Characterization of Small Ruminant Breeds in Central Asia and the Caucasus

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ICARDA

International Center for Agricultural Research in the Dry Areas

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Foreword

The demise of the Soviet Union in the early 1990s brought unparalleled changes to the economic and social context of Central Asia and the Caucasus. The imperative for the emerging independent republics to move from a centralized to an open market economy, shifts in land tenure and agricultural production infrastructure, and the dissolution of the large Soviet market were, among others, major forces of change. These changes severely affected the emerging rural sector consisting of smallholders, most landless, some with small livestock herds. By the mid 1990s, the critical deterioration in the agricultural sector in the region was becoming apparent, with indications of increasing levels of poverty and food insecurity.

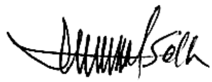
At about the same time, ICARDA, along with other international organizations, began efforts to help rebuild the region's agricultural research and contribute to the development of the emerging agricultural production systems. These efforts included institutional strengthening and building the capacity of research organizations, as well as joint research in developing market-oriented production strategies to enhance the incomes of the emerging farm units. The first evaluations of the impact of economic changes and reforms revealed a decline in agricultural productivity, deterioration in the natural resources on which agricultural production depends, and potential losses in agro-biodiversity. In the absence of options to utilize the region's extensive rangelands, small farmers were limited to grazing their animals around their villages, causing severe land degradation. Without alternative income sources, farmers began to slaughter their animals to raise cash, causing unprecedented depletion of animal stocks. By the end of the 1990s, the region's sheep population fell by 70-80% below pre-Independence levels. In Kazakhstan, for example, 25.2 million head of sheep were lost in less than 10 years.

In response to this unprecedented decline, ICARDA recognized the urgent need to assess the genetic diversity of the region's livestock and its suitability for the new demands of the emerging economic and production systems. ICARDA, in partnership with national research organizations, began a major task: to characterize the region's small ruminant genetic diversity, identify potential threats to this diversity, and preserve the information gathered during the Soviet Union era about indigenous and non-indigenous breeds. This task was made possible through research grants from USDA and IFAD, and ultimately by ICARDA's own resources.

ICARDA is pleased to present this volume, the third in a series on characterization of small ruminants. The first two volumes covered West Asia and North Africa. The series aims to lay the foundation for designing strategies for sustainable management of animal diversity in this region. The characterization focuses on market opportunities as drivers of further change that could lead to the conservation or, conversely, the disappearance of breeds. The study concludes that, with a few exceptions, native genetic resources are not under severe risk. It also suggests avenues to ensure the appropriate management of these resources in the future. With this in view, ICARDA is currently engaged in several countries in the development of community-based breeding programs, with direct participation of farmers, to manage and improve indigenous breeds.

This volume is expected to serve not only the scientific community, but also academics, students, development projects, governments, and ultimately farm communities and farmers' associations, in looking at avenues for maintaining and improving the region's animal diversity.

I congratulate the contributors – all leading scientists in the field of animal breeding and genetic diversity – for the detail and quality of information and analysis offered in the country chapters. I also thank the funding organizations that helped ICARDA achieve this landmark. I hope this effort will eventually translate into sustainable management and improvement of animal genetic resources in the dry areas, and into direct benefits to resource-poor livestock producers.



Mahmoud Solh
Director General
ICARDA

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The editors express their thanks and appreciation to several colleagues, including:

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Finally, the editors express their special thanks to Dr Mahmoud Solh, ICARDA's Director General, who was instrumental during the inception of this mission in his former position as ICARDA's Assistant Director General for International Cooperation, and for his encouragement and personal interest during the preparation of this volume.

Chapter One

Small Ruminant Diversity in Central Asia and the Caucasus: an Overview

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Introduction

Three countries in the Caucasus, Azerbaijan, Georgia, and Armenia, and five countries in Central Asia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, became independent republics following the dissolution of the Soviet Union in the early 1990s. While Azerbaijan and the new Central Asian republics are linked, somewhat, ethnically and linguistically, Armenia and Georgia maintain a separate linguistic identity, speaking and writing languages with their own alphabets. However, historically these countries have been closely linked. This region that extends over 4.189 million km^2 and has a population estimated at 75.6 million people (Wikipedia 2007), has been the bridge between Europe and Asia Minor with China through the Silk Road. The region has a special place in history, with intensive cultural and technological exchanges between civilizations that expanded and decayed. Additionally, it is home to a large diversity of livestock and plant species and is, very likely, the ground where some species were domesticated (Gromova 1935; Kiyatkin 1968).

In 1989 the FAO published a book entitled Animal Genetic Resources of the USSR (Dimitriev and Ernst 1989), which could be considered as the first documented account of livestock diversity characterization in Central Asia and the Caucasus. In view of the large territory being covered, the book's descriptions of small ruminants were brief and provided little individual breed information, so that the wealth of knowledge accumulated during the Soviet period on the subject was not fully disclosed. About ten years later, ICARDA began to develop a collaborative research exchange in this region and soon recognized the need to compile all the information regarding sheep and goat diversity, to understand the means to manage these resources appropriately and rescue information that might otherwise be lost. In line with this goal a proposal to include and support a breed characterization component within a collaborative research project, jointly undertaken in Central Asia by ICARDA and the United States Departement of Agriculture (USDA), was granted in 2000 and some funding was apportioned towards the characterization initiative (ICARDA 2001a). During the same period, another research project on integrated feed-livestock production in Central Asia was being implemented by ICARDA with funds provided by the International Agricultural Development Fund (IFAD) (ICARDA 2003). This project also contributed to co-funding the effort. The balance of the funds required to get this initiative underway were derived from ICARDA's own resources.

The characterization initiative would result in a document, of similar scope to those produced by ICARDA for West Asia and North Africa (Iñiguez 2005b; Iñiguez 2006), which would assess the status of small ruminant diversity, briefly document the consequences of the change of an economic system from a centrally funded economy to an open market one, and, in addition, provide key information on the diversity of small ruminants. ICARDA identified key researchers in the areas of animal breeding and production and commissioned them to prepare eight country reports, or chapters, that, together, could serve as a reference document to substantiate strategies for the better management of the region's genetic diversity. All selected authors were directly involved in the genetic improvement of indigenous breeds, in particular sheep, or in the development of an extraordinary large number of synthetic breeds that suited the large Soviet market demand.

Beset by translation difficulties, from Russian to English and English to Russian, as well as the various writing styles of the individual authors, the editorial iterations were extremely cumbersome and resulted in lengthy gestation periods for the individual country chapters. An additional obstacle was the lack of good photographic material on the breeds and this resulted in a real struggle to acquire photos with the required resolution for publication. This chapter rapidly summarizes the materials contained in the individual chapters together with the experience of the author in the region. It reports on the general trends occurring in small ruminant diversity, addressing, in particular, the impact of the downfall of the Soviet Union. This collapse not only had a social and economic cost, but also a cost to the diversity and the integrity of the natural resources of the region. A quick characterization of the type and nature of the prevailing production systems is also given. The chapter analyzes changes in animal populations and presents, based on these changes, the authors' perceptions of the threats posed to the diversity of specific breeds in each country. Concluding remarks are also offered that summarize the potential threats to diversity.

The Sequels Following the Collapse of the Soviet Union

The demise of the Soviet regime brought changes that severely impacted the agricultural sector of the whole region. The move to a new economic system had, in fact, serious consequences in the early 1990s (Suleimenov and Oram 2000; Iñiguez *et al.* 2004; Schillhorn van Veen 2004). It is important to highlight the main changes occurring in this transitional period in order to better understand the impacts on diversity and the context within which livestock production, in general, and small ruminant production, in particular, is currently structured.

Impacts on the Production Context

The Soviet production systems

The descriptions that follow largely derive from Suleimenov *et al.* (2006) supplemented by information provided by Academician Mekhlis Suleimenov, former Director of the Shortandy Research Center of Grain Farming in Kazakhstan during the Soviet Union (Mekhlis Suleimenov, personal communication 2007). Soviet production systems involving the exploitation of sheep and goats were collectively owned, by cooperatives (Kolkhoz) or State owned farms (Sovjoz). These consisted of large production units with holdings sometimes amounting to or exceeding several thousands of hectares and animals. There were no farmers in the usual context of the word; rather, the Soviet rural sector was comprised of salaried workers. These holdings, usually staffed with professionals in animal production (zootechnicians), veterinarians, agronomists, and also range specialists, were equipped with animal facilities, machinery, and infrastructure for irrigation that allowed the production and conservation of cultivated forage. Forage was also collected from the range. The feeding system was largely range-based, involving migratory grazing with winter feed supplemented from conserved and stored stocks. Winter feeding in barns was the norm, particularly in countries with severe winters, such as Kazakhstan, and in the high mountainous areas of Kyrgyzstan, Tajikistan, and the Caucasus. Turkmenistan and some other southern areas of Central Asia, which experience mild winters, were the only places in the region where sheep and goat production depended solely on year-round grazing with little or no supplementation in the winter or in periods of severe drought (see the chapter on Turkmenistan diversity in this volume). Though plagued by inefficient management, these systems suited Soviet market demand and were fully operational (Suleimenov *et al.* 2006).

Privatization and fragmentation of production systems

The economic transition following the downfall of the Soviet Union was coupled to a period of intensive reform, the most important involving the privatization of resources and animal tenure and liberalization. This triggered the fragmentation of the large collective or state owned farms into numerous, unproductive smallholdings, not known in the region before, most without land and owning only a handful of animals (Schillhorn van Veen 1996; Iñiguez and Suleimenov 1999; ICARDA 2003; Vares 2003; Schillhorn van Veen 2004; Suleimenov *et al.* 2006). The fragmentation of large holdings caused a shift in the management and use of natural resources, in particular the ranges, with serious implications on feeding systems. The application of the reforms was not equal in intensity and some countries, particularly in Central Asia, namely Turkmenistan and Uzbekistan, followed a more conservative approach in this application (Kerven *et al.* 2003; Iñiguez *et al.* 2004). Figure 1 shows these changes, contrasting the more intensive applications of the reforms in Kyrgyzstan, Kazakhstan, and the Caucasian republics.

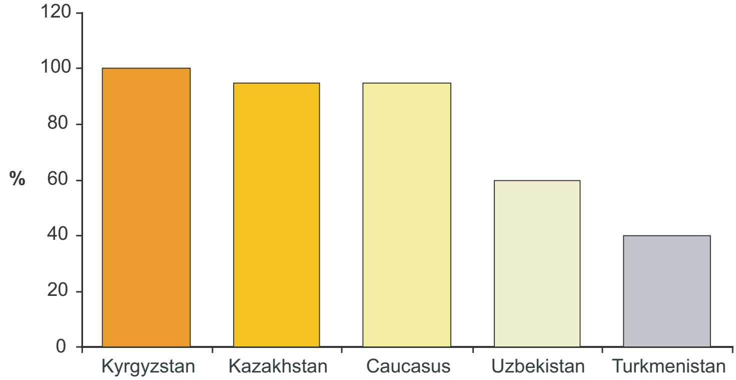

Figure 1. Gross estimates of the intensity of application of economic reforms (%), in the Caucasus and Central Asia during the period after the downfall of the Soviet Union.
Source: Arranged by the author on the basis of ICARDA (2003).

Market disruption

Another important change in the production context involved the break up of the large Soviet market. Under the Soviet centralized economy, countries like Kazakhstan and Kyrgyzstan were dedicated to the massive production of wool while the production of Karakul sheep, from which astrakhan pelts are obtained, involved mainly the steppes and desert areas of Uzbekistan. After collection, the wool and pelts were transported to other republics for processing, and then marketed in the large Soviet market extending from East Europe through Asia (Suleimenov *et al.* 2006). In the Caucasus small ruminant production was not a priority and in Turkmenistan and Tajikistan it had a minor role. The dissolution of the Soviet market impacted the emerging production systems as it resulted in a dramatic decline in demand and lower prices for many traditional products, such as wool and pelts (Bloch 1997; ICARDA 2003). This caused product stagnation as farmers did not have the opportunities to sell their products. Farmers, in fact, had difficulties in marketing the wool and pelts produced, a problem not only resulting from the lack of demand and an organized marketing system, but also exacerbated, in the case of Karakul pelts, by the increasing concern for animal rights (ICARDA 2003). Moreover, with a change in production scale from large to small holdings, and with fewer animals to shear and obtain pelts from, the contribution per flock to income from these traditional products was often negligible (Iñiguez *et al.* 2004). However, the demand for meat and milk in markets neighboring the production areas within a country, particularly in those of large urban areas, remained high as no other sources of these products were available (Iñiguez and Suleimenov 1999; ICARDA 2003).

Additional constraints for production enhancement and the marketing of products in the region that farmers faced included the landlocked condition of Central

Asia and the Caucasus, except for Georgia, and the rather small populations driving the internal demand in a given country. Populations of the countries in the region range from 3.3 to 8.1 million people, except for Uzbekistan and Kazakhstan with populations of 26.6 and 15.3 million, respectively (Wikipedia 2007).

The social context and unemployment

Another, equally important change occurred in the social context of the rural areas, with an emerging sector of smallholders with no income other than that generated from the selling of a few animal products. Formerly employed by the collective system, these people became unemployed and started to experience the tragic consequences and sequels of poverty. In many areas an intensive rural migration occurred as a result of the deterioration in the quality of life, and the lack of social and educational opportunities (Suleimenov *et al.* 2006).

Disruption of production support services

Finally, the transition also recorded a disruption of production support services at all levels (Iñiguez and Suleimenov 1999; ICARDA 2003; Iñiguez *et al.* 2004). At a more general level, given the disorganized veterinary control, farmers had to confront animal diseases not commonly seen before. The breeding systems collapsed and breeds began to be crossed indiscriminately. This occurred particularly in organized breeding schemes for wool and pelts involving synthetic breeds in the first case and indigenous breeds, such as the Karakul, in the second (Iñiguez and Suleimenov 1999; Iñiguez *et al.* 2004). The absence of an extension service was felt from the start while research organizations deteriorated and entered in a period of obsolescence. At the farm level there was a dearth of information on how to manage and operate a small farm. Most technologies applicable for large holdings, i.e. large scale silage production (Sansizbay 2003), were not applicable to the small scales of the newly emerging production systems. In addition, the infrastructure and machinery, if not dismantled, deteriorated rapidly, became obsolete

Production infrastructure dismantled

Soviet agricultural equipment obsolete

or turned into trash. These problems were reflected in the deteriorating quality of the products to be marketed, in particular wool, which could not compete in quality with more organized wool producing countries with a well structured and aggressive marketing system for a high quality product, i.e. Australia and New Zealand (Mueller 2000).

Impacts on Land and Animal Populations

The main small ruminant feeding base: rangelands and their deterioration

The rangelands of Central Asia and the Caucasus co-existed and eventually co-evolved with ruminant grazing. According to FAO data, the total area of the region's rangelands amounts to 256.1 million ha (FAOSTAT 2007a); 250.6 million ha in Central Asia and 5.5 million ha in the Caucasus. This territory was home to the development of many pastoralist societies that constituted an important economic base before and during the period of the Soviet Union.

As indicated earlier, Soviet animal farm management targeted the utilization of rangelands on a rotational grazing basis through the organized movements of large flocks over vast territories; from the lowlands to the high mountains in the summer and then gradually returning back to the plains as winter approached (ICARDA 2003). A series of ranges close to the settlements were kept unused during the year to be available in the fall, winter, and spring. These areas of reserved rangelands were determined according to the climates of the regions and the lengths of time they would be required for grazing during these periods. With the break up of the Soviet Union this type of management was seriously affected, with a few exceptions, because, with their small sizes of flocks and marginal income, farmers could not cover the costs involved in rotational grazing. For a large number of emerging farmers the only choice was to graze their animals around the villages and settlements year-round. This caused a severe impact on the rangelands and the landscapes show evidence of degrees of erosion. Figure 2

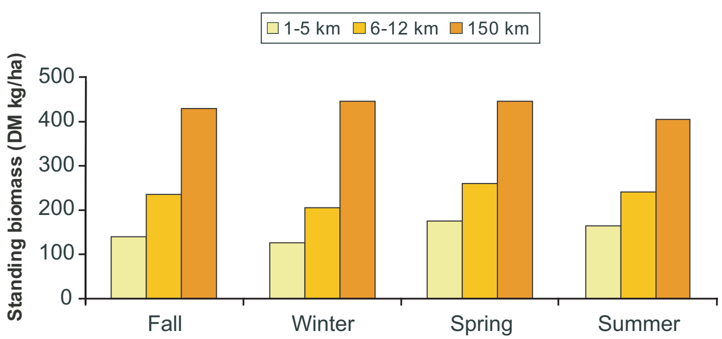

Figure 2. Standing biomass at different distances from villages in each season of the year in Berlik, Zhambyl District, foothill steppes of the Alatau range, Kazakhstan.
Source: Iñiguez *et al.* (2004).

shows the different standing biomass at different distances from villages in each season of the year (ICARDA 2003; Iñiguez *et al.* 2004). Clearly, the production of biomass increased in remote ranges that were practically no accessed by animals, whereas minimum biomass production was the case near the settlements due to intensive overgrazing. It is obvious that such conditions were negatively reflected in animal productivity indexes that departed from the levels established under Soviet control (Iñiguez and Suleimenov 1999).

Decline in Animal Populations

The latest information available on animal populations in Central Asia and the Caucasus refers to the situation in 2004 (FAOSTAT 2007b). The estimates indicate a total population of 51.6 million head of small ruminants, including 45.5 million head of sheep and 6.1 million head of goats. These data on animal population numbers may not reflect reality as they are estimates supplied by countries to the FAO and are not the results of actual censuses. It is felt that the figures for some of the countries could be somewhat inflated because of concerns by policy makers at showing a decline.

After the early 1990s and for a period of about ten years, faced with unemployment and no other sources of income, smallholders began to slaughter their animals for meat or sold them to generate cash. This resulted in a sharp contraction of the animal populations; more so in countries where the reforms were implemented aggressively than in other, more conservative, countries (Schillhorn van Veen 1996; Iñiguez *et al.* 2004). Figures 3 and 4 illustrate the changes in the population of sheep and goats, respectively, for the Caucasus and Central Asia by country. The change that occurred in less than 10 years after the end of the Soviet period was without precedent. During the period 1992 to 1999, in Kazakhstan alone, up to 25.2 million sheep, 74% of its sheep stock in 1992, were lost.

The declines in sheep populations, in descending order of magnitude and percent, were Kazakhstan (74%), Kyrgyzstan (74%), Georgia (63%), Tajikistan (41%), and Armenia (41%) (Figure 3). Less pronounced population changes (0% and 11%) were recorded in Turkmenistan and Uzbekistan where the application of reforms was more conservative. The privatization process in these countries was slower and the cooperative structure remained until after 2000 (Suleimenov and Oram 2000; Suleimenov *et al.* 2006). In this case, neighboring smallholdings benefited substantially from the cooperative holdings. In Uzbekistan, for instance, these benefits were in the form of the provision of fodder or allowing the animals of smallholders to be mixed with cooperative flocks for rotational grazing (ICARDA 2003). In addition, Turkmenistan subsidized livestock production and implemented actions towards a goal of achieving a population increase. Recently Kazakhstan has followed Turkmenistan’s lead in re-stocking or avoiding population depletion (Suleimenov *et al.* 2006). It also has provided credits and incentives for small ruminant production, leading towards achievement of this goal.

With the exception of Azerbaijan, which exhibited a sheep population recovery as early as 1994, the rest of the countries either stabilized or began to recover their population numbers around 2000 (FAOSTAT 2007b).

The dynamics of the population trends for goats provides a contrast. In general, the populations were affected less (Figure 4). The goat population of Turkmenistan showed a continuous increase over the period 1992 to 2000. The goat populations of Kyrgyzstan, Armenia, and Georgia experienced a decline until the period 1994 to 1996 and then recovered at a rapid rate thereafter. The goat populations of Kazakhstan, Uzbekistan, and Tajikistan also displayed a decline during the same period, 1994 to 1996; however, the populations remained relatively stable thereafter.

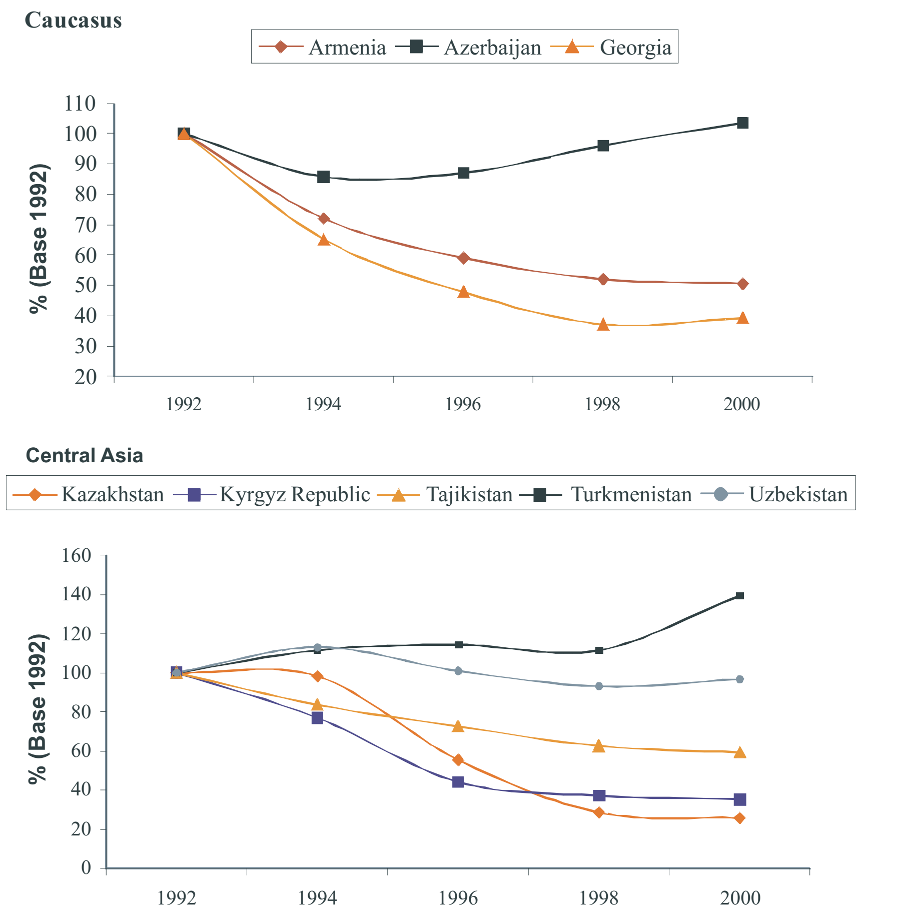

Figure 3. Changes in sheep populations in Central Asia and the Caucasus during the period 1992-2000 (1992 as the base year).

Data source: FAOSTAT (2007b).

Note: Sheep populations (in million head) in 1992: Kazakhstan (33.9), Kyrgyzstan (9.2), Tajikistan (2.5), Turkmenistan (5.4), Uzbekistan (8.3), Azerbaijan (5.1), Georgia (1.4), and Armenia (1.0).

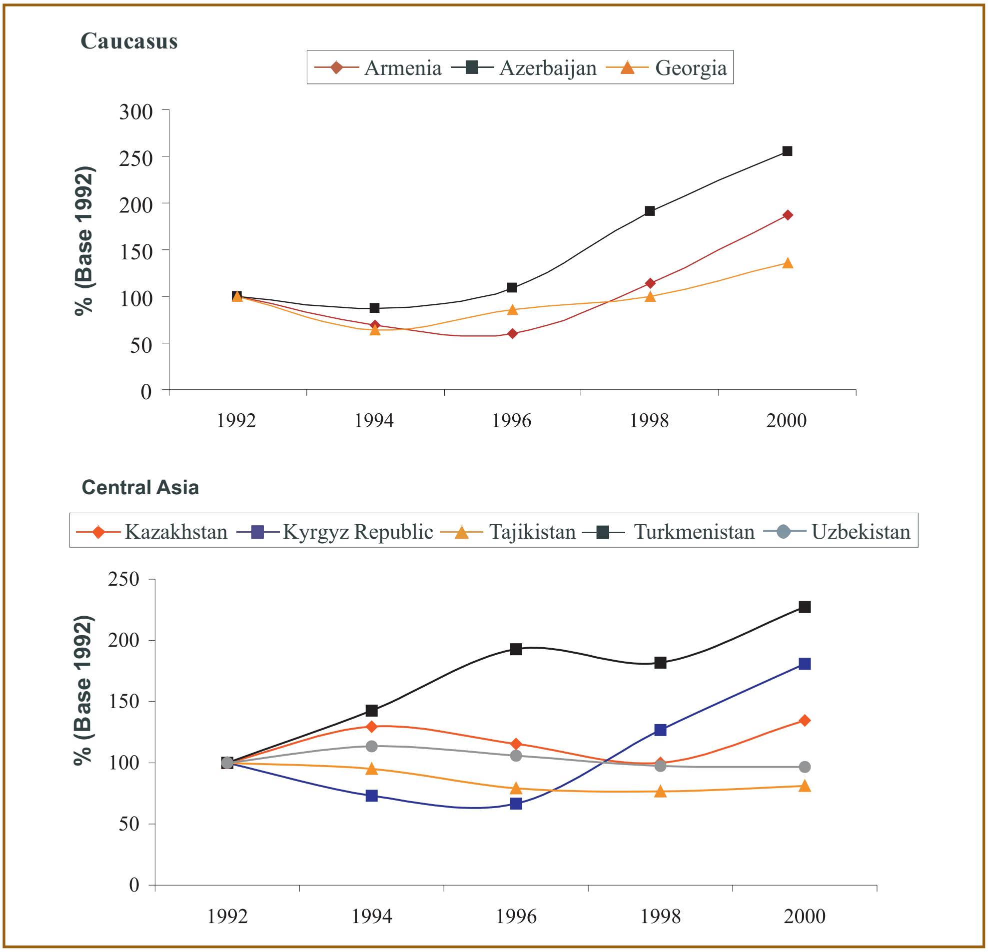

Figure 4. Changes in goat populations in Central Asia and the Caucasus during the period 1992-2000 (1992 as the base year).
Data source: FAOSTAT (2007b).
Note: Goat populations (in million head) in 1992: Kazakhstan (0.692), Kyrgyzstan (0.3), Tajikistan (0.871), Turkmenistan (0.22), Uzbekistan (0.918), Azerbaijan (0.194), Georgia (0.059), and Armenia (0.023).

In 2004 the goat populations of almost all the countries were above the 1992 figures. It seems that a possible explanatory reason for the rather rapid increase in goat populations, as opposed to the sharp decline in sheep populations, was due to the large demand for mutton in the markets. Smallholders in the region, as a rule, keep fewer numbers of goats and usually integrate them into the more numerous flocks of sheep. It is likely that goats have been naturally protected because of these conditions, as farmers resorted first to selling their more numerous sheep. Moreover, scientists from the region suggest that because most goats were not managed under organized production schemes like sheep, the disruption of these schemes did not greatly affect the goat populations. Also, scientists claim that goats thrived better than sheep under the more deprived conditions. Clarification of these issues requires further investigation.

It is estimated that the loss of sheep and goats during the period 1992 to 2000 amounted to 36.1 million head (FAOSTAT 2007b), the loss being more severe for sheep (35.6 million head) than for goats (0.5 million head). There is no doubt that this loss was accompanied by a loss in animal diversity.

Figures 5 and 6 illustrate the geographical distributions of the changes in sheep and goat populations for the period 1992 to 2004, both in Central Asia and the Caucasus.

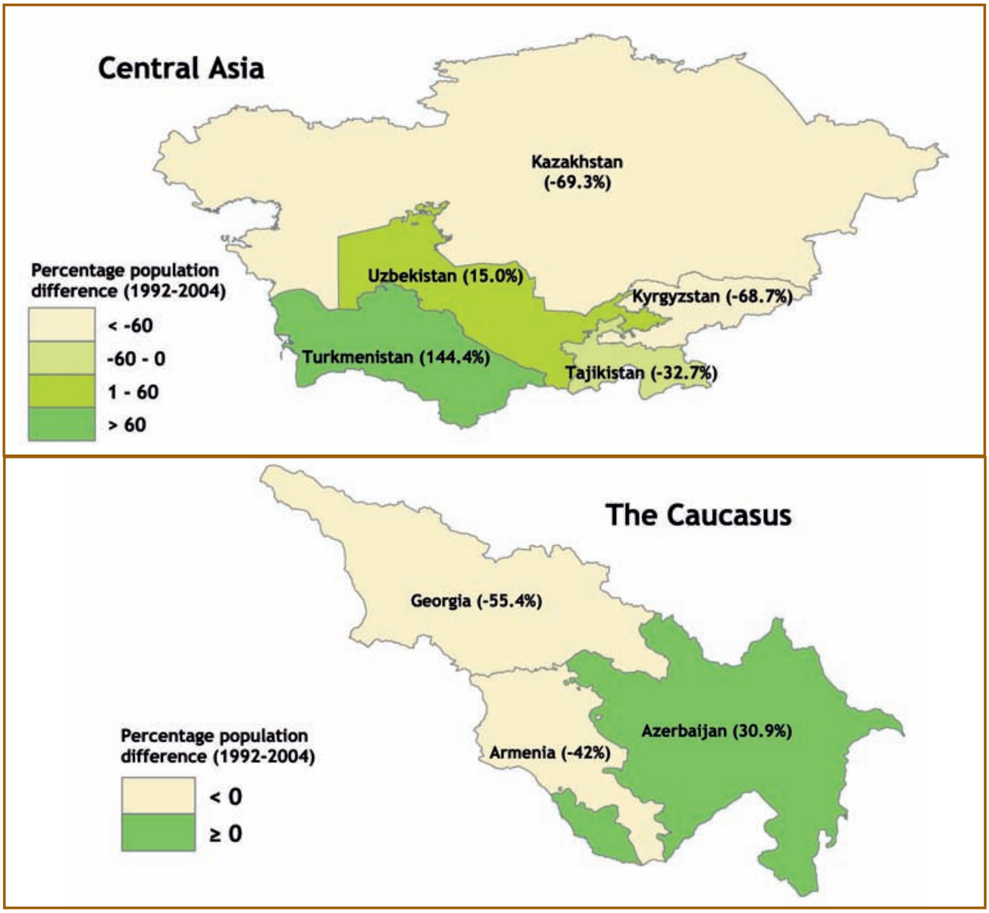

Figure 5. Changes in the sheep populations of Central Asia and the Caucasus (1992-2004).
Source: Map was drawn by Piero Daltan—ICARDA, 2007, based on information organized by the author from FAOSTAT (2007b) data.
Note: In parenthesis percentages of change relative to population in 1992.

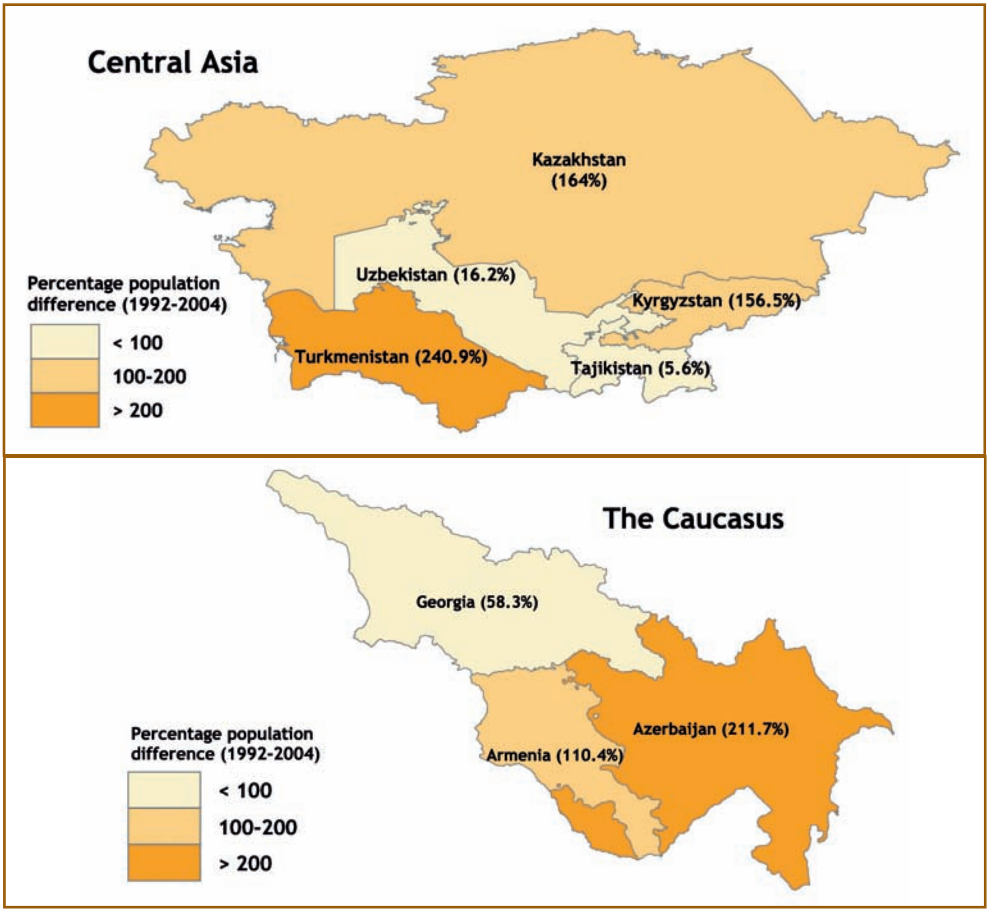

Figure 6. Changes in the goat populations of Central Asia and the Caucasus (1992-2004).
Source: Map was drawn by Piero Daltan—ICARDA, 2007, based on information organized by the author from FAOSTAT (2007b) data.
Note: In parenthesis percentages of change relative to population in 1992.

Production Systems and their Market Opportunities

Current Production Systems and Conditions

Although farmers learned, at a heavy cost, the difficulties involved in running a farm under an open economy with a market with which to interact, they have held onto their livelihoods without alternative sources of employment. The difficulties have been manifested in low productivity and competitiveness. In addition, livestock production has been largely neglected in national development plans, in contrast to the plans for the production of strategic foods or crop commodities (i.e. grains and cotton) (Suleimenov and Oram 2000). Therefore, production support, extension, and research services have not yet been developed to effectively serve the poor. Furthermore, the markets are operated under an unfair intermediation without the farmers benefiting fully from the existing opportunities (Schillhorn van Veen 1996; ICARDA 2001b).

Smallholdings are still managed on a range grazing basis, with grazing practiced continuously around settlements. This has translated into overgrazing and feed scarcity. Some farmers still collect feed from the range for winter feeding, the period that impacts most severely on the animals' annual production cycle. Unfortunately, many farmers have poor strategies for coping with feed fluctuations and the critical lack of forage seed supply in the market (Iñiguez and Suleimenov 1999; Iñiguez *et al.* 2004). This causes high feeding costs and the scarcity of fodder during winter (ICARDA 1999, 2000, 2001b and 2002).

Veterinary services are poorly developed (Schillhorn van Veen 2004) and appropriate breeding plans are still non-existent. With the deterioration of breeding systems, the farmers' access to improved animals has been halted and many breeds, formerly managed as pure stands and under production improvement schemes, have been crossed, in particular, with indigenous animals, as these are preferred (Mueller 2000; ICARDA 2003).

Current Market Opportunities and Farmers' Responses to them

The whole region does not yet operate as a common market. Additionally, the countries are not keen on open exchange and are very careful about their borders. The export opportunities are not promising, though there is an informal trade with China and Russia, in particular involving the fine fibers of cashmere and mohair (Mueller 2000; Kerven 2007). Wool is also marketed informally. However, quality standards are not competitive (Mueller 2000). Nevertheless there are potential opportunities for fibers and wool in Russia and China. This is particularly the case for Central Asian countries with capacity to produce these products, i.e. Kazakhstan and Kyrgyzstan (Kerven 2006), Tajikistan and Uzbekistan, for the benefit of resource-poor farmers. In addition to these prospects, and to improve the capacity of Central Asia to produce cashmere fiber, the Macaulay Institute imported Cashmere goat semen from the UK in 2005 for an ongoing cross-breeding plan in Kazakhstan (Macaulay Institute 2005).

Informal market of mohair processed fiber in Khujand, Sogd region, Tajikistan

The demand for indigenous sheep meat has notably increased due to a tradition of consumption of meat and fat (ICARDA 2003). This type of production fits better with the production scales of smallholders. A type of brochette known as

Meat sold on the roads of the Caucasus

Sheep meat for *shaslik* is in high demand in Samarkand, Uzbekistan

shaslik is popular and widely consumed in the whole region. This is why wool and mutton synthetics are sold to target this demand, but the meat of indigenous fat-tailed animals is preferred. Most farmers sell their animals for mutton; however the production strategies are not well market-targeted (ICARDA 2003).

