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REVIEW ARTICLE

Kazakh Sheep Review: History, Breeds, Genetic Characteristics, Important Hereditary Diseases and Disorders

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A B S T R A C T

The livestock industry of Kazakhstan has a historical basis, especially with sheep (*Ovis aries*), which were adapted over centuries to suit the local terrains and climates of the country, which are diverse and differ greatly. Sheep have become one of the pillars in the livestock industry in Kazakhstan because of its multiple benefits including production of meat and wool. Multiple breeds of sheep, such as fat-tailed coarse-wooled, fine-wool, and mutton-wool semi-coarse, are significant in the production of meat, wool, and fat among the native types of sheep. This review provides the historical data of the domestication and subsequent evolution of sheep in Kazakhstan. The hereditary conditions that are recorded in certain breeds and their breeding and conservation implications are discussed in this review, with the significance of genetic resources for viable sheep production in Central Asia.

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INTRODUCTION

Sheep (*Ovis aries*) are listed among the oldest domesticated types of livestock and played a significant part in human economic and cultural development throughout Eurasia, and specifically the region of Central Asia (Machová *et al.*, 2022; Daly *et al.*, 2025). The sheep in Kazakhstan has been a constitutive element of the pastoralism among the nomadic herds in the country for centuries. Multiple sheep breed in Kazakhstan have the ability to provides meat, wool, and fat productions under severe conditions of the steppe, semi-desert, and mountainous areas (Kerven *et al.*, 2021). Although domestication of sheep probably began in the Fertile Crescent circa 10,000 years ago and then spread across Asia (Mas-Coma *et al.*, 2022). Long-term evolutionary adaptation to local environmental conditions has resulted in the formation of diverse types of Kazakh sheep, each exhibiting specific adaptive characteristics suited to the harsh regional climate (Nendissa *et al.*, 2023). The domestic sheep in Kazakhstan are mainly typified by three broad types, including fine-wool, fat-tailed coarse-wooled, and mutton-wool (semifine-wool) sheep (Dossybayev *et al.*, 2019). These forms are a result of ancient adaptation and crossbreeding occurrences of the past centuries, which have taken place in the pastoral movement and agricultural growth (Cavalli-Sforza, 2024; Harris, 2024). Genetic studies and field reports indicate that the Kazakh pastoralists had highly nomadic sheep. These herds were moved over long distances through the steppe with their herders, and improved the hardiness and resistance of the animals (Ferret, 2018). The contemporary sheep production in Kazakhstan has its opportunities as well as challenges (Yerzhanova *et al.*, 2022; Nendissa *et al.*, 2023). After the Soviet period, there was a reorganization of the industry, the total number of sheep decreased, but nowadays it has stabilized in the last few decades (Shadskaja *et al.*, 2015). The dominance of native sheep breeds still prevails, with government and private breeding schemes all geared towards enhancing meat and wool production as well as maintaining genetic material (Gowane *et al.*, 2019).

Genetic studies are essential for elucidating breed structure and guiding conservation strategies to maintain genetic diversity. They also support targeted breeding programs aimed at improving economically important production traits (Salgotra and Chauhan, 2023). The breeds of sheep kept in Kazakhstan are highly phenotypically and genetically diverse (Zhumadillayev *et al.*, 2022). The Edilbay breed is a breed of classical Kazakh fat-tailed sheep, which is strong and suitable in extreme temperatures and can be used in the production of meat, milk, and wool (Irzagaliev and Dzhanaev, 2025). It has been demonstrated that genetic diversity studies in Edilbay sheep have some of the richest allelic richness when compared to other native breeds, showing that Edilbay sheep has a lengthy and varied genetic past (Castillo-Rodríguez *et al.*, 2022). Kazakh fat-tailed coarse-wooled sheep are one of the most represented types of this nation, with a wider genetic substructure which points to not only breed integrity but also to intermingling with other related groups (Beketov *et al.*, 2024). In the same way, the Kazakh Arkhar-Merino was a genetically hybridized breed of wild and fine-wool which shows the introduction of breeding strategies in the Soviet Kazakhstan that fixed the quality of the wool and body shape (Iskakova *et al.*, 2020; Lv *et al.*, 2022). Outside these traditional lines has been new breeding that has seen the emergence of new breeds of sheep such as the Baisary fat-tailed breeds, which have much higher weights and are marked by unique genetic traits that have never been seen in the other old breeds (Da Silva *et al.*, 2025). These are the developments that depict the market needs for better meat production as well as the continued use of genomics in the sheep industry in Kazakhstan (Begenova *et al.*, 2025). Knowledge on the genetics of Kazakh sheep is not only useful in terms of production efficiency (Orkara *et al.*, 2025). Native breeds form rare stocks of genetic diversity that accrue to illness resistance, adaptability to the environment, and sexual attributes (Gibson, 2022). With the growing menace of global climatic change on livestock productivity, the need to conserve and use these local sources becomes strategic (Bogale and Erena, 2022; Cheng *et al.*, 2022). Mitochondrial DNA and SNP genotyping arrays, and microsatellite markers have been utilized in genetic studies to demonstrate abundant haplotype structure, distribution patterns of breed differentiation, and past occurrences of gene flow, which offer important information on breeding programs (Wenne, 2023).

