly soils with very sparse vegetation (“The Large Soviet Encyclopedia. in 30 volumes,” 1986). On northern slopes small couch grass steppes are interspersed with thickets of exochorda bushes and rose hips. Rocky slopes are covered with thickets of juniper. At high altitudes, subalpine meadows and steppes are common, which have substantial food value for yaks bred here, as well as other domestic animals.

5. Results and Discussion

As compared to the control group, results of intra-breed selection of Pamir ecotype yaks using selected the best yak sires showed a positive effect on the growth and development indicators of the resulting offspring, namely in terms of live weight (**Table 1** and **2**). From birth (April) to 8 months of age (l December) weights of yak calves in the experimental group increased by 56.71 kg on average from 22.46 kg to 79.17 kg. Respectively, in bulls, the live weight increased by 57.81 kg on average from 23.45 kg to 81.26 kg, while heifers added 55.06 kg gaining from 20.99 kg to 76.05 kg. In the control group, these figures averaged from 19.87 kg to 73.55 kg, or 53.69 kg gain in weight in absolute terms, whereas, for bulls, the gain was 55.03 kg from 21.81 to 76.84 kg, and for heifers, it was 52.35 kg increasing from 17.93 kg to 70.27 kg. Young yaks of the experimental group exceeded controls in live weight: bulls at birth by 1.64 kg (7.5%) and at 8 months by 4.42 kg (5.8%), heifers at birth by 3.07 kg (17.1%) and at 8 months by 5.77 kg (8.2%). The average daily gain of yaks up to 8 months of age was 240.7 g in bulls and 229.3 g in heifers in the experimental group, while in the control group the gains were somewhat lower at 229.2 and 219.6 g, respectively.

Table 1. Live weights of yak offspring in the experimental group

#	Tag number	Date of birth	Sex	Live weight at birth, kg	Live weight at 6 months of age, kg	Live weight at 8 months of age, kg	Absolute live weight gain, kg	Average daily live weight gain, g
1	0213	04.04.2022	bull	23.56	66.0	85.70	62.14	258.3
2	0267	10.04.2022	heifer	20.62	58.3	77.75	57.13	238.0
3	0278	10.04.2022	heifer	21.36	62.0	74.34	52.98	220.6
4	0263	11.04.2022	bull	24.32	62.7	79.50	55.18	229.9
5	0266	18.04.2022	bull	22.46	62.25	78.57	56.11	233.8
		Average		**22.46**	**62.25**	**79.17**	**56.71**	**236.12**

Table 2. Live weights of yak offspring in the control group

#	Tag number	Date of birth	Sex	Live weight at birth, kg	Live weight at 6 months of age, kg	Live weight at 8 months of age, kg	Absolute live weight gain, kg	Average daily live weight gain, g
1		30.04.2022	heifer	17.62	55.40	69.42	51.80	218.8
2		1.04.2022	heifer	18.23	56.5	71.12	52.89	220.4
3		4.04.2022	bull	22.27	59.70	79.22	56.95	237.2
4		8.04.2022	bull	21.34	57.80	74.45	53.11	221.2
		Average		**19.87**	**57.35**	**73.55**	**53.69**	**224.40**

Even though the experimental group outperformed the control group, the statistical differences may be questionable because the sample sizes were extremely small (5 in the experimental group and 4 in the control). Nonetheless, a two-sample t-test (parametric) was conducted as the underlying assumptions of normal distribution and equal variance are mostly satisfied in the two samples (de Winter, J.C.F., 2013. Based on the t-test, differences between experimental and control groups at birth are significant at the 10% level (p-value: 0.079), at 6 months significant at 5% (p-value: 0.018), and at 8 months significant at 10% (p-value: 0.087). Moreover, comparing the gains between the two groups at 6 months (weight at 6 months minus weight at birth; i.e., mean 39.79 kg in experimental vs, 37.49 kg in control) the difference is statistically significant at 5% (0.029). However, the differences in gains at 8 months (56.71 kg vs 53.69 kg) as well as between 6 and 8 months (16.92 kg vs 16.20 kg) are not statistically significant (p-values: 0.126 and 0.613, respectively).

Photos of the calves raised within the THRIVE project

For the statistically significant differences, the effect sizes can be shown in terms of Hedges' g value (the difference between the sample means of two groups divided by the pooled weighted standard deviation) that is suitable for very small sample sizes. For the differences between the experimental and control groups at birth, the value is 0.68, which can be interpreted as a medium effect size. The value at 6 months of age is 0.81 or large effect size, whereas at 8 months it is only 0.32 or small effect size. For gains at 6 months, the value is 1.30, a very large effect size. In other words, differences between the experimental and control group are most salient and statistically significant at 6 months of age. Notably, an earlier study showed that young yaks of (6 months) weighed 50–55 kg (Padenko, 1964), whereas in this study, both groups exceeded the upper limit, i.e., the control group weighed 55.40 – 59.70 kg while the experimental group weighed 58.30 – 66.00 kg.