In Central Asia no sheep breeds have been exploited for milk production. However, there is a tradition of the production of milk from sheep and goats in the Caucasus, where breeds with milk production potential could be found. In this subregion there is an excellent market niche for processed milk products from small ruminants that farmers could target more efficiently. Interest in improving the production of milk developed into a successful cross-breeding plan between native Armenian goats with exotic European breeds. This started in 1999 in Vayots Dzor province with the support of the USDA (Engels and Sardaryan 2006).

Balbass sheep being milked by an Armenian farmer

Azerbaijan also started a breeding plan with imported Awassi sheep from Turkey in 2004 (30 ewes and 5 rams) in order to offer producers a possibility to capture the market demand for processed milk products and thus increase their incomes (Yagub Guliyev, Agrarian Science Center, Baku, Azerbaijan, Personal communication 2007).

Sheep cheese in the markets of Baku, Azerbaijan

A study of consumer trends in the Central Asian countries, revealed that Turkmenistan and Uzbekistan also have a tradition of consuming sheep milk products, however this was not the case of Kazakhstan and Kyrgyzstan, though high interest was shown among producers and intermediaries, particularly in the latter country (ICARDA 2002). The need for diversifying production became apparent in Kazakhstan which in the late 1990's imported from Israel a flock of highly productive Awassi improved animals. This flock is being used in different crossbreeding plans. No reports of the outcome of this project are yet available.

Prospects for Karakul pelts are not promising. In 2002 in Uzbekistan there were still government processing factories that offered low prices and delayed payments, while other countries report selling their pelts to Russia through an informal market (ICARDA 2002). Karakul mutton is however produced and sold widely in the region.

Some options for livestock production diversification have been tested by ICARDA with success (ICARDA 2003). These included strategies for mutton production and also the possibility to collect and process sheep's milk in Uzbekistan and Turkmenistan to target the promising markets for dairy products.

Milking Karakul sheep in Nurata, Uzbekistan: an option for diversification

Small Ruminant Genetic Resources

Sheep Diversity

In the regions of concern, sheep are more numerous and diverse than goats. A total of 40 different, non-repeated sheep breeds were accounted for, with only one of them that is exotic to the region, the Australian Merino of Kazakhstan, included in this tally. In those cases where the same breed was repeated in different countries (Table 1), i.e. the Gissar, with occurrence in Uzbekistan and Tajikistan, the breed was counted once only. It is possible that in some situations, as with the Karakul sheep, there are differences among the variants of the breeds in different countries, due to the selection imposed during Soviet times. These differences could be sufficiently large and important for the variants to be counted separately. Likewise, the indigenous fat-tailed sheep from Kyrgyzstan and Kazakhstan have been considered similar for geographical reasons and production similarities. However there could be real breed differences, particularly in remote, non-neighboring areas in the large territory of Kazakhstan. This requires clarification in the future.

Table 1. Indigenous small ruminant breeds that are shared by more than one country.

Breed	Main country of occurrence	Other countries sharing the same breed (possible equivalent name of the breed in parenthesis)
Sheep		
Karakul	Uzbekistan	Kazakhstan, Tajikistan, Turkmenistan
Kazakh Fat-tailed MCW	Kazakhstan	Kyrgyzstan (Indigenous coarse wool)
Gissar	Tajikistan	Uzbekistan
Jaidara	Uzbekistan	Tajikistan
Balbass	Azerbaijan	Armenia
Bozakh	Azerbaijan	Armenia
Karabakh	Azerbaijan	Armenia
Goats		
Kazakh Cashmere	Kazakhstan	Kyrgyzstan (Kyrgyz Cashmere), Tajikistan (Pamir) Uzbekistan (Uzbek Black Cashmere)
Kazakh Mohair	Kazakhstan	Kyrgyzstan (Kyrgyz Mohair), Tajikistan (Tajik Mohair), Uzbekistan (Uzbek Mohair)
Kazakh Native	Kazakhstan	Kyrgyzstan (Indigenous)
Uzbek Native	Uzbekistan	Tajikistan (Native coarse fiber) and Turkmenistan (Indigenous Turkmen)
Azerbaijan goat	Azerbaijan	Armenia (Armenian native), Georgia (Indigenous Georgian)

Source: Organized by the author from Chapters 2-9 in this volume.
Note: MCW: Mutton Coarse Wool.

There were 27 non-repeated breeds (67%) in Central Asia and 13 breeds (33%) in the Caucasus.

Unlike many other countries in the world there was an outstanding number of synthetic breeds formed and released during the Soviet period (Iñiguez 2005a). Virtually each country had its own breeding plan, targeting what, probably, was envisioned as most important by the breeders involved. A common denominator in the formation of these breeds, however, was the breed's sturdiness and adaptive capabilities to cope with the environmental demands of the environments where they were developed.

Academician Aliev, meritorious sheep breeder (center) and author of the Tajik breed, spring 2006, Gissar region, Tajikistan

The synthetic breeds covered a range of specialized wool producing breeds. These produce either fine wool or coarse wool with minimal, if any, value in current markets. The development of these breeds began with either a single or multiple crossing of a native breed and a given, introduced, improved European breed or breeds (such as the Merino, Lincoln or Romanov, among others) (Iñiguez 2005a). The crossbred populations produced were then interbred following selection or underwent absorption to a European breed before selection. At a given point, the selected or upgraded populations were again crossed with a new breed in order to introduce specific characteristics. Once some degree of homogeneity was displayed by the selected groups during the selection process, they were declared to be breeds by Soviet standards. Thus, in the formation of a synthetic, 3 to 4 breeds could be involved in a continuous cycle of crossbreeding followed by selection (Iñiguez 2005a).

Crossbreeding was facilitated by massive artificial insemination (AI). This procedure was so popular that it continued after the break up of the Soviet Union and was further applied to some synthetics, even if they were already declared to be breeds. This information is important when considering the potential for conserving the breeds. For those synthetics under the threat of extinction, the genetic pool of native and European breeds from which they were derived is still available, and could act as a natural gene reservoir in the context of their preservation (Iñiguez 2005a).

There were 27 different synthetic sheep breeds out of the 40 breeds (67.5%) counted; more in Central Asia (21) than in the Caucasus (6). The remaining 13 breeds (32.5%) are true indigenous breeds (6 breeds in Central Asia and 7 breeds in the Caucasus) (Table 2). Thus, out of this subtotal the distribution of indigenous breeds in both Central Asia and the Caucasus is approximately the same, 46% and 54%, which, given the rather smaller territory of the latter subregion, is an interesting contrast.

Table 2. Distribution of indigenous and synthetic small ruminant breeds in Central Asia and the Caucasus.

Species/breeds	Central Asia	Caucasus	Total
Sheep			
Indigenous breeds	6 (46)	7 (54)	13
Synthetic breeds	21 (78)	6 (22)	27
Total		13 (32)	40
Goats			
Indigenous breeds	2 (50)	2 (50)	4
Synthetic breeds	3 (75)	1 (25)	4
Total	5 (62)	3 (38)	8

Source: Organized by the author from Chapters 2-9 in this volume.
Note: The percent of breeds of a given category in each subregion is shown in parentheses.

As was pointed out earlier, in Central Asia sheep are mainly raised to produce mutton, wool, and pelts and are not milked. In contrast, in addition to producing mutton, sheep are milked in the Caucasus to meet a traditional demand. Figure 7 shows the distribution of the production orientation for the breeds. From the figure it can be seen that 50% of the breeds are wool producers (fine and semi-fine wool), however all these breeds are currently used for mutton production. Of the total number of breeds in the whole region, five breeds in the Caucasus are milked, that is, 38% of the breed diversity in that subregion.

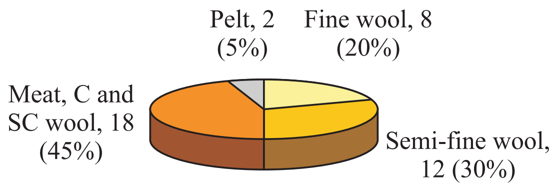

Figure 7. Number and percent of sheep breeds with different production specialties.
Source: Organized by the author from Chapters 2-9 in this volume.
Note: C and SC wool: Coarse and semi coarse wool.

The capacity for meat production is an important value of the breed's diversity. Most indigenous breeds are preferred all over the region very likely because of the flavor characteristics of their meat. Though most consumers or people involved in the rearing of the dominant breed in a given region would ascribe the best gastronomic properties to its products, it seems that the Georgian Tushetian sheep was widely recognized because of the exceptional flavor of its meat (see the chapter on Georgian breeds in this volume). The indigenous animals are all fat-tailed, with hanging fat tails similar to those displayed in West Asia, in particular in the Caucasus region, and a different type of fat-tail, known as Kurdyuk, in the case of the largest breeds of Central Asia, such as Gissar, Jaidara and others. A transition between a thin tail and a fat tail is found in the Caucasus where some breeds, such as the Imeretian, some times displays a fat tail and some times a thin tail, as described in Chapter 8 of this volume. The distribution of fat-tailed breeds in the region is shown in Figure 8.

The Gissar sheep from Central Asia with a typical Kurdyuk fat tail

The more numerous thin-tailed breeds in Central Asia correspond to the various wool producing, synthetic, thin-tailed breeds. All the true indigenous breeds in both sub-regions are fat-tailed and their number seem to be expanding at the expense of the fine and semi-fine wool sheep, like in Kyrgyzstan, as shown in Figure 9 (Iñiguez *et al.* 2004).

Pelt breeds include the most numerous Karakul breed and the Atirau, a synthetic developed in Southern Kazakhstan. Karakul sheep are available in all Central Asian countries, except Kyrgyzstan and show a tremendous diversity which is the result of a well organized selection process during the Soviet period, in particular in Uzbekistan. The frontispiece of the Uzbekistan chapter shows a

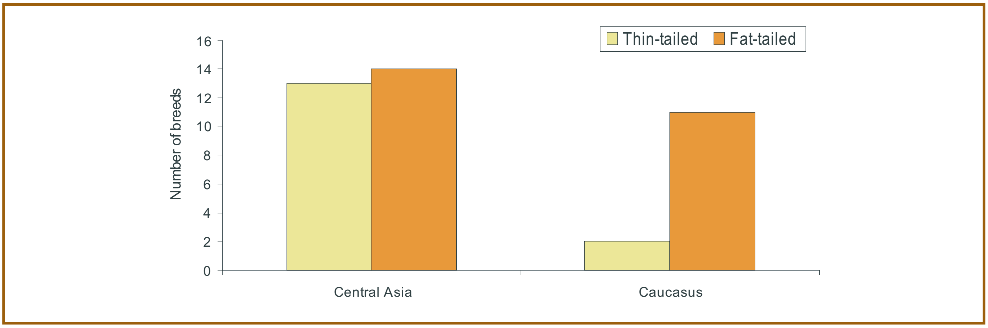

Figure 8. Number of thin-tailed and fat-tailed breeds in Central Asia and the Caucasus.
Source: Organized by the author from Chapters 2-9 in this volume.

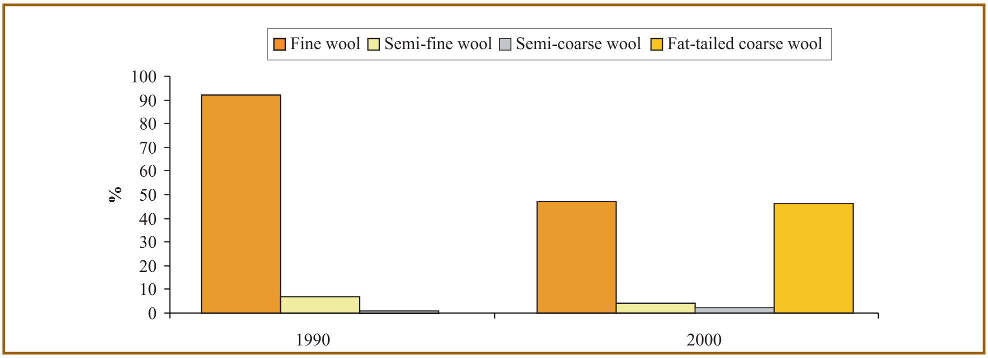

Figure 9. The distribution of fine wool, semi-fine wool and fat-tailed sheep breeds in Kyrgyzstan at the end of the period of Soviet domination and 10 years later.
Source: Iñiguez *et al.* (2004).

statue of a Karakul sheep built during Soviet times which was placed in the only center in the Union dedicated to Karakul research studies, the Karakul Research Institute of Samarkand. Several lines of different colors, including different tones of black, Sur, brown, and white Karakul, along with other colors are still available in pure stands under the control of this Institute, now called the Karakul Sheep Breeding and Desert Ecology Research Institute. There is a need to consider ways to diversify Karakul production and eventually find alternatives for the conservation of existing lines to avoid them disappearing altogether (ICARDA 2001a).

Table 3 lists the sheep breeds counted by the authors of the chapters in relation to their production specializations.

Karakul pelts at the Kazakh Karakul Sheep Breeding Research Institute museum in Chimkent, Kazakhstan

Table 3. Sheep breeds per country and their main production specialties.

Country	n	Breed's production specialization Fine wool	 Semi-fine wool	 Coarse and semi-coarse wool	 Pelt
Kazakhstan	16	**Kazakh Fine Wool***	**Kazakh Mutton- Wool***	Kazakh Fat-tailed Mutton Coarse Wool	Karakul
		Northern Kazakh Merino*	**Akjaik***	**Kazakh Fat-tailed Mutton Semi-Coarse Wool**	**Atirau**
		Southern Kazakh Merino*	**Kazakh Semi-Fine Wool**	Edilbay	
		Kazakh Arkharo Merino*	**Degeress**	**Sariarka Fat-tailed Coarse Wool**	
		Australian Merino*	**Tsigai***		
Kyrgyzstan	4	**Kyrgyz Fine Wool***	**Tien-Shan***	**Alay** Indigenous Coarse Wool	None
Tajikistan	5	None	**Tajik** **Pamir***	Gissar Jaidara	Karakul
Turkmenistan	3	None	None	Sarajin	Karakul
Uzbekistan	5	None	**Mutton-wool**	Jaidara Gissar **Mutton-Fat-Wool**	Karakul
Armenia	7	None	**Corriedale***	[Mazekh] [Balbass] Bozakh Karabakh **Medium-Coarse Wool Martunin** **Medium-Coarse Wool Aragat**	None
Georgia	3	**Georgian**	**[New Georgian]**	[Tushetian and their crosses]	None
Azerbaijan	6	None	**Merino***	[Balbass] [Karabakh (and Garadolag)] [Gala-Apsheron (or Shirvan)] Lezgin Bozakh	None

Source: Organized by the author from Chapters 2-9 in this volume.
Notes: Synthetic breeds listed in bold; breeds that are milked enclosed in brackets.
*Indicates thin-tailed breeds (the remaining breeds without an asterisk are fat-tailed).

It is pertinent to also mention that in association with sheep genetic resources, there is a wealth of diversity of horses and dogs which are integral part of the grazing systems of Central Asia and the Caucasus.

Sheepdog puppy in the mountains of Central Asia

Sheepherder and dog in the Caucasus

Goat Diversity

As in West Asia and North Africa, goats are poorly characterized with scanty information available (Iñiguez 2004; Iñiguez 2005a; 2005b). A total of eight non-repeated breeds were reported, five (62%) in Central Asia and three (38%) in the Caucasus. In this account the indigenous goat breeds of Turkmenistan, Uzbekistan, and Tajikistan are declared as versions of a similar goat (Table 1), differing from those of Kazakhstan and Kyrgyzstan which were clustered separately, as in the case of the indigenous goats of the Caucasus. This differentiation is based on geographical and production similarities only, and was assumed following consultations between the authors of the different chapters of this volume. Under this categorization no large differences between countries with regard to either their Cashmere or Mohair synthetics could be expected because they were the product of similar development during the Soviet times.

Most goats of the region are native to it, and are raised for multipurpose production. Goats from Central Asia produce cashmere and mohair and, apparently, there is a good genetic variability that could be exploited in this regard (Dimitriev and Ernst 1989; Mueller 2000; Iñiguez 2004). The only specialized dairy goat is the Megrelian of Georgia that contributes, along with sheep, to satisfy the traditional demand for processed milk products in the Caucasus. Goats are also milked in this subregion along with sheep.

The production orientation of the goat breeds is outlined in Figure 10.

There is just one Cashmere goat breed because this category contained only the synthetic animals. Many goats of the region have down fibers that are fine and cashmere-type, with some goats more specialized in producing this type of fiber, in particular in Kazakhstan and Kyrgyzstan (Mueller 2000).

Table 4 lists the goat breeds, in relation to the breeds' production specializations, counted by the authors of the chapters.

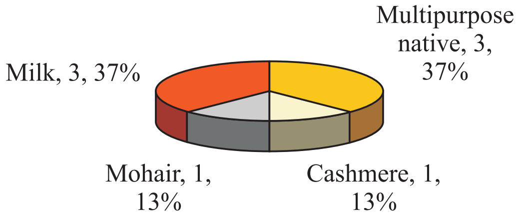

Figure 10. Number and percent of goat breeds with different production specialties.
Source: Organized by the author from Chapters 2-9 in this volume.

Table 4. Goat breeds per country and their main production specialties.

Country	n	Multipurpose	Cashmere	Mohair	Milk
Kazakhstan	4	Native	**Kazakh**	**Kazakh**	**ED crosses**
Kyrgyzstan	3	Native	**Kyrgyz**	**Kyrgyz**	None
Tajikistan	3	Native	**Pamir**	**Tajik**	None
Turkmenistan	1	Local goats	None	None	None
Uzbekistan	3	Uzbek Native	**Uzbek Black**	**Uzbek**	None
Armenia	2	Armenian native	None	None	**ED crosses**
Georgia	2	Indigenous Georgian	None	None	Megrelian
Azerbaijan	1	Azerbaijan goat	None	None	None

Source: Organized by the author from Chapters 2-9 in this volume.
Notes: ED - crossbred goats with exotic dairy germplasm.
Synthetic breeds listed in bold.

Status of Breed Characterization

Sufficient phenotypic characterization has been conducted on most breeds of the region, mostly under research station or cooperative farm conditions. Table 5 summarizes the needs for characterization and should be read with the proviso that breeds listed under Column 3 were sufficiently characterized. However current information is needed on variability for growth under fattening strategies, milk production, or fiber production, considering the market opportunities to target. By ignoring Column 3, Table 5 shows fewer breeds with scanty information for which additional knowledge is needed (Column 2), provided the breeds in consideration still exist in pure stands. No information is available for only one indigenous sheep breed (the indigenous Kyrgyz Coarse-wool) and one synthetic sheep breed (Arkharo), in addition to all indigenous goats. The information contained in the country chapters summarizes the features of the breeds under a different economic context and many are outdated. There is a need for on-farm characterization under the current economic conditions and market context. This task could be insurmountable given the current funding scenarios and priorities of the countries, so that a quick and affordable methodology is needed to rapidly acquire the key information needed.

Table 5. Breeds that require different levels of characterization.

Country	Breeds with very marginal information available†	Breeds with fewer traits to characterize under current market context‡	Breeds still not characterized
Sheep			
Kazakhstan	*Semi-fine:* Kazakh Mutton-Wool (Kalchengil and Chuy), Tsigai	*Fine wool (f,g,m):* Kazakh Fine Wool , Northern and Southern Kazakhstan Merino	Kazakh Arkharo Merino
	Mutton Fat-tailed Coarse-wool: Kazakh Fat-tailed Semi-Coarse Wool, Edilbay, Sariarka Fat-tailed Coarse Wool	*Semi-fine (g,m):* Kazakh Mutton-Wool (Aksenger), Akjaik Mutton-wool, Degeress and all coarse wool indigenous breeds	
	Pelt breeds: Atirau	All pelt breeds (p,g,m)	
Kyrgyzstan	Indigenous Coarse-Wool	Kyrgyz Fine-Wool (f), Alay (g,m), Tien-Shan (g,m)	Indigenous Kyrgyz Coarse-Wool
Tajikistan	Pamir (Darvaz)	Gissar (g,m), Jaidara (g,m), and Tajik (g)	None
Turkmenistan	None	Sarajin (f,g,m) and Karakul (f,g,m)	None
Uzbekistan	Mutton-fat-wool synthetics	Gissar (g,m), Jaidara (g,m) and Karakul (p,g,m)	None
Azerbaijan	None	Balbass (g,m), Bozakh (g,m), Gala-Apsheron (g,m), Karabakh (g,m) and Merino (g,m)	None
Georgia	None	Tushetian (g,m) and Imeretian (g)	None
Armenia	None	Balbass (g,m), Mazekh (g,m), MCW Martunin (g,m), MCW Aragat (g,m) and Armenian crossbreed (g,m)	None
Goats			
Kazakhstan	Kazakh Black Cashmere (f) and Kazakh Mohair (f)	Kazakh Cashmere (f) and Kazakh Mohair (f)	Indigenous (Cashmere)
Kyrgyzstan	None	Kyrgyz Cashmere (f), and Kyrgyz Mohair (f)	Indigenous (Cashmere)
Tajikistan	None	Pamir Cashmere (f) and Tajik Mohair (f)	Indigenous (Cashmere)
Turkmenistan	None	Indigenous goats (f,g,m)	Indigenous
Uzbekistan	None	Indigenous goats (f,g,m)	Indigenous
Azerbaijan	Azerbaijan native	Indigenous goats (f,g,m)	Indigenous
Georgia	None	Megrelian (g,m) and Indigenous goats (f,g,m)	Indigenous
Armenia	Armenian native	Indigenous goats (f,g,m)	Indigenous

Source: Organized by the author from Chapters 2-9 of this volume.

Notes: † Characterization is needed based on careful assessment of available information.

‡ Growth under fattening schemes (g), milk production (m), fiber production (f), or pelt production (p) potentials, has not been measured adequately.

Breeds may have special attributes that have note yet been discovered. Variability for cashmere production has not been characterized thoroughly in the region and was recently the subject of attention of an excellent effort towards improving the livelihoods of resource-poor goat producers in Central Asia (Kerven 2007). Likewise, the possibility to look at variability for super fine wool or other attributes could be justified. Most sheep breeds and most goat breeds have not been evaluated specifically for their capacity for high lamb growth rates under different production scenarios, for instance using a system known in the region as the Nagul system: weaning animals in the high mountains with good pastures and fattening them in the plains, or ending the fattening with a pre-fattening period in the range. In all these cases the market opportunities should be carefully considered in the light of natural resource potentials to produce meat all over the region.

Risks to the Integrity of Genetic Resources

There is no doubt that the change to a new economic system after the end of the Soviet period has had a severe impact on the genetic diversity of small ruminants of the region, more so in sheep than in goats (Iñiguez 2005a). The population trends are now more stable and animal stocks, both sheep and goats, are on the increase with the sole exception of the sheep stocks of Kyrgyzstan that continue to decline, probably as a reflection of political instability and increasing poverty.

A quantitative assessment of the risks to genetic diversity has not been conducted in the region. The authors of the country chapters in this book provided a qualitative assessment based solely on their own experiences, mostly reflecting breed population trends coupled with the influence of crossbreeding. Except in a few cases, the national statistics concerning livestock numbers offer a compound estimate of domestic animal numbers by species, but not by breeds within species. This is because, as has already been pointed out, thorough and detailed censuses have not yet been conducted. Authors were asked to provide educated estimates of the breed populations taking into account the experiences and reports of people working with the different breeds. Therefore, the reader should bear in mind this caveat while using or interpreting the individual information reported on the breed populations. Nevertheless, it is felt that the assessments made by the authors do reflect reality to a large extent.

Save for a few exceptions, it is clear that the indigenous breeds of Central Asia and the Caucasus are not under risk, which is consistent with Iñiguez (2005a). While the author of the Armenian chapter claimed a degree of risk for the native breeds of Armenia as a result of a decline in their populations, it is felt that the threat, if any, will disappear in view of the rapid population recovery that is illustrated in Figure 3. Fortunately, in the remote case that the threat for these breeds is evident, a full reservoir of the same breeds, except the Mazekh, is available in Azerbaijan under no risk. The stability of the indigenous breeds just described contrasts with that for the synthetic breeds developed during Soviet times to address the specific needs of the Soviet market. Most are under evident threat due to crossbreeding with indigenous sheep, both in Central Asia and the Caucasus (Iñiguez 2005a).

Table 6 lists the breeds at risk, as reported by the chapter authors and as a result of further discussions with them.

Table 6. Threats to small ruminant diversity by country.

Country	Breeds at risk and reasons for this (in parenthesis)
Sheep	
Kazakhstan	*Semi-fine wool synthetics:* Akjaik, Kazakh Mutton-Wool, Kazakh Semi-Fine Wool, Degeress and Tsigai (crossbreeding with FTI) *Coarse/Semi-coarse wool synthetics:* Kazakh Fat-tailed Semi-coarse wool and Sariarka Fat-tailed coarse wool (crossbreeding with FTI)
Kyrgyzstan	*Semi-fine wool synthetics:* Tien-Shan (crossbreeding with FTI) ***Coarse/Semi-course wool synthetics**: **Alay** (crossbreeding with FTI)
Tajikistan	***Semi-fine wool synthetics*: Tajik** and **Pamir** (crossbreeding with FTI)
Turkmenistan	**Fine wool crossbreds** (crossbreeding with Sarajin)
Uzbekistan	**Semi-fine and coarse wool synthetics** (crossbreeding with FTI)
Azerbaijan	***Semi-fine wool synthetic:* Merino** (crossbreeding with FTI)
Georgia	***Fine wool synthetic:* Georgian F** (crossbreeding with FTI) ***Semi- fine wool synthetic:* New Georgian SF** (crossbreeding with FTI)
Armenia	*Course wool synthetics*: MCW Martunin and Aragat (crossbreeding)
Goats	
Kazakhstan	No risk
Kyrgyzstan	No risk
Tajikistan	**Synthetic Pamir (Mohair)**
Turkmenistan	No risk
Uzbekistan	Synthetic Cashmere and Mohair (indiscriminate crossbreeding)
Azerbaijan	No risk
Georgia	Megrelian (indiscriminate crossbreeding)
Armenia	No risk

Source: Organized by the author from Chapters 2-9 of this volume.
Notes: Breeds at extreme risk are listed in bold.
FTI: Fat-tailed indigenous sheep.

A common feature to all countries listed in Table 6 is that the indigenous diversity is not under risk. Table 6 also reflects the threats to synthetic breeds, with the exception of the fine wool breeds developed in Kazakhstan and Kyrgyzstan, which could be considered stable. Fine wool breeds have the potential to produce desirable quality wool if a well structured breeding plan is re-established under modern directions (Mueller 2000). Semi-fine wool breeds may still be used secondarily to produce wool, but more particularly to produce mutton. These breeds, in general, are large, well adapted to the environments they are found in, and could well satisfy a demand for mutton. However, without a well structured breeding plan it is likely that individual farmers could cross them with indigenous fat-tailed breeds to produce a more desirable animal. For coarse and semi-coarse wool synthetics, it is expected that they will be crossed, if this has not already been undertaken, with native fat-tailed breeds, unless a realistic breeding plan could also manage them with the maximum benefit to farmers.

Though the Karakul sheep is deemed to be under no risk, the color lines developed during Soviet times could face a risk if the market for pelts does not improve. It is hoped that Russia will offer some market for these pelts as the tradition of wearing Karakul garments is still well accepted there. Some steps to consider the conservation of this impressive diversity within a breed are needed.

There are no modern breeding plans available in the region to support a sustainable improvement either for fine wool or for other pure native breeds. In this context even fine wool and pure native breeds are under the threat of indiscriminate crossbreeding. Former Soviet plans used artificial insemination to facilitate massive genetic improvement. This practice is unsuitable for the current animal tenure structure. Currently farmers have no means to access improved animals and their flocks thrive together with other flocks in areas containing other breeds, which gives place to indiscriminate crossing. There is a need to develop breeding systems that are simple, but efficient, decentralized and owned by farmers. The road to the organization of breed associations is open and will require a tremendous effort; an undertaking where international collaborative research could have a special role, in particular in developing methods that are conducive to securing farmers' access to improved germplasm.

Although little is know about goats, in general, there seems to be no serious risks to them. The only risk cases reported for synthetic breeds are in Tajikistan and Uzbekistan, however the breeds deemed to be under risk are available, under no risk, in other, neighboring countries, so that this is not an issue of concern.

The Megrelian goat is the only native breed reported to be under some degree of threat due to a 70% decline in its population. This is the only goat milk breed in the region. Efforts should be made to make sure that the risk to this breed, particularly from crossbreeding with exotic dairy breeds that started in the Caucasus from the late 1990s, is reduced.

Goat producer (left) and animal breeders starting a community breeding plan for Mohair goats designed by ICARDA, fall 2007, Khujand, Sogd region, Tajikistan

The risks faced by synthetic breeds seem inevitable. The main reason is market driven. However, as indicated earlier, these breeds have been formed by crossing the native sheep with European breeds that are available nowadays in Europe, Australia and other countries as pure stands. Therefore under the event of extreme risk and erosion, there would always be gene reservoirs available elsewhere.

Conclusions

This analysis has summarized the main effects on small ruminant population and diversity emanating from the change to an economic system that occurred in the whole region for most of the 1990s. The change impacted several areas in relation to production. Tenure was privatized, while markets and the production support services (such as health and breeding programs) disintegrated. With other priorities to attend to, the governments of the countries did little with regard to improving the enabling conditions for these reforms so that they could be translated into economic growth and the improvement of livestock production. Large holding were fragmented into a myriad of smallholdings having each a small number of animals, all emerging under a production context which they were not prepared for. This has led to a tremendous decline in population numbers, more so in sheep than in goats, and a loss of diversity. Lack of income sources and unemployment were the determinants for farmers to start selling the products that were in more demand in the markets, mainly sheep meat. This preference determined that the impact on goats was minor relative to the impact on sheep.

Farmers learned in this process to work more carefully with market realities. However, with levels of productivity still low they are not sufficiently effective in targeting markets. Some countries have also realized the need to restock their populations. Starting in about 2000 the sheep populations, with the exception of the Kyrgyz Republic, started to increase. Goats started their increase in numbers earlier.

A total of 40 non repeated sheep breeds and 8 non repeated goat breeds have been identified in the region. These numbers include 27 synthetics and 13 native fat-tailed sheep and 4 synthetic and 4 native goats.

Most native genetic resources are stable and under no risk. In the extreme case of a breed in a given country, in particular in the Caucasus, being threatened there seems that potential gene reservoirs for the same breed are available in neighboring countries.

Synthetic breeds have undergone continuous cycles of crossbreeding with several European breeds and were developed under a market and production context different from that of today. In this production context most of these breeds could only provide meat and skins. These breeds are large in size. However, farmers are looking for traits and characteristics, other than size, which are found among indigenous fat-tailed animals that are preferred by consumers. Without crossbreeding programs, indiscriminant crossing is reported with native fat-tailed breeds thus posing a clear diversity risk. Nevertheless, should this crossing reach extremes, the synthetics, will always have gene reservoirs in the parental breeds kept elsewhere.

It is important to make the efforts needed to help farmers reorient their production systems, so they can better utilize the genetic resources available. Steps must also be taken to develop community-based and decentralized, breeding strategies which are owned by the farmers. This will help to provide them with access to sources of improved animals.

Market issues and opportunities should be monitored to assess, and eventually anticipate, changes in genetic resources, as well as to capitalize upon the possibilities available to increase the value of undervalued breeds by taking advantage of their adaptations, specific attributes, and the quality of their products.

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Kazakhstan

Chapter Two

Small Ruminant Breeds of Kazakhstan

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Introduction

Since ancient times, sheep and goats have played a major role in the lives of people living in rural Kazakhstan—the largest country in Central Asia. By 2004, there were about 10.8 million sheep and 1.5 million goats in the country. These were distributed across a vast rangeland territory that occupies over 150 million ha (FAO 2004). Both populations include indigenous and synthetic breeds developed during the Soviet Union.

The country's independence, following the fall of the Soviet regime, was accompanied by a tremendous decline in the number of livestock kept in Kazakhstan, particularly sheep. It also led to the dissolution of many services, and the loss of the country's breeding strategies and schemes. Such a decline posed a threat to the diversity of the country's livestock. However, plans are being made to restock. This occur as the country develops its agricultural sector, farmers progressively direct their production strategies towards market opportunities, research and educational institutions receive more attention, production supporting services emerge and credit is accessed by farmers.

This chapter attempts to describe small ruminant breed diversity in Kazakhstan, based on available information collected in the past. It will be noted that particular attention has been paid to the characterization of synthetic breeds. This is because information was gathered during the development of those breeds, as opposed to indigenous sheep which, with a few exceptions, were mainly maintained as part of household stocks.

The Economic Importance and Role of Sheep and Goats

Despite the tremendous decline observed in Kazakhstan's small ruminant populations, livestock production is a traditional activity which remains important to the economy of the country. In regions such as Almaty, Aktau, Atirau, East-Kazakhstan, Zhambul, Karaganda, Kizil Orda, Mangistau, Turgay, and South-Kazakhstan, sheep production is the most important of all livestock activities. In fact, sheep products account for nearly 20% of the country's total agricultural output and are the basis of the livelihoods of farmers in remote areas who have no other source of income.

By 1991, with a sheep population of 35.7 million head, mutton production in the country reached 270,000 tons per year and wool production 104,400 tons per year. After 1993 sheep production declined following privatization and structural reforms in the country. By 2003, Kazakhstan's sheep population had fallen to 1/3 of the population in 1991, while mutton production had fallen to 24,400 tons per year and wool production to 24,800 tons per year (Statistic Agency of the Republic of Kazakhstan 2003). Sheep production on State and collective farms disappeared. And, the emerging private farms were confronted by serious constraints which resulted in many of them being non-viable. Lack of markets for wool, low prices for the small ruminant products, the dissolution and decay of farm infrastructure, and a lack of effective and sufficient state support added to the complex problems producers faced.

In this context, Kazakhstan's newly emerging farms are unable to attain the production levels formerly seen in the country. The contribution of different types of farms to mutton and wool production in the country in 1997 is given in Table 1, from which it can be seen that most of the country's livestock is owned by individual households. These are also the least productive of the livestock producers in the country.

Table 1. Farm category contribution to mutton and wool production in 1997 (%).

Product	All farm categories	State agricultural enterprises	Peasant farms	Individual households
Mutton	100	6.4	4.8	88.8
Wool	100	8.4	9.2	82.4

Source: Statistic Agency of the Republic of Kazakhstan (2003).

Changes in the Population of Small Ruminants

The economic transition that followed the collapse of the Soviet Union had a negative impact upon the whole of Kazakhstan's small ruminant production sector. The number of sheep in the country fell from 34.6 million in 1992 to 9.6 million in 2000 (FAO 2000), one of the most spectacular declines in the history of the country. As a result, Kazakhstan ceased to be a leading wool-exporting nation. After 2000, numbers recovered to some extent, so that by 2003 the country's sheep population amounted to 12.1 million head (Ministry of Agriculture of Kazakhstan 2004).

The economic reforms of the period also severely affected the country's breeding structure, which was almost completely dismantled. At the start of 1990, there were 241 pedigree farms in Kazakhstan, holding 18,249,000 pedigree animals. By January 2000 the number of farms had fallen to 80, while the number of pedigree sheep held had fallen to only 474,000. By 2003, however, the number of pedigree sheep kept on these farms had risen to 652,200 head (Ministry of Agriculture of Kazakhstan 2004).

The Kazakh goat population had declined significantly even before the break-up of the Soviet Union. In fact, from 1955 to 1968, it fell from 2.7 million head to 488,800 head. Due to a government resolution passed in 1971, however, the goat population increased, reaching 983,000 animals by 1991. Most of these animals (89%) were managed by the private sector. Thus, when the country's collective farms and state farms were privatized after 1992, the reduction seen in the goat population was far less dramatic than it would have been if most of the animals had been kept by the public sector.

Table 2 provides data on the changes that have occurred in Kazakhstan's sheep and goat populations since 1913, as well as information concerning the number of different types of agricultural enterprises involved.

Table 2. Sheep and goat numbers, according to farm type (thousands).