This review summarizes the past records, biomineralization, present-day distributions, and phenotype traits of Kazakh sheep breeds as a combination of both traditional phenotypes and recent molecular findings. In doing this, it highlights the value of indigenous sheep genetic resources in sustainable agricultural modes and sets out paths for future research and breeding approaches. By having an all-inclusive view, researchers and breeders shall have a better chance of valuing the biological and cultural value of Kazakh sheep, and tackle issues of conservation and productivity.

History of Sheep in Kazakhstan: Sheep domestication in Central Asia has an extensive history, and that of sheep in Kazakhstan is part of it (Duisebayeva and Campbell, 2023; Dossybayev *et al.*, 2025). One of the earliest domesticated animals was sheep, and it is believed that they were initially domesticated in the areas related to the Fertile Crescent since more than 10000 years ago and then spread to the Eurasia region (Harris, 2024). Extensive pastoralism in Central Asia has led to the widespread distribution of sheep well adapted to steppe and arid climatic conditions (Tugjamba *et al.*, 2023). In Kazakhstan, the growth of the local sheep population could be explained by the existence of traditional nomadic pastoralism (Baytelieva *et al.*, 2023). The nomads relied upon shearwaters as a source of meat, milk, fat, hides, and fiber, and came to capitalize on the capacity of the animals to survive in the harsh climates of the continents with vast variations in temperatures, seasonal droughts, and scarce vegetation (Corbett and Hanson, 2024). These activities produced highly resilient and broadly adaptive animals (Moore and Schindler, 2022).

As Russian influence increased during the 18th and 19th centuries, planned crossings and breeding of sheep were introduced. These programs were implemented through state-supported agricultural institutions and breeding stations to enhance sheep productivity and wool quality (Chernikova, 2022; Duisebayeva and Campbell, 2023). Structured breeding programs were carried out during the Soviet era in order to boost production of sheep and industrial wool and meat markets (Burambayeva *et al.*, 2025). These notable results were the Kazakh breed Arkhar-Merino breed which was the product of a cross between 1934 and1950 between wild Arkhar rams and fine-wool ewes including Novocaucasian Merino and Précoce as the resultant one to create fine-wool performance on the mountainous pastures (Langerová *et al.*, 2026).

The number of sheep in Kazakhstan increased massively in the 20th century to the point that the country became one of the greatest producers of sheep and wool in the former Soviet Union (Yerzhanova *et al.*, 2022; Duisebayeva and Campbell, 2023). Agrarian reforms in the post-Soviet period resulted in the restructuring of state and collective enterprises, and livestock production was based on native sheep breeds (Górz and Kurek, 2024). Modern breeding is still concerned with the conservation of indigenous breeds and the amelioration of economically significant features using scientific breeding and genetic choice (Mathew and Mathew, 2023).

Current Status, Distribution Area, and Description of Breeds

Edilbay Sheep: The Edilbay breed is a coarse-wooled fat-tailed sheep breed one of the oldest Kazakh breeds, developed by nomadic pastoralists through long-term natural selection under harsh climatic conditions (Irzagaliev and Dzhanaev, 2025). They do not have horns and are weighing approximately 67-115kg, have a height of 75-84cm. (Rout and Behera, 2021). The main products of Edilbay sheep include meat and tail fat, where sheep are kept first to provide meat and later to give wool and milk (Irzagaliev and Dzhanaev, 2025). The breed is highly hardy with a great ability to cover long distances and with endurance to climatic stress (Paliwal *et al.*, 2023). The lambing rate is about 110–120 lambs per 100 ewes per year (Рузибоев and Аширов, 2025). Edilbay sheep have high allelic richness in genetic variation among the breeds of Kazakh, which suggests high genetic diversity that is very important in adaptation and breed resilience (Kozhakhmet *et al.*, 2025). Today, it is distributed in the west, north and central parts of Kazakhstan, and the population is also found in neighboring Russia (Figure 1 and Figure 2) (Kireyeva *et al.*, 2023; Tishkov, 2023).