Besides weight, the main body measurements were also collected for both yak calf groups (**Table 3**). The experimental group exceeded the control for bull height at the withers by 3.5 cm (3.8%), chest girth by 2.5 cm (2.2%), oblique torso length by 1.8 cm (2.2%), height at the sacrum by 3.6 cm (4.12%), for heifer height at the withers by 1.7 cm (1.8%), chest girth by 2.1 cm (1.9%), oblique torso length by 2 cm (2.5%), height at the sacrum by 4.5 cm (5.44%).

Table 3. Main measurements of body parts of the Pamir ecotype of yaks at the age of 8 months

Indicators	Experimental group		Control group	
	Bulls	Heifers	Bulls	Heifers
Height at the withers, cm	96.7	94.4	93.2	92.7
Chest girth, cm	117.3	114.3	114.8	112.2
Oblique torso length, cm	84.6	82.4	82.8	80.4

It can be inferred from the analysis that when using intrabreeding selection based on the selection of the best sires of yaks of the Mongolian ecotype, while not allowing closely related mating, more full-weight calves can be obtained. Nonetheless, further investigation is necessary to monitor their growth to maturity to verify that the gains are sustained over time.

6. Dissemination

The results of the research work have been disseminated via the following publications:

1. "Improving breeding qualities and increasing the productivity of yaks in the highlands of the Eastern Pamirs". Collection of scientific articles // Proceedings of the scientific-practical conference on the topic: "Development of innovations in the field of animal husbandry and its role in ensuring biological safety", dedicated to the 30th anniversary of the state independence of the Republic of Tatarstan and the 90th anniversary of the formation of TAU named after. Sh. Shotemur, Dushanbe, 2021. P. 165-169. Ikromov F., Kudratbekova N., Shamsiddinov P.

2. “Growth and development of young animals of the Pamir ecotype of yaks and their crosses with the Mongolian ecotype, depending on the system of care and maintenance” / Kudratbekova N., Ikromov F., Shamsiddinov P., Nusayrieva L. Materials of the International Scientific and Practical Conference “From Modernization to Advanced Development: ensuring competitiveness and scientific leadership of the agro-industrial complex” dedicated to the foundation day of the Ural State Agrarian University on February 24-25, 2022 in the city of Yekaterinburg.
3. “Studying the growth and development of young growth of the Pamir ecotype of yaks in comparison with their crosses, methods of keeping and growing” / / M. Kudratbekova N., Shamsiddinov P., Nusayrieva N. G.. Proceedings of the International scientific and practical conference “Innovative technologies for production and processing of products livestock, poultry, fisheries and beekeeping in the Republic of Tajikistan”, published in the Journal of Scientific Research of TAU named after Sh. Shokhtemur, March 29, 2022.
4. “Epizootological monitoring of GBAO during the independence of the republic”. Materials of the scientific-practical conference dedicated to the 30th anniversary of the founding of the Academy of Agricultural Sciences, Gulamadshoeva L. G., Azizbekov M., Navruzbekova M. D., Dushanbe, 2021.

The following article was submitted for publication:

“Impact of climate change on the spread of animal diseases”, Veterinary and Nutrition Journal (RF), Gulamadshoeva L. G.

7. Next steps

As a result of breeding activities in the subsidiary farm of PARC, a selection and breeding group of Pamir ecotype yaks will be created with the foundation laid for the creation of breeding groups and herds of yaks. The widespread use of breeding highly productive yaks of the Pamir ecotype in breeding and selection to increase the number of livestock and their meat and dairy productivity in farms and private households in GBAO will contribute to the further development of this industry. To improve the genetic properties and productivity of yak meat and milk, processing its products, and increasing the efficiency of breeding for production, specific recommendations and proposals will be presented.

The research results and insights will be transferred to households, dekhkan, and farm breeding farms for yak breeding in Murgab district, GBAO. To improve the quality of offspring and reduce the harmful effects of inbreeding, it is necessary to conduct zootechnical and breeding work among local yak herds. It is necessary to strictly monitor the level of inbreeding, which does not reduce the viability and level of reproductive qualities of inbred animals.

8. Conclusion

This project conducted an experiment in breeding purebred yak sires with local yak cows of Pamir ecotype. The results indicate that the offspring of the purebred yaks were heavier than those of the control group. Moreover, the body measurements of height at the withers, chest girth, oblique torso length, and height at the sacrum and pastern girth were larger in the experimental group, and the differences were statistically significant. Even though sample sizes were extremely small, such findings provide early insights into positive gains associated with the method of intrabreed selection in yak breeding. Further monitoring is needed to track the growth and development of young yaks to maturity to verify the extent to which gains will be sustained. Concurrently, the productive qualities of the resulting crossbred yaks should be studied. As a logical next step, using larger sample sizes to obtain more robust results is recommended.

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