Year	Total	Agricultural enterprises†	Individual (household) farms
1913	19,597.0	na	na
1916	18,364.1	na	na
1928	19,169.0	na	na
1934	2212.0	1696.0	616.0
1941	8132.2	6595.7	1536.5
1951	18,038.2	16,411.2	1627.0
1961	28,517.0	26,636.2	1880.8
1971	31,776.6	28,865.9	2910.7
1976	34,579.3	31,372.7	3206.6
1981	35,484.7	31,491.7	3993.0
1986	36,407.9	31,906.5	4501.4
1992	34,555.7	25,743.4	8812.3
1993	34,419.8	25,853.9	8565.9
1998	10,614.0	2150.0	8464.0
1999	9527.0	1500.0	8027.0
2000	9644.0	1250.0	8394.0

Sources: Diyarov (1963); Statistic Agency of the Republic of Kazakhstan (2003).
Notes: †Includes all forms of enterprises (i.e. State farms, stock companies, partnerships with limited liability, and peasant farms); na = data not available.

In 1935, fine wool breeds and crosses accounted for only 2% of the sheep population. However, by the beginning of the 1990s this situation had changed, thanks to the intensive selection and development of about 20 fine wool breeds, pedigree groups, and improved wool lines. It is estimated that before the Soviet Revolution coarse wool animals made up the majority (97%) of the sheep population. By 1986, fine and semi-fine wool sheep accounted for 58% of the country's sheep population. This situation deteriorated during the transition period following the fall of the Soviet Union. In 2001, the proportions of the different breeds were as follows: fine wool, 24%; semi-fine wool, 6%; coarse and semi-coarse, 57%; and Karakul, 13% (Satybaldin 2001).

No exact information is available concerning what proportion of the current sheep population is accounted for by different breeds. According to Ministry of Agriculture of Kazakhstan (2004), by 2003 the country's pedigree population (652,200 head) consisted of the following mix: 30% fine breeds, 28% semi fine breeds, 36% semi coarse and coarse breeds and 6% Karakul.

Small Ruminant Breeds, Distribution, and Threats to Diversity

There are 17 sheep breeds in Kazakhstan (Table 3): three purebred indigenous breeds, 12 synthetic breeds produced during the Soviet Union, and two imported breeds. These breeds can be categorized as follows:

- Five fine wool sheep breeds. These consist of one imported breed (the Australian Merino) and four synthetics: the Kazakh Fine Wool (KFW), Northern Kazakhstan Merino (NKM), Southern Kazakhstan Merino (SKM), and Kazakh Arkharo Merino.
- Six semi-fine wool breeds. These consist of one imported breed (the Hampshire) and five synthetics: the Kazakh Mutton-Wool, Akjaik, the Kazakh Semi-Fine (crossbred) wool, the Degeress and the Tsigai.
- Four semi-coarse and coarse sheep mutton-producing animals. These consist of two indigenous breeds (the Kazakh Fat-tailed Mutton Coarse Wool and the Edilbay) and two synthetics based on crosses between indigenous sheep (the Kazakh Fat-Tailed Semi-Coarse Wool and the Sariarka).
- Two pelt breeds: the indigenous Karakul and the Atirau (a synthetic based on crosses with indigenous sheep).

The synthetic breeds were created in several periods during the Soviet Union in general to produce more wool for the large Soviet market and also to supply the demand for meat. Local fat-tailed animals were crossed with rams from several European breeds and the crossbred progeny subjected to selection, or crossed again to another European breed to introduce in the synthetic a particular production attribute. In the case of goats only synthetics to produce cashmere or mohair were produced. Because interest was largely focused on synthetic development, the native breeds of Kazakhstan were not studied thoroughly and thus were neglected. The exception was the Karakul sheep which was the subject of selection in view of the high demand for pelts in the Soviet market.

Table 3. Sheep breeds of Kazakhstan: some salient features.

Breed	Breed type	Tail type	Fiber diameter (μ)
Fine wool breeds			
Kazakh Fine Wool (KFW)	Fine wool	Thin	19.2-22.0
Northern Kazakhstan Merino (NKM)	Fine wool	Thin	20.6-22.0
Southern Kazakhstan Merino (SKM)	Fine wool	Thin	19.2-22.0
Kazakh Arkharo Merino	Fine wool	Thin	na
Australian Merino	Fine wool	Thin	20.6-22.0
Semi-fine wool breeds			
Kazakh Mutton-Wool (KMW)	Semi-fine	Thin	23.5-26.4
Akjaik	Semi-fine	Thin	25.0-27.8
Kazakh Semi-Fine Wool	Semi-fine	Fat	25.0-27.8
Degeress	Semi-fine	Fat	26.4-32.7
Tsigai	Semi-fine	Thin	26.4-31.0
Hampshire	Semi fine	Thin	na
Mutton Fat-tailed Coarse Wool breeds			
Kazakh Fat-tailed Mutton Coarse Wool	Mutton	Fat	na
Kazakh Fat-tailed Mutton Semi-Coarse Wool	Mutton	Fat	na
Edilbay	Mutton	Fat	na
Sariarka Fat-tailed Coarse Wool	Mutton	Fat	na
Pelt breeds			na
Karakul	Pelt	Fat	na
Atirau	Pelt-meat	Fat	na

Source: Compiled by authors.
Note: na = not available.

The two main goat breeds in Kazakhstan are the Kazakh Cashmere (or coarse fiber) goat and the Kazakh Mohair (or Soviet Mohair) goat. There are also insignificant numbers of Mengrel Zaaneski goats in South-east Kazakhstan and Russian Mohair goats in West Kazakhstan.

Table 4 gives data showing the approximate distribution of sheep and goat breeds. It also shows the level of threat to genetic diversity in either case. The table does not include crossbred populations, and therefore total head numbers differ from those given in Table 2. Figures 1-10 also depicts the geographical distribution of sheep and goats.

Only synthetic breeds are thin-tailed, whereas all native sheep of the country are fat-tailed. In spite of their specialties, currently all sheep from Kazakhstan are used for meat production.

Table 4. Main sheep and goat breeds, population distribution and risk to genetic integrity.

Breed	Population	Distribution by Oblast	Risk to genetic integrity
Sheep breeds			
Fine wool (2,600,000 head)			
Kazakh Fine Wool (KFW)	1,590,000	Almaty Oblast	Low
Northern Kazakhstan Merino (NKM)	50,000	Northern Steppes	Low
Southern Kazakhstan Merino (SKM)	580,000	Zhambul, South Kazakhstan	Low
Kazakh Arkharo-Merino (AK)	260,000	Almaty Oblast Alpine mountain	Low
Australian Merino	120,000	Almaty Oblast	Low
Semi-Fine Wool (600,000 head)			
Kazakh Mutton-Wool (KMW)†	21,000	South, South-East	Low
Akjaik Mutton-Wool	220,000	West	Low
Kazakh Semi-Fine Wool	51,000	South-East	Low
Degeress	149,000	Almaty Oblast	Low
Tsigai	149,000	West	Low
Hampshire	10,000	South-East	Low
Mutton Fat-tailed Coarse Wool (6,100,100 head)			
Kazakh Fat-tailed Mutton Coarse Wool	4,870,000	All Zones of Kazakhstan	No
Kazakh Fat-tailed Semi-Coarse Wool‡	70,000	West Central Zone. Northeast, South East	Low
Edilbay	1,100,000	West, East and Central Semi deserts and arid steppes	No
Sariarka Fat-tailed Coarse Wool	60,100	Central Zone	Low
Pelt (1,620,000 head)			
Karakul, including Atirau	1,620,000	Deserts and Semi Deserts§	No
Goat breeds (1,500,000 head)			
Kazakh Down (Cashmere)	1,039,000	All Oblasts of Kazakhstan	No
Kazakh Mohair	450,000	North-East, South-East	Low
Russian Mohair	10,000	West-borders with Russian Federation	Low
Milk Goats	1000	South-East-within Almaty City	Low

Source: Compiled by authors using the FAO (2004) population estimates of 10.8 million sheep and 1.5 million goats.
Notes: †Aksenger, Kalchengil and Chuy; ‡ Kargali, Aktau and Bayis; §Deserts and semi deserts of South and South-East: Zhambul, South Kazakhstan, Kizil Orda, Atirau and Magnistau.

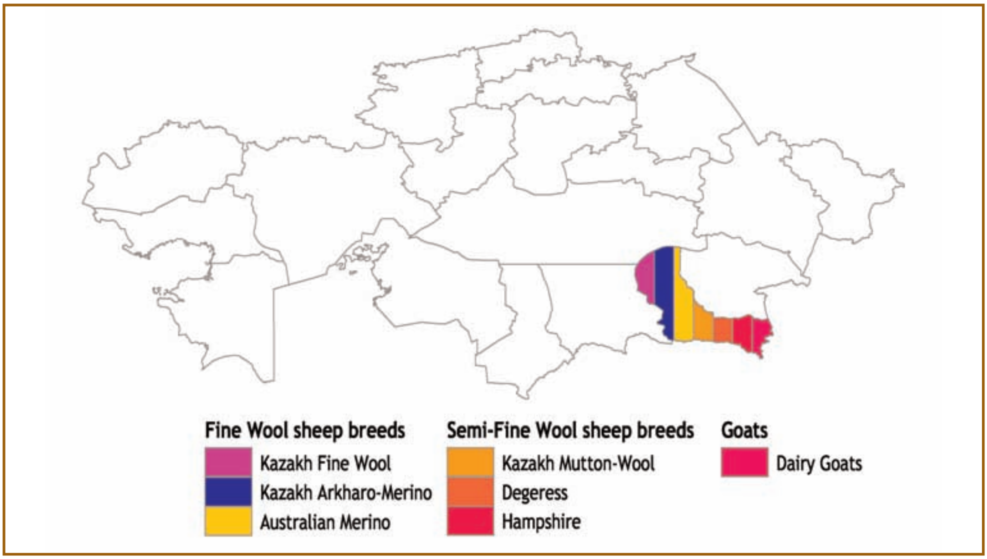

Figure 1. Geographical distribution of sheep and goat breeds in mostly available in the Almaty region (Oblast).
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.

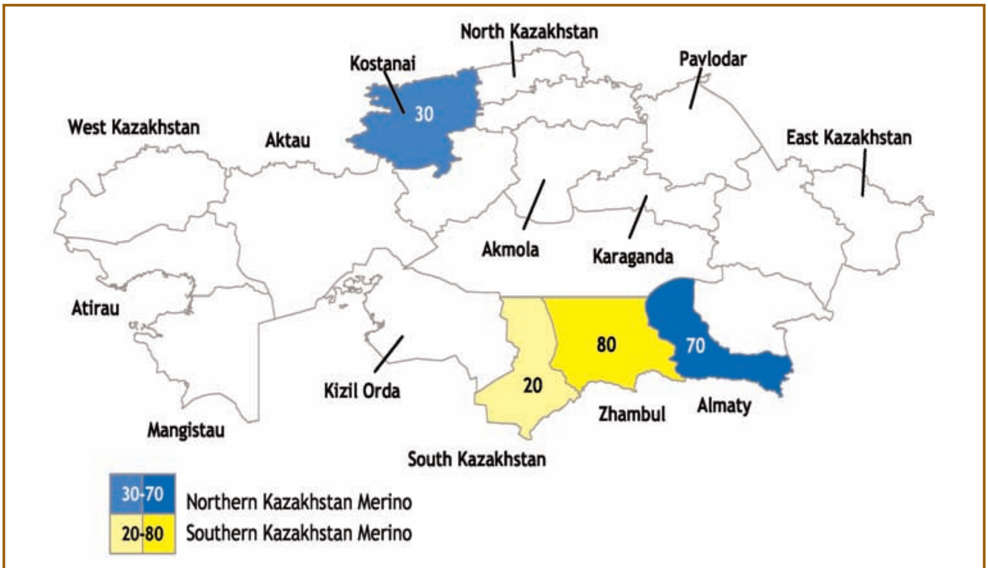

Figure 2. Geographical distribution of Fine Wool sheep breeds: Northern Kazakhstan Merino and Southern Kazakhstan Merino.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different regions of Kazakhstan.

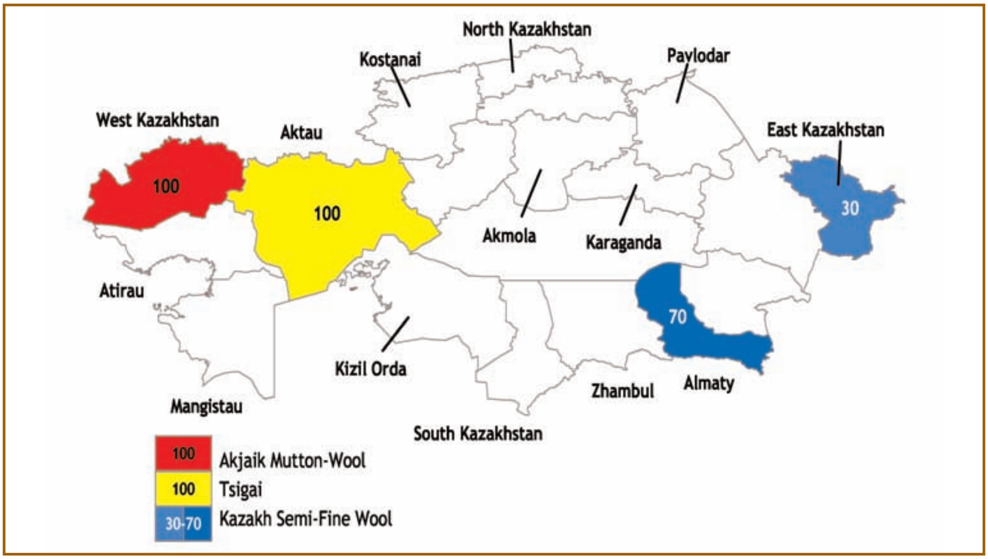

Figure 3. Geographical distribution of Semi-Fine Wool breeds: Kazakh Semi-Fine Wool, Akjaik Mutton-Wool and Tsigai.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different regions of Kazakhstan.

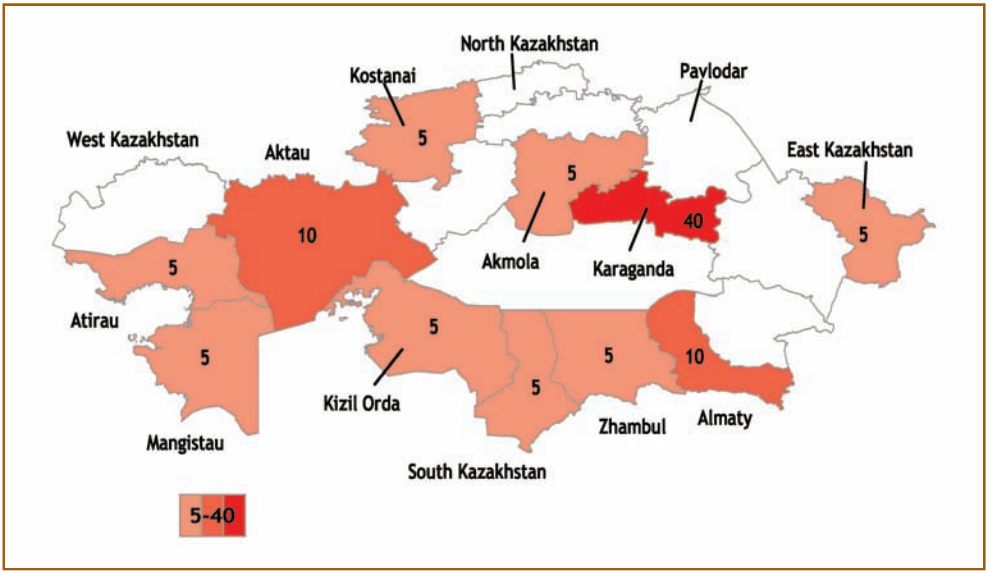

Figure 4. Geographical distribution of Kazakh Mutton Fat-tailed Coarse Wool.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kazakhstan.

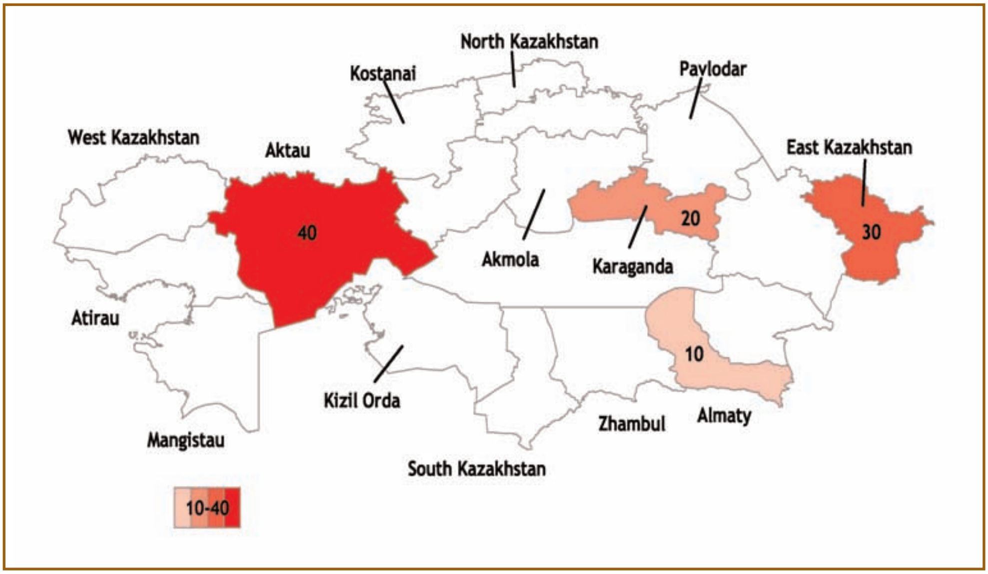

Figure 5. Geographical distribution of Kazakh Fat-Tailed Semi-Coarse Wool.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kazakhstan.

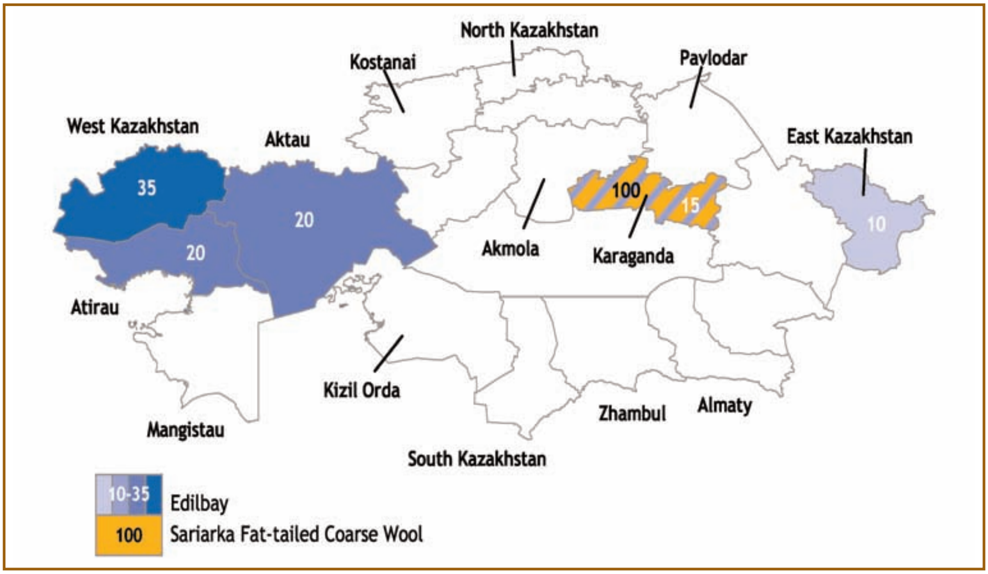

Figure 6. Geographical distribution of Mutton Fat-tailed Coarse Wool breeds: Edilbay and Sariarka.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different regions of Kazakhstan.

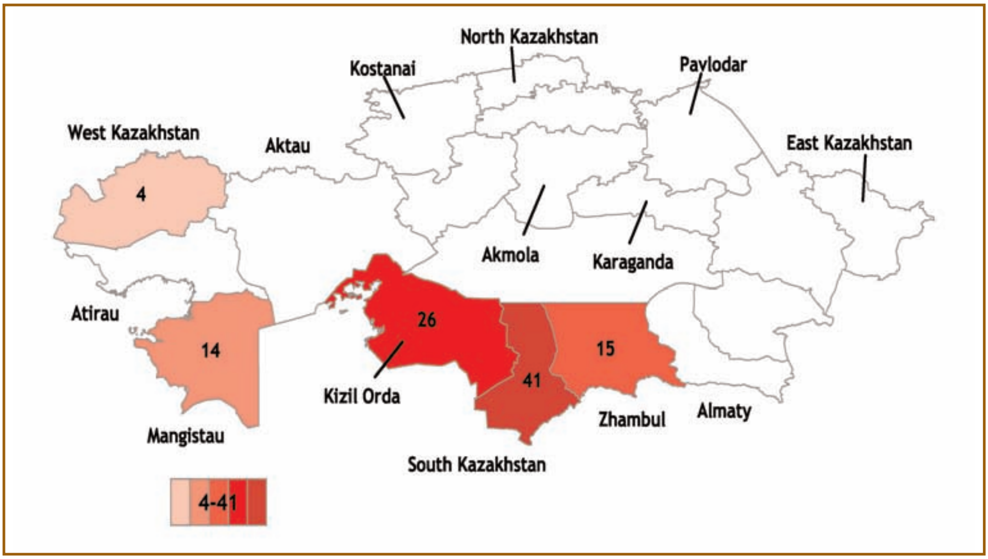

Figure 7. Geographical distribution of Karakul sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kazakhstan.

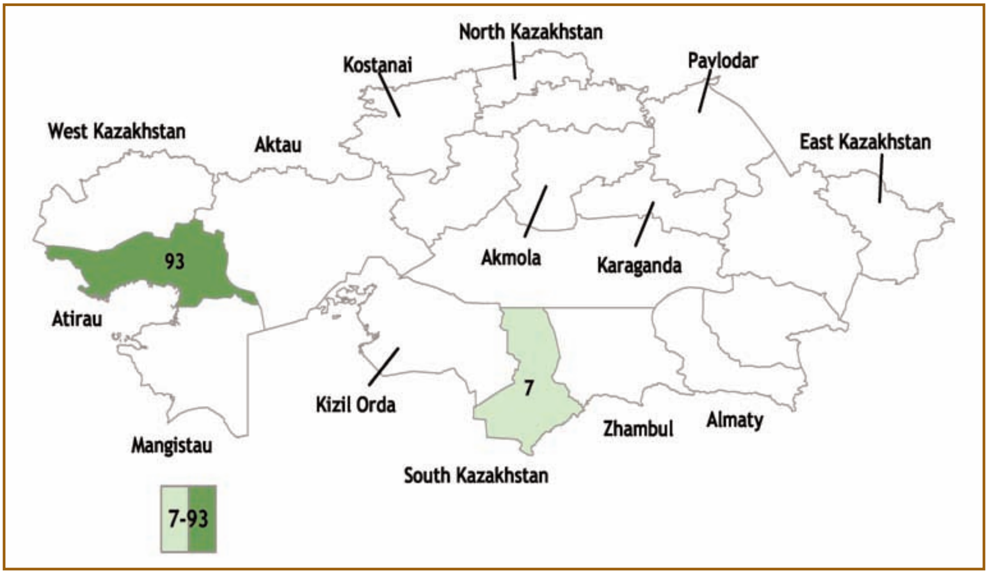

Figure 8. Geographical distribution of Atirau sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kazakhstan.

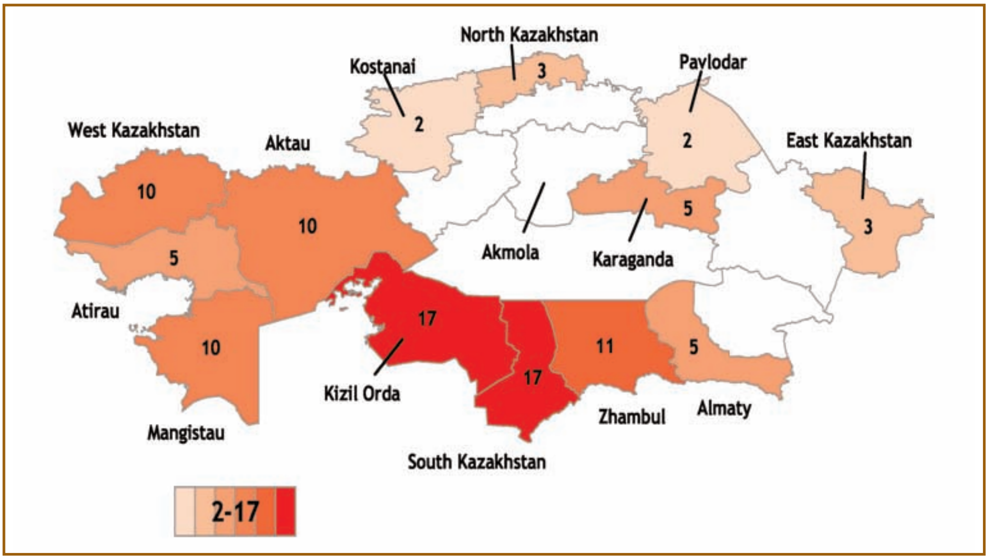

Figure 9. Geographical distribution of Kazakh Down-Cashmere goats.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kazakhstan.

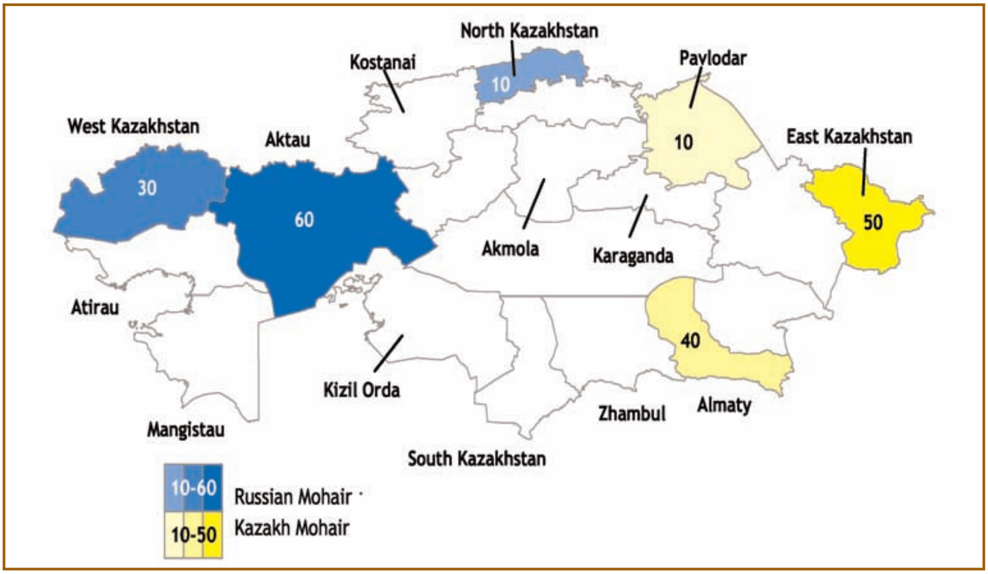

Figure 10. Geographical distribution of Kazakh Mohair goats, including that of the fewer Russian Mohair goats.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different regions of Kazakhstan.

Sheep and Goat Breeding Regions

Kazakhstan's territory covers 276 million ha, extending over 3000 km from west to east and over 1500 km from north to south. Four main agro-ecological areas can be distinguished: forest-steppes with 350-400 mm rainfall (a minor part of the country's area), steppes with 250-300 mm rainfall, semi-deserts with 160-220 mm rainfall and deserts with 100-160 mm rainfall. According to the State Committee on Statistics and Analysis of the Soviet Socialist Republic of Kazakhstan (1990), as of January 1, 1987, agricultural land in Kazakhstan covered 223 million ha, a major proportion of which (87%) consisted of rangelands. Desert and semi-desert zones cover 120 million ha of the Republic's territory, accounting for 62% of total rangeland resources. By 2003 the amount of agricultural land available in the country had fallen to 80.4 million ha, of which hayland and rangeland accounted for 56.4 million ha (70%; Statistic Agency of the Republic of Kazakhstan 2003).

In general the diets of sheep and goats are based on grazing rangelands. During the winter, 70% of the animals' diet derives from range pastures, while the remaining 30% is accounted for by the provision of supplements in the form of hay, straw, and concentrates, with the exception of Karakul sheep that is reared on rangelands year-round. The length of time for which supplements are provided varies according to the climatic zones in the case of sheep breeding (ranging from 60 to 150 days). Milk goats are given supplementary feed for 180 days.

In Kazakhstan, different types of rangelands and their uses are defined by the seasons. Summer ranges amount to 50.9 million ha, while spring–fall ranges consist of 76.1 million ha and winter ranges 24.8 million ha. In pre-Soviet times this diversity allowed for seasonal grazing and a nomadic life style.

Unfavorable climatic conditions caused by cold winters and droughts severely affect the productivity of rangelands and animals. Table 5 summarizes the main ecosystems associated with the different breeds of sheep and goats described later in this chapter.

Table 5. Breeds and the main features of associated ecosystem.

Breeds	Brief description of the ecosystem associated with each breed
Sheep	
Kazakhstan Fine Wool (KFW)	Most of this breed's territory consists of spring-fall and summer rangelands in foothills and steppe areas of the Alatau Mountains. Summer ranges (Ush-Konir and Alayak Sarisay) are located at 2134-3500 m a.s.l. Climate is moderately warm, with an average annual temperature of 7°C and annual rainfall of 351 mm. The soils are Chernozem and vegetation cover is diverse. Animals can be grazed up to 130 days and have the Kargali River as their main water source. Semi-sandy and sandy zones, formerly used as winter ranges are currently unused due to their remote location from villages (100-200 km) and high transportation costs. In winter-spring sheep are reared under supplements for 4 months.

Breeds	Brief description of the ecosystem associated with each breed
Northern Kazakhstan Merino (NKM)	Kept in the northeast arid steppe and semi-desert zones with chestnut soils. Climate is continental and temperature fluctuates greatly. During summer the temperature rises to 35-40ºC, in winter it falls to -45 to -50ºC. Annual rainfall in the arid steppes is 200-250 mm, and 170-190 mm in semi-desert. Winters are long, snow lies 30-40 cm deep and lasts for 150-180 days, during which animals cannot graze. Snows cover melts in early April. Dust storms are common in summer, occurring on more than 70 days per year. Soils in the area are subject to wind erosion. Droughts and dry winds are frequent. The vegetation available for use as fodder consists of feather grass (*Stipa pennata*), wormwood (*Artemisia* spp.), as well as a number of different grasses. Vegetation cover is poor, particularly in semi-desert areas. Hay collected per ha from the range amounts to 200-300 kg/year in arid steppes and to 100-150 kg/year in semi-deserts. In winter and spring in these areas sheep are provided with feed supplements for 5 months.
Southern Kazakhstan Merino (SKM)	Kept in desert and semi-desert foothills and mountains in the Alatau range. Annual rainfall in the desert zone is 180-200 mm, but can be as low as 80-100 mm in dry years. In the mountainous zones more than 1000 mm of rain falls per year on average. Summers are hot (up to 38-45ºC) and winters are cold (-30 to -35ºC). Water resources are poor. Year-round grazing is possible. In winter and spring sheep are provided with feed supplements for 3 months.
Australian Merino	Kept in semi-desert steppe and slightly hilly areas supporting dry-farming agriculture and the harvesting of hay from rangelands. Precipitation averages 250-350 mm per year. 75-80% of sheep feed is provided by the ranges, while the remaining 20-25% is provided by fodder produced by the farm for winter feeding. Summers are hot and dry, with temperatures reaching 42ºC. Winters are cold, with temperatures as low as -35ºC and heavy snowfalls. Springs are cool, with unstable weather and recurrent cold days in March and April. Water sources are sufficient. During summer (July-August till early September) sheep graze the mountain rangelands of Zailiyskiy Alatau (2500 m a.s.l.). In winter and spring, sheep in these areas are given feed supplements for 5 months.
Kazakh Mutton-Wool (KMW)	Found in areas with a sharp continental climate. The average annual air temperature is 18.8ºC, ranging from a maximum of 42ºC to a minimum of -39ºC. Average annual rainfall is 249 mm, much of which falls during spring and autumn; maximum rainfall is received in April, and minimum in January. In winter sheep in these areas are provided with feed supplements for 3 months.
Akjaik	Kept on the arid steppes of Western Kazakhstan, which have a continental climate and dry cold winters. Summers are hot and dry. The average temperature of the hottest month (July) is 24ºC (max 41.8ºC). Winters last from November until April, with a snow cover that lasts for 130 days. January is the coldest month, with average temperature of minus 24.8ºC (min -40.3ºC). Dry winds area common in summer and snowstorms are common in winter.

Breeds	Brief description of the ecosystem associated with each breed
	The landscape includes steppes and hills. Soils are chestnut, with heavy clay and salt contents. Vegetation cover is diverse. River depressions are covered with meadow vegetation. Average annual rainfall ranges from 140 to 360 mm. In winter and spring, sheep in these areas are provided with feed supplements for 4 months.
Edilbay	Kept in semi desert and arid steppes with up to 200 mm rainfall. This breed is grazed on rangeland all year. Summers in these areas are hot (up to 35ºC), and winters are cold (-40ºC). Water supplies are insufficient. In some areas, the water available has a high salinity. Fat-tailed sheep, including Edilbay, are well adapted to grazing local grasses and being driven to distant seasonal rangelands. In winter, sheep in these areas are provided with feed supplements for 3 months.
Karakul (including Atirau)	Found in the desert and semi-desert zones of the Republic. Rainfall in the South is 130-150 mm and in the North 160-2,170 mm. These hot and dry deserts and semi-deserts allow sheep to be grazed on rangelands all year round. Farmers require only enough fodder reserves to supply their sheep for 50 days during the winter. Summers are very hot and dry, with temperatures reaching as high as 47°C. In the South of the Republic winters are warm, with average temperatures ranging from 8°C to 12°C. In the north winters are cold, with temperatures falling to -36°C. Natural and artesian wells are the main sources of water for the sheep kept in these areas.
Goats	
Kazakh Cashmere	Found in all climatic and feeding zones of Kazakhstan but principally in the desert semi desert steppes, mountains, and Alpine areas. In winter goats are provided with feed supplements for 3 months.
Kazakh Mohair	Found in the steppes of Northwest Kazakhstan, which have a continental climate. Temperatures average 21.9°C in summer and -17.9°C in winter. The maximum temperature is 49.2°C. Annual rainfall averages 272 mm. Also found in semi-desert areas, where average monthly temperatures range from 23°C to 25°C in summer and from -9°C to -13°C in winter, the maximum and minimum temperatures reached are 42°C and -37°C, respectively. Average annual rainfall in these areas is 200 mm. In addition, Mohair goats are found in mountain areas with average summer and winter temperatures of 15°C and -13°C, with a max and min of 30°C and -33°C, respectively. In these regions annual rainfall ranges from 450-900 mm. In winter and spring, these goats are provided with supplements for 4 months.

Source: Compiled by the authors.

Market Demand for Sheep and Goat Products

Table 6 summarizes the current demand for the products of Kazakhstan's small ruminants.

Table 6. General estimates of the market demand for sheep and goat products.

Breed	Wool or Fiber	Meat	Skin	Pelts	Milk
Sheep					
Kazakhstan Fine Wool (KFW)	H	M	M	None	None
Northern Kazakhstan Merino (NKM)	H	H	M	None	None
Southern Kazakhstan Merino (SKM)	H	H	M	None	None
Kazakh Arkharo-Merino	H	H	M	None	None
Australian Merino†	H	M	M	None	None
Kazakh Mutton-Wool (KMW)	M	H	M	None	None
Akjaik	M	M	None	None	None
Degeress	L	H	Unknown	None	None
Kazakh Mutton Fat-tailed Coarse Wool	L	H	M	None	None
Kazakh Fat-tailed Semi Coarse Wool	M	H	M	None	None
Edilbay	L	H	M	None	None
Sariarka Fat-tailed Coarse Wool	M	H	H	None	None
Karakul	L	H	L	M	None
Atirau	L	M	L	M	None
Goats					
Kazakh Down (Cashmere)	H	M	L	None	None
Kazakh Mohair	M	M	L	None	None
Milk Goats	None	M	H	None	H

Source: Compiled by the authors.
Notes: †Demand for Merino breeding sires is high; H = high, M = medium; L = low.

With regard to wool the demand is depressed in general, with the exception of the wool produced by pedigree animals. Meat is traditionally preferred in all Kazakhstan where a high per capita consumption of meat is recorded.