Kazakh Fat-Tailed Coarse-Wooled Sheep: The fat-tailed coarse-wooled sheep of the Kazakh is one of the oldest and most widely distributed breeds of indigenous sheep of Kazakhstan (Малмаков *et al.*, 2023; Dossybayev *et al.*, 2025). The breed emerged predominantly as a result of natural selection under nomadic pastoral conditions, rather than through intentional or managed breeding efforts (Faraz *et al.*, 2025). These sheep animals are mostly concentrated in western, central, and south Kazakhstan, semi-desert and desert steppe regions where the quality of pasture is low and climatic conditions are extreme (Nasiyev *et al.*, 2022; Nasiyev *et al.*, 2023). The breed category has a well-formed fat tail as an energy store during periods of low food availability, a characteristic that is common in the breeds of the Central Asian sheep that are reported to have had much documentation in FAO and other local studies (Gaouar *et al.*, 2025). The morphologically developed fat-tailed coarse-wooled sheep of the Kazakh population have a great skeletal system, deep chest, and long legs adapted to extensive grazing and seasonal migration (Dossybayev *et al.*, 2024). The appearance of the coats is very diverse as they can be black, brown, red, or white, thus showing a low pressure of selecting homogeneous wool characteristics (Anello *et al.*, 2022). Wool is rough, heterogeneous, and not fine textiles, but mostly carpets, felt, and traditional products (Jayalakshmi, 2024). The average weight of adult ewes is 55 to 70kg, whereas the average weight of adult rams ranges between 90 and 110kg, based on ecological zone and types of management (Kenyon and Corner-Thomas, 2022).

Production performance focuses on meat and fat as opposed to wool yield (Chacko Kaitholil *et al.*, 2024; Liu *et al.*, 2024). When raised on pasture, lambs express a relatively high rate of early development, which qualifies the breed as the preferred choice of the low-input meat production systems (Neeteson *et al.*, 2023). There is consistency in reproductive performance, whereby lambing rates are normal at an average of 100 to 115 lambs per 100 ewes and would be under extensive management (Bates *et al.*, 2022). Research into group composition has shown that this area of breed is genetically diverse, i.e., there must have been both geographic isolations, as well as historical gene blending with other nearby Central Asian sheep groups (Wanjala *et al.*, 2025).

Fat-tailed coarse-wooled sheep of Kazakh origin are still at the core of rural livelihoods and small-holding farms (Beketov *et al.*, 2024; Burambayeva *et al.*, 2025). The situation with conservation issues is moderate as the population size is also high; nevertheless, genetic dilution due to unregulated crossbreeding is also becoming a concern, and the need to organize breeding and genetic control programs (Engdawork *et al.*, 2024).

Kazakh Arkhar-Merino Sheep: Kazakh Arkhar-Merino is a scientifically developed fine-wool breed, created by the Soviets between the 1930s and 1950s (Iskakova *et al.*, 2020). It was a product of the domestication of crossbreeding of wild Arkhar (Towards the Novocaucasian and Précoce lines) ewes (*Ovis ammon*) with domestic fine-wool sheep (Hills and Moule, 2024). This was to create a fine wool sheep that would endure the mountainous and high-altitude pastures in southeastern Kazakhstan and still have a high production of wool (Soma, 2025). The breed is mainly concentrated in the Almaty and Zhambyl regions of the country, especially in the foothill and mountain areas. The Arkhar-Merino is stronger and heavier than regular Merino sheep. Rams can weigh up to 120kg, while ewes usually weigh between 65 and 70kg (Menatian and Alamouti, 2020). The animals have powerful limbs, well-formed musculature, and a thick, fine fleece (Walker and Niehaus, 2022). The diameter of the wool fiber is usually between 20 and 22 microns, which falls under the fine-wool category that is used in the production of textiles (Lakshmanan, 2022).