Sheep products

Because the wool market is depressed, wool quality has declined in Kazakhstan and market channels have become informal. As a result, buyers are able to pay producers low prices. The prospects for the wool industry are low (1) because the wool produced cannot compete on the international market unless a niche is found for such a poor quality and variable product; and (2) because of scale economy. Only farmers with large flocks will be able to make a profit. Even if exceptional prices are available for the wool produced (a circumstance which is not likely to occur) profits per flock will be low because farmers only have small flocks.

The prospects for mutton and lamb production, on the other hand, are good. Demand leans towards fat-tailed breeds because the producers prefer them, which explains an apparent increase of fat-tailed landraces in the country relative to fine wool sheep.

There will always be a demand for sheepskin in Kazakhstan because, traditionally, they are used to make clothing. If sheepskin clothes could be produced cheaply, making use of local labor, such products would have a market among the local population. Sheepskin production could therefore be used to boost farmers' incomes.

The future of Kazakhstan's Karakul industry is similar to that of other Karakul-producing countries affected by the dissolution of the large Soviet market, as the rapid saturation of the market and issues of animal rights are increasingly interfering with exports.

Goat products

Of all Kazakhstan's goat products, uniform mohair has the highest domestic demand. This is stimulating an increase in the Kazakh Mohair goat population. At present Kazakhstan is producing sufficient amounts of good quality mohair and is exporting it to neighboring countries, particularly Russia and China.

The demand for cashmere is increasing among foreign commercial importers, especially China. The world market price for combed cashmere is US$15-18/kg, depending on how heavily the fleece is contaminated with coarse fibers. In Kazakhstan, most goats are shorn – which provides a fleece containing a mix of fibers that has a much lower market value, about US$1-1.2/kg. Combing instead of shearing allows about 250-300 g cashmere to be separated from the fleece of each Kazakh Cashmere goat.

Goat milk is in high demand in the large cities of Kazakhstan. Over the past 5-6 years, pure breed and crossbred Saanen goats have been introduced to Kazakhstan to improve milk production. However, there are not yet enough of these animals to satisfy more than the demands exerted by the suburbs of Almaty. There is also a substantial demand for goat meat, which is commonly eaten in Kazakhstan.

The skin of Kazakh Cashmere goats is good for making boots and shoes, while the skins of Kazakh Mohair goats slaughtered in the autumn/winter are good for making fur-coats.

Current Breeding Plans

The dissolution of the Soviet Union was paralleled by the dissolution of breeding schemes in Kazakhstan, as such schemes became ineffective. Some structured breeding continues, under Government control, for the most important synthetic breeds. However, these efforts do not effectively address the demands currently being exerted by the market. Nor do they address the requirements of the tenure structure of the livestock sector. Markets are drifting, and the demand for traditional products, particularly wool is minimal. With lack of competitiveness and a tenure structure based upon small rather than large flocks, breeding plans need to be reviewed in light of new production priorities.

Table 7 summarizes the breeding units currently operating in Kazakhstan, showing the number of animals under performance and/or genealogical control and the institutions responsible for the breeding program.

After 2000, the Government of Kazakhstan begun to implement some measures leading to the restocking of sheep populations. This has translated into an improvement of the situation following the fall of the Soviet Union.

Responsibilities for breeding are concentrated in 3 institutions: in the Almaty area the Kazakh Technological Research Institute of Sheep Breeding, in the north the Northern Kazakhstan Livestock Production Research Institute and in the south the Kazakh Research Institute of Karakul Sheep Breeding.

Table 7. Sheep and goat breeds under genetic control and improvement.

Breed	Breeding unit	Animals controlled	Institute responsible	Location
Sheep				
Kazakh Fine Wool	Minbaevo PF			
(KFW)	Aldabergenov PF	45,000	KTRISB	Almaty
Northern Kazakhstan	Beskaragai PP,	7000	KTRISB	Almaty
Merino (NKM)	Sulukol PP and Karakol PF	4000	NKLPRI	Bishkul
Southern Kazakhstan	Merken PP, Kuyluk PP			
Merino (SKM)	and Akbulak PP	20,000	KTRISB	Almaty
Australian Merino	Minbaevo PF	183	KTRISB	Almaty
Kazakh Mutton-	Kalchengil PF and Bokin PF	5000	KTRISB	Almaty
Wool- Aksenger	Aksenger PF	3500	KTRISB	Almaty
Akjaik	40th Anniversary of Kazakhstan PP	9200	KTRISB	Almaty
Edilbay	Birlik JSF and Suyundik JSF	10,000	KTRISB	Almaty
Karakul	Birlik, Akdala	53,000	KRIKSB	Shymkent
Atirau	KRIKSB	3000	KRIKSB	Shymkent
Goats				
Cashmere goats	Private farms in West Kazakhstan	480 (crosses)	KTRISB	Almaty
	Private farms in Almaty Province	230	KTRISB	Almaty
	Private farms in Enbekshy-Kazakh	350	KTRISB	Almaty
Mohair goats	Private farms in Abai, East Kazakhstan	750	KTRISB	Almaty
	Private farms in Kokpetinskiy	500	KTRISB	Almaty
	Private farms in Almaty	650	KTRISB	Almaty
Dairy goats	Private farms in Kok-Jarma and, Almaty	250 (crosses)	KTRISB	Almaty

Source: Compiled by authors.
Notes: PP = Pedigree Plant; PF = Pedigree Farm, JSF = Joint Stock Farm (farm with limited liability).
KTRISB: Kazakh Technological Research Institute of Sheep Breeding.
NKLPRI: Northern Kazakhstan Livestock Production Research Institute.
KRIKSB: Kazakh Research Institute of Karakul Sheep Breeding.

Sheep Breed Characterization

Fine Wool Breeds

The fine wool sheep found in Kazakhstan consist of four synthetic breeds developed during the Soviet Union and one imported breed: (1) the Kazakh Fine Wool (KFW); (2) the Northern Kazakhstan Merino (NKM); (3) the Southern Kazakhstan Merino (SKM); (4) the Kazakh Arkharo-Merino (AK); and (5) the imported Australian Merino sheep. The number of fine wool sheep in the country amounts to 2.6 million head (Table 4). All the fine wool breeds with exception of the Kazakh Arkharo-Merino (AK) are described in this chapter because of scanty information available concerning this breed.

Kazakh Arkharo-Merino ram
Source: Courtesy of Dr. Liba Brent

Kazakh Arkharo-Merino ewe
Source: Courtesy of Dr. Liba Brent

The Kazakh Fine Wool Sheep

In 1992 there were 4.2 million head of Kazakh Fine Wool (KFW) sheep in Kazakhstan. By 1995, numbers had fallen to 3.1 million head. And by 2004 the population, 90% of which was owned by private farmers, had declined to about 1.6 million head. Most KFW sheep are found in the Almaty Region and the South-East of Kazakhstan (Table 4). Only 10% of the national flock, about 200,000 animals, is managed by large cooperatives and state enterprises.

Brief account of the development and improvement of the breed

The KFW sheep was developed by crossbreeding native fat-tailed ewes with fine wool Precoz sires. The breed was intended for use in the Southeast of Kazakhstan. The flock was closed in 1931; selection was then undertaken using F2s with a uniformly fine and semi-fine wool. The best ewes were mated to best rams.

In 1946 the KFW breed was released as Kazakhstan's first fine wool, dual purpose breed. The breeders involved in its development were led by Dr. Vladimir A. Balmont. The breed was developed at the Minbaevo Experimental Farm under the control of the Kazakh Technological Research Institute of Sheep Breeding (KTRISB).

Management

Table 8 summarizes the sheep management system followed at the Minbaevo pedigree farm. Currently, due to the disruption of seasonal grazing after the dissolution of cooperative and State farms following the fall of the Soviet Union, most animals are grazed around the villages and settelments for most of the year which is leading to serious overgrazing and land degradation.

Table 8. Management calendar of Kazakh Fine Wool sheep at Minbaevo pedigree farm.

Events and seasons	**Months**											
	D	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating												
Lambing												
Weaning												
Shearing												
Grazing SuR												
Grazing stubbles												
Grazing FR												
Grazing WiR												
Grazing SpR												
Seasons	Winter			Spring			Summer			Fall		

Source: Compiled by authors.
Notes: SuR = Summer range, WiR = Winter range, and SpR = Spring range; FR = Fall range.

In summer the animals are grazed on the mountain ranges, which have sufficient fodder and water resources. During the early fall, they are grazed on corn and cereal stubbles and on *Artemisia* ranges, where satisfactory fodder is also available. From November to March *Artemisia* winter ranges are used, and additional hay and feed concentrates are provided during critical days of snow cover. This is clearly a fodder-deficient period. From April to May the flocks graze on spring ephemerals ranges, which have abundant Gramineae vegetation.

Appearance

Kazakh fine wool sheep has a large frame, a fact which is reflected in its heavy body weight. Individuals are broad with a strong neck and wide chest. Their backs are straight, and their haunches well shaped. The head is of a regular size. About 30% of rams have a slightly roman profile. Rams and ewes are mainly polled: only 15% of rams and 8% of ewes have horns. The fleece, ears, head, and limbs are white.

Kazakh Fine Wool ram

Kazakh Fine Wool ewe

Body measurements

The body measurements of adult the Kazakh Fine Wool sheep, which is a large breed, are shown in Table 9.

Table 9. Body measurements (cm) of Kazakh Fine Wool sheep.

Trait	3-year-old rams (n=16)	4-year-old ewes (n=125)
Height at withers	85	70
Diagonal body length	86	75
Chest girth	114	97
Metacarpus girth	12	8

Source: Seitpan (1998).

Body weights, growth and carcass traits

At Minbaevo Experimental Farm, during the autumn, 5.5-year old ewes were found to weigh an average of 65 kg, while 3.5- to 5-year old rams weigh 114-122 kg. Average birth weights were recorded as 3.5-5.0 kg. Yearling ewes weighed 42-45 kg and 1.5-year-old ewes 51-55 kg. Animals of this breed are characterized by early maturity: at weaning (4-months-old) ram lambs weigh 32-39 kg and ewe lambs weigh 30-32 kg (Seitpan 1998).

Some information on the growth of this breed is provided in Table 10. Weaning occurs at 4 months of age. Pre-weaning weight gain rates have been recorded as 234 g/d for ram lambs and 208 g/d for ewe lambs, the corresponding rates from weaning to the age of one year were 96 g/d for rams and 68 g/d for ewes (Seitpan 1998).

Table 10. Body weights of Kazakh Fine Wool sheep (Mean±Standard error).

	Body weight	
Age	Rams (n=76)	Ewes (n=88)
At birth	4.4±0.04	3.9±0.03
At weaning (4 months)	32.5±0.30	28.9±0.30
1 year	54.0±0.40	42.0±0.40

Source: Seitpan (1998).

Under the conditions found at Kastek Batyr pedigree farm, ram lambs from the Almaty Region raised for 102 days on the range (after they had been weaned) gained 153 g/d in average (range 145 to 160 g/d). Two months later, under barn fattening conditions, they gained an average of 239 g/d (range 213 to 260 g/d) (Kasenov *et al*. 1985).

The carcass yield of mature castrated rams in the fall was 56.7%, while that of 5-months-old rams 52.9% (Tolubaev 1965).

Reproductive performance and milk production
No information is available on the fertility of this breed. Recent records indicate that prolificacy is high, ranging from 130% to 140%; however, this information needs to be validated. Animals are usually able to mate for the first time at around 14-16 months. In general, survival rates are high. In different lines, survival from birth to weaning has been found to range from 95.7 to 98.6%, while survival from weaning to 1-year has been found to range from 86.3 to 88.2% (Kasenov *et al*. 1985).

Researchers have estimated milk production over 100 days of lactation at the Kastek Batyr pedigree farm by weighing lambs before and after suckling and comparing the differences. Milk yield varied from 109.7 to 131.8 kg. The milk needed per kg weight gain in a lamb was 2.96-3.79 kg (Kasenov *et al*. 1985).

Wool production
Average fleece weight ranges from 10 kg to 14 kg for rams and from 4.0 kg to 4.5 kg for ewes. Two-year-old ewes produce 3.5-4.0 kg of greasy wool with an average staple length of 9-10.5 cm and a fiber diameter of 21 to 24 µm (Nartbayev *et al*. 2001). In elite flocks the fleece weight of adult rams and ewes (3.5-5 years of age) ranges from 12-14 kg and 5.0-6.0 kg, respectively. The average greasy fleece weight of flocks has been found to be 4.0-4.5 kg, and clean fleece weight has been measured as 2.0-2.2 kg (Terentyev *et al.* 2003). Table 11 provides data on wool yields at different ages.

Table 11. Wool traits of Kazakh Fine Wool sheep.

Sex and age	Wool weight (kg)	Average fiber diameter (microns)	Length of fleece (cm)
Ewes			
First shearing (12 months) (n=6)	3.5-5.0	20-22	8-9
3-4 years (n=6)	7.0-8.0	21-24	9-12
Rams			
First shearing (12 months) (n=6)	4.5-9.0	22-23	9-12
3-4 years (n=6)	10.5-15.0	22-25	10-13

Source: Terentyev *et al.* (2003).

Genetic and phenotypic parameter estimates
The heritability and phenotypic correlations of selected traits were calculated for four pedigree lines at Minbaevo pedigree farm (Spivakov 1999) and for three pedigree lines at Kastek Batyr pedigree farm (Tokpaev 1999). Results based on a very small number of observations are shown in Tables 12 and 13; however, few conclusive statements can be made based on these.

Table 12. Heritability estimates for wool traits in Kazakh Fine Wool sheep.

	Minbaevo PF (Spivakov 1999)		Kastek Batyr PF (Tokpaev 1999)	
Trait	h^2	n	h^2	n
Fleece weight	0.22-0.43	42-75	0.66-0.66	61-118
Staple length	0.13-0.37	42-75	0.49-0.67	61-118
Body weight	0.09-0.20	42-75	0.36-0.49	61-118

Note: Heritabilities were estimated from daughter-dam regression.

Table 13. Phenotypic correlation for Kazakh Fine Wool sheep.

Traits involved	Correlation	n
Body weight and fleece weight	0.15-0.38	58-114
Staple length and fleece weight	0.16-0.32	58-114

Sources: Spivakov (1999); Tokpaev (1999).

Current breeding structure

The Kazakh Fine Wool breed is the most numerous breed of fine wool sheep in Kazakhstan. Within the last 3-4 years in the Almaty Region the population has stabilized at just under 1.6 million animals (Table 4). This breed is still being bred successfully in large cooperatives and small private farms, and is still rendering profits. This is especially true with regard to lamb production, because of the breed's prolificacy and early maturity. The best pedigree Kazakh Fine Wool flocks are managed at the Minbaevo pedigree farm, the Kastek Batyr pedigree farm and the Sarybulakskiy pedigree plant.

Scientists from KTRISB supervise and participate in the breeding plans being undertaken at Minbaevo, Kastek Batyr, and Sarybulak, as well as in those undertaken by the Aldabergenov Agrocompany in the Almaty Region. These farms produce pedigree ram lambs, which are widely used to influence breeding efforts.

The Northern Kazakh Merino Sheep

Northern Kazakh Merino (NKM) is the most productive fine wool sheep breed kept in Kazakhstan. They produce a fine, white merino-type wool. The breed was developed for Northeast Kazakhstan, which has a harsh climate (see Table 5). Although there are few purebred NKM sheep in the country (approximately 50,000 head, Table 4), the rams of this breed are extensively used in improvement efforts. This is because the breed produces high levels of wool, good quality mutton, and is adapted to the conditions found in Pavlodar, Semipalatinsk, and other regions of North and Northeast Kazakhstan.

Brief account of the development and improvement of the breed

Northern Kazakhstan Merino sheep were developed by crossing New-Caucasus and Mazayevsk Merino sheep, imported into the Irtish river valley at the beginning of the 20th century. These were then crossbred with sires of different breeds, including local coarse wool Ramboulliet (in 1933), Ascanian (1934), Altay (1947), Ascania-Caucasus (1950), and Groznensky rams (1957). The new breed was released in 1976 with two bloodlines: the Beskaraga and the Sulukol.

This breed is considered a dual purpose fine wool and mutton breed. The main difference between the Northern Kazakhstan Merino sheep and the other dual purpose fine wool breeds used elsewhere in the country is the fact that the breed can adapt to the environmental and climatic conditions found in Northeast Kazakhstan. The animals are not only able to graze and make good use of the arid-steppe rangelands of northeast Kazakhstan in the summer, they can also be managed in pens and provided with supplemental feed during the severe winters experienced in that area.

Management

Table 14 contains brief details of the management system used with this breed.

Table 14. Management calendar of Northern Kazakhstan Merino sheep.

	Months											
Events and seasons	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating											■	■
Lambing				■	■							
Weaning									■	■		
Shearing						■						
Grazing† SuR							■	■	■			
Grazing† stubbles											■	■
Grazing† FR										■	■	■
Grazing† WiR	■	■	■									
Grazing† SpR				■	■	■						
Stall feeding			■	■	■							
Seasons	Winter			Spring			Summer			Fall		

Source: Compiled by authors.
Notes: † Grazing on ranges near the settlements.
SuR = Summer range, WiR = Winter range, and SpR = Spring range; FR = Fall range.

Appearance

Northern Kazakhstan Merinos are large, with a wide and deep body. Most animals have a moderate number of skin folds. Ewes are polled and almost all rams are horned. The wool produced is white and fine. The skin folds of ewes are small, and mainly take the form of an apron on the chest. Sires have one or two deep neck folds or three incomplete neck folds. Animals are active and good-tempered.

Northern Kazakh Merino ram

Northern Kazakh Merino ewes

Body measurements

Table 15 provides data on the body measurements for this breed.

Table 15. Body measurement (cm) of Northern Kazakhstan Merino at 'Beskaragai' breeding plant.

Trait	3.5 years old ewes (n=15)
Height at withers	68.4
Diagonal length of body	80.5
Chest depth	34.0
Chest girth	105.2
Width at sacrum	25.4

Source: Nartbayev *et al.* (1989).

Body weights, growth and carcass traits

Birth weight ranges from 3.0 to 4.5 kg in ewe lambs and 3.5-5 kg in ram lambs (Asilbekova 2001). The body weights for different ages during two seasons are shown in Table 16.

Table 16. Body weight of Northern Kazakhstan Merino females of different ages.

	Sheep born in 1962 (n=300)			Sheep born in 1972 (n=330)		
Age	Weight (kg)	SD (kg)	CV (%)	Weight (kg)	SD (kg)	CV (%)
At weaning	27.3	4.1	15	28.9	4.7	16
1 year	42.0	4.4	10	43.6	5.1	12
2 years	51.4	5.5	11	51.6	5.7	11
3 years	57.9	5.1	9	53.9	6.2	12
4 years	55.7	5.5	10	56.1	5.7	10
5 years	56.2	6.8	12	57.4	7.4	13

Source: Medeubekov *et al.* (1996).

Notes: SD: Standard deviation; CV: Coefficient of variation.

The average weights of selected elite and first class animals in Beskaragai farm are shown in Table 17. These values are higher than those given in Table 16 due to the genetic quality of the animals found on the farm. These should probably be considered 'ceilings' for the breed in terms of individuals' live weight performance.

Table 17. Autumn live weight (kg) of Northern Kazakhstan Merino at Beskaragai breeding plant.

	Elite		First class	
Group of sheep	n	Average	n	Average
Adult rams (3-5 years)	50	105	na	na
Replacement one year old rams	40	65	na	na
Rams for selling (one year old)	560	60	350	55
Adult ewes (3.5 years)	1500	64	630	58
Younger ewes (1.5 years)	750	50	530	45

Source: Nartbayev *et al.* (1989).
Note: na = data not available.

The carcass characteristics of Northern Kazakhstan Merino are shown in Table 18. It should be noted that these are relatively low compared to large framed sheep in general.

Table 18. Carcass performance of castrated male Northern Kazakhstan Merino at Beskaragai pedigree plant.

Age	n	Body weight (kg)	Carcass weight (kg)	Carcass yield (%)	Carcass composition: Meat (%)	Carcass composition: Bones (%)
1.5 years	5	45.7	18.2	39.8	83.0	17.0
2.5 years	5	56.4	25.0	44.3	84.5	16.5
3.5 years	5	56.7	27.3	48.2	85.3	14.7

Source: Kazakh Research Institute of Livestock (1973).

At Beskaragai breeding plant, Asilbekova (2001) measured the dressed carcass yields of 7-month old ram lambs of four lines. The weights of live animals ranged from 32.2 to 34.5 kg. Dressed-carcass weight ranged from 13.6 to 15.4 kg, and carcass yields ranged 42.2% to 44.6%. The percentage of meat obtained ranged from 74% to 77.3%.

Reproductive performance

Prolificacy was reported to range from 130% to 150% and fertility from 95% to 97% (Medeubekov *et al.* 1996). The same author using farm records reported that pre-weaning lamb mortality averaged 7-9%.

Wool production

The variation in fleece weight that occurs with age is documented in Table 19. Fleece weights increase until the age of 3 years and then decline.

Table 19. Variation in fleece weights according to age in Northern Kazakhstan Merino ewes.

	Sheep born in 1962 (n=300)			Sheep born in 1972 (n=330)		
Age	Fleece weight (kg)	SD (kg)	CV (%)	Fleece weight (kg)	SD (kg)	CV (%)
1 year	5.25	0.94	18	5.45	1.19	22
2 years	5.59	0.82	15	5.82	1.05	18
3 years	6.05	0.93	15	6.34	1.03	16
4 years	5.79	1.03	18	6.13	0.97	16
5 years	5.32	0.41	8	5.80	1.07	18

Source: Medeubekov *et al.* (1996).

Notes: SD: Standard deviation; CV: Coefficient of variation.

Table 20. Wool production of Northern Kazakhstan Merino at Beskaragai breeding plant.

Trait	Rams (n=54)	Ewes (n=1500)
Density of fleece, %		
MM and M+	100	75
M	na	25
Length of fleece (cm)	11	10
Weight of fleece (kg)	13	6.4
Weight of clean wool (kg)	7.5	3.6
Diameter of fiber (µm)	23	21

Source: Asilbekova (2001).

Notes: MM = very high density wool, and M+ = high density wool M = normal density wool; na = not available.

At the Beskaragai pedigree farm, animals yield more and perform better than other flocks. Table 20 summarizes some features of the fleeces of animals in this flock.

In the Sulukol line, the average fleece weight of ewes ranges from 3.5 to 4.5 kg, respectively, staple length in both sexes ranged from 9 cm to 10.5 cm, while the average fiber diameter was 21-22 µm. Clean yield in ewes ranged from 55% to 60%. (Livestock Production Research Institute 2000).

Genetic and phenotypic parameter estimates

No particular levels of correlation between body weights and fleece traits were found: most correlations were below 0.5 (Table 21).

Table 21. Phenotypic correlations between production traits in yearling Northern Kazakhstan Merino sheep.

	Correlation coefficient				
Traits correlated	Sire 1810 (n=87)	Sire 5714 (n=91)	Sire 89133 (n=74 ewes)	Sire 89133 (n=74 rams)	Sire 65080 (n=91 ewes)
Body weight and staple length	0.14	0.17	0.26	0.30	0.13
Body weight and fleece weight	0.37	0.44	0.37	0.37	0.58
Staple length and fleece weight	0.24	0.37	0.27	0.44	0.32

Source: Medeubekov *et al.* (1996).

Repeatabilities were estimated as the correlation of weights taken at different times in ewes (Table 22). The lowest body weight repeatability coefficients were observed at weaning. This appears to result from the fact that sheep weight is more variable when animals are younger than when they are older. Weights at one or more years were more strongly correlated with weights at later years than they were with weight at weaning; however, in most cases, the correlation coefficients were less than 0.5.

For the same groups of animals, the repeatability of fleece weight was slightly higher. The strongest correlation was obtained between fleece weight records at 1 year of age and at 2 years of age (Table 23).

Table 22. Repeatability of body weight in Northern Kazakhstan Merino sheep.

Age	1 year	2 years	3 years	4 years	5 years
Weaning	0.27 (0.34)	0.29 (0.33)	0.22 (0.21)	0.20 (0.22)	0.21 (0.18)
1 year		0.42 (0.49)	0.31 (0.37)	0.23 (0.28)	0.15 (0.25)
2 years			0.37 (0.45)	0.33 (0.35)	0.26 (0.23)
3 years				0.51 (0.55)	0.27 (0.30)
4 years					0.43 (0.49)

Source: Medeubekov *et al.* (1996).
Notes: Estimates for sheep born in 1962 (n=300) outside parenthesis; estimates for sheep born in 1972 (n=300) in parenthesis.

Table 23. Repeatability of fleece weight in Northern Kazakhstan Merino sheep.

Age	2 year	3 years	4 years	5 years
1 year	0.52 (0.64)	0.39 (0.42)	0.30 (0.43)	0.20 (0.28)
2 years		0.49 (0.56)	0.36 (0.43)	0.17 (0.46)
3 years			0.48 (0.55)	0.35 (0.48)
4 years				0.48 (0.59)

Source: Medeubekov *et al.* (1996).
Notes: Estimates for sheep born in 1962 (n=300) outside parenthesis; estimates for sheep born in 1972 (n=300) in parenthesis.

Current breeding structure

Breeding work is still being done to produce lines from outstanding sires. This work needs to be revised to better suit new production systems and market trends.

Currently, 15,000 pedigree sheep are managed by three State pedigree farms: the Beskaragai Pedigree farm in the Pavlodar Region; the Sulukol pedigree farm in the Kustanay Region and the Karakol pedigree farm in the East-Kazakhstan Region. These farms conduct continuous genetic improvement work. Beskaragai and Sulukol are the main breeding plants producing Northern Kazakh Merinos. Within the last 10 years, farms in the Pavlodar, Semipalatinsk, Kokchetav, Tselinograd, and Taldy-Kyrgan Regions have purchased 12,196 rams and 6,218 ewes from Beskaragai.

For many years, the Sulukol pedigree farm has been the main source of the breed for farms in the Kustanay Region. Annually, this farm supplies a large number of pedigree Sulukol rams and ewes. Since1992, the farm has sold 103,763 sheep including 8,798 pedigree rams.

Outside the Kustanay Region, pedigree rams supplied by State pedigree stations are also being used in flocks kept in the Turgay and Kokchetav Regions. Rams have also been sold to the Varnenskaya State pedigree station in Russia's Chelyabinsk Region.

The Southern Kazakhstan Merino Sheep

There are approximately 580,000 Southern Kazakhstan Merino (SKM) sheep in Kazakhstan (Table 4), most of which (96%) are owned by different types of private farms: peasant farmers, cooperatives, and individual farms. The remaining 4% are managed on state farms.

The breed's main ecosystems are described in Table 5. They extend from the Alatau Mountains to the Kzyl-Kum desert. Deserts, foothills, and mountain ranges are the major source of feed for these animals. The ranges cover 23.5 million ha, mostly (about 70%) concentrated in desert and semi-desert areas found on the plains, whereas ranges in mountain and foothills account for only a small portion of this area (8.6% and 21.0%, respectively).

Brief account of the development and improvement of the breed

Fine wool sheep breeding was established in Southern Kazakhstan in the period 1932-1933, when native fat-tailed coarse wool ewes were crossed with New-Caucasus Fine Wool sires. Later (1946-1948) the crossbred animals were mated to sires representing different fine wool breeds, including the Caucasian, Altay, Stavropol, Grozniy, Soviet Merino, and, in 1971, to the Australian Merino.

Crossbreeding followed by selection improved wool quality and fineness. During the breed development process, attention was paid to the need to manage young animals under year-round grazing conditions. Two outstanding lines were developed during the process: the Merken and the Kuyuk, which were registered in 1994 and 1996, respectively.

The breed was developed to be distributed in 15 districts of the Zhambul and Shymkent (Southern-Kazakhstan) Regions. At the time of the breed's release in 1966, the number of Southern Kazakhstan Merino sheep had reached 3,933,000. About 2,292,000 of this total were managed in the Zhambul Region, and the remainder in the Southern-Kazakhstan Region (Petrov and Metlitskiy 1970).

The SKM has a pedigree base spread across six breeding plants. The Merken breeding plant of Zhambul is the leading breeding plant. Currently organized as an open joint-stock company with 14,000 head, of which 8600 are ewes. Every year the plant sells up to 1000 elite ram lambs and 1500 summer ram lambs to private farms in southern provinces. The body weight and clean wool yields of these ram lambs range from 60 to 62 kg and 3.2 to 3.5 kg, respectively.

Management

Lambing takes place in spring on rangelands in the foothills. The prevailing vegetation includes sand sedges such as: *Carex physoides*, *Carex pachystylis*, *Carex praeccox*, *Carex vesicaria*, *Poa pratensis*, *Poa bulbosa*, and rangeland grasses such as *Festuca sulcata*, *Agrostis alba*, *Agropyron repens*, *Lolium perenne*, and *Phragmites communis*.

Lambing ends by April. Shearing occurs in early May and ends by mid June. After shearing, sheep are taken to the summer mountain ranges. Vegetation on summer ranges consists of different grasses, such as: *Phleum pratense*, *Phleum phleoides*, *Psathyrostachys juncea*, *Avena sativa*, *Astragalus rytilobus*, *Trifolium pratense*, as well as legumes such as *Astragalus* spp. and clover.

At about mid September, the animals are taken to the plains to graze near to the settlements, in stubble fields, hay fields, and other unoccupied areas. In the past, this was also the time when producers considered whether or not to make use of veterinary and prophylactic interventions.

By the end of October and beginning of November, sheep are moved to Moiynkum sands, where they are inseminated artificially. The flock remains in this place for the whole winter. The dominant vegetation in these sandy rangelands consists mainly of ephemeral *Artemisia* (*Artemisia lercheana*, *Artemisia pauciflora*) and *Salsola* spp. However, semi-shrubs such as saxaul (*Haloxylon persicum* and *Haloxylon aphyllum*) also occur.

Water resources are poor, making the remote ranges difficult to access. This has disrupted rotational grazing and caused overgrazing of ranges near settlements, which has led to degradation, especially in desert areas. Table 24 shows the main management features of this breed.

Table 24. Management calendar of Southern Kazakhstan Merino sheep.

Events and seasons	Months											
	D	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating											■	■
Lambing				■	■							
Weaning								■	■			
Shearing						■						
Grazing SuR						■	■	■	■	■		
Grazing stubbles										■		
Grazing FR											■	■
Grazing WiR†	■	■	■	■								
Grazing SpR					■	■						
Stall feeding		■	■									
Seasons and main features	Winter 3-3.5 months of cold with 20-25 cm snow cover for 30 days January is coldest month (with temperatures falling to -35°C)			Spring Rainy season, with maximum rainfall in April			Summer Dry, intense solar radiation, hottest month is July (30°C average)			Fall Dry partially cloudy, low rainfall, frosts in 2nd half of October		

Source: Compiled by authors.
Notes: This management is relevant to state farms, whereas in other farms the management scheme was completely disrupted.
SuR = Summer range, WiR = Winter range, and SpR = Spring range; FR = Fall range.
†Grazing in the Moiynkum desert with use of conserved fodder during frosts and rainy days.

Appearance

The breed is mainly white and white cream, with a medium sized head which has a straight profile. Rams can have a convex nose. The animals have a strong constitution, a well-developed frame, and a thin tail. Their bodies are compact, with wide withers. Some individuals also have high withers.

Southern Kazakhstan Merino ram

Shorn Southern Kazakhstan Merino ewe

The skin has moderate fold formations, with 1-2 complete or incomplete neck folds. As a rule, rams are horned while ewes, with a few exceptions, are polled. Most of the body is covered with wool from the eye line on the head to the metacarpal joints in the fore legs and the hock joints on the hind legs. In some rams, the wool line can end even lower. The fleece is dense.

Body measurements

Average measurements for withers height, body length, chest depth, width at hips, width at shoulder joint, and chest girth in 3.5-year old ewes have been reported to be 68.7 cm, 74.3 cm, 30.2 cm, 19.8 cm, 19.2 cm, and 98.0 cm, respectively (Petrov and Metlitskiy 1970).

Body weights, growth and carcass traits

The SKM sheep is heavy, both at birth and when older. At the age of 1 year, lambs attain a marketable weight (Table 25). Average daily gains shown in Table 25 are somewhat lower than expected, because the measurements recorded were obtained under rangeland grazing conditions.

The heavier weights for this breed are also reflected in Table 26, which gives data for body weights and wool production at the Merken pedigree plant in Kazakhstan's Zhambul Region at the time of the breed's release in 1993. According to different studies, carcass percentage of SKM range from 45.5 to 49.6% (Petrov and Metlitski 1970).

Table 25. Body weight and growth of Southern Kazakhstan Merino.

	Merken pedigree plant		Kuyuk pedigree plant	
Age and growth period	Rams (n=1,136)	Ewes (n=1,603)	Rams (n=2,144)	Ewes (n=40,723)
At birth (kg)	3.9	3.8	3.9	3.6
At weaning (4 months) (kg)	29.3	27.1	29.1	27.7
12 months (kg)	54.7	37.9	55.6	37.0
1.5 years (kg)	72.1	43.7	60.0	46.0
Average daily gain from birth to weaning (g/d)	188.0	177.0	187.0	177.0
Average daily gain from weaning to 1 year (g/d)	111.0	47.0	110.0	41.7
1.5 years (% of mature weight)	76.8	78.0	75.0	81.0

Source: Petrov and Metlitskiy (1970).

Table 26. Productivity of Southern Kazakhstan Merino sheep at Merken pedigree plant.

Sex and age group	n	Body weight (kg)	Fleece weight (kg) Greasy	Fleece weight (kg) Clean	Staple length (cm)
Adult rams (3 to 5 years)	56	102.2	12.60	7.94	11.80
Replacement yearling rams	32	70.0	9.16	5.68	11.61
Adult ewes (3 to 5 years)	4,864	54.5	5.95	3.38	9.40
Yearling ewes	2,162	41.2	4.95	2.96	9.89

Source: Berus (1997a).

Reproductive performance and milk production

Southern Kazakhstan Merino sheep are characterized by relatively high levels of prolificacy. In favorable years under year-round grazing management the breed attains a prolificacy of 150%. For several years, in the large pedigree farms of Southern Kazakhstan, prolificacy has ranged from 111% to 145% (Petrov and Metlitskiy 1970). According to studies conducted in the flock belonging to Merken pedigree plant, fertility ranges from 92.3% to 98.0% and the prolificacy rate from 137.6% to 140.0% (Berus 1995). In a 1995 study by Berus, lamb mortality rates during the suckling period averaged 3.7 to 5.1%.

Milk production in Southern Kazakhstan Merino ewes is rather high, averaging 100.7 liters over the first 100 days of lactation (Petrov and Metlitskiy 1970). These authors found that the fat, protein, and dry matter contents of the milk tested averaged 6.3%, 4.9%, and 15.8%, respectively.

Wool production

SKM produce high-quality white wool which is suitable for industrial processing. It has large, uniform curls, a good depth of staples, and a lustrous shine. Average fiber diameter is 24 μm in the case of sires and 21-22 μm in the case of ewes and hoggets. The fiber diameter coefficient of variation is within 17.3-22.3% (Berus 1995). Average clean yield is 62.0% in the case of sires, 63.1% in the case of ewes, and 59.7% in the case of ewe hoggets. Mid-side fiber lengths in sires, ewes, and ewe hoggets average 11.0, 9.30, and 10.9 cm, respectively, while straightened fiber lengths average 16.6, 15.1, and 15.2 cm, respectively.

Genetic and phenotypic parameter estimates

Through analyzing the variance components, using a full random model, the following estimates of heritability were obtained: 0.19-0.35 for body weight, 0.37-0.43 for fleece weight and 0.38-0.45 for staple length (Berus 1995).

Repeatability, estimated as the correlation between records taken at different ages within a given trait, is shown in Table 27.

Table 27. The repeatability of traits at different ages in Southern Kazakhstan Merino sheep.

Ages correlated	Body weight	Fleece weight	Staple length
Birth and 4 months	0.23	na	na
4 months and 1 year	0.46	na	0.70
1 year and 2 years	0.47	0.58	0.84
2 years and 3 years	0.43	0.61	0.82
3 years and 4 years	0.32	0.62	0.79

Source: Berus (1997b).

Notes: na = not available; number of observations was not provided.

Current breeding structure

Southern Kazakhstan Merino sheep can be found in all types of production systems throughout the country, including state pedigree plants, joint-stock companies, peasant farms and individual farms (Table 28).

Table 28. Distribution of Southern Kazakhstan Merino sheep according to farm type.

		Farm categories			
Indices	n	State	Private farmers	Cooperative	Households
Ewes	380,000	16,000	125,000	63,000	176,000
Pedigree sheep	55,000	20,000	15,000	20,000	0
Total head number	600,000	25,000	200,000	100,000	275,000

Source: Compiled by authors.

Under genealogical control, 20,000 pedigree sheep are managed at the Merken and Akbulak pedigree plants in the Zhambul Region and at the Kuyuk pedigree plant in the Southern-Kazakhstan Region. Merken pedigree plant manages 12,000 animals or 60% of all pedigree animals in this farm category.

The economic crises that followed the fall of the Soviet Union affected the development of the SKM sheep. The number of animals declined greatly, especially in Southern Kazakhstan. Present numbers total around 600,000 animals. Nevertheless, the breed has good development prospects. It is therefore important to continue adequate breeding programs; these must aim to re-stock the breed while making use of outstanding animals such as those kept at Merken pedigree plant.

The Australian Merino Sheep in Kazakhstan

Brief account of the introduction and improvement of the breed

The fine fleece sheep breeds established in Kazakhstan are well adapted to local conditions, demonstrate acceptable fertility, and produce good quality mutton. However, the wool produced is short and staple tops are dry (because both wool grease content and quality are lower). In addition, the clean fleece weight is poor, as are the physical and technical characteristics of the fibers. These shortcomings make these breeds less competitive under present market conditions. To improve wool production among these breeds, an Australian Merino nucleus was established in Kazakhstan in October 1993 for crossbreeding purposes. This was done by importing 100 rams and 350 ewe lambs from western Australia (Perth) (Dorman and Louis farms). This breeding nucleus was located at the Minbaevo pedigree farm of the Kazakh Technological Research Institute of Sheep Breeding (KTRISB). The Australian Merinos acquired have been well described elsewhere, and have strong constitutions. They are white and with an average number of folds in the neck and chest.

Appearance

The Merino animals kept at the Minbaevo plant have adapted well to local conditions and display the characteristics typical of Merino with their background, including an excellent fleece and size. The animals are tall and well built.

Australian Merino ram

Australian Merino ewe

Management

Table 29 summarizes the main management features of Australian Merino sheep at Minbaevo pedigree farm.

Table 29. Management calendar of Australian Merino sheep kept at Minbaevo pedigree farm.

	Months											
Events and seasons	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating											■	■
Lambing					■	■						
Weaning									■			
Shearing						■						
Grazing SuR†								■	■	■		
Grazing stubbles										■	■	■
Grazing FR										■	■	■
Grazing WiR‡	■	■	■	■								
Grazing SpR‡					■	■	■	■				
Stall feeding	■	■	■	■								
Seasons	Winter§			Spring			Summer			Fall		

Source: Compiled by authors.
Notes: †Grazing on mountain ranges; ‡Grazing on semi-desert steppes.
SuR = Summer range, WiR = Winter range, SpR = Spring range; FR = Fall range.
§Steppe is covered with 5-10 cm snow.

From the end of July until September the animals are grazed on mountain ranges with sufficient fodder. Lambs are weaned in early August. From September to November they are moved to stubbles and fall ranges in the semi-arid steppes, and from December to March they graze winter ranges and are supplied with extra hay and some concentrates. Lambing takes place in April. From April to June shearing and drenching takes place, while lactation is ongoing. At this time, the flocks graze the spring, semi desert, steppe ranges.

Body weights, growth and carcass traits

Average birth weight ranges from 3.9 kg to 4.0 kg in the case of ram lambs, and from 3.8 kg to 3.9 kg in the case of ewe lambs. Average weaning weight ranges from 29.0 kg to 30.6 kg in the case of rams and from 27.5 kg to 28.8 kg in the case of ewes (KTRISB 2001). Average daily weight gain from birth to weaning for ram and ewe lambs ranges from 209 to 221 g/d and 197 to 208 g/d, respectively. The average weights of 109 rams lambs at Minbaevo pedigree farm at birth, weaning, 4 months, 6 months, 7 months, 10 months and 12 months were 4.02 kg; 30.2 kg; 32.2 kg; 35.3 kg; 38.9 kg; and 60.5 kg, respectively (KTRISB 2001).

The same 2001 KTRISB report states that, at weaning, the average weight of ewes at Minbaevo farm ranged from 44.9 to 46 kg during 1993-1999.

Ewe hoggets at the age of 1.5 years have an average body weight of 47.0-48.5 kg, which represents 81.0-83.6% of their mature weight (at 2.5 years). These data show satisfactory growth and development.

Reproductive performance

According to data collected at KTRISB (Medeubekov *et al.* 2001a), prolificacy ranged 122% to 130%, a rate lower than that of Kazakh fine wool sheep. Lamb survival rate from birth to weaning was 90-93%.

Wool production

The fleece of the Australian Merino is dense and white. Crimps develop uniformly and neatly along the staple. The clean wool yield is 62.8% for adult rams, 61.8-63.0% for yearling rams, 60.2-62.2% for adult ewes, and 58.9-62.4% for yearling ewes. Clean fleece weights range from 5.1 kg to 5.7 kg in adult ewes, and 2.8 kg to 2.9 kg in yearling ewes. Average staple lengths range from 9.0 to 9.5 cm. The average greasy fleece weight has been recorded as 12.5 kg in the case of rams and 5.7 kg in the case of ewes. (Medeubekov *et al.* 2001b).

Genetic and phenotypic parameter estimates

The phenotypic correlations between body weight and fleece weight range from 0.36 to 0.52. Between body weight and staple length they range from 0.30 to 0.47. Between fleece weight and wool length they range from 0.28 to 0.37; the correlation between fleece weight and wool density was 0.32 (Plohinskiy 1969).

Within-sire heritabilities for body weight at the age of 2.5 years have been estimated by daughter–dam regression (Plohinskiy 1969); these ranged from 0.25 to 0.33. The equivalent figures for wool at the age of 2 years ranged from 0.14 to 0.21 (Medeubekov *et al.* 2001b).

Current breeding structure

The elite flock of Australian Merinos kept in Kazakhstan is currently under genealogical control. However, the pedigree breeding system followed is obsolete. The Merino sheep nucleus at the Minbaevo pedigree farm as of January 1, 2000, consisted of 800 animals including 400 ewes. The animals are being distributed to different regions of the country. From 1995 until 1999, a total of 419 rams were distributed for breeding purposes.

Semi-Fine Wool Breeds

Semi-fine wool sheep in Kazakhstan consist of one imported breed (the Hampshire sheep) and five synthetic breeds developed during the Soviet Union: the Kazakh Mutton-Wool (KMW), the Akjaik Mutton-Wool, the Kazakh Semi-Fine Wool, the Degeress and the Tsigai sheep The country's population of semi-fine wool sheep amounts to 0.6 million head (Table 4). All the semi-fine wool breeds, except the Kazakh Semi-Fine Wool and the Hampshire, are described in this chapter. The information on Kazakh Semi-Fine Wool and the performance of the Hampshire breed in Kazakhstan is not available. Hampshire sheep are used for terminal lamb production and their wool is of little if any value.

The Kazakh Mutton-Wool Sheep

The Kazakh Mutton-Wool Sheep belongs to the group of semi-fine wool sheep found in the country. By 2004 there were approximately 21,000 animals left in Kazakhstan (Table 4).

Brief account of the development and improvement of the breed

Dual purpose mutton-wool sheep have considerable economic significance for Kazakhstan, as they help to meet the high demand within the country for mutton and wool. It is estimated that the proportion of mutton that makes up the country's total meat production should remain at the present level of 20-30%. However, the amount of semi-fine crossbred wool produced (wool with fibers 8-10 cm length and with a lustrous shine) should increase by at least 5-6 times. No less than 8-10 million mutton-wool sheep are needed, therefore, a number which could be raised on Kazakhstan's vast natural rangelands. This said, these estimates should be reviewed in light of any future changes in the market.

Dr. V.A. Balmont at the Minbaevo pedigree farm initiated the development of a mutton semi-fine wool sheep in 1945. This synthetic was released in 1991 under the name the Kazakh Mutton-Wool sheep. It has three lines: the Aksenger, the Kalchengil, and the Chuy.

The development of this breed began with the screening of a significant number of animals producing uniform, semi-fine wool with a diameter of 24-27 μm and a staple length of 10-12 cm. These were the F1 and F2 progeny of indigenous fat-tailed ewes crossed with Precoz sires. The objective of this cross was to incorporate the advantages of the indigenous fat-tailed sheep into the new breed. At the beginning of the 1960s, Lincoln sires were used to increase the length, curliness, luster, and wool uniformity of the breed. Continuous selection for a high clean-fleece weight, and good fattening performance and mutton quality resulted in a highly productive breed adapted to local fodder resources and local climatic conditions.

The Aksenger and Kalchengil lines of this breed are raised on the Minbaevo pedigree farm, the Aksenger pedigree farm, and the Botkin pedigree plant in the Zhambul and Iliysk Districts of the Almaty Region. Climatic conditions are similar on the three farms. They are located in desert and semi-desert areas and have summer mountain rangelands in Zailiy Alatau. Water is available in springs, wells, and other watering points. Surface water sources may amount to 41% of the total water supply available. Contrasting the adequate supply available in the mountains and foothills, the supply of open water on the plains is limited.

Management

Currently the Kazakh Mutton-Wool breed is managed on most farms under rangeland conditions for most of the year, except during those periods when the ground is covered by ice and hard frosts. No stubble grazing is practiced. Table 30 summarizes the management characteristics of the KMW breed.

Table 30. Management calendar of Kazakh Mutton-Wool sheep at Botkin pedigree plant.

	Months											
Events and seasons	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating												
Lambing												
Weaning												
Shearing												
Grazing SuR†												
Grazing FR†												
Grazing WiR‡												
Grazing SpR												
Dipping												
Drenching												
Seasons and main features	Winter with snowfall in December. Snow cover remains until March. Grazing occurs in sandy desert areas			Spring begins in mid March, and is wet. Grazing animals move to semi-desert ranges			Summer is a hot season. Animals are moved to summer ranges.			Fall temperatures drop and animals are moved to fall ranges		

Source: Compiled by the authors.
Notes: †Grazing in pre-desert areas; ‡Grazing in winter ranges.
SuR = Summer range, WiR = Winter range and SpR = Spring range; FR = Fall range.

Shearing and weaning occurs from June to mid November, a period when animals graze in pre-desert zones where there is sufficient water and fodder. Artificial insemination is practiced in late October. From Mid November until March, with lambing in late March, the flocks graze winter ranges and are provided with additional hay in intensely cold years. From March to May, grazing takes place on spring ephemeral and Gramineae grasses.

Appearance

Most Kazakh Mutton-Wool rams and ewes are hornless, with upright ears and a clean face. They have rounded and rather long necks a compact body and broad withers. The muscles around the chest, belly, and legs are well developed. The tail is thin. The skin is thick and the fleece is white with a lustrous shine. The animals are suited to range grazing.

The Aksenger type mostly displays the general features of the breed.

Kazakh Mutton-Wool ram

Kazakh Mutton-Wool ewe

Body measurements

Body measurements for this breed at different ages are shown in Table 31. It can be seen that the most intensive changes occur from birth to weaning (4-4.5 months). For example 77.6% of the sacrum height and 91.7% of the chest width achieved at 12 months has already been achieved by the time animals are weaned.

Body weights, growth and carcass traits

Good precocity, growth, and development characterize the Kazakh Mutton-Wool breed (Table 32).

Mature sheep display relatively heavy weights (Table 33).

Table 31. Body measurements (cm) of Kazakh Mutton-Wool sheep.

Trait	Age (Mean±Standard error)			
	At birth	4-4.5 month	12 month	Mature animals (24-36 months)
Rams (n=14)				
Height at withers	39.2±0.32	61.3±0.42	66.2±0.47	77.4±0.69
Height at sacrum	41.1±0.36	61.6±0.13	67.5±0.56	78.8±0.67
Diagonal body length	34.2±0.27	64.3±0.46	70.0±0.54	83.0±0.72
Chest girth	36.7±0.31	86.0±0.63	99.5±0.72	139.6±0.81
Chest depth	14.3±0.19	26.4±0.31	29.4±0.35	42.5±0.42
Chest width	9.6±0.12	20.7±0.25	21.7±0.29	30.6±0.27
Width at hips	8.0±0.13	14.6±0.31	16.4±0.27	24.0±0.31
Metacarpus girth	6.2±0.11	8.5±0.16	9.0±0.16	11.0±0.18
Ewes (n=25)				
Height at withers	37.5±0.31	57.3±0.42	60.2±0.33	65.2±0.41
Height at sacrum	39.4±0.34	59.4±0.47	63.8±0.42	67.5±0.46
Diagonal body length	33.2±0.27	60.2±0.46	65.2±0.44	67.7±0.43
Chest girth	35.1±0.31	86.5±0.50	90.5±0.53	108.7±0.62
Chest depth	14.2±0.13	24.1±0.36	28.7±0.46	33.9±0.44
Chest width	9.4±0.12	16.4±0.21	20.0±0.29	21.9±0.31
Width at hips	7.8±0.14	14.2±0.17	15.7±0.22	20.0±0.32
Metacarpus girth	6.0±0.12	7.6±0.15	8.0±0.16	8.0±0.15

Source: Kasymov *et al.* (1996).

Table 32. Body weight and growth of Kazakh Mutton-Wool sheep (Mean±SE).

Sex	n	Birth weight (kg)	Weaning weight (kg)	Average daily gain (g/d)	Body weight at 1 year (kg)	Average daily gain (g/d)
Ram lambs	112	3.96±0.60	34.3±0.36	253	50.2±0.51	151
Ewe lambs	173	3.83±0.08	29.3±0.32	212	48.2±0.47	121

Source: Kasymov *et al.* (1996).
Note: SE: Standard error.

Table 33. Body weights of Kazakh Mutton-Wool pedigree sheep at Minbaevo pedigree farm.

Liveweight trait (kg)	Rams	Ewes		Ram hoggets	Ewe hoggets	
	Elite n=22	Elite n=130	Top class n=534	Elite n=22	Elite n=22	Top class n=534
Average body weight	101	56.8	56.0	56.9	44.6	40.7
Maximum body weight	120	73.0	69.0	76.0	54.0	51.0

Source: Kasymov and Batirshanov (1991).

Lambs slaughtered at weaning (4 months) averaged 31.5 kg, and their carcasses were categorized as first class. The carcass weight of castrated 18-month-old rams raised under farm-fed conditions averaged 23 kg, while the average carcass yield was 50.1% (Table 34).

Table 34. Carcass performance of Kazakh Mutton-Wool ram lambs and castrated rams of different age.

	Age	
Traits and meat composition	4-month-old (n=8)	18-month-old (n=7)
Main carcass traits		
Pre-slaughter weight (kg)	31.5	48.1
Carcass weight (kg)	14.3	23.0
Weight of visceral fat (kg)	0.76	1.07
Slaughter output (%)	49.7	50.1
Meat's chemical composition		
Fat (%)	22.9	24.7
Protein (%)	16.9	15.6

Source: Kasymov *et al*. (1996).

Reproductive performance and milk production

Based on a study of 525 mated ewes at Minbaevo pedigree farm, Kasymov (1991) reported a fertility level of 96% (504 lambed ewes), a prolificacy of 119% (601 lambs born) and a survival rate of 95.2% for this breed. Lambing takes place once a year (Kasymov 1991).

Kasymov *et al.* (1991) also studied milk production by ewes kept under improved feed and management conditions during the winter at Minbaevo pedigree farm (Table 35).

Table 35. Milk production of Kazakh Mutton-Wool ewes and growth indices of their single offspring (n=5) at Minbaevo pedigree farm.

Milking period	Milk production (kg)	Lamb weight at end of period (kg)	Daily weight gain (g/d)
Day 1 to day 30	45.0	13.2	287
Day 31 to day 60	43.8	21.3	270
Day 61 to day 90	29.0	27.4	203
Day 91 to day 120	26.0	34.0	220
	Total = 144.8		Average = 245

Source: Kasymov *et al*. (1991).

During the first month of lactation, a good diet was provided to animals kept in barns. The second month of lactation coincided with the transfer of ewes to the range, where they grazed but were provided with additional concentrates as a support (0.5 kg per animal). It seems that these changes had little effect on milk production or on the growth of lambs. The milk's dry matter, protein, and fat contents were 14.8%, 4.2-4.7%, and 5.2-6.2%, respectively.

Wool production

The KMW produces semi-fine wool. Kasymov *et al.* (1991) reported that ewes at the Minbaevo experimental farm yielded 2.5-3.3 kg of wool. Other more recent estimates are included in Table 36.

Table 36. Wool production performance of Kazakh Mutton-Wool sheep.

Sire line	n	Greasy fleece weight (kg)	Clean fleece weight (kg)	Clean yield (%)
Rams				
X2317	10	7.8	5.03	64.3
89127	9	7.2	4.71	65.8
89060	6	8.0	4.86	61.0
Total and weighted averages	25	7.6	4.90	64.1
Ewes				
X2317	7	4.3	2.85	66.0
89127	6	4.5	3.02	67.3
89060	4	4.4	2.76	63.8
Total and weighted averages	17	4.4	2.90	65.9

Source: Kasymov *et al.* (1996).

Genetic and phenotypic parameter estimates

Table 37 includes intra-sire phenotypic correlation estimates between body weight and different wool traits. The highest association was found between staple length and fleece weight. The correlation between body weight and fleece weight was relatively higher than the correlation between body weight and staple length.

Correlations were used to calculate the repeatability of consecutive measurements of body weight and fleece weight (Tables 37 and 38).

Table 38 suggests that adult live weights should not be predicted based on weights at a younger age, as the estimates display low correlation, while Table 39 shows low predictability of future fleece weight performance when records at 1 or 2 years are used.

Table 37. Phenotypic correlations of traits of Kazakh Mutton-Wool ewes.

		Correlated traits		
Sire line	n	Body weight and fleece weight	Staple length and fleece weight	Body weight and staple length
H4595	45	0.41	0.26	0.07
P5741	22	0.33	0.13	0.25
T0140	24	0.20	0.36	0.15

Source: KTRISB (1985).

Table 38. Repeatability of body weights in Kazakh Mutton-Wool sheep (±SE) (n=87).

Age	**4 months**	**12 months**	**2.5 years**	**3.5 years**
Birth	0.35±0.06	0.11±0.15	0.34±0.07	0.40±0.12
4 months		0.30±0.09	0.19±0.08	0.19±0.13
12 months			0.13±0.09	0.15±0.16
2.5 years				0.47±0.14

Source: Kasymov (1990).
Note: SE: Standard error.

Table 39. Repeatability of fleece weight in Kazakh Mutton-Wool sheep (n=140 ewes).

Age	2 years	3 years	4 years	5 years	6 years
1 year	0.40	0.29	0.09	-0.08	0.03
2 years		0.24	0.19	-0.07	-0.08
3 years			0.26	0.03	0.07
4 years				0.13	0.28
5 years					-0.13

Source: Kasymov (1990).

Heritabilities were estimated by doubling the intra-sire offspring-dam regression for measurements taken at one year of age (Table 40). Note that in all these estimates the number of observations is excessively low, to such an extent that the estimates could be meaningless. Thus, these estimates should be treated with extreme caution when being considered.

Table 40. Heritability of body weight and wool traits in Kazakh Mutton-Wool sheep.

	Sire line (number of pairs)		
Trait (at 12 months age)	X2317 (n=54)	89060 (n=23)	89127(n=24)
Staple length	0.34	0.31	0.30
Fleece weight	0.30	0.23	0.23
Body weight	0.16	0.33	0.39

Source: KTRISB (1985).

Current breeding structure

Currently the number of Kazakh Mutton-Wool sheep belonging to the Aksenger and Kalchengil lines amounts to 7,544 animals. This figure includes the 492 animals managed at Minbaevo pedigree farm, the 19,000 or so animals kept on farms in the Iliy District of the Almaty Region and the 5152 animals kept in the flocks of private households.

Sheep flocks managed by private farms vary from 150 to 500 animals in size. These farms face serious financial limitations, but are capable of increasing the head number they keep, and so of increasing mutton production at low cost, provided the state renders the necessary support. In the future some of these farms may acquire pedigree status. Currently, the only pedigree farms left belong to the state and are under the supervision of KTRISB, which provides genealogical control. In fact, the Kazakh Technological Research Institute of Sheep Breeding is the main institution responsible for the genetic improvement of, and research into, the Kazakh Mutton-Wool sheep. It should also be noted that Kazakhstan's pedigree farms also lack finance and state support.

Technical projections state that, in the near future, KMW sheep numbers should increase and the breed should become more widely distributed. However, further genetic improvement of the breed is required—examples of ways to achieve this would include crossbreeding ewes with Lincoln, Romney Marsh, and

Corriedale sires. This said, it must be remembered that any future plans have to be matched to the current market possibilities for the products of this breed.

The Kazakh Mutton-Wool sheep's Aksenger line

Line development and management

The Aksenger line was obtained by crossing Kazakhstan Fine Wool ewes with Lincoln, Romney, and Australian Corriedale sires. This was done under the continental climatic conditions found at the Aksenger pedigree farm in the Almaty Region of Southeast Kazakhstan.

This area is characterized by semi-desert and desert foothills, as well as by the mountain ranges of Zailiy Alatau. The dry-steppe and semi-desert zones found in the foothills of Zailiy Alatau have an annual rainfall which ranges from 350 mm to 360 mm. Summers are hot and dry (up to 40°C). Winters are moderate with a snow cover of 15-25 cm. Winter temperatures average 13.8°C; however, on some days they can fall to below -30°C. Water sources are satisfactory. The mountain zone (1800-3,000 m a.s.l.) is characterized by a moderate continental climate with an average summer temperature of 14.1°C. Annual rainfall is about 830 mm, 52% of which falls in April-July. In general grazing and water resources are sufficient (Table 41).

Table 41. Management calendar of Aksenger KMW sheep.

	Months											
Events and seasons	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating												
Lambing												
Weaning												
Shearing												
Grazing SuR†												
Grazing FR‡												
Grazing WiR												
Hay feeding												
Grazing SpR												
Seasons	Winter§			Spring			Summer			Fall		

Source: Compiled by authors.
Notes: †Grazing mountain ranges; ‡Foothill ranges.
SuR = Summer range, WiR = Winter range and SpR = Spring range; FR = Fall range.
§Steppe ranges are covered with 5-10 cm snow.

From the second half of June until August, animals are grazed on the mountain ranges. Weaning begins in July. After this time, and until mid December, animals are grazed on the ranges in the foothills and on any stubble available. Mating occurs by the end October. From the end of December to February, animals are grazed on the winter ranges, where they are provided with supplementary hay and concentrates. From March to early June they are grazed on the spring ranges.

Appearance

This mutton-wool breed is medium sized. In terms of appearance and body structure, the Aksenger line falls between the Lincoln, Romney, and Kazakhstan Fine Wool breeds. The wool produced by this line is white, the head is covered by wool to the eye line, while the face is clean. The ears are medium sized and upright, a feature typical of the breed. The breed is hornless with a long and thin tail which is usually docked after birth. The animals have a strong constitution. The chest is deep and wide with rounded ribs.

Body measurements

The average height at the withers is 68.5 cm, while the average diagonal body length is 75.6 cm. Chest depth averages 33.6 cm, chest width behind the shoulders 27.4 cm, chest girth 97.2 cm, and width at hips 21.2 cm (KTRSIB 2000).

Body weights and growth

At birth ram lambs average 4-4.5 kg and ewe lambs 3.8-4.5 kg. The average birth weight of single-born lambs is 4.57 kg, while that of twins is 3.49 kg (Kasymov 1995).

The average live weights of acceptable sheep are 90 kg for mature (3.5-year old) rams, 55 kg for mature (3.5-year old) ewes, 50 kg for yearling rams, and 40 kg for yearling ewes. At weaning, ram lambs (4-4.5 months) should weigh 31-33 kg and ewe lambs 28-30 kg. Depending on the yearly and seasonal conditions, the average daily weight gain from birth to weaning is 211-242 g/d for ram lambs and 192-229 g/d for ewe lambs (Kasymov 1995).

Table 42 shows the weights of animals at different ages and pre-weaning growth. Up to weaning, lambs grew very fast—reaching 33.1 kg at 4 months without any additional feeding. After weaning, however, lambs were grazed on natural rangelands—which explains the slower growth rates exhibited.

Table 42. Growth and development of Aksenger KMW sheep.

Age of ewe lambs	n	Live body weight (Mean±Standard error) (kg)
At birth	611	4.4±0.02
12 months	932	44.8±0.14
16 months	329	57.7±0.34

Source: Kasymov (1995).

Aksenger sheep produce excellent mutton. Baratov (1995) determined that the most intensive development of tissues, takes place during the suckling period. Bone, muscle, and fat during this period increased by 4.4, 5.8, and 27.1 times, respectively. After weaning, until the age of 16 months, bone, muscle and fat only increased by 1.8, 2.7 and 4.0 times, respectively (Table 43).

Table 43. Carcass composition of Aksenger KMW sheep (n=13).

	Age					
Trait	Birth	2 months	4 months	8 months	12 months	16 months
Carcass weight (kg)	2.30	10.3	13.9	18.2	26.1	34.6
Flesh yield (%)	68.7	76.3	77.5	79.6	81.6	83.3
Muscles (kg)	1.51	6.86	8.9	11.5	16.9	21.2
Fat (kg)	0.07	1.0	1.9	3.0	4.4	7.6
Bones (kg)	0.67	2.3	2.9	3.4	4.4	5.3
Muscle-bone weight ratio	2.25	3.11	3.07	3.38	3.84	4.00
Muscle-fat weight ratio	21.6	6.86	4.68	3.86	3.84	2.78

Source: Baratov (1995).

Reproduction performance and milk production

Kasymov (1995) monitored the reproductive performance of Aksenger ewes for four years, and found that prolificacy averaged 144% (n=2,134 lambed ewes). Survival of lambs at weaning averaged 90.8%.

Milk production by ewes with single-born lambs, adjusted to 120 days, was 106.7 kg (Kasymov 1995). In another study, corrected milk production (also obtained during a 120-day lactation period) was 142.6 kg among ewes with singles and 207 kg among ewes with twins (Kasymov 1995).

Wool production

Aksenger sheep produce semi-fine wool. According to on-farm data taken over several years, average clean fleece weights range from 4.7-5.5 kg for rams to 2.5-2.7 kg for ewes, and from 2.2-2.4 kg for yearling ewes to 2.5-2.9 kg for yearling rams. And, for a group of 1500 selected ewes, the average was 3.0 kg (Medeubekov and Kasymov 1993). Shearing of Aksenger lambs at the age of 3-3.5 and 6.5-7 months resulted in 0.65 and 0.83 kg of wool, respectively.

The wool staples produced average 12-13 cm in length, while the fibers produced are semi-fine and uniform with a semi-lustrous brilliance. The diameter of the fiber produced is 26-30 µm in the case of ewes and 26-32 µm in the case of rams. Medium and large curls are uniform along the staple. The uniformity of fiber diameter and length is acceptable in the case of both the staples and fleece. Clean yield is 58-65%.

Genetic parameter estimates

Fleece weight heritability in Aksenger sheep (estimated by doubling the daughter–dam correlation coefficient and doubling the daughter–dam regression coefficient) was 0.71 and 0.77, respectively. In contrast an analysis of variance components using a full random model gave a rather low estimate (0.15 in the case of wool yield). The estimates for live weight heritability also varied according to the three methods used: 0.47, 0.35, and 0.13, respectively (Medeubekov and Kasym 1995). Such discrepancy among estimates probably relates to the number of observations involved (Kasymov 1995).

Phenotypic correlation between body weight and fleece weight was 0.52, while between fleece weight and wool density it was 0.49. Between body weight and staple length, it was 0.47 (Medeubekov and Kasymov 1995).

The Kalchengil line of the Kazakh Mutton-Wool sheep

Line development

The Kalchengil line was developed by crossing indigenous Kazakh Fat-tailed Mutton Coarse Wool ewes with the Merino Precoz, and then following a process of selection. A further crossing was conducted when the selected population was crossed with Lincoln rams. This was again followed by a process of selection. The breed was approved in 1991 (Kasymov 2001).

Production traits

Information on this breed is extremely limited. The description of the breed that follows is extracted from Kasymov (2001).

This breed is distinguished by a high level of meat production. At weaning (4 months of age) liveweight average 32 kg for ram lambs and 29 kg for ewe lambs. After fattening, at the age 8 months, lambs weigh 21.5 kg and the dressing percentage of their carcasses averages 48.2%. The liveweight in adult animals (>3years) ranges from 100-110 kg for males to 58-60 kg for females. Wool yield ranges from 7.5-9.5 kg for rams to 4.0-4.5 kg for ewes. The clean wool yield of the breed ranges from 62% to 64%. Prolificacy fluctuates between 120% and 130%.

This breed is kept in the desert and semi-desert areas of southeastern Kazakhstan. The best flocks are located at the experimental farms of the Kazakh Technological Research Institute of Sheep Breeding, in the Zhambul district, and at the Bokin breeding farm, in the Iliy district. Both of these are in Almaty Province.

The Kazakh Mutton-Wool sheep’s Chuy line

Line development

The Chuy line was developed by crossbreeding native Kazakh Fat-tailed Mutton Coarse Wool ewes with the rams of different fine wool breeds (including the Soviet Merino, the Precoz, the Stavropol and the Southern Kazakhstan Merino) as well as with rams representing the Kazakh Mutton-Wool producing breeds kept at the Minbaevo experimental farm, under the supervision of the Kazakh Technological Research Institute of Sheep Breeding. Semi-fine wool breeds were also involved in the breeding process. Those used included the Northern Kazakhstan Merino, the Romney Marsh, and the Argentinean and the British Lincoln. Selection was always undertaken following the different periods of crossbreeding (Rakhimjanov 2001).

Production traits

Information on this breed is also extremely limited. The description that follows is extracted from Rakhimjanov *et al.* (1994).

At the age of 1.5 years, the liveweights of this breed average 61.6-68.7 kg for rams and 43.7-48.4 kg for ewes. In adult animals liveweights average 89.2-94.6 for >3-year-old rams and 56.0-59.3 kg for >3.5-year-old ewes. The breed is early maturing as at the age of 4 months the carcass weight averages 36 kg with a 47% dressing percentage.

The ewes of this breed are also known for their high rate of prolificacy (120-140%) and good milk production (130-132 kg of milk during 100 days of lactation).

The Akjaik Mutton-Wool Sheep

Brief description of the development and improvement of the breed

The Akjaik Mutton-Wool breed was developed by crossing fine wool and semi-fine wool ewes with Lincoln and Romney crossbred sires. Continued selection from F2 individuals resulted in the establishment of the Akjaik breed, which was officially registered in 1996 in West Kazakhstan. A distinctive peculiarity of this new breed is that all the selection work was based on the use of crossbred animals.

In 1996 there were 464,000 head of this breed. This figure includes 49,000 elite and first class animals. Two pedigree plants and two pedigree farms were involved in the raising of pedigree animals. In 2004 the population was estimated to stand at 220,000 animals (Table 4). The leading plant in the breeding work was the 40th Anniversary of Kazakhstan pedigree plant, located in the Taskalin District of Western-Kazakhstan.

Appearance

The breed is characterized by a strong constitution and well-proportioned conformation. The head is medium sized and straight; the nose is slightly convex. Wool covers the head to the eye line. Small dark spots occur on the nose and ears. The neck is rounded and of medium length; its lower part can be either plain or can have some small folds. The withers, back, loin and sacrum are wide and slightly long. The chest is deep and wide and the ribs are rounded. The legs are of medium length with firm hooves and strong bones. The animals are white and the fleece covers the legs up to, and sometimes beyond, the hock joint. Some small dark spots occur on the lower part of the legs.

Management

Table 44 includes the salient features of the management of this breed.

Akjaik Mutton-Wool ram

Akjaik Mutton-Wool ewe

Table 44. Management calendar of Akjaik sheep.

	Months											
Events and seasons	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating												
Lambing												
Weaning												
Shearing												
Grazing SuR												
Grazing FR												
Grazing WiR												
Grazing SpR												
Stall feeding†												
Seasons	Winter‡			Spring			Summer			Fall		

Source: Compiled by authors.
Notes: SuR = Summer range, WiR = Winter range and SpR = Spring range; FR = Fall range.
†On exceptionally cold days, when snow covers the range, the animals are stalled.
‡Steppe ranges are covered with 1-30 cm of snow.

Akjaik sheep are well adapted to year-round grazing and are able to tolerate cold winters. In exceptional cases when snow cover reaches 20 cm and the air temperature descends to around -30°C, the animals have to be moved and provided with 1.5-2.5 kg per day per head of hay and 0.15-0.2 grams per day per head of concentrates. The animals are then kept in stables for 40-60 days. This breed is not grazed on stubbles.

Body weights, growth and carcass traits

This breed is characterized by its precocity. Average birth weight, weaning weight (at 4-4.5 months) and average daily weight gain from birth to weaning are 4.38 kg, 31.2 kg and 218 g for ram lambs, respectively, and 4.17 kg, 29.4 kg and 205 g, for ewe lambs, respectively (Terentyev 2000). The body weights of animals of different ages kept at the 40th Anniversary of Kazakhstan pedigree plant are shown in Table 45.

Table 45. Productivity of elite Akjaik Mutton-Wool sheep kept at the 40th Anniversary of Kazakhstan pedigree plant.

Groups	Body weight (kg)	Fleece weight (kg)		Staple length (cm)
		Greasy	Clean	
Sires 3-5 years (n=55)	98.7	7.4	4.7	14.4
Replacement yearling rams (n=18)	55.8	4.6	2.9	14.6
Commercial yearling rams (n=184)	61.4	5.2	3.4	15.4
Mature ewes 3-5 years (n=1372)	57.4	4.4	2.8	12.3
Yearling ewes (n=201)	40.4	3.7	2.4	14.2

Source: Terentyev *et al.* (1996).

Animals are usually slaughtered at 4-4.5 months of age, immediately after weaning. Studies have shown that the average pre-slaughter body weight ranges from 30.6 kg to 32.1 kg, while carcass weight ranges from 13.6 kg to 14.5 kg, and carcass yield from 44.4% to 45.2%. Visceral fat content ranges from 0.60 kg to 0.68 kg (2.0-2.1%) (Terentyev *et al.* 1996; Terentyev 2000).

Reproductive performance and milk production

Over several recording years, following artificial insemination with fresh semen in November, average rates of fertility and prolificacy were recorded as 91.6% and 136.3%, respectively. The birth to weaning lamb survival rate (with weaning at the age of 4-4.5 months) was 94.8%. (Terentyev *et al.* 1996; Terentyev 2000).

Terentyev (1993) estimated milk production based on the difference in the weights of lambs before and after suckling on control days over the four months of lactation. Weighing was undertaken separately for ewes with singles and with twins. For ewes with singles, milk production during the first, second, third and fourth month of lactation amounted to 51.2 kg, 44.6 kg, 24.8 kg and 16.3 kg, respectively, with a total yield of 136.8 kg. For ewes with twins, it amounted to 60.1 kg, 53.6 kg, 21.2 kg, and 18.1 kg for each of the four months, and totaled 158.9 kg (Terentyev 1993).

Wool production

The wool produced by this breed corresponds to that of similar crossbred sheep, with staple length averaging 11-18 cm, fiber diameter averaging 26-30 μm (Terentyev 1993; 2001) and fleece weights averaging 4 to 5 kg (Table 54).

Fibers display uniform diameter and length in both the staple and the fleece. Large and medium size crimps are evenly distributed along the whole staple. Wool fibers are white and lustrous. This and their length are attributes associated with crossbred wool. In general, the Akjaik Mutton-Wool breed is the major producer of crossbred wool in the Republic, accounting for about one thousand tonnes—63% of the country's total production of wool.

Genetic and phenotypic parameter estimates

Estimated by doubling the dam–offspring correlation, the heritabilities of body weight, fleece weight, staple length, and fiber diameter were 0.27, 0.34, 0.45, and 0.41, respectively (Terentyev 2000).

Within-sire phenotypic correlation between body weight and fleece weight was 0.45; between body weight and staple length it was 0.02, and between body weight and fiber diameter it was 0.22. Finally, within-sire phenotypic correlation between fleece weight and fiber diameter was 0.22, while between staple length and fiber diameter it was 0.72 (Terentyev 1984).

Repeatabilities were calculated by within-sire correlation of the same trait measured at different ages. For live weights the correlation estimates were as follows: birth vs. 4-months, 0.34; birth vs. 1.5-year, 0.22; 4-months vs. 1-year, 0.36; 1-year vs. 1.5-years, 0.30; 1.5-years vs. 2.5-years, 0.62; and 1.5-years vs. 5.5-years, 0.30. In the case of fleece weights, the correlation estimates were: 1-year vs. 2-years, 0.39; 1-year vs. 3-years, 0.35; 1-year vs. 4-years, 0.25; and 1-year vs. 5-years, 0.20 (Terentyev 1984).