The Arabek type breed, the Kaphar-Merino, has a strong adaptation to harsh climate, lengthy grazing duration, and a climate that changes (Harek *et al.*, 2022). The average wool production per shearing is 6-7kg in rams and 3.5-4kg in ewes (Behrem and Gül, 2022). The performance of reproductive traits is similar to other fine-wool breeds, and the lambing rates are 105 to 110% (Karatieieva *et al.*, 2022). Genetic research proves that although wild Arkhar was introduced to the breed as introgression, the breed is entirely domesticated, fertile, and stable, and no further wild introgression takes place (Akhatayeva *et al.*, 2025).

The Kazakh Arkhar-Merino sheep can be regarded as a precious genetic system for producing fine wool in Kazakhstan (Iskakova *et al.*, 2020; Langerová *et al.*, 2026). Their numbers are, though, lower than fat-tailed breeds, and conservation breeding programs are therefore necessary to maintain genetic purity and production characteristics (Ben Sassi-Zaidy *et al.*, 2022; Alfiya *et al.*, 2025). The objective of this breeding program was to combine the exceptional hardiness and environmental adaptability of Arkhar with the superior wool production and quality traits of Merino sheep.

Baisary Sheep: Baisary sheep breed is a comparatively unknown fat-tailed meat breed, which has been developed in Kazakhstan as a result of strict selection of indigenous populations of fat-tailed sheep (Doldasheva *et al.*, 2024). The breeding goal was to produce higher body weight, meat production, and growth rate, and remain adaptable to conditions of severe environmental conditions (Selaledi *et al.*, 2025). It is mostly found in the south of Kazakhstan, where pastoral production dominates livestock production (Robinson and Petrick, 2024). Baisary sheep are distinguished by the large size of the body, the good constitution, and the excessively fat tail (Parzhanov *et al.*, 2024b). On large-scale grazing systems, ewes rarely carry over 70-75kg alive, whereas adult rams can weigh up to 120kg (Hynd, 2024). The color of the coat is mainly white or light colored, but a variation exists (McFadden *et al.*, 2024). Wool is thick and a by-product, which is typical of the main purpose of the breed, which is as a source of meat (Camilli *et al.*, 2025).

Baisary lambs have more advantages in the form of average weight gain in a day than the traditional local fat-tailed sheep, especially in the pre-weaning period (Muhammad *et al.*, 2022). Carcass attributes, such as carcass weight and dressing percentage, are also enhanced, which favors the increased popularity of the breed among commercial growers (Ncube *et al.*, 2025). Reproductive indicators are also in acceptable ranges of large systems with lambing rates of 110 (Lijalem Mesele and Zereu Hadgu, 2024).

SNP markers and microsatellite loci have shown that Baisary sheep belong to a unique genetic cluster but with an average genetic diversity (Zhumadillayev *et al.*, 2022; Kizilaslan *et al.*, 2024). This implies effective breed conglomeration without over-inbreeding (Romanov *et al.*, 2023). Baisary sheep, though small in number relative to older breeds, are an example of significant use of modern breed development on the basis of indigenous genetic materials (Kawęcka *et al.*, 2022; Wana, 2024).