Current breeding structure

Due to the recent general economic crisis and sharp decline in animal numbers, our estimates suggest that the Akjaik Mutton-Wool sheep population declined from 464,000 in 1996 (the breed's registration year) to 248,000 animals in 2000; however, the breed is not at risk of disappearance. Breed development still continues at an optimal level, because the pedigree base and breed structure required for reproduction and breeding was preserved.

There are no longer any large state farms or collective farms in the Akjaik Mutton-Wool sheep area. Instead, newly formed peasant farms and farms owned by private individuals manage this breed in flocks which range in size from 100 to 2500 animals. The bulk of the sheep (75-80%) are kept by individual households, each possessing 5 to 100 animals. The 40th Anniversary of Kazakhstan pedigree plant still keeps 9200 animals and remains the leading pedigree unit associated with this breed.

The Degeress Sheep

The Degeress sheep is the only semi-fine wool fat-tailed sheep in the country. It is well adapted to year-round grazing on semi-steppe and steppe rangelands. The only well documented information on this breed is found in Sadikulov (1985).

Brief account of the development and improvement of the breed

According to the 1985 document published by Sadikulov, the Degeress sheep was developed by crossing Kazakh fat-tailed ewes from the Semirechiye area with Shropshire rams held at the Degeress farm in Almaty Province. The breed's development started in 1929, and was intended to improve the wool quality of Kazakh fat-tailed sheep, which have a strong constitution and well developed meat traits.

The Shropshire x fat-tailed crossbreeds produced were then crossed with Precoz × fat-tailed animals. This was followed by selection. During the period 1931-1932 the live weights of the Degeress sheep kept on the Kargaly breeding farm averaged 80 kg in the case of adult rams (3.5 years old) and 49 kg in the case of adult ewes (3.5 year old). Wool yield averaged 3.73 kg for rams and 2.60 kg for ewes (Sadikulov 1985).

The development of this breed resulted in a fat-tailed animal with a homogeneous semi-fine wool. Degeress rams were also used to develop the Kazakh fat-tailed and semi-coarse wool breed. They were also exported to Uzbekistan, Turkmenistan and to the Mongolian Republic for breeding purposes during the Soviet Union (Sadikulov 1985).

At the start of the 1980s, the best flocks of Degeress sheep were found on the Bakanass breeding farm and the Minbaevo experimental farm, in Almaty Province, as well as on the Aktogai farm in Zhezkazgan Province.

The Degeress has a broad compact body, a deep chest, a wide sacrum, a medium-sized head, a short neck, a strongly built carcass, and a medium-sized fat tail (averaging 2-3 kg in ewes and 4-6 kg in rams).

Degeress ram

Degeress ewe

Production traits

As indicated above, the 1985 publication by Sadikulov contains all the production details given below.

Degeress sheep are early maturing. At the age of 2.5 years, lamb rams can reach 96% of the weight of an adult animal. At the Minbaevo experimental farm, which is under the control of the Kazakh Technological Research Institute of Sheep Breeding, Degeress animals exhibit a strong physical constitution, reasonably well-developed meat muscles, and a well-defined fat tail. Body weights average 102-105 kg in the case of adult (3 year old) rams and 60-65 kg for adult (3 year old) ewes. The wool is white and contains homogeneous semi-fine fibers. Wool yield averages 4.0-4.9 kg in the case of adult (3 year old) rams and 2.2-2.6 kg in the case of adult (3 year old) ewes. On average, fibers reach 11-17 cm in length, with an average diameter of 26.4-29.3 µm.

Degeress breeding currently follows two trends: (i) selection for semi-fine wool animals and (ii) selection for semi-coarse wool.

The Tsigai Sheep

The Tsigai is also a semi-fine wool-meat producing sheep. Raised in the dry steppe areas of Aktau Province, this sheep is considered to be a “type”, and was designated as such in 1977 by the USSR’s Ministry of Agriculture. The development of this type began in 1959 with the crossing of wool and meat producing Tsigai brought from Russia to the Aktau Province. These crosses were followed by selection, resulting in animals with strong physical constitutions and a fleece containing a high density of fibers, which helps them to resist the strong winds that occur in the region.

The information available on this breed is scanty, and the descriptions provided below are derived from Rakhimjanov *et al.* (1997a). This is the only source of information available.

The Tsigai is a thin-tailed animal with a white coat. Live weights average 95-100 kg in the case of rams and 52-54 kg in the case of ewes. Fertility in this sheep type ranges from 95% to 97%.

The wool produced is semi-fine, and is distinguished by its high levels of elasticity and moisture absorption. It is used to produce fine textured fabrics and knitted goods. Wool yield averages 7.6-8.0 kg for rams and 4.0-4.5 kg for ewes. Average fiber diameter ranges from 26.4 to 31.0 µm, and wool fibers average 10-12 cm in length, with 3-4 crimps per cm. The clean yield percentage of the wool averages 46-50%.

Tsigai ram

Tsigai ewes

Mutton Fat-tailed Coarse Wool Breeds

Mutton Fat-tailed Coarse Wool sheep in Kazakhstan include the country’s indigenous sheep, which are known to be adapted to most local conditions and which display good meat and fat production traits. It is estimated that the current population of indigenous fat-tailed sheep amounts to about 6.1 million head (Table 4).

A wide degree of variation is found in this category. There are about 20 different geographical ecotypes, most of which are categorized under the Kazakh Mutton Fat-tailed Coarse Wool sheep. In total, these sheep amount to 4.87 million head (Table 4). Tables 3 and 4 account for the Kazakh Mutton Fat-tailed Coarse Wool sheep as a breed, however there is no information documented about this breed or rather category. The category also includes three additional breeds, all of which are described in this chapter: the Kazakh Fat-tailed Semi-Coarse Wool sheep (70,000 head); the Edilbay sheep (1.1 million head); and the Sariarka sheep (60,100 head) (Table 4; Ermekov 1976). The Edilbay is a well disseminated breed which has been used in productivity improvement efforts involving indigenous fat-tailed sheep in all regions of Kazakhstan.

Kazakh Mutton Fat-tailed Coarse Wool brown ewe and black ram

Kazakh Fat-tailed Semi-Coarse Wool Sheep

The Kazakh Fat-tailed Semi-Coarse Wool breed is the only Kazakh breed producing semi-coarse wool that is white or grey. It is well adapted to desert and dry steppe ranges. Little information is available on this breed. Most of that included here has been summarized by Kanapin and Jumadilla (2001).

Brief account of the development and improvement of the breed

Different breeds were crossed to develop this breed. Those used include the Kazakh coarse wool, the improved Edilbay, the Sarajin, the Degeress, and the Tajik. Selection was undertaken after each round of crossbreeding. The most valued traits of the breed are its semi-coarse wool (which is suitable for carpet making) its good level of meat-fat production, and its adaptability. The Kazakh Fat-tailed Semi-Coarse Wool was approved as a breed in 1994 and has three associated lines: the Kargali, the Aktau, and the Bayis (Kanapin and Jumadilla 2001).

Kazakh Fat-tailed Mutton Semi-Coarse Wool ram

Kazakh Fat-tailed Mutton Semi-Coarse Wool ewe

The Kargali sheep was produced by crossbreeding the indigenous Kazakh Fat-tailed Coarse Wool sheep with the Edilbay, Sarajin, and Degeress, and then selecting from the crossbred population produced. This line is mainly raised in the Karagandy and Almaty Provinces (Kanapin 2001).

The Aktau sheep was produced by crossing Kazakh Fat-tailed Coarse Wool sheep from the Temir area in Aktau Province with Sarajin sheep. This was then followed by a process of selection using the crossbred population. This line is being widely disseminated in the Irgiz and Aitekebiy Districts of Aktau Province (Alishev 1994).

The Bayis line, which is mainly raised in Eastern Kazakhstan, was produced by crossing Tajik fat-tailed rams with Edilbay x fat-tailed crossbred sheep. These crossing efforts began in 1967. Selection was then undertaken, using the progeny of these crosses to develop an animal with a strong constitution and a long body with a deep and wide chest, long legs, and average-sized fat tail (Rakhimjanov *et al.* 1997b; Maitkanov 1999).

Kargaly Semi-Coarse Wool rams

Kargaly Semi-Coarse Wool ewe

Production traits

Descriptions of the Kazakh Fat-tailed Semi-Coarse Wool sheep given below are derived from Kanapin and Jumadilla (2001).

The liveweight of the Kazakh Fat-tailed Semi-Coarse Wool rams ranges from 90 kg to 112 kg, while that of ewes ranges from 58 kg to 62 kg. Wool yields range 4.0-5.0 kg for rams and 2.2-2.8 kg for ewes. Clean wool yield ranges 66-72%. The prolificacy rate of ewes is 105-115%. At weaning, liveweight ranges 35-38 kg for ram lambs and 33-36 kg for ewe lambs.

Due to the fact that they are well adapted to the environmental conditions found in the western, central, and northeastern regions of Kazakhstan, flocks of Kazakh Fat-tailed Semi-Coarse Wool sheep are raised in Aktau, Karaganda, East Kazakhstan, and the Almaty Provinces. In these areas, the breed is being used to improve wool and meat-fat productivity in indigenous Kazakh Fat-tailed Coarse Wool sheep.

The Edilbay Sheep

Currently this breed is the most important breed of fat tailed coarse wool sheep found in the country. The Edilbay population amounts to 1.1 million head (Table 4). About 75% of these animals are located in the west, and the remainder are found in Eastern Kazakhstan (10%) and Central Kazakhstan (15%).

The breed, along with other fat-tailed sheep found in the country, is raised in the major mutton-fat sheep zone. This includes the semi desert and arid steppes, which receive 200 mm of rainfall per year and allow year-round rangeland grazing. Summers in the area are hot (up to 35ºC) and winters are cold (-40ºC). Water supplies are insufficient, and in some areas highly saline. Fat-tailed sheep, like the Edilbay breed, are well adapted to this environment, to the local natural grasses that grow in it and to the need to move them to distant seasonal rangelands.

Market demand for the mutton and fat produced by fat-tailed sheep is high and on the increase, because of the flavor of the meat and a preference for carcasses with fat tails. This is in particular true for lamb meat. Demand for sheepskins and wool is very low and the milk is not marketed.

Brief account of the development and improvement of the breed

The Edilbay breed was developed at the end of nineteenth century in the Ural Province. The real origin of this breed is not known. To improve the production traits of these animals, however, the State organized a Breeding Center in the Ural Province during the Soviet Union.

The current Edilbay sheep weighs less and is smaller than the Edilbays recorded in 1930-1935. It also has a longer body and a smaller chest girth (Balmont 1935; Popov 1951; Kanapin 2003). This breed was well characterized on the Berlik Joint Stock Farm (JSF) and the Suyundik JSF.

Management

This breed is managed entirely through range grazing, except during critical periods of the winter when animals have to be moved to barns and fed with hay and concentrates. From June to October, they are grazed on the ranges of Jaylau. Fattening occurs while animals graze on the ranges in this period, in a management known as the Nagul system, which starts in the summer. From the first half of November the flocks are moved to the fall ranges, which have good grasses and good water supplies and the fattening is ended. From this time to March sheep graze on winter ranges with additional hay feeding. From March to May grazing is on spring ranges in steppes and valleys. Table 46 summarizes the main management characteristics of the breed.

Table 46. Management calendar of Edilbay sheep.

Events and seasons	Months											
	D	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating												
Lambing												
Weaning												
Shearing												
Grazing SuR†												
Grazing stubbles												
Grazing WiR												
Grazing SpR												
Seasons	Winter			Spring			Summer			Fall		

Source: Compiled by authors.
Notes: †grazing in ranges of Jaylau.
SuR = Summer range, WiR = Winter range and SpR = Spring range; FR = Fall range.

Appearance

Individuals are large, with a compact deep and relatively wide body. The back is straight and wide and the head is massive, with a long and clearly hooked-nosed (particularly in rams). Rams and ewes are usually polled, though they may display some rudimentary horns. The ears of individuals are long and hang down, while the fat tail is large and slightly elevated. The legs are lean and long, and the hooves are firm enough to allow the animals to cover the long distances necessary when grazing the scanty rangelands. The coat and wool color of Edilbay has changed. Previously, typical composition of a flock in terms of color was 24% brown, 37% chestnut, 23% black, 11% skewbald, and 5% white and gray. Currently the proportion of black has increased significantly, and now accounts for 65-70% of a flock.

Edilbay ram

Edilbay ewe

Body weight, growth and carcass traits

At birth ewe lambs weigh 4.5-5 kg and ram lambs 5-5.4 kg. At weaning (at the age of 4-4.5 months) ewe lambs weigh 36-37 kg and ram lambs 38-40 kg (Kanapin *et al.* 2001). At the age of 1.5 years ewes weigh from 60 kg to 65 kg and rams from 70 kg to 75 kg. The average live weight of mature (4.5 year old) ewes and mature (3.5 years) rams ranges form 66 kg to 75 kg and 95 kg to 120 kg, respectively (Ermekov and Koptleyov 1982; Balmont 1984; Kanapin and Akhatov 2000).

At Berlik JSF in Western-Kazakhstan, live weights have been found to range from 100-120 kg in the case of mature (3.5 year old) rams and 65-75 kg in the case of mature ewes (4.5 years). Fleece weights ranged from 2.2 kg to 2.6 kg. The live weight of ram hoggets was 40-45 kg while that of ewe hoggets was 38-42 kg (Balmont 1984; Kanapin and Akhatov 2000; Ermekov and Golodnov 1976; Ermekov and Koptleyov 1982).

Reproductive performance and milk production

Fertility is high as only about 5-8% of ewes remain barren. At the age of 18 months ewes are ready to reproduce. Prolificacy ranges from 110-120%, with most ewes producing single lambs (Popov 1951; Ermekov and Koptleyov 1982; Kanapin and Isenbayev 2001). Lamb survival until weaning is 95-98% (Popov 1951; Ermekov and Golodnov 1976; Kanapin and Isenbayev 2001).

The prolificacy and fattening capabilities of the breed have not been researched or recorded in recent years. The same is true of milk production; however, from the intense growth of lambs that has been observed, it is inferred that milk production is high and that lambs grow fast—as by weaning they reach 35-40 kg or 55-60% of their dam’s weight (Popov 1951; Ermekov and Golodnov 1976; Kanapin and Isenbayev 2001).

Genetic and phenotypic parameter estimates

No information on heritabilities or other genetic parameters is available for this breed.

Current breeding structure

According to national plans for breed distribution, Edilbay sires will be distributed throughout all areas containing indigenous coarse wool fat-tailed sheep.

Flocks with a registered genealogy are currently available at the Berlik JSF in West-Kazakhstan and Suyundik JSF in the Atirau Region, which between them hold a total of 10,000 head (Kanapin *et al.* 2001). Sheep on pedigree farms are owned by the State and researchers control their breeding plans. In fact, KTRISB is the main coordinator of research and genetic improvement plans applied to Edilbay sheep. Further development and improvement of this important breed requires State support.

It is suggested that the extensive use of highly productive Edilbay rams will improve the mutton-fat properties of indigenous coarse wool sheep, increasing the supply of competitively priced mutton available. Commercial farms run 200-500 sheep and could integrate breeding and fattening at a low cost using seasonal grazing. However, at present they have to face serious financial limitations.

The Sariarka Fat-tailed Coarse Wool Sheep

The Sariarka sheep is the first fat-tailed breed with a white and light gray colored coarse wool that is adapted to deserts, semi-deserts, and dry steppes. The only available reference work that contains the information that follows is Esentaev (2001).

The breed was developed in the Karaganda province by the Kazakh State Agrarian University, the Kazakh Technological Research Institute of Sheep Production at the Jenis breeding plant (a stock company) and Sarisu (a private company). Work to develop the breed began in the period 1970-1980, with the crossing of Kazakh fat-tailed sheep and Edilbay and Kargali sheep (a fat-tailed semi-coarse wool animal). This was followed by a process of selection.

The Sariarka has a strong physical constitution, well developed bones and muscles, and strong legs and horns, which are very important for all year round grazing. The animals' meat productivity excels in comparison to the indigenous

Sariarka Fat-tailed Coarse Wool ram

Sariarka Fat-tailed Coarse Wool ewe

Kazakh Coarse Wool sheep (producing 8-10% more). Its wool yield is actually similar to that of the indigenous Kazakh Fat-tailed Coarse Wool sheep. The liveweight of rams ranges 95-110 kg and that of ewes 60-65 kg. Wool yields range 3.0-3.5 kg for rams and 2.0-2.4 kg for ewes. Prolificacy ranges 105-115%.

The breed is mainly kept in the Jana-Arka and Uli-Tau districts of Karaganda Province. It is recommended for use in the dry steppe areas of Akmola, East Kazakhstan, Kostanai, and the Pavlodar Provinces.

Pelt Breeds

The pelt breeds kept in Kazakhstan include the Karakul and the Atirau breed that derives from the former. There are approximately 1.5 million head of pelt animals (Table 4).

The Karakul Pelt-Mutton-Fat Sheep

Brief account of the development and improvement of the breed

The origin of Karakul sheep is uncertain. However, these fat-tailed sheep have a long history of adaptation and selection in the country. No other breeds can thrive and produce on the 40 million hectares of desert rangelands found in the Republic of Kazakhstan. Karakul sheep were improved since the 1930s.

Currently Karakul sheep are distributed over five regions in Kazakhstan: 650,000 head in South Kazakhstan, 420,000 in Kizil Orda, 250,000 in Zhambul, 230,000 in Mangistau and 70,000 in West Kazakhstan. It is estimated that the Karakul population amounts to 1.5 million animals (Table 4).

The breed produces valuable multicolored pelts, as well as mutton, and fat. Until the fall of the Soviet Union, Karakul pelts were sold at the Leningrad International Auction and were an important source of hard currency for the Republic. The collapse of the market has caused production to stagnate. Other products in demand in the domestic market are sheepskins and rennet. The latter is a very important raw material for cheese making and medicine.

Management

Except for periods of extreme bad weather, Karakul sheep graze year-round on open rangelands (Table 47).

Appearance

The Karakul is a fat-tailed sheep. The head is narrow, with a slightly roman profile and drooping long ears that can be up to ¾ of the length of the head. Rams have spiraled, downward curving horns, while ewes are polled. The neck is of medium length. The body is relatively small, pear-shaped and has thin but strong bones. The animals have well-developed muscles and long, thin legs. Coat colors include black (about 60-65%), the dominant color, gray (15-18%), and Sur or light brown (13-15%). A small proportion of animals have coats of a less common color, including white, brown, fawn, or pink. It is felt that the productivity of Karakul sheep differs depending on the coat color; black coated animals are the most hardy (Jilyakova and Chepeleva 1976; Ombaev 2003; Elemesov 1991; Shirinskiy 1997).

The fat-tail is an adaptation which confers upon animals the capacity to survive the unfavorable winter conditions found in the deserts where they live. The tail is long and forms the typical pillow of fat-tailed animals ending in an S-shaped narrow appendix (Jilyakova and Chepeleva 1976).

Table 47. Management calendar for Karakul sheep.

	Months											
Events and seasons	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**
Mating											■	■
Lambing				■	■							
Weaning								■	■			
Shearing					■	■				■		
Range grazing†	■	■	■	■	■	■	■	■	■	■	■	■
Seasons	Winter			Spring			Summer			Fall		

Source: Compiled by authors.

Note: †Karakul graze the ranges of the region year-round.

Body measurements

Most of the descriptive data available (including production data) comes from experimental farms. Table 48 shows the body weight and body measurements of this sheep at different ages.

Black Karakul ram

Black Karakul ewe

Grey Karakul ram

Grey Karakul ewe

Sur Karakul ewe, Bukhara type

Sur Karakul ram, Bukhara type

White Karakul ram

Table 48. Average body measurements in cm (±Standard error) of Karakul sheep (n=50).

Trait	At birth	At weaning (4-4.5 months)	At 12 months	At 24 months
Height at withers	37.5±0.15	59.8±0.24	60.4±0.23	66.5±0.16
Diagonal body length	31.8±0.22	52.3±0.13	63.7±0.23	70.8±0.24
Chest girth	37.9±0.18	66.8±0.14	69.8±0.23	77.0±0.22
Metacarpus girth	5.0±0.03	7.0±0.04	7.0±0.04	7.8±0.06

Source: Ombaev *et al.* (2004).

Body weights, growth and carcass traits

The average weights of ewe lambs at birth, at weaning (4-4.5 months) and at 1.5 years are 4.68±0.03, 25.6±0.05, and 42.8±0.23 kg, respectively. The average daily gains from birth to weaning and from weaning to 1.5 years are 156.2 and 161.3 g, respectively. The characteristic body weight of mature rams and ewes is 77.2 and 50.6 kg, respectively, though this varies from province to province (Elemesov 1986; Ombaev 2003).

No reliable information on carcass weights is available.

Reproductive performance and milk production

In desert areas, only Karakul sheep are able to perform with a good reproductive rate, reflecting an adaptation to harsh conditions. Under ordinary conditions, prolificacy ranges from 101% to 104% (Tuekbasov 2004) and could be increased to 140-150% with the use of hormone treatments. (Sadikbekov 1988). Under more abundant feeding conditions (such as those found in West Kazakhstan and Astrakhan oblast) prolificacy increases to 120-125% (Sadikbekov 1988).

With rather high birth weights (up to 5 kg), Karakul lambs have a high survival rate and grow very fast. At weaning ram lambs weigh 27.0-30.0 kg and ewe lambs 25.6-26.9 kg. (Jilyakova and Chepeleva 1976).

Commercial milk production using Karakul sheep has not been practiced since 1950. Karakul milk is rich in dry matter, protein, and fat and is suitable for processing into *brynza* (cheese) and butter. Karakul sheep milk contains, on average, 8.6% fat, 6.2% protein, and 20.9% dry matter (Ahmetov and Akimov 1989). Average daily milk yield ranges from 400 g to 420 g, but can reach a maximum of 630 g. The lactation period lasts for 4-6 months. Mature Karakul ewes produce on average 65-67 kg of milk during one season and ewes that are lambing for the first time 6-7 kg less (Ahmetov and Akimov 1989).

Pelt production

Several colors are available in Karakul. The black, grey and sur are the most common, with variations within colors. Litter size influences pelt size. The pelt of single born lambs is always 10-12% larger than that of twins and 20.5-25% larger than that of triplets. Nevertheless, the sum pelt area of twins and triples is larger than that of singles (Youdin 1966). Triplets and quadruplets are not desirable for pelt production, because the pelt area is reduced and the quality diminished (Ahmetshyev 1989).

Black Karakul lamb

White Karakul lamb

Sur Karakul lamb, Bukhara type

Sur Karakul lamb, Kazakh type

Wool production

The Karakul sheep produces a coarse wool which is often used in the manufacture of carpets. The animals are shorn twice a year, as indicated in Table 47. Yields in the spring and fall shearings range from 1.09 kg to 1.69 kg and 0.86 kg to 1.1 kg, respectively (Ombaev *et al.* 2003).

Genetic parameters

Few estimates of the genetic parameters Karakul are available. Heritabilities for hair length, birth weight curl width and prolificacy were 0.63 (n=105), 0.31 (n=115), 0.42 (n=105) and 0.16 (n=106) (Ahmetshyev 1989, using methods of Merkuryeva and Shangin-Berezovskiy 1983). The heritability of prolificacy is unusually high in a breed where little variation in litter size is exhibited. This suggests that the procedures used to calculate it may not be the correct ones, in addition to the sample size being insufficient.

Genetic correlations for some pelt traits are included in Table 49.

Table 49. Genetic correlations of Karakul sheep pelt traits.

Traits correlated	Genetic correlation
Hair length-skin thickness	0.66
Hair length-curl width	0.08
Skin thickness-curl width	0.44

Source: Umurzakov (1992).
Note: Number of observations involved was not provided.

Vasin (1968) studied the inheritance of pelt color, identifying those genes responsible for silver, light brown, dominant black, brown, and dark brown colors, as well as lethal genes that cause a roan color. Some theoretical assumptions made by this author on color inheritance were not confirmed in practice.

Youdin (1966) worked out a methodology to obtain Karakul sheep flock of a Sur color.

Current breeding structure

Kazakhstan's Karakul Sheep Breeding Institute coordinated the selection work dealing with the Karakul and Atirau (a variety of Karakul) on State farms affiliated to the Institute (Kulzhabaev, Birlik, Akdala, and Halel). The flocks of these farms consisted of 53,000 animals, all with controlled genealogies. The institute also undertook research and supervised breeding activities on 23 farms under a variety of different forms of ownership. The flocks held by these establishments amount to 25,000 animals.

Karakul sheep numbers have shrunk significantly due to the general crisis faced by the livestock industry. The pedigree breeding stock was relatively preserved in the experimental farms affiliated to the Karakul Sheep Breeding Institute (KSBI); but, with no support little genetic progress could be expected. A Karakul Breeding Center is being established. This will coordinate future changes in the genetic structure of the breed and in selection procedures.

Table 50 gives an account of the different farms involved in Karakul breeding in Kazakhstan.

The Atirau Pelt-Mutton-Fat Sheep

The Atirau sheep was established in 1998 by crossing Surkhandarya light brown Karakul sires with indigenous fat-tailed and Edilbay ewes. This was done in order to fix the brown Karakul pelt color and incorporate the large body and precocity of the Edilbay. The breed developed therefore produces pelts, wool, and meat typical of Karakul, in addition to the fact that is in high demand.

At present the population of this breed amounts to 14,000 head: 13,000 raised in the Atirau region and 1000 in Southern Kazakhstan.

Atirau sheep are characterized by their heavy live weights and large bodies, traits that are inherited from the Edilbay sheep. The head is oblong and with a roman profile. The fat-tail is round.

Table 50. Characteristics of Karakul production systems.

Farm type	Number of animals	Number of farms	Ownership form	Financial conditions	Main characteristic
State enterprises	3000-10,000	3	Public	Minimal	High production performance
Production cooperatives	10,000-17,000	9	Cooperative	Minor financial problems	Operate on own financial resources. There is an agreement with the Karakul Sheep Breeding Institute with regard to breeding activities
Commercial enterprises	5000-10,000	12	Private	Serious financial problems	These farms have good production prospects in case the receive long-term favorable loans. They are the country's main pelt manufacturers.
Farms	3000-7000	12	Private	Financial problems	Face shortage of rangeland and water sources.

Source: Compiled by authors.
Note: na = data not available.

Birth weight ranges from 4.2 kg to 4.7 kg in the case of ram lambs and 4.0 to 4.5 kg in the case of ewe lambs. By weaning, ram lambs achieve a live weight of 36-38 kg and ewe lambs a live weight of 31-34 kg. The average live weight of mature (>2.5 years) rams is 90 kg (up to 100 kg) while that of ewes ranges 52-56 kg. In comparison with Karakul sheep Atirau animals are 26.5% heavier, have a 27.4% heavier carcass, and a 51.3% heavier fat tail (Tuekbasov 2004).

As with ordinary Karakul, Atirau ewes have not been milked commercially since the 1950s, and milk is not considered a commercial product of this breed. Both breeds produce a coarse wool which is arranged in staples. Staple length varies from 8 to 20 cm. Down content ranges from 25% to 50% of the fleece. A summary of the differences between both breeds is shown in Table 51.

Table 51. Summary of differences between Karakul and Atirau sheep.

Trait	Karakul	Atirau
Size	Medium	Large
Fat tail	Fat, oblong ending in an appendix	Fat, round
Ears	Large	Large, hanging down
Wool type	Coarse wool	Coarse wool
Primary specialization	Karakul pelt	Karakul pelt, mutton and fat

Note: Arranged by authors.

Atirau ram

Atirau ewe

Flock of Atirau ewes

Goat Breed Characterization

The literal translation of the two goat breeds of Kazakhstan, "Soviet Wool Goats of Kazakhstan Population" and "Coarse Wool Goats" is not very useful and may mislead English readers. Goats produce basically two types of fleeces. A fleece with uniform, long or short fibers and a fleece with mixed fibers, which includes short, fine undercoat fibers (or down) and coarse, long guard hair. If the uniform fibers are largely white, long, and lustrous and have a characteristic curl it is called Mohair. And, if the proportion of down fibers in the mixed fibers fleece is appropriate and the fibers have a very fine in diameter, it is called Cashmere. Therefore, in what follows, we shall refer to the "Coarse Wool Goats" as "Kazakh Cashmere" as this breed includes goats with mixed fibers which include fine undercoat fibers that qualify as Cashmere. We shall refer to "Soviet Wool Goats" as "Kazakh Mohair", as this breed produces a uniform long fiber which is like Mohair. In addition to the goat breeds that produce these two types of special fibers, crossbred populations and native or non specialized goat populations are also found in the country.

About two thirds of Kazakhstan's total goat population is made up of the Kazakh Cashmere, while Kazakh Mohair account for the remaining third. Though Kazakh Cashmere goats are found in all regions, Kazakh Mohair goats are basically only found in the South and Northeast (Table 52).

Table 52. Geographical distribution of goat breeds in Kazakhstan (thousands).

	South		Center		West		North and East		
Breed	n	%	n	%	n	%	n	%	Total
Kazakh Cashmere	519	50	52	5	364	35	104	10	1,039
Kazakh Mohair	180	40	0	0	0	0	270	60	450

Source: Compiled by authors.
Notes: the South includes the Almaty, Zhambul, South-Kazakhstan and Kizil Orda regions; the Center includes the Karaganda and Akmola regions; the West includes West-Kazakhstan, Aktau, Atirau and the Mangistau regions; North and East include North-Kazakhstan, Kustanay, Pavlodar, and the East-Kazakhstan regions.

The Kazakh Cashmere Goat (Coarse Wool Goat)

This breed represents the native goat population found in all climatic areas and feeding zones of Kazakhstan, but principally in the desert, semi-desert, steppe, mountain, and alpine areas. Little information is available concerning this breed.

These goats are usually managed under year-round range grazing conditions. However, in the northeast they may be housed at some times of the year. The breed is estimated to stand at 1.039 million head (Table 4).

Appearance

These animals have a strong constitution. They are horned as a rule (crescent-shaped horns) with drooping ears and a small beard. The normal coat color is black; the coat consists of short down fibers and long top hair.

Kazakh Cashmere buck

Kazakh Cashmere doe and kid

Body measurements, body weight, growth and carcass traits

Animals differ according to the particular breeding environment. Kazakh Cashmere goats bred in the Northeast are the biggest. Bucks average 66 cm in height at the withers, and have an average diagonal body length of 74.5 cm, an average chest depth of 31.8 cm, and an average live weight of 42.3 kg (Musazhanov 1989). In the Southeast, average height, length, chest depth, and live weight of does are 56.9 cm, 73.8 cm, 31.3 cm, and 38.6 kg, respectively (Mutairov 1991).

Body weight evolution with age and prolificacy, as measured by different authors, is shown in Table 53.

Table 53. On-farm body weight and prolificacy of Kazakh Cashmere goat females.

	Region		
Trait	Northeast†	Southeast‡	West§
Birth weight (kg)	2.97	2.55	2.32
4-months weight (kg)	17.8	17.6	16.1
12-months weight (kg)	23.9	18.4	18.5
18-months weight (kg)	34.6	29.4	27.3
Mature (≥3 years) weight (kg)	42.3	38.6	36.3
Prolificacy (%)	130.1	131.3	119.6

Sources: †Musazhanov (1989); ‡Aryngaziev (1983); §Tisher (1991).
Note: Number of observations was not provided by authors.

Fattening trials suggest that young Cashmere goats will respond to diets containing concentrates, growing more than Mohair goats which provided lower growth rates on the same diet (Musazhanov 1989; Aryngaziev 1983).

Musazhanov (1989) provided a concentrate diet based on pellets containing 0.73 feed units and 80 g of digestible protein. The pellets were composed of *Artemisia*-grass hay (35%), straw (15%), crushed barley (29.3%), ground alfalfa hay (20%), and salt (0.7%). Aryngaziev (1983) provided a diet of concentrate pellets which provided 0.65 feed units and 72 g of digestible protein. The pellet composition was as follows: *Artemisia*–grass hay (20%), straw (20%), crushed barley (42.5%), grounded alfalfa hay (14%), salt (0.5%), and molasses (3%). Table 54 shows the results for these experiments and the general low rate of growth that is typical of goats.

Table 54. Results of Cashmere and Mohair goat fattening experiments.

Fattening period	Breed	n	Initial weight (kg)	Final weight (kg)	Total weight gain (kg)	Average daily (g/d)	Feed conversion (feed units/kg)
4 to 6 months	KC†	20	18.3	27.2	8.4	146	6.84
6-6.5 to 8-8.5 months	KC‡	20	18.6	26.0	7.5	122	6.60
	KM‡	20	17.3	23.6	6.3	104	7.08
8-8.5 to 10-10.5 months	KC‡	20	26.0	33.9	7.9	133	8.10
	KM‡	20	23.6	30.7	7.1	119	8.17
16 to 18 months	KC†	25	33.4	40.8	7.4	123	9.80

Sources: †Musazhanov (1989); ‡Aryngaziev (1983).
Notes: KC: Kazakh Cashmere, KM: Kazakh Mohair.

More recent fattening trials (Mutairov 1991; Tisher 1991), conducted on kids aged 6 to 6.5 months and continued until the kids reached 8-8.5 months of age confirmed the superior growth rates of Cashmere goats (122 g/d; Mutairov 1991 and 119 g/d; Tisher 1991) than those of Mohair goats (104-110 g/d).

The carcass performances attained in the experiments performed by Aryngaziev (1983) are summarized in Table 55 for both Mohair and Cashmere goats. Carcass yields and the composition of the carcass in relation to percent of meat and percent of bones at 8-8.5 months and 10-10.5 months of age did not differ between the Cashmere and the Mohair goat breeds.

Table 55. Carcass performance of Cashmere and Mohair Kids after fattening.

	Age (months) of n=3 kids at each slaughter age			
	8-8.5		10-10.5	
Carcass trait and composition	KC	KM	KC	KM
Carcass traits				
Pre-slaughter weight (kg)	26.2	23.0	33.6	29.7
Carcass weight (kg)	11.5	10.0	14.3	12.8
Carcass yield (%)	43.9	43.6	42.8	43.1
Weight of visceral fat (kg)	1.30	0.40	1.56	1.04
Visceral fat yield (%)	2.60	1.72	4.90	3.60
Carcass composition				
Meat (%)	76.7	76.4	80.8	81.0
Bones (%)	23.3	23.6	19.2	19.0

Source: Aryngaziev (1983).
Notes: KC: Kazakh Cashmere, KM: Kazakh Mohair.

Fiber production (cashmere)

The down (cashmere) yield of Kazakh goats accounts for 23.6-32.2% of their fleece weight. Most of the down produced is colored, though some is white. White down is characteristic of goats with white, gray, and pale-yellow coats. Animals with coats of these colors, as well as those with brown and red coats, are considered inferior to animals with black coats in terms of their down yield. The average weight of down produced by goats with different colored coats other than black ranges from 143 to 146 g. The average weight of down produced by goats with black coats, however, ranges from 190 to 266 g (Aryngaziev 2000).

The number of animals with white coats has increased in many flocks in recent years, especially in Southeast Kazakhstan. This is due to the influence of the Kazakh Mohair bucks used in the region. Less contaminated herds are found at remote grazing sites, and are notable for the color of their coats. The proportions of black, gray, brown, red, and pale-yellow coats in the Southeastern zone have been recorded as 46.3%, 4.2%, 10.4%, 3.8%, and 35.3%, respectively, while in the Northeastern zone they have been found to be 86.0%, 6.4%, 2.8%, 1.6%, and 3.2%, respectively (Musazhanov 1989; Aryngaziev 1983).

In terms of down yield, the goats of Western Kazakhstan excel in comparison to those of Southeast Kazakhstan (producing 199 g as opposed to 137 g; see Table 56).

Table 56. On-farm fleece characteristics of female Kazakh Cashmere goats.

Trait	Region		
	Northeast[†] (n=52)	Southeast[‡] (n=45)	West[§] (n=74)
Fleece weight of yearlings (kg)	0.28	0.26	na
Fleece weight of mature goats[¶] (kg)	0.61	0.48	na
Fiber length of yearlings (cm)	9.5	9.2	na
Fiber length of mature goats[¶] (cm)	12.4	11.3	na
Down weight of yearlings (g)	na	85	145
Down weight of mature goats[¶] (g)	na	137	199
Down length of yearlings (cm)	na	5.1	4.7
Down length of mature goats[¶] (cm)	na	5.6	5.1
Down fiber diameter of yearlings (µm)	na	16.5	16.9
Down fiber diameter of mature goats[¶] (µm)	na	16.6	17.4

Sources: [†]Musazhanov (1989); [‡]Aryngaziev (1983); [§]Tisher (1991).
Note: [¶]Mature: (≥3 years).

A survey was conducted of native goats in Kazakhstan, as well as in other Central Asian Republics, during the period 1925-1930. As reported by Aryngaziev and Tisher (1993), this survey obtained the following measurements for female goats in Kazakhstan: body weight, 39.6-44.5 kg; height at withers, 61.5-66.1 cm; diagonal length of body, 66.0-69.6 cm; chest girth, 78.0-82.2 cm; prolificacy, 110-130%; fiber production, 0.27-0.45 kg; down content, 15.6-46.1%; down production, 102-234 g; and down fiber diameter, 11.4-16.0 µm. The ranges given for these measurements relate to differences encountered among regions. Comparing these results with contemporary goat herd data shows that production traits have not improved over the last 60 years. On the contrary, body weights, down yields and fiber fineness have actually fallen.

Current breeding structure

Under current conditions, the prospects for Kazakh Cashmere goat breeding depend on the quality of down that can be produced. This needs to correspond to the requirements of the market. Genetic improvement of coarse fiber goat herds should be resumed without delay. This should aim firstly to increase down productivity by using purebred Kazakh Cashmere bucks. This is a priority, because there is high demand for goat down on the domestic and international markets. Coarse fiber goats are polyestrous, a condition allowing them to kid three times within two years. These properties of Kazakhstan coarse fiber goats are currently exploited in the individual farming sector.

As indicated above, some deterioration has been observed with regard to the breeding of Kazakh Cashmere goats. A particular cause of this is indiscriminate crossing with mohair-producing bucks, which is causing down quality to degrade.

Selection work in the North of the Republic has resulted in the establishment of a small but productive flock of Cashmere goats. The flock was developed by crossing 2-3 generations of coarse fiber goats from Western Europe with

Pridonskaya, Gornoaltayskaya, and Orenburgskaya sires imported from the Russian Federation. The live weight of these crossbreds varies depending on their origins, ranging from 38.5 to 40.0 kg. Down yield, by the same token, ranges from 308 to 497 g, down length from 6.5 to 7.9 cm, and down diameter from 17.3 to 19.9 µm. The highest level of productivity with regard to down yield, length, and diameter is displayed by the offspring of the Pridonskaya crosses. The down yields of Orenburgskaya crosses fall between those of the Pridonskaya and Gornoaltayskaya crosses However, they outperform them in terms of live weight (Aryngaziev and Izbasarov 1998).

The Kazakh Mohair Goat (*Soviet Wool*)

There were 450,000 Kazakh Mohair goats in Kazakhstan in 2004 (Table 4). This breed is kept in Uzbekistan, Kazakhstan, Tajikistan, and Kyrgyzstan.

Brief account of the development and improvement of the breed

According to a survey conducted during the Soviet Union (Dauletbaev 1978), there were approximately 7000 Kazakh Mohair in Kazakhstan in 1971. These were kept on two farms in the Semipalatinsk (at present East-Kazakhstan) Region. This population became the basis for renewed research and breeding work in 1973. The studies undertaken aimed both to develop the pure breed of Kazakh Mohair goats found in the main breeding area (the Semipalatinsk Region) and to establish new herds in the Southeast of the Republic by crossing indigenous coarse fiber does with Kazakh Mohair bucks. The breed was registered in 1962. During the development of the breed, Angora bucks were imported from the USA and crossed with coarse fiber does from Kazakhstan, Uzbekistan, Tajikistan, and Turkmenistan. The crossbred progeny of mainly the second (but in some cases the first and third) generations were used for breeding, followed by pure breeding of the offspring.

It was shown that Kazakh and Kyrgyz Mohair goats were heavier than goats from other countries. However, no differences were found with regard to fleece weight among the populations. Furthermore it appears that, for the processing industry, Kazakh and Kyrgyz Mohair goats also produce a higher mohair quality. Therefore bucks from these two populations were used to further improve goat herds in other Central Asian Republics and in the Russian Federation.

Management

This type of goat is subject to range-based management for most of the year, except in winter when they are fed in sheds. When kept on farms, kidding takes place all year-round. Early weaning is not a common practice in Kazakhstan, due to a lack of adequate extension work and feeding conditions. It is a common practice to milk does once in the morning. To allow this, kids older than two months are, as a rule, separated from their dams during the night.

Appearance

Animals of this breed are characterized by having moderately developed horns, a small head, a roman profile, and drooping ears. Their fleece has curly, white, uniform and lustrous fibers. The morphological composition of the fleece of this breed is similar to that of mohair produced by Angora goats, though the fibers are shorter and thinner.

Kazakh colored Mohair buck

Kazakh Mohair doe

Body weight, growth and carcass traits

The average body weight of different goats across the country ranges from 65 to 70 kg for bucks and 38 to 40 kg for does (Aryngaziev and Tisher 1993). When the breed was registered, the average body weights and fleece weights of does ranged, respectively, from 36 kg to 41 kg and from 1.6 kg to 1.9 kg. In the case of bucks the respective ranges were 54-65 kg and 2.8-3.8 kg. Clean yield obtained ranged 74-80% and the breed's prolificacy ranged 104-106% (Aryngaziev and Izbasarov 1998).

Weights at different ages are shown in Table 57.

Table 57. On-farm body growth and prolificacy of Kazakh Mohair females.

Trait	Mutairov (1991) (n=105-120 head)	Aryngaziev (1983) (n=45 head)
Birth weight (kg)	2.33-2.99	2.43
4-months weight (kg)	17.4-16.4	15.8
12-months weight (kg)	20.9-19.5	16.3
18-months weight (kg)	31.4-28.6	25.9
Mature (≥3 years) weight (kg)	43.1-40.3	37.1
Prolificacy (%)	121.5-126.2	115.3

Mohair goats are slow growers and ranked the lowest in fattening trials in relation to Cashmere goats (Table 54). Carcass evaluations also ranked Mohair goats as more bony than Cashmere goats (Table 55).

Fiber production (mohair)

Spring (mid-March) is the period when down combing followed by shearing is undertaken. For Kazakh Mohair goats the optimal shearing dates depend on the region: the end of March to the beginning of April in the Southeast and the end of April to the beginning of May in the North and Northeast. Native coarse fiber goats and their Kazakh Mohair crosses are predisposed to shed their fibers—much more so than purebred Kazakh Mohair goats or Angora goats. Late shearing may significantly reduce fiber output due to shedding. Average fleece weight in different regions of the country range from 3.5 kg to 4.0 kg for bucks and from 2.0 kg to 2.5 kg for rams (Aryngaziev and Tisher 1993). Table 58 presents fleece yields and fleece characteristics at different ages.

Table 58. Fleece yields and characteristics of Kazakh Mohair does.

Trait	Mutairov (1991) (n=10)	Aryngaziev (1983) (n=8)
Fleece weight of yearlings (kg)	0.81-0.90	0.75
Fleece weight of mature goats (≥3 years) (kg)	1.54-1.70	1.25
Staple length of yearlings (cm)	18.7-20.2	17.7
Staple length of mature goats (≥3 years)	18.6-20.4	18.5
Fiber diameter of yearlings (µm)	23.1-25.4	25.3
Fiber diameter of mature goats (≥3 years) (µm)	32.6-34.3	31.5

The data given in Table 58 correspond to Kazakh Mohair goats in the two main production regions. The Mutairov (1991) data, collected in the Northeast, suggest that fleeces are heavier and the mohair coarser in that area than in the Southeast, where the study by Aryngaziev (1983) was conducted. It is not known whether these differences are environmental or genetic.

Current genetic structure

In Kazakhstan, most goat herds are managed by individual farmers or, to a certain extent, by farming enterprises. Experimental farms and most research institutions do not possess goat herds. Research into goat breeding was initiated in Kazakhstan only in 1973, and the only research institution dealing with goats is KTRISB.

In general, there are no pedigree farms. In the past, there was one pedigree plant and three pedigree farms engaged in breeding the Kazakh Mohair. Lately, however, those farms were privatized and the number of pedigree animals in their herds has declined significantly. This resulted in the breeding plan being discontinued.

In the Southeast, as mentioned above, coarse wool goats were upgraded by crossing them with Kazakh Mohair goats for 3 or 4 generations. Crossbred goats from this area are characterized by their low body and fleece weights: does weigh 34.6-35.8 kg, producing 1.07 kg to 1.20 kg of fiber respectively (Nurmakhanbetov 1997). Research work is currently being undertaken by the KTRISB researchers using small herds (50 to 400 animals) owned by peasant farmers and individuals. This aims to produce specialized flocks for cashmere, mohair or dairy production.

Prospects for Small Ruminant Production in Kazakhstan

National Plans

Kazakhstan's Ministry of Agriculture has proposed a new Government Strategic Plan for sheep production until 2030. This states that sheep production should develop in three stages. In the first stage, before 2003, sheep and goat populations should stabilize at 11.2-11.5 million animals. The second phase is to be achieved by 2010, and should see the population increase to 22-24 million. In the final stage, which should be achieved by 2030, the population should reach 36 million animals (Table 59). The Plan assumes certain trends in animal numbers and productivity, particularly on those projected for fine wool sheep. Whether these targets will be achieved is arguable, as market considerations need to be taken into account, in particular with regard to fiber production.

Table 59. Expected sheep production by 2030 as stated by the Government Strategic Plan.

	Head (million)		Productivity per head (kg)		Overall production (thousand tonnes)	
Type of sheep	Total	Ewes,%	Wool	Mutton	Wool	Mutton
Fine fleece	18.3	54-56	3.6	18.0	65.9	329.4
Semi-fine fleece	3.4	58-60	3.2	19.0	10.9	64.6
Mutton-fat	8.3	70-72	2.2	22.0	18.3	182.6
Karakul	6.0	72-74	2.3	10.0	13.8	60.0
Total/average	36.0	ns	3.0	17.7	108.0	637.2

Source: Arranged by authors.
Note: ns: not stated.

These plans anticipate fine fleece and semi-fine fleece breeds being reared in the mountain zones and zones of developed land farming. The farms in these zones will produce fine Merino and semi-fine crossbred wool. In the arid-steppe, semi-desert, and desert zones and on remote rangelands the target is to produce mutton and fat, based on coarse wool and semi-coarse wool breeds (24%) and Karakul sheep (13%). It is clear such regionalization would constitute a step forward towards diversification and production that could assure the future of the small ruminant sector in Kazakhstan.

Production Orientation

Kazakhstan was the leading producer of fine and semi-fine wool during the Soviet Union, and the country benefited substantially as a result. Currently, the small ruminant fiber industry in the country is not competitive and its future will be dictated by its ability to produce better quality products. Intensive work will be needed to meet national goals and to produce wool of a quality equal to, or better than, that produced by competitors such as Australia and New Zealand.

Given the present tenure structure, the collapse of the country's research institutions and breeding organizations, as well as the lack of production support and organized marketing schemes, this goal will be very difficult to achieve. Markets will have to be assessed very carefully to see if a clear niche can be identified in those countries to which Kazakhstan can easily export, such as Russia and China. The national goals will then have to be re-designed accordingly. Pursuing goals that are not realistic will reflect badly on research and development and will be damaging to the economy on which farmers rely.

Kazakhstan does not have a large human population in relation to the size of its territory. However, this population defines the national market for lamb and mutton, which is on the increase. This market should be covered well, using all the breeds produced in Kazakhstan and any appropriate technologies. Exports to China or Russia should be considered in the long term, as both can be reached by road and rail. Assessments should be made to target these efforts. And, given current consumer trends, efforts should also be made to assess the possibility of producing organic meat/lamb at a low cost by making appropriate use of the ranges.

A careful analysis of market trends is definitely needed in order to reorient the production of all breeds and species. Little attention was given to the capacity that native goats have with regard to producing high-quality products such as cashmere. Efforts in this direction should not be made without involving the private sector and assessing marketing pathways to avoid farmers being frustrated by producing products but being unable to access the market. The role that can be played by milking goats is also one that should be considered, as should the production of dairy sheep in areas where they might prove profitable. It is clear that mono-production may not be the future for the country.

The case of Karakul sheep is a critical issue. The market for pelts has been lost, and markets are suffering generally as a result of the pressure being placed on them by people's new awareness of animal rights. However, further studies should be conducted to explore new opportunities. To avoid farmers suffering financially, this sector has to look for ways to diversify.

Research and Development

The socioeconomics of farming within Kazakhstan have been developing very slowly, and the necessary methodologies have not been adopted at the rate required by the country. Researchers need to be provided with more training, in order to allow them to cope better with the emerging production systems based around small producers—who face problems for which no corrective approach is available. Research should move on farm and farm communities to solve problems and help farmers to reorient production.

The issue of feeding systems is also something that needs to be researched and supported. The country's newly emerging production systems have different technological demands. And the production scenarios evolved during the Soviet Union did so under different conditions—so much so that many of the technologies formerly used may not be suitable under the current conditions.

Livestock production in general, and small ruminant production in particular, depends on access to productive ranges. The rational and appropriate use of these ranges should always be factored in when considering how to improve feeding strategies. The ranges around villages are now overgrazed, due to the disruption of rotational grazing that resulted after the breakdown of the Soviet Union. Ways need to be devised to restore rotational range grazing. Crop–livestock interactions should also be looked upon as a way of maximizing the return provided by cropping systems.

Animal health problems also increased following the fall of the Soviet Union. Newly emerging systems face new problems and raise more difficulties for national epidemiological services. New epidemiological approaches are needed in Kazakhstan and scientists urgently need to be trained in the use of new methodologies.

Further reforms are expected in the way production is organized, and in the cooperative efforts and links between commodity producers, processors, and sellers. Reformed systems should ensure appropriate investments and the better targeting of markets, both of which will help to increase the incomes of farmers and other actors.

In all cases breeding plans need to be reformulated in accordance with new market trends and the realities of the rural sector.

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Kyrgyzstan

Chapter Three

Small Ruminant Breeds of Kyrgyzstan

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Introduction

Small ruminant production played a major role in both Kyrgyzstan's agricultural sector and the country's economy when it was part of the Soviet Union. It remains an important aspect of the country's economy, despite the fact that livestock numbers declined drastically after the dissolution of the Soviet Union. It is estimated that more than half of the revenue produced by the country's livestock production sector is derived from sheep production. In addition, sheep and goat production are the only means of subsistence available to people living in the country's alpine areas.

The Republic of Kyrgyzstan has a total area of approximately 200,000 km^2. However, only 56% of the country's land area is suitable for economic use. Of this, 82% consists of rangeland. More than half of the territory is over 3000 meters above sea level (m a.s.l.), and much of these highland areas fall within the Tien-Shan and Pamir-Alay mountain ranges. The country's vast rangelands cover more than 9 million ha, including the arid steppes (250-350 mm of rainfall per year), and are the mainstay of the country's small ruminant production.

Sheep and Goat Breeds and Populations

In 1999, Kyrgyzstan's sheep population amounted to 3,660,300 head, about 6 million head less than seven years earlier. Most of the country's sheep can be classified as either Kyrgyz Fine-Wool or grades of indigenous coarse-wool sheep. Only 183,000 Tien-Shan Semi-Fine-Wool sheep and 22,000 Alay Medium-Coarse-Wool sheep remain, and the latter breed faces a high risk of extinction. In this document, the names of these two breeds will be shortened to 'Tien-Shan' and 'Alay'.

In 1999, Kyrgyzstan's goat population consisted of 150,300 head, about 40,000 less than in 1992. Two goat breeds are recognized in Kyrgyzstan: the Kyrgyz Fur Hair goat and the so called Kyrgyz Wool goat. These breeds produce cashmere and mohair, respectively. For clarity, these two goat breeds will henceforth be referred to as 'Kyrgyz Cashmere goats' and 'Kyrgyz Mohair goats' (Table 1).

Table 1. Population trends in Kyrgyzstan's sheep and goat breeds (in thousands).

Breed	1992		1995		1999		Extinction risk
	n	%†	n	%†	n	%†	
Sheep							
Kyrgyz Fine-Wool	8,569.0	92	3,807.0	78	1,756.9	48	Medium
Tien-Shan	662.7	7	303.8	6	183.0	5	Medium
Alay	102.7	1	34.3	1	22.0	1	High
Indigenous Coarse-Wool	na	0	754.5	15	1,698.4	46	None
Total	9,334.4	100	4,899.6	100	3,660.3	100	
Goats							
Kyrgyz Mohair	76.2	40	70.7	40	60.1	40	None
Kyrgyz Cashmere	114.3	60	106.1	60	90.2	60	None
Total	190.5	100	176.8	100	150.3	100	

Source: Ministry of Agriculture and Water Management (2000).
Notes: †Percentage of the total number of animals of that species in a particular year; na: not available.

Table 2. Characteristics of Kyrgyzstan's sheep breeds.

Breeds	Size	Tail	Ears	Wool type	Main products
KFW	Medium	Thin	Medium, semi pendulous	Fine	Fine wool, meat, skins
Tien-Shan	Large	Thin	Medium, horizontal	Semi fine	Meat, crossbred wool, skins
Alay	Large	Fat	Large, drooping	Semi coarse	Meat, semi-coarse wool, skins
IKCW	Large	Fat	Large, drooping	Coarse	Meat, fat and coarse wool

Source: Compiled by authors.
Notes: KFW: Kyrgyz Fine-Wool; IKCW: Indigenous Kyrgyz Coarse-Wool.

Table 3. Characteristics of Kyrgyzstan's goat breeds.

Main features	Kyrgyz Cashmere goats	Kyrgyz Mohair goats	Native Kyrgyz goats
Size	Medium	Medium	Medium
Horns bucks	Large horns	Large horns	Horned and polled
Horns does	Small horns	Small horns	Horned and polled
Ears	Long and hanging	Long and hanging	Long and hanging
Tail	Small	Small	Small
Fiber	Medium coarse	Medium coarse	Coarse
Main Products:	Cashmere, raw skins, meat	Mohair, raw skins, meat	Raw leather, meat, dairy products

Source: Compiled by authors.

Kyrgyzstan's sheep and goat breeds are comprehensively described in the sections which follow. For a summary description and comparison of Kyrgyzstan's sheep and goat breeds see Tables 2 and 3, respectively.

Regional Distribution of Sheep and Goat Breeds

The Kyrgyz Fine-Wool sheep is bred throughout all regions of the Republic, as are the country's indigenous coarse-wool sheep. The Tien-Shan breed, however, is concentrated in three districts of the Central Tien-Shan area: Narynskiy, Ak-Talinskiy and Togu-Torouzskiy. Alay sheep are raised in the Alayskiy district of the Batken region (formerly known as the Osh region). Goats are mainly kept in the south of the country (Batken and Jalal-Abad). Table 4 and Figures 1-6 account for the distribution of sheep and goat breeds in the country.

Table 4. Sheep and goat distribution by region (in thousands).

	Batken		Jalal-Abad		Naryn		Issik-kul		Chui		Talas		Total
Breeds	n	% of breed	n	% of breed	n	% of breed	n	% of breed	n	% of breed	n	% of breed	n
Sheep													
KFW	197.8	11	150.9	9	404.6	23	447.7	25	283.9	16	273.8	16	1758.7
Tien-Shan	0	0	0	0	182.9	100	0	0	0	0	0	0	182.9
Alay	20.8	100	0	0	0	0	0	0	0	0	0	0	20.8
IKCW	713.2	53	266.1	21	44.2	3	177.6	13	73.6	5	67.4	5	1342.1
Totals	931.8	28	417	13	631.7	19	625.3	19	357.5	11	341.2	10	3304.5
Goats													
Mohair	34.9	58	25.2	42	0	0	0	0	0	0	0	0	60.1
Cashmere	52.3	58	37.9	42	0	0	0	0	0	0	0	0	90.2
Totals	87.2	58	63.1	42	0	0	0	0	0	0	0	0	150.3

Source: Ministry of Agriculture and Water Management (2000).
Notes: KFW: Kyrgyz Fine-Wool sheep; IKCW: Indigenous Kyrgyz Coarse-Wool sheep.

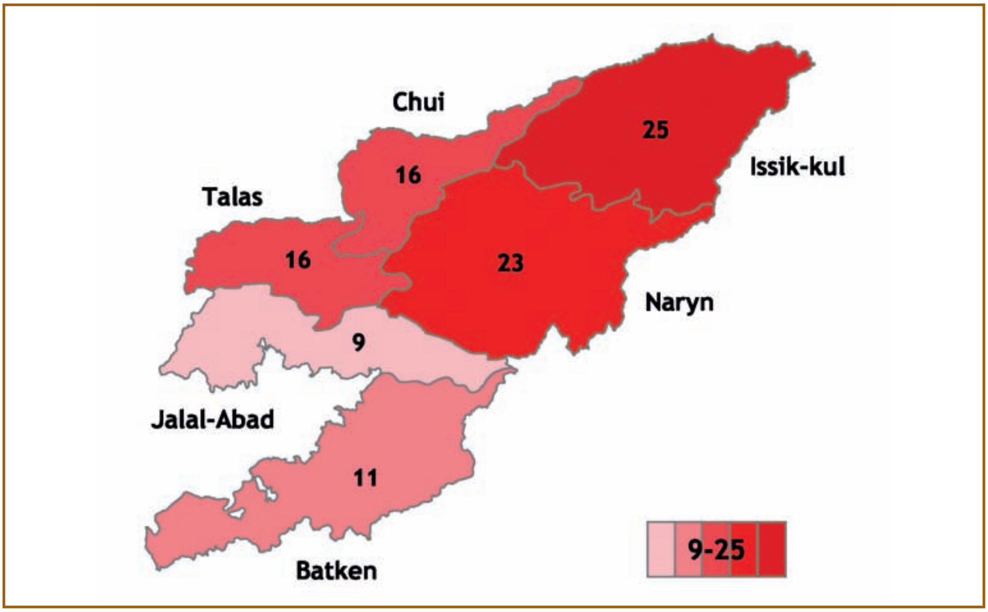

Figure 1. Geographical distribution of Kyrgyz Fine-Wool sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kyrgyzstan.

Figure 2. Geographical distribution of Tien-Shan Semi-Fine-Wool sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by authors.
Number represents percent distribution of the breed which occurs mostly in Naryn.

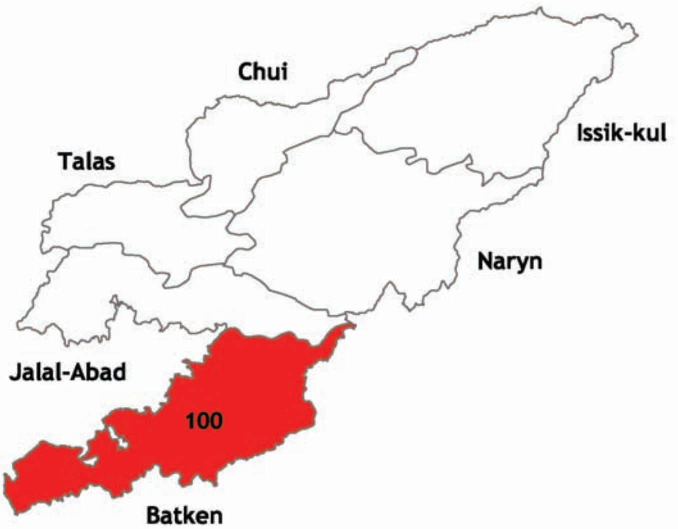

Figure 3. Geographical distribution of Alay Medium-Coarse-Wool sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by authors.
Number represents percent distribution of the breed which occurs mostly in Batken.

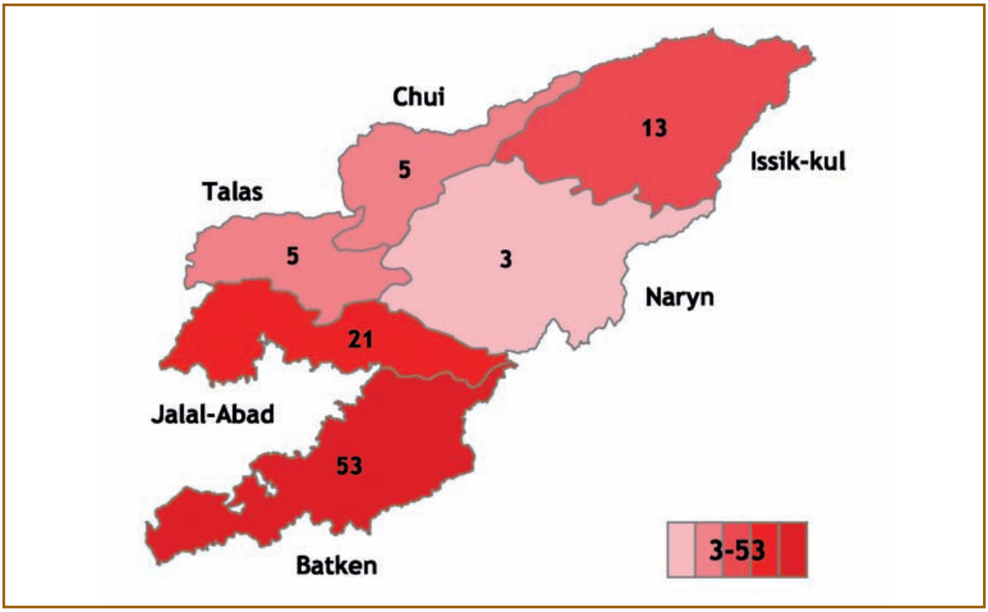

Figure 4. Geographical distribution of Indigenous Kyrgyz Coarse-Wool sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kyrgyzstan.

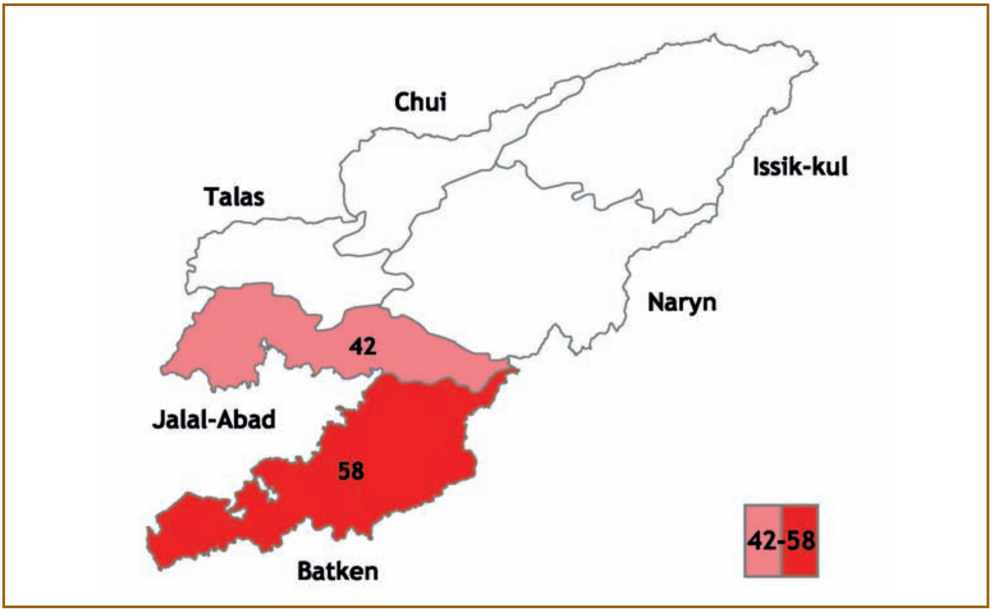

Figure 5. Geographical distribution of Kyrgyz Mohair goats.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kyrgyzstan.

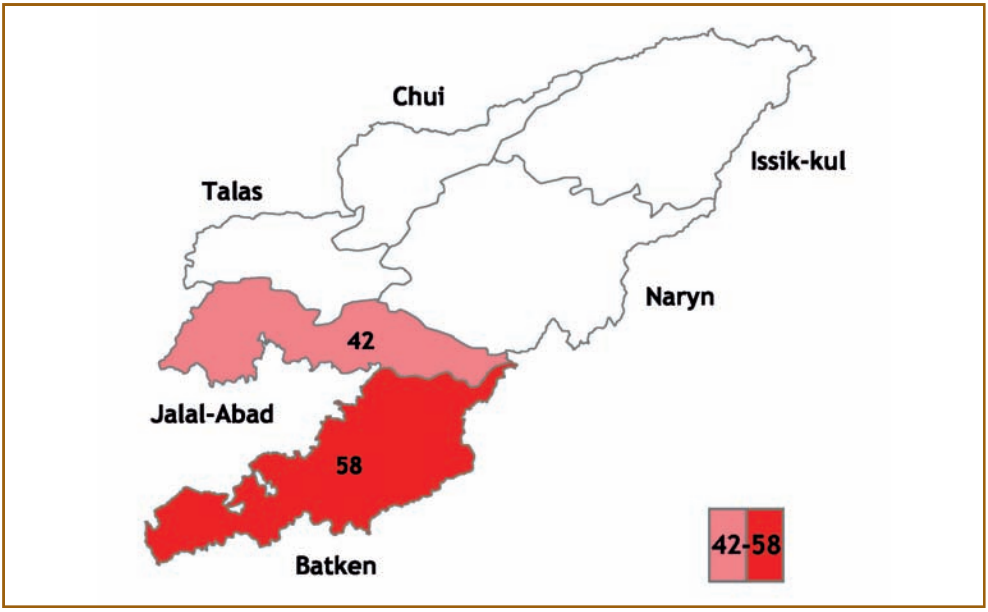

Figure 6. Geographical distribution of Kyrgyz Cashmere goats.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by authors.
Numbers represent percent distribution of the breed in the different regions of Kyrgyzstan.

Currently, most small ruminants and farms are privately owned, and most privately owned farms face serious financial problems. Collective farms, however, are in better financial shape. Genetic improvement efforts are concentrated in state-owned farming units. Table 5 shows the approximate distribution and characteristics of Kyrgyzstan's different farming units.

In all, 97.7% of Kyrgyzstan's small ruminants are privately owned. Of the total number of animals, 56.5% (2.15 million animals, Table 5) are owned by private households and 41.2% (1.57 million animals) are owned by individual farming units.

Sheep and Goat Breeding Regions

Four sheep and goat breeding areas (Mezentsev *et al*. 1997) exist in Kyrgyzstan, as described below. Most of the terrain of these areas is rugged and varies greatly in altitude.

The northern area

The north of Kyrgyzstan (around the Talas and Chui valleys) has a continental climate and is characterized by cold winters (in January average temperatures range from –10°C to –15°C) and hot dry summers (in July average temperatures range from 15°C to 25°C). The area's well-developed land farming systems provide sufficient feed that complements range grazing in winter. The ratio of arable land to rangeland is about 1:6. The majority of sheep in this area are of the Kyrgyz Fine-Wool breed.

Table 5. Distribution of sheep and goats within different categories of farming units.

Type of farming unit	Livestock population (thousands)	No. of farming units	Ownership	Financial situation	Major characteristics
State-owned	27.6	58 (0.1%)	State	Receive insufficient funding	Concentrate on pedigree and commercial stock. Undertake genetic improvement.
Collective	58.4	609 (1.0%)	Cooperative	Face minimal financial difficulties	Consist mostly of commercial flocks that utilize ranges seasonally in combination with cultivated areas for winter feeding. Production targets markets.
Individual farming units	1,570.8	60,111 (98.9%)	Private	Face serious financial problems	Mixed farming. Make maximum use of range and insignificant use of supplementary winter feeding, as arable land is available. Production is intended to meet the demands of the national market.
Private households	2,153.8	nk	Private	Private subsistence farms; living in poverty	Consist mostly of landless producers or those with little land. Producers graze flocks around villages. Production is used to meet family needs and any surplus is sent to market.

Source: Compiled by authors.
Notes: nk: not known; numbers given in parentheses are the proportions of farms in each category expressed as a percentage of the number of all known farms (excluding private households).

The north-eastern area

The northeast of the country (the Issik-Kul Basin) has a less continental climate than the north of the country, with relatively mild winters (average temperatures of -5°C to -10°C in January) and cool wet summers (average temperatures of 10°C to 15°C in July), with good feed provision for winter housing that complements rangeland grazing in this period. The ratio of arable lands to rangelands is 1:12. This is a Kyrgyz Fine-Wool sheep production area.

The southern area

The south of Kyrgyzstan (the foothills of the Fergana valley) has a continental climate with mild winters (average temperatures range from 0°C to -10°C in January) and dry, hot summers (average temperatures range from 15°C to 30°C in July). A medium level of feed is provided during the winter. The ratio of arable land to rangeland is 1:14. Goats, and fat-tailed, Alay and Kyrgyz Fine-Wool sheep, are bred in this area.

The central Tien-Shan area

The central Tien-Shan area consists of alpine valleys such as Kochkor, Jumagul, and Naryn. It is characterized by severe, cold winters (in January average temperatures range from -15°C to -30°C) and cool summers (in July average temperatures range from 5°C to 15°C). The level of feed provided during the winter housing period is poor. This forces producers to make significant use of the rangelands; rangeland grazing is combined with housing during the winter. The ratio of arable land to rangeland is 1:22. Tien Shan and Kyrgyz Fine-Wool sheep are raised in this area.

Main Management Characteristics

Details of the management calendar and of the feed sources available for Kyrgyzstan's sheep and goats, both currently and during the Soviet Union, are given in Tables 6 and 7.

Table 6. Sheep management calendar.

	Months											
Events and seasons	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Mating†												
Lambing												
Lactation												
Weaning												
Shearing‡												
Grazing	F	F	W	W	S	S	M	M	M	M	M	F
Supplementation			•••	•••	•	•						
Barley cropping												
Stubble grazing												
Hay preparation												
Parasite control												
Seasons	Winter			Spring			Summer			Fall		

Source: Compiled by authors.
Notes: F: fall-range grazing around producers' villages and on crop stubbles; W: Winter-range grazing and supplementation with hay and broken barley grain; S: Spring-range grazing, around the producers' villages, coupled with the provision of small amount of supplements in the form of barley grain; M: summer-range grazing in the mountains, where edible biomass is abundant. •••: Intensive supplementation; •: Minor supplementation.
†Artificial insemination of pedigree flocks; ‡Shearing of fine wool.

Barley and hay, harvested annually, and perennial range vegetation are used to provide the feed needs of sheep flocks during the winter. Barley is usually planted in April or May and is harvested from August to September. Stubbles are grazed from October until December.

Fine wool sheep are usually shorn once a year, in May or June. Alay sheep can be shorn twice a year, in April and September.

Sheep are artificially inseminated in November in the case of pedigree flocks and those owned by farmers living near to pedigree flocks. In the case of small-holders and household producers, natural mating occurs from August to December.

Table 7. Goat management calendar.

Events and seasons	Months											
	Dec	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Mating												
Lambing												
Lactation												
Weaning												
Shearing												
Grazing												
Supplementation	F	F	W	W	S	S	M	M	M	M&F	F	F
Stubble grazing			•	•								
Hay preparation												
Parasite control												
Mating												
Seasons		Winter			Spring			Summer			Fall	

Source: Compiled by authors.
Notes: F, W: fall and winter range grazing in the foothills with supplementary feed being provided in the form of concentrates; S: spring-range grazing; M: summer-range grazing, which begins in the second half of June and continues until September in alpine areas, where abundant amounts of edible biomass aid fattening and milk production. •: minor supplementation.

Supplementary feeding includes the use of concentrates (grains) and root crops (carrots, beets, etc.). The types of feed stored for winter include alfalfa hay, straw, barley grain and ears of maize.

Spring combing of cashmere is undertaken during the first 10 days of March, at which time Mohair goats are also shorn. Mating begins ten days into November and continues until early December.

Markets for Sheep and Goat Products

Kyrgyzstan's sheep breeds produce several types of wool (fine Merino, semi-fine crossbred, medium-coarse carpet wool and coarse wool), while the country's goats produce two types of fiber (cashmere and mohair). Sheep and goats are also used to produce meat and skins. Market demand for these various products varies (Table 8).

Table 8. Gross assessment of the market demand for sheep and goat products in Kyrgyzstan.

Breed	Types of products	Level of market demand
Kyrgyz Fine-Wool sheep	Fine Merino wool	Very high
	Meat	High
	Sheepskins	High
Tien-Shan sheep	Crossbred wool	High
	Meat	High
	Sheepskins	High
Alay sheep	Carpet wool	High
	Meat	High
	Sheepskins	Medium
Indigenous Coarse-Wool sheep	Coarse wool	Very low
	Meat	High
	Sheepskins	Medium
Kyrgyz Cashmere goats	Cashmere	Very high
	Meat	High
	Goat skins (leather)	High
Kyrgyz Mohair goats	Mohair	Very high
	Meat	High
	Goat skins (with fur)	High

Source: Compiled by authors.