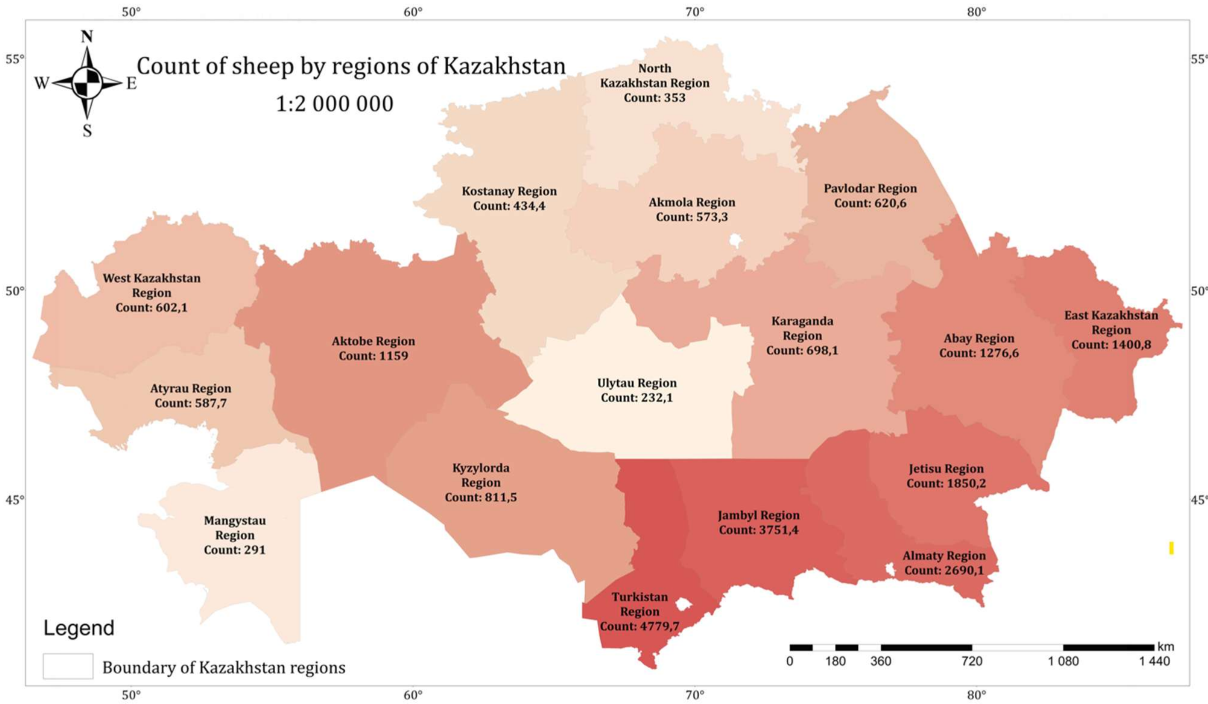

Fig. 1: Count of sheep by regions of Kazakhstan (2024). Sheep population density increases with the intensity of the color.

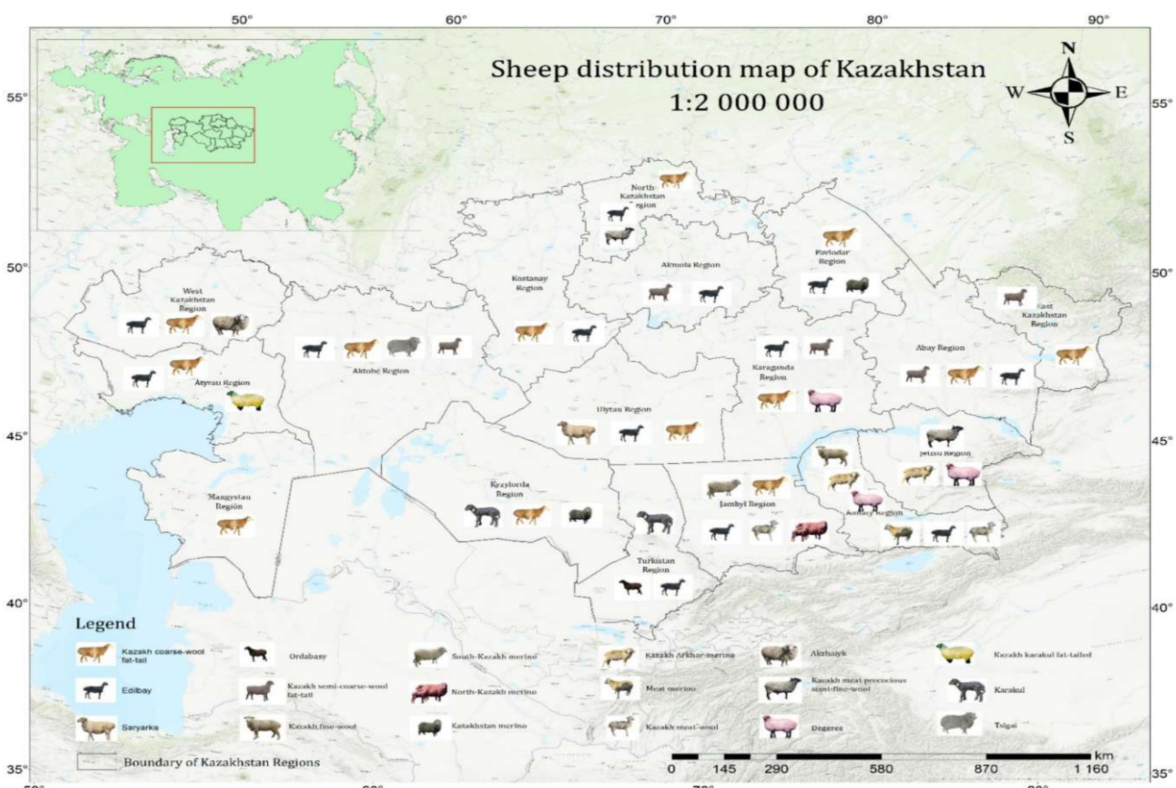

Fig. 2: Sheep breeds by region distribution map of Kazakhstan.

Genetic Characteristics of Kazakh Sheep Breeds: Genetic analysis of Kazakh sheep breeds shows that there is a high degree of diversity due to the long-term evolution, the isolation of an area, and historic breeding strategies (Kichamu *et al.*, 2025). The molecular studies based on mitochondrial DNA (mtDNA), microsatellite, and high-density SNP show have continuously indicated a high degree of genetic variability in indigenous Kazakh sheep when compared with most of the commercial breeds, which are highly selected (He *et al.*, 2022).

Mitochondrial DNA research has shown that the Kazakh sheep is mostly of haplogroups A and B, which are common among Eurasian sheep (Koshkina *et al.*, 2023; Perfilyeva *et al.*, 2024). This trend can be attributed to the domestication paths in the ancient past and population surges in Central Asia (Fuks *et al.*, 2022). The high level of haplotype variation in some breeds like Edilbay and Kazakh fat-tailed coarse-wooled sheep postulates extensive evolutionary events with few constraints on the genetic bottleneck (Karakoc *et al.*, 2024; Yildirir *et al.*, 2025). Additional evidence is provided by the analyses of microsatellite markers, which indicate moderate to high heterozygosity among native breeds (Bora *et al.*, 2023). Of these, the richest allelic richness among them is usually observed in Edilbay sheep, which have a wide geographic area and limited artificial selection (Ceccobelli *et al.*, 2023). The analyses of the population structure show apparent classification into fine-wool breeds (e.g., Arkhar-Merino) and fat-tailed coarse-woolled breeds, but also imply the historical gene flow among the populations that are currently in geographically close locations (Talebi *et al.*, 2025).

Genomic SNP research has given a better understanding of selection signatures in regard to adaptation and production characteristics (Peng *et al.*, 2024; Hassanine *et al.*, 2025). On the other hand, there is a selection signature in the genomes of the Arkhar-Merino sheep that pertains to wool quality and fiber evolution (Ghildiyal *et al.*, 2023). Notably, continuous hybrid instability and decreased fertility were not identified in the case of Arkhar-Merino sheep, which validates longer-term stabilization of their genetic material after the first crossbreeding (Caradus and Chapman, 2025).

The breeds of Kazakh sheep are a good source of genetic diversity (Parzhanov *et al.*, 2024a; Dossybayev *et al.*, 2025; Khamzina *et al.,* 2025). Molecular prevalence of *Coenurus cerebralis* in sheep exhibiting neurological symptoms in Kazakhstan was previously reported by Kozhayeva et al. (2025), who confirmed the circulation of the parasite in affected flocks using molecular diagnostic approaches. Genomic technologies are also finding their way into national breeding approaches to strike a core balance between breeding productivity and conservation of native genetic resources (Segelbacher *et al.*, 2022) (Table 1).

Table 1: Comprehensive Overview of Kazakh Sheep Breeds: History, Distribution, Phenotypic Traits, Adaptation, and Genetic Characteristics

Sr. No.	Breed	Breed Category	Geographical Distribution	Historical Origin & Development	Primary Production Purpose	Tail Type	Wool Type	Phenotypic Characteristics	Adaptation to Environment	Production System	Genetic Characteristics	Genetic Diversity Findings	Use in Breeding Programs	References
1.	Edilbay Sheep	Indigenous fat-tailed breed	Western Kazakhstan (semi-desert and steppe zones)	One of the oldest Kazakh breeds, developed by nomadic pastoralists through long-term natural selection under harsh climatic conditions	Meat and fat production	Fat-tailed	Coarse wool	Large body frame, strong constitution, well-developed fat tail, variable coat color	Highly tolerant to drought, temperature extremes, and long-distance grazing	Extensive pastoral and nomadic systems	Distinct genetic structure with minimal introgression from exotic breeds	High within-breed genetic variability was reported using microsatellites and mtDNA markers	Used as a genetic resource for improving meat productivity and adaptability	(Khamzina *et al.,* 2025)
2.	Kazakh Fat-Tailed Coarse-Wooled Sheep	Indigenous local population group	Distributed across the arid and semi-arid regions of Kazakhstan	Formed through centuries of natural selection without formal breed standardization	Meat and fat	Fat-tailed	Coarse wool	Morphologically heterogeneous, strong legs, coarse fleece	Exceptional resistance to feed scarcity and climatic stress	Traditional extensive grazing	High genetic heterogeneity reflecting low selection pressure	High intra-population diversity documented by molecular markers	Limited structured breeding; mainly conserved as local genetic resources	(Dossybayev *et al.*, 2025)
3.	Kazakh Arkhar-Merino Sheep	Improved fine-wool breed	Mountainous and foothill regions of southeastern Kazakhstan	Developed by crossing wild Arkhar (Ovis ammon) with Merino sheep to combine hardiness and fine wool quality	Fine wool and meat	Thin-tailed	Fine wool	Medium to large body, dense fine fleece, strong skeletal structure	Adapted to mountainous terrain and cold climates	Semi-intensive and breeding farms	Contains introgressed genes from wild Arkhar populations	Reduced genetic diversity compared to indigenous breeds; detectable Arkhar ancestry	Used for fine-wool improvement programs	(Iskakova *et al.*, 2020)
4.	Baisary Sheep	Indigenous coarse-wool breed	Southern Kazakhstan	Developed through the selection of local fat-tailed sheep adapted to regional conditions	Meat and fat	Fat-tailed	Coarse wool	Robust body, well-developed fat tail, coarse fleece	Well adapted to hot, dry climates	Extensive grazing	Limited molecular characterization available	Genetic distinctiveness reported at the population level	Locally important; limited use in national breeding programs	(Zhumadillayev *et al.*, 2022)

Hereditary Diseases/disorders

Congenital Limb and Skeletal Malformations: Congenital limb deformities, such as angular limb deviations, shortened limbs, or joint abnormalities, have been sporadically reported in sheep populations worldwide. In rare accounts of Central Asian massive systems, such conditions have been termed as rare and isolated cases, which usually take place at very low frequencies (Dong *et al.*, 2025).

The literature at hand suggests that such abnormalities are most likely to be related to inbreeding, nutritional deficiencies during the gestation period or environmental stress and not incurable mutations in a breed (Brown, 2022). Notably, no molecular markers and inherited syndromes that are unique to Kazakh sheep breeds have been determined (Zhanerke *et al.*, 2025). Field observations also indicate that the occurrence of skeletal malformations is not high in Kazakh sheep because they have a broad genetic base and low use of close mating practices (Amandykova *et al.*, 2023).

Congenital Craniofacial Abnormalities: Sheep populations around the world have been reported to have craniofacial abnormalities such as prognathism (overshot or undershot jaw), and it has been known as a congenital defect that has possible genetic factors (Jaruga *et al.*, 2022). When it comes to Kazakh sheep, the mention of such defects is only found in general veterinary reports, without being associated with a particular breed or genealogy (Khamzina *et al.*, 2024; Khamzina *et al.*, 2025). The current evidence indicates that these conditions are low and sporadic in occurrence and tend to be multifactorial in nature with a strong likelihood of being caused by embryonic developmental anomalies, as well as maternal nutrition (Moreno *et al.*, 2023). No published evidences have been made of the inheritance of these traits in Kazakh sheep populations, and there are no reports that they represent a serious limit to production or well-being (Kirgiafini *et al.*, 2024).

Metabolic Sensitivity Related to Fat Deposition (Non-Disease Trait): Fat-tailed sheep, some of the breeds of the Kazakh, have a genetically controlled capacity to accumulate adipose tissue in the tail (Dossybayev *et al.*, 2024; Karimov *et al.*, 2024). Although this attribute is adaptive in large grazing systems, research has shown that management stress could be metabolic in the event that this kind of breed is exposed to intensive feeding systems (Masters *et al.*, 2023). It is important to highlight that it is not a hereditary disease but a physiological sensitivity associated with a lack of conformity between genotype and management system (Derbyshire *et al.*, 2024). Kazakh fat-tailed breeds have not been identified to have any genetic disorder related to fat metabolism, and the trait of fat deposition has been seen to be of an adaptive advantage instead of being a pathological disorder (Mukanova *et al.*, 2024).

Implications of Limited Documentation of Hereditary Diseases in Kazakh Sheep Breeds: The scarcity of documented hereditary diseases in Kazakh sheep breeds has important implications for genetic health assessment, breeding strategies, conservation planning, veterinary management, and future research (Marzanov *et al.*, 2023). Existing evidence indicates that indigenous populations of Kazakh sheep are broadly in good genetic condition, probably as a result of large pastoral organizations, dominance of large effective, and large-scale natural selection in adverse environmental circumstances (Bratcher, 2025). These factors both cause a decrease in pressure of inbreeding and restrict the nature of the deleterious allele, which may be one of the reasons why there seems to be no breed-specific inherited disorders appearing in the literature (Wanjala *et al.*, 2023a).

Nevertheless, the absence of any hereditary diseases in the past history should be seen with skepticism (Casanova, 2023; Meneganzin and Killin, 2025). It is an indicator of poor systematic attention and not an absolute lack of inherited diseases (Andreassen *et al.*, 2023). Congenital abnormalities in large-scale production systems might be operated at low frequency and do not turn up, owing to low veterinary procedures and lack of pedigree registration (Jones and Wilson, 2022). Consequently, they could develop rare recessive characteristics or subclinical inherited abnormalities that would not be identified easily, especially when they do not crippling productivity or survival (Zschocke *et al.*, 2023).

Breeding-wise, such a lack of information limits the application of specific genetic screening programs (Wang *et al.*, 2022; Ali *et al.*, 2025). The selection methods used currently depend mainly on the phenotypic performance characteristics (growth, carcass yield, and wool quality), with less emphasis on genetic health indicators (Wanjala *et al.*, 2023b). When the intensity of selection rises, particularly with the emergence of semi-intensive systems, there is the possibility of accidentally concentrating concealed harmful alleles in case the genetic diversity is not maintained (Didenko and Nazarenko, 2025). It is hence important to ensure a wide genetic variation and not focus on a specific breeding end state, but rather focus on long-term herd health (Gutiérrez-Reinoso *et al.*, 2023).

To take conservation measures, the fact that little is documented about the hereditary diseases emphasizes the strength as well as the vulnerability of the Kazakh sheep genetic resources (Marzanov *et al.*, 2023; McManus *et al.*, 2025). Although indigenous breeds may seem genetically sound, the crossbreeding of these breeds with imported ones is not controlled, which can result in the introduction of inherited diseases that others did not have before in the local population (Assan *et al.*, 2024). The approaches to conservation work should then be aimed at genetic characterization and controlled breeding as opposed to the use of phenotypic traits only (Segelbacher *et al.*, 2022; Willi *et al.*, 2022).

There are no detailed data on hereditary diseases, which contributes to a great research prospect (Kernohan and Boycott, 2024; Solomon *et al.*, 2024). By incorporating veterinary findings with current genomic methodology, including SNP genotyping and whole-genome sequencing, it would be possible to quickly identify potentially detrimental genetic variations (Husien *et al.*, 2024). To facilitate sustainable breeding, preserve the adaptive traits, and assure the viability of the Kazakh sheep in a constantly changing environmental and production environment, it is important to establish baseline genetic health data (Perfilyeva *et al.*, 2025).

Conclusions: Kazakh sheep are an important part of the livestock heritage of Central Asia and still have an important role in the Kazakh agricultural economy. These sheep have evolved through centuries of nomadic pastoralism and more recently by programmed breeding programs and show great adaptability, resilience, and genetic diversity. Extensive production systems are controlled by native fat-tailed breeds like Edilbay and Kazakh fat-tailed coarse-wooled sheep, and specialized breeds, including the Kazakh Arkhar-Merino breed, are used in the production of fine wool. According to genetic research, Kazakh sheep carry a huge variation both at the micro-mitochondrial and nuclear levels, and this indicates their extensive evolutionary backgrounds and concentration in a wide range of environmental areas. This variety is a precious genetic pool of sustainable breeding, adaptation to climate change, and enhancement programs in the future. Despite the comparative rarity of cases of hereditary diseases, genetic purity due to controlled breeding and molecular control is necessary. Further research in genetics, breed protection, and evidence-based breeding will guarantee that such exceptional genetic sources will not be lost but used efficiently by the new generations.

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