The market demand particularly for sheep meat within the country is high, and may remain high in the near future given the slow but steady improvement noted in the local economy. Wool and goat fiber demand depend on the economies of China and the countries in the West. At present, the outlook for these international markets is positive, particularly with regard to high-quality fine wool, as global stocks of wool-producing sheep have drastically declined over the last decade. Uncontaminated, pure mohair and cashmere will probably also continue to maintain a good level of demand. However to reach these markets, and in particular those for fine wool, profound changes will have to be made in the production structure in the country.

Breeding Programs

Current sheep and goat breeding programs are very poorly equipped and supported: most deteriorated to ineffective levels during the 1990s. Artificial insemination, which was formerly applied on a wide scale, is no longer undertaken at the farm level, where the use of unimproved sires and indiscriminate crossing of breeds occurs. A few breeding centers still perform modest amounts of work; however, their activities are mostly confined to neighboring areas. Some of the centers that still have genealogically controlled flocks and herds are listed in Table 9. Animals at these centers are purebred and are selected on the basis of performance records and genealogy.

Table 9. Establishments conducting pedigree work.

Breed and farms	Location (province)	Number of pedigree animals	Ownership
Kyrgyz Fine-Wool sheep			
Orgochor	Issik-Kul	1198	State
Son-Kul	Naryn	3000	Cooperative
Kochkor	Naryn	2815	State
Katta-Taldyk	Batken (Osh)	2329	State
Lushikhin	Talass	3033	State
Tien-Shan sheep			
Tien-Shanskiy	Naryn	4070	State
Kyrgyz Cashmere goats			
Tegirmen-Bashi	Batken	3598	Cooperative
Kyrgyz Mohair goats			
Erkin	Batken	600	State

Source: Compiled by authors.

Sheep Breed Characterization

The Kyrgyz Fine-Wool Sheep

The development and improvement of the breed

Until the 1930s, the fat-tailed, indigenous coarse-wool sheep was the main breed of sheep kept in Kyrgyzstan. This type of animal is medium-sized with a body weight that reaches 58-59 kg in autumn and a fat-tail weighing 3.0-3.5 kg. It has a low prolificacy, averaging 105-107% maximum, and is considered a poor wool producer as it produces a greasy fleece weight of about 2 kg. However, this type of sheep does have a strong constitution and is well adapted to highland rangeland management. It therefore suited the requirements of nomadic farmers (Lushikhin 1964).

In Kyrgyzstan, the transition from a nomadic to a settled way of life began in 1929, with the reorganization of the agricultural sector. This was accompanied by radical changes in sheep management and in the country's sheep breeds, resulting in the development of a new fine-fleece sheep that was bred for in several phases (Lushikhin 1958, 1964, 1975).

During the first phase (1930-1939) a massive crossbreeding program was implemented, in which fat-tailed coarse-wool ewes were bred with fine-fleece sires of several breeds, mainly the North Caucasus Merino, the Siberian Rambouillet-Merino, the Würtemberg, and the Précoce.

In the second phase (1939-1952) the crossbred population underwent selection to fix the characteristics required in the new type of fine-fleece sheep being produced. The new type combined fours traits important for highland management: (1) a high yield of fine worsted wool, (2) good meat traits and early maturity, (3) a strong constitution and (4) good adaptation. Selection and reproduction were initiated at the Juan-Tebe sheep breeding farm, later renamed the M.N. Lushikhin sheep breeding farm.

In the third phase (1952-1956) major attention was paid to the improvement of the breed's main wool traits. For this, crosses were made with the best wool breeds from the USSR: the Groznenskaya and the Stavropolskaya breeds. This process resulted in a new fine-wool breed, the "Kyrgyz Fine-Wool" (Table 10).

Table 10. Body weight and fleece weight of Kyrgyz Fine-Wool sheep.

	Body weight (kg)		Fleece weight (kg)	
Type of animal	Average	Range	Average	Range
Adult rams	98.0	85-122	11.4	9.5-14.0
Ram hoggets	68.2	59-78	9.9	8.5-14.0
Ewes	52.7	46-73	4.3	3.0-8.5
Ewe lambs	37.0	33-52	3.8	2.9-6.0

Source: Lushikhin (1964).

Note: Number of records was not available.

The fourth phase of the breeding program (1956-1971) concentrated on further developing the new breed and quickly upgrading the sheep stocks held by collective and state farms. This was followed by pure breeding of desirable Kyrgyz Fine-Wool animals in the pedigree flocks. Kyrgyz Fine-Wool ewes were also mated with imported sires from wool and wool–mutton breeds (the Groznenskaya, Stavropolskaya, Askaniyskaya, and Caucasus breeds, among others). This process was intended to combine high wool productivity with good meat traits and excellent adaptability to highland range feeding. At the same time, attention was also paid to staple density, crimp frequency, worsted wool length, wool character, wool entanglement, elasticity, the production of light-colored grease, and a high output of pure fiber. By the end of this stage of the breeding program, the Kyrgyz Fine-Wool sheep kept at pedigree plants (parent studs) and on pedigree farms (daughter studs) were highly productive (Table 11) and produced a wool classed as equivalent to high-quality Merino.

Table 11. Body weight and fleece weight of elite Kyrgyz Fine-Wool sheep in stud farms.

Farm enterprises	Sex	Body weight (kg)	Greasy fleece weight (kg)	Clean fleece weight (kg)
Pedigree plants	Rams	112.0	11.55	5.80
	Ewes	62.0	4.62	2.40
Pedigree farms	Rams	110.5	11.38	5.78
	Ewes	60.7	4.30	2.28

Source: Mezentsev *et al.* (1987).
Note: Number of records was not available.

However, at farm level the average greasy fleece weight was only 3.1 kg and the clean fleece weight only 1.58 kg; the proportion of pure Merino wool in the clipped wool was only 35-38%. This created the motivation to begin a new breeding phase.

The fifth phase (1971-1991) used Australian Merino sires as part of a large crossbreeding plan. During the 20-year period covered by this phase, 109 imported Australian Merino sires were mated with the best ewes from pedigree farms. On average, sires were mated for about 2.5 mating seasons at a rate of approximately 600 ewes per sire, producing a total of 125,000 lambs. Crossbreeding with the Australian Merino increased wool productivity and improved wool quality. Average clean fleece weight was increased by 100-150 g, wool length by 1.0-1.5 cm, and clean yield by 2-3%. Staple quality also improved significantly, as did the proportion of wool classed in top Merino wool category, which increased by 100%. Extensive use of Australian Merino sires contributed to 14-15% of the country’s sheep stock. In fact, all 9.5 million head of fine-fleece sheep had at least 1/16 to 7/8 Australian Merino breeding (Mezentsev *et al.* 1987).

During the sixth phase (1991-1999) the country’s sheep population declined dramatically (from 9.0 million in 1991 to 1.8 million in 1999), as did productivity (clean fleece weight fell from 2.01 kg to 1.68 kg per head). The decline was particularly noticeable in pedigree plants, where sheep numbers fell from 197,300 in 1991 to 14,300 in 1999. Currently there are 35 private Kyrgyz Fine-Wool sheep pedigree farms in Kyrgyzstan.

Appearance

Today's Kyrgyz Fine-Wool sheep can be described as a wool–mutton breed, though its phenotype is different from that of other wool–mutton breeds. Lushikhin (1964, 1975) described the main characteristics of the breed in detail.

The head is somewhat oblong, is thinly covered with bright hair, and has a straight or hook-nosed profile. On the head, the wool reaches the eye line, while wool staples reach the borders of the fleece mantle. The fleece is white. The ears are medium sized, slightly hanging down, and contain dense cartilage. They are covered with thick bright hair. Rams and ewes are polled. The neck is round and of medium length, with one or two incomplete wrinkles which continue into a number of body wrinkles that end in an apron on the chest. The body is compact, with rounded ribs. The chest is wide and deep and the rump is either straight or turned slightly downwards. The crest is slightly raised, while the spine is either straight or has a small saddle. The body is not angular. The belly is covered with wool and the legs are of a medium length. The breed's wool reaches to the knees on the forelegs, and to the hocks on the back legs.

Kyrgyz Fine-Wool sheep have a strong constitution and well developed extremities, which allow them to graze in mountains and under alpine conditions. They will seek out grass covered by snow, and will walk 120 to 300 km to reach their seasonal grazing sites. These animals can easily cross mountain passes at 3500 to 4000 m a.s.l.

Kyrgyz Fine-Wool ram

Kyrgyz Fine-Wool ewe

Body measurements

The body measurements of Kyrgyz Fine-Wool sheep are presented in Table 12.

The changes in the breed over a 10-year period are noted in Table 13, in which unselected ewe hoggets are classed as having 'insufficient', 'normal' or 'excessive' levels of a particular trait.

Table 12. Body measurements of Kyrgyz Fine-Wool sheep.

Trait (cm)	Adult rams	Ram hoggets	Adult ewes	Ewe hoggets
Head length	25.2	21.7	21.8	19.6
Head width	13.8	12.4	12.0	11.0
Height at ridge	78.6	71.4	66.4	60.3
Height at sacrum	76.5	70.2	66.7	60.8
Chest width at shoulders	24.9	20.0	18.8	16.0
Chest width behind shoulder blades	35.3	29.4	25.7	22.3
Chest girth	125.7	106.7	95.7	81.5
Chest depth	42.0	35.8	32.9	28.2
Width at pelvis	20.2	16.1	16.7	13.9
Diagonal body length	79.9	71.7	67.2	61.4
Metacarpus circumference	11.4	9.9	8.2	7.8

Source: Mezentsev *et al*. (1992).
Notes: Adult animals are ≥3 years old. Replacement ewes (hoggets) are 13 to 14 months old; number of records was not available.

Table 13. Proportions of Kyrgyz Fine-Wool ewe lambs with different levels of trait development.

	Trait development (% of lambs)					
	1978-1979			1988-1989		
Trait	Insufficient	Normal	Excessive	Insufficient	Normal	Excessive
Face cover	25	61	14	18	75	7
Staple density	6	72	22	6	71	23
Fiber diameter	33	59	8	13	72	15
Level of uniformity	8	92	0	6	94	0

Source: Mezentsev *et al*. (1997).
Note: number of records was not available.

Within the 10-year period of selection, face cover improved significantly in this breed, while wool staple density remained unchanged. Fiber diameter and uniformity increased; in addition, the number of animals with dark-colored grease decreased. A degree of regional heterogeneity is to be expected in the breed, since selection efforts in different regions placed an emphasis on different traits.

Body weight, growth and carcass traits

The spring body weights of Kyrgyz Fine-Wool sheep kept in commercial flocks are presented in Table 14. In autumn, after fattening, the body weights recorded, particularly those of ewes, could increase by 10% to 15%.

Kyrgyz Fine-Wool sheep mature early. By 12-14 months of age, ewe lambs are 65-67% of the weight of an adult ewe; by 18 months of age their weight is 80-90% that of an adult.

In commercial Kyrgyz Fine-Wool flocks, the degree of heterogeneity in the mix of animals kept is not reflected in body weight (Table 15). However, an improved feeding regime clearly increases body weight (Table 16).

The Kyrgyz Fine-Wool breed possesses well-developed meat traits, which it inherited from the native fat-tailed and mutton–wool breeds used in the breeding program. The dressing percentage of the breed averages more than 50%, and it gives a desirable meat yield (Table 17).

Reproductive performance and milk production

The prolificacy (the number of lambs produced per 100 ewes lambed) of the breed stands at 127 lambs on average, and is positively correlated with the body weight of ewes (Table 18).

Table 14. Average spring body weights of Kyrgyz Fine-Wool sheep (kg).

	Age				
Sex	At birth	At weaning†	1 year	1.5 years	Adult
Rams	3.7	31.6	43.1	69.6	97.4
Ewes	3.4	28.6	43.0	40.9	50.1

Source: Mezentsev *et al*. (1992).

Notes: †Animals are weaned at the age of 4.0-4.5 months; number of records was not available.

Table 15. Average body weights of Kyrgyz Fine-Wool sheep ewes in commercial flocks (kg).

	Age				
Group of animals† weighed	Birth	15 days	30 days	4.5 months	14 months
Heterogeneous	3.67	6.13	11.6	30.2	38.6
Homogeneous	3.90	6.41	11.8	30.7	38.8

Source: Tursunbaev *et al*. (1997).

Notes: †in relation to phenotypic features of the breed; number of records was not available.

Table 16. Weight and growth of Kyrgyz Fine-Wool ewes under different feeding regimes.

	Group with improved feeding		Group fed under ordinary management	
Age (months)	n	Mean±SE (kg)	n	Mean±SE (kg)
4.5	769	26.5±0.1	736	26.3±0.1
8	711	33.4±0.1	675	30.2±0.1
14	656	39.0±0.1	540	37.3±0.1
18	575	47.8±0.2	456	45.5±0.2
21	545	50.8±0.2	435	40.3±0.2
24	513	47.0±0.2	427	41.1±0.2
26	502	42.9±0.2	424	40.3±0.2
30	459	55.8±0.2	402	49.6±0.2
33	437	61.0±0.3	377	46.8±0.2
37	411	54.5±0.3	341	48.8±0.3

Source: Lushikhina *et al*. (1991).
Note: SE: Standard error.

Table 17. Carcass performance of Kyrgyz Fine-Wool ram lambs of different age.

	Slaughter age		
Carcass traits	10 months	18 months	30 months
Weight before slaughter (kg)	41.8	61.5	66.5
Carcass weight (kg)	18.5	29.3	32.9
Weight of visceral fat (kg)	0.88	1.09	3.03
Dressing percentage (%)	46.3	54.4	53.5
Grade I meat output (%)	72.0	73.5	74.1

Source: Mezentsev *et al*. (1987).
Note: Number of records was not available.

Table 18. Body weight and prolificacy rate of Kyrgyz Fine-Wool ewes.

	Body weight (kg)					
	<46	46-50	51-55	56-60	>60	Average
Lambs per 100 ewes lambed	113	116	122	130	146	127

Source: Mezentsev *et al.* (1997).
Note: Number of records was not available.

The number of lambs per 100 ewes mated varies according to the season and location. In spring, 95 to 105 lambs are obtained, while in winter 145 to 150 lambs are produced per 100 mated ewes. During the period 1997-1999 in the north of the country, where 74% of the sheep kept were of the fine-fleece variety, up to 97 lambs were obtained per ewe mated. During the same period in the south of the country, where fat-tailed sheep accounted for 73.3% of the animals kept, only 86 lambs were produced per 100 ewes mated.

At birth, Kyrgyz Fine-Wool lambs are large and have good wool coverage and breech wool, which indicates a strong constitution. Lamb mortality during the lactation period that lasts for about 4 months varies from 2.5% to 7.3%. Average milk production within the 4 months of lactation is 102.3 kg, which supports an average daily weight gain of 203 g (Mezentsev *et al*. 1987).

Wool production

Under normal farm feeding and management conditions, the wool productivity of Kyrgyz Fine-Wool sheep is high (Table 19).

The quality of the wool produced by the breed is comparable to that of medium-fine Merino wool. By the end of the 1980s, 80% of the wool produced in Kyrgyzstan had the characteristics shown in Table 20.

Table 19. Wool production of Kyrgyz Fine-Wool sheep.

Wool production traits	Adult rams	Ram hoggets	Adult ewes	Ewe hoggets
Greasy fleece weight (kg)	9.53	5.48	4.18	3.60
Clean fleece weight (kg)	5.09	2.94	2.34	2.05
Clean yield (%)	53.40	53.60	56.00	56.90

Source: Mezentsev *et al*. (1987, 1997).

Table 20. Wool characteristics of Kyrgyz Fine-Wool sheep in commercial flocks.

Type of animal	Staple length (cm)	Fiber diameter (µm)	Fiber density (fibers/mm^2)
Rams	10.6	22.9	50
Ewes	7.7	22.8	39
Young animals	11.9	19.8	42

Source: Tursunbaev and Khalyapov (1997).
Note: Number of records was not available.

Most of the wool produced by the breed has a fiber diameter of 21-22 µm; worsted wool length is 8 cm or more. The fiber produced is resistant to tearing, and demonstrates high levels of uniformity in terms of fleece quality and a uniform staple length. Clean fleece yield varies between 50% and 58%. The fleeces produced are very dense, which provides protection from the harsh weather faced by the breed during winter rangeland grazing.

Skin measurements and quality

Skin characteristics are shown in Table 21. The data in the table indicates that the effects that age has on the skin traits of Kyrgyz Fine-Wool sheep are similar to those noted in other wool breeds (Lushikhina 1994).

Although follicle densities differ among animals, in the Kyrgyz Fine-Wool breed the total amount of follicles per animal is genetically pre-defined, amounting to 30-34 million on average.

The fine fleece sheep-breeding sector produces sheepskins for the fur industry. By the time the Soviet Union broke up, 3.5 million sheepskins were being produced each year. However, by 2001 this figure had fallen to only 250,000-300,000 skins. Preserved sheepskins for use in the fur industry vary between 3.5

and 4.1 kg in weight, and between 90 and 110 dm^2 in area. Fur sheepskins are strong and have characteristics which offer a high level of thermal protection; these levels conform to standards set by the state (Baybekov 1973).

Table 21. Skin traits of Kyrgyz Fine-Wool female sheep.

	Age			
Skin traits	Birth	Weaning	1 year	2.5 years
Thickness of skin (µm)	1,987	2,630	2,666	1,923
Thickness of follicle bearing layer (µm)	1,175	1,424	1,315	911
Thickness of reticular layer (µm)	758	1,201	1,384	1,014
Depth of follicle (µm)	1,028	1,241	1,062	808
Follicle density (follicles/mm^2)	133.5	869.0	642.0	553.0
Secondary/primary follicle ratio	12.7	10.9	10.6	10.0

Source: Lushikhina (1994).
Note: Number of records was not available.

Blood polymorphisms

Polymorphism associated with blood types, transferrin and potassium levels have been studied in this breed. Only two hemoglobin types, A and B, were found. Type B occurred 2.5 times more often than type A (Table 22). Five co-dominant transferrin alleles (A-E) were found. The C allele occurred most frequently, followed by the A allele. The other alleles were rare. It was also found that the gene for high potassium (HK) levels occurs only infrequently in Kyrgyz Fine-Wool sheep. It has been speculated that these polymorphic variability is related to wool productivity and the breed's ability to adapt to alpine conditions.

Table 22. Gene frequencies associated with hemoglobin, potassium levels, and transferrins in Kyrgyz Fine-Wool sheep.

	Hemoglobin		Potassium level		Transferrin				
Flock	A	B	HK	LK	A	B	C	D	E
Katta-Taldyk	0.227	0.773	na	na	0.380	0.111	0.453	0.051	0.005
Kochkorka	0.318	0.682	0.234	0.766	0.328	0.092	0.531	0.042	0.007
N.M. Lushikhin	0.259	0.741	na	na	0.236	0.037	0.681	0.046	0
Orgochor	0.333	0.667	0.192	0.808	0.280	0.186	0.508	0.026	0
Average	0.284	0.716	0.203	0.797	0.307	0.107	0.542	0.041	0.003

Sources: Bykovchenko and Bonetskaya (1984); Bonetskaya *et al*. (1987); Gafarov *et al*. (1991).

Studies of blood groups and erythrocyte antigens of Kyrgyz Fine-Wool sheep have identified 12 different antigens (Aa, Ab, Bb, Bc, Bd, Be, Bq, La, Da, Ma, R, and O), distributed within six genetic systems of blood groups. The frequency with which the various antigens occurred ranged from 14.3% (in the case of La) to 73.2% (in the case of Bb) (Gafarov *et al*. 1991).

Genetic and phenotypic parameter estimates

Genetic and phenotypic parameter estimates of the breed have been studied, with most of the research being undertaken at the N.M. Lushikhin, Kochkorka and Katta-Taldyk pedigree plants. New studies using modern tools for parameter estimation need to be conducted to assess the variability of the main production traits. Such studies are important because, during the post-Soviet Union, both animal populations and management methods have changed. The degree of phenotypic variability is shown in Table 23. Wool production traits and body weight showed medium to high levels of repeatability, which suggest that selection at as early as one year of age could be feasible (Table 24).

Table 23. Variability of characteristics of Kyrgyz Fine-Wool sheep.

Degree of variability	Body weight and wool traits	Skin traits
Low (CV < 12%)	-Body weight and body measurements -Fiber length and diameter, pH and melting temperature of wool grease	None
Medium (CV 12 to 25%)	Only greasy and clean fleece weight, clean yield, specific wool productivity, dust penetration, staple density, crimp frequency	Thickness of skin and follicle bearing layer, depth of follicles, S/P ratio
High (CV > 25%)	Only wool density, wool coverage, wrinkles, moisture, grease, vegetable matter	Follicle density, thickness of reticular layer

Source: Lushikhina (1994).
Note: CV: Coefficient of variation.

Table 24. Repeatability of economically important traits in Kyrgyz Fine-Wool sheep.

Trait	Repeatability†
Body weight	0.58
Greasy wool weight	0.57
Wool coverage	0.38
Staple density	0.24
Staple length	0.43
Animal classing grade	0.33

Source: Lushikhina *et al*. (1991).
Note: †Estimates obtained from correlation between records of the same trait at first and second shearing (n=100 in each case).

Heritability estimates for wool traits calculated using half-sib intraclass correlation are shown in Table 25 and heritability estimates for body traits using daughter-dam regressions are shown in Table 26. These estimates are based on data gathered at N.M. Lushikhin farm, and suggest that mass selection could lead to an acceptable level of genetic progress (Lushikhina *et al*. 1991).

Coefficients of phenotypic and genetic correlations are presented in Table 27.

Estimates suggest that selection for increased greasy fleece weight would result in increased clean fleece weights. It can be speculated that fleece weights and clean yield would be improved by selecting for increased fiber density. Genetic correlations between other traits were found to be small.

Table 25. Heritability of wool traits in Kyrgyz Fine-Wool sheep.

Trait	Heritability
Fleece weight	0.36
Fiber length	0.67
Fiber diameter	0.49
Amount of wool wax	0.29
Amount of wool suint	0.20
Fiber density	0.54
Dust penetration	0.50
Amount of wool per square unit	0.56
Clean yield	0.01
Crimp frequency	0.48
Natural length and real length ratio	0.29
Level of fiber uniformity in fleece	0.51
Level of fiber uniformity in staples	0.85
Fiber strength	0.48
Grease color	0.42

Source: Lushikhina *et al*. (1991).
Note: Lushikhina *et al*. (1991) do not state what method they used to estimate the values they quote. However, it is very probably related to Henderson's Method I using a random model for variance component estimation; number of records was not provided.

Table 26. Heritability of body traits and prolificacy of Kyrgyz Fine-Wool sheep.

Trait	Heritability
Body weight	0.45
Height at ridge	0.45
Height at sacrum	0.73
Diagonal body length	0.30
Chest width	0.23
Chest depth	0.28
Chest circumference	0.45
Width at pelvis	0.38
Prolificacy	0.03

Source: Lushikhina *et al*. (1991).
Note: Estimates calculated by daughter-dam regression; number of records was not provided.

Table 27. Phenotypic correlations (above diagonal) and genetic correlations (below diagonal) in wool traits of Kyrgyz Fine-Wool sheep (n>100).

Trait	GFW	CFW	CY	FL	FD	Den
Greasy fleece weight (GFW)	1.00	0.61	-0.06	-0.02	-0.03	0.19
Clean fleece weight (CFW)	0.63	1.00	0.66	-0.01	-0.01	0.26
Clean yield (CY)	-0.08	0.73	1.00	0.00	-0.13	0.08
Fiber length (FL)	-0.01	-0.02	-0.02	1.00	-0.06	-0.02
Fiber diameter (FD)	-0.04	-0.01	-0.06	0.03	1.00	-0.18
Fiber density (Den)	0.21	0.31	0.19	-0.01	0.10	1.00

Source: Lushikhina *et al*. (1991).
Note: Lushikhina *et al*. (1991) do not state what method they used to estimate the values they quote.

Current structure of breeding programs

Kyrgyzstan's sheep improvement activities are controlled by the Kyrgyz Livestock Production Research Institute. The country's Kyrgyz Fine-Wool breeding stock is kept on five pedigree farms: M.N. Lushikhin, Orgochor, Kochkorka, Son-Kul, and Katta-Taldyk. However, the flocks kept on these farms now amount to only about 15,000 sheep (Table 28), a dramatic decrease since 1991 when 197,300 head were available for breeding.

Based on the breeding structure mounted at the five stud farms, a breeding program could be implemented which would improve the breed's body weight, meat traits, fiber diameter, fiber length, fiber density and milk production, all of which are traits of major economic importance (Mezentsev *et al*. 1992, 1997). The stud farms keep genealogical records and the production performances of about 2000 animals. Currently, the state stud farm Orgochor and the breeding farm Issik-Ata are the leading centers in the genetic improvement of this breed (Gafarov *et al*. 1991).

In 1997, 694 Australian Merinos (294 rams and 400 ewes) were imported into Kyrgyzstan to improve Kyrgyz wool breeds. Currently there are about 100,000 Australian Merino crossbreds in Kyrgyzstan, and a purebred Merino flock has been established to produce Merino rams.

Table 28. Present situation of Kyrgyz Fine-Wool sheep in stud farms.

Stud farm†	Location	Number of sheep	Team leaders
Orgochor	Issik-Kul	2000	Y.G. Mezentsev
Kochkor	Naryn	2000	Y.G. Mezentsev
Son-Kul	Naryn	3200	Y.G. Mezentsev and I.R. Razzakov
N.M. Lushikhin	Talas	3700	Y.G. Mezentsev
Katta-Taldyk	Batken (Osh)	3500	Y.G. Mezentsev

Source: Compiled by authors.
Note: †All under the Kyrgyz Livestock Production Research Institute.

The Tien-Shan Semi-Fine-Wool Sheep

The development and improvement of the breed

Work to develop the Tien-Shan Semi-Fine-Wool breed began in 1950, at the Lakhol Alpine sheep-breeding farm, now known as the Tien-Shanskiy stud farm. This involved crossbreeding Précoce fat-tailed, medium-coarse, and Kyrgyz Fine-Wool ewes with Lincoln sires. To this end, five 1-year-old British Lincoln rams were imported from Russia's Kirov state farm, which lies in the Volokolamsk district, in the Moscow region (Druzhenkov and Druzhenkova 1972).

Selection was used to develop a meat production animal with semi-fine wool characteristics from the crossbred population. The proportion of ewe lambs of the type desired increased from 45.7% in 1959 to 69.4% in 1961. In 1966, the State Expert Commission approved the new breed. At this time, the body weights of rams and ewes from the newly approved breed averaged 103.2 and 66.5 kg, respectively, while the body weight of 1.5-year-old ewe hoggets averaged 53.6 kg. The wool yields of rams, ewes, and 1.5-year-old ewe hoggets averaged 7.5, 3.72, and 3.3 kg, respectively.

Currently 5500 Tien-Shan sheep are available for breeding, of which 3700 are subject to genealogical control and performance recording by the Kyrgyz Livestock Production Research Institute.

Appearance

Tien-Shan sheep are well developed, well proportioned animals which have a strong constitution. They have a medium-sized head, which has either a straight or a slightly Roman profile and is covered with bright white hair. Black spots are acceptable on the nose and ears; however, red pigmentation is considered a defect. The breed's nostrils are wide and open. Both rams and ewes are polled, but can develop horn cones instead of horns. The fleece reaches eye level on the head, hanging down to form a small forelock.

The breed's ears are medium sized. Positioned horizontally, they are directed slightly forwards. The neck is wide, rounded, and of medium length; its lower part is free of wrinkles. The breed's legs are of medium length and its hooves are strong. The forelegs are covered with wool to the knee, while on the rear legs wool cover extends to the top of the hock. Wool reaches the knee joints in all legs. The tail is thin and long.

The ridge is wide, as is the chest, which is also deep and well developed. The lower line of the chest is horizontal and runs parallel to the backbone's line. Rams often have a projecting brisket that is covered with loose skin. The ribs are rounded, forming a barrel-shaped body. Spine, loin, and croup form a straight line. The back is heavily muscled, rounded, and meaty. The belly is covered with fleece wool.

The characteristics of this breed can be compared with Kyrgyzstan's other specialized meat–wool breeds by referring to Table 2.

Tien-Shan sheep are adapted to the severe conditions found on the alpine rangelands where they are kept year-round. They can easily cope with large temperature variations as well as high-altitude grazing, and in winter graze on ranges covered with snow.

From left to right: two Tien-Shan rams and crossbred Suffolk x Tien-Shan ram

Tien-Shan ewe

Tien-Shan lambs

Body measurements

Tien-Shan sheep display characteristics typical of the mutton–wool Corriedale sheep, as shown by the body measurements given in Table 29. The breed is taller than the Kyrgyz Fine-Wool sheep (see Table 2) though its chest is less projected.

Body weight, growth and carcass traits

Tien-Shan sheep attain a heavy body weight. Maximum weights are reached on stud farms, due to the better management and feed provided (Ajibekov 1995; Table 30).

Ajibekov (1995) also found that the proportion of adult rams having an above-average body weight was 38%, and the maximum weight observed was 138 kg; the corresponding figures for ewes were 32% and 96 kg, respectively.

The growth of rams under range conditions (Table 31) suggests fast growth during lactation and early maturity.

The salient carcass characteristics of this breed are presented in Table 32.

Table 29. Body measurements of Tien-Shan sheep.

	Rams		Ewes	
Trait (cm)	6 months	Adult	6 months	Adult
Height at ridge	67.4	81.5	60.1	64.9
Height at sacrum	68.5	81.6	61.0	66.5
Chest width at shoulders	23.3	29.2	21.4	24.5
Chest girth	88.9	114.3	74.9	93.3
Chest depth	31.4	41.7	27.8	32.1
Width at pelvis	16.8	20.6	14.2	18.3
Diagonal body length	74.1	91.4	65.6	70.6
Metacarpus circumference	na	11.0	na	8.0

Source: Ajibekov (1995).
Notes: na: not available; number of records was not available.

Table 30. Body weights of Tien-Shan sheep kept on different pedigree farms.

Type of animal	n	Mean±SE (kg)	SD (kg)	CV (%)
Tien-Shanskiy pedigree farm				
Sires	88	107.0±0.8	7.5	7.0
1.5-year-old rams	40	75.5±1.0	6.3	8.4
Adult ewes, elite	917	61.4±0.2	5.5	9.0
Adult ewes, I class	1,538	57.3±0.1	4.7	8.1
Ewe lambs, elite	326	38.1±0.2	2.8	7.2
Ewe lambs, I class	646	35.4±0.1	3.2	9.2
Narynskiy pedigree farm				
Sires	45	99.4±1.3	7.9	7.9
Adult ewes	451	57.9±0.5	3.8	6.5
1-year-old ewe lambs	116	36.5±0.3	3.1	8.5

Source: Ajibekov (1995).
Notes: SE: Standard error; SD: Standard deviaiton; CV: Coefficient of variation.

Table 31. Growth of Tien-Shan rams under range conditions (n=20).

Age	Mean body weight±SE (kg)	Percentage of mature weight
At birth	5.2±0.2	na
4-4.5 months	37.8±0.8	67.3
12 months	44.0±1.2	78.3
18 months	56.2±0.9	80-85

Source: Ajibekov (1979).
Notes: na: not available; SE: Standard error.

Table 32. Carcass performance of Tien-Shan sheep of different age.

	Slaughter age		
Carcass traits	7-8 months	18-20 months	32-36 months
Pre-slaughter live weight (kg)	35.0	48.2	68.6
Carcass and kidney fat weight (kg)	16.5	23.8	34.5
Dressing percentage (%)	47.1	49.3	50.2
Kidney fat weight (kg)	0.67	0.97	1.86
Kidney fat / pre-slaughter weight (%)	1.9	2.0	2.7
Carcass weight (kg)	15.8	22.8	32.6
Carcass weight / pre-slaughter weight (%)	45.2	47.3	47.5

Source: Ajibekov (1995).
Note: Number of records was not available.

Young animals are suitable for slaughter because they reach maturity early. At 7-8 months of age, lambs with a pre-slaughter weight of 35.0 kg have, on average, a carcass weight of 15.8 kg, a dressing percentage of 47%, and 0.67 kg of kidney fat. The carcasses are large and rounded with a well-developed musculature, particularly on the back. They also have a rich and uniform layer of fat that is valued by consumers. In general, in animals of more than 3 years of age, the dressing percentage of rams is 53-54% while that of ewes is 55% (Druzhenkov and Druzhenkova 1985).

The fattening performance of this breed is acceptable. Over 80-90 days under alpine rangeland conditions, ram lambs increase their weight by 13-15 kg, gaining 150-165 grams per day (g/d) on average, and reaching body weights of 70 kg or more.

Ajibekov (1995) studied the economics of fattening 6-month-old lambs, using a control group fattened on natural rangelands and barley stubble. The treatment lambs were subject to similar management and feeding regimes, but were also provided with an additional 0.3 kg of barley grain per day (Table 33).

Table 33. Fattening trial of Tien-Shan rams (n=40).

Group	Fattening period (days)	Body weight (kg)		Average daily weight gain (g/day)
		At beginning of fattening period	At end of fattening period	
Supplemented	45	36.0	46.7	238
	75	36.0	51.5	207
Control	45	36.0	44.0	178
	75	36.0	49.5	180

Source: Ajibekov (1995).

Feed-use efficiency was high in both groups and over both fattening periods: 6.04-6.86 feeding units were required for 1 kg of weight gain. The treatment group gained more than 200 g/day, while the control group managed under range conditions gained about 180 g/day.

Reproductive performance

The reproductive performance of this breed makes it suitable for breeding under range conditions; prolificacy is rather low (Table 34). Note that the results given in Table 34 derive from large-scale artificial insemination efforts.

Table 34. Reproductive performance of Tien-Shan ewes.

Items	Pedigree plant	Pedigree farm	Throughout the zone (24 farms)
Number of ewes	11,579	9440	398,780
Prolificacy (%)	111.2	110.6	106.9
Live lambs† per 100 ewes mated	106.5	107.7	97.8

Sources: Druzhenkova (1965); Druzhenkov and Druzhenkova (1985); Ajibekov (1995).
Note: †Live by the end of lambing.

At birth, Tien-Shan lambs are strong and well developed, with sturdy extremities and a good level of wool coverage. These characteristics help to ensure rather low levels of lamb mortality under alpine conditions. Lamb mortality from birth to weaning varies from 2.5% to 8% (Druzhenkova 1965).

Kuikeyev (1991) studied the reproductive capacity of immature and mature Tien-Shan rams and found that the age of a ram had no significant effect on the outcome of that insemination (Table 35).

Table 35. Reproductive capacity and semen quality of Tien-Shan rams.

	Age	
Trait	6 months	Mature (1.5-year-old)
Ejaculate volume (ml)	0.81	1.68
Semen activity (score)†	0.88	0.89
Concentration (billion/ml)	2.198	2.430
Ewes fertilized after first insemination (%)	86.2	89.6
Prolificacy (%)	113.0	109.0

Source: Kuikeyev (1991).
Note: †1 is the score representing maximum activity and zero no activity.

Milk production

Studies of milk production during the lactation period (Kasymov 1981) have demonstrated that, under the usual husbandry conditions, ewes with a single lamb produce 155 kg of milk over a 140-day lactation period, while ewes with twins produce 170 kg of milk over the same period. Average daily milk yields are 1.1 and 1.2 kg, respectively. At the age of 4 months, lambs borne by ewes with a high milk yield weigh 47.8 kg. Such lambs are 28% heavier than those produced by ewes with a medium milk yield and 74% heavier than lambs whose mothers yield low levels of milk. The milk of this breed contains 8.28% fat, 7.28% protein and 4.23% sugar.

Wool production

Data on wool production by different types of Tien-Shan sheep kept on a pedigree farm is shown in Table 36.

Table 36. Wool production of Tien-Shan sheep at a pedigree farm.

Type of animal	n	Greasy fleece weight±SE (kg)	Clean fleece weight (kg)	Wool length±SE (cm)
Sires	88	9.3±0.1	6.67	15.2±0.2
1.5-year-old rams	40	6.9±0.1	4.76	16.8±0.1
Adult ewes, elite	967	4.9±0.02	3.00	13.5±0.1
Adult ewes, first class	1,538	3.6±0.04	2.57	12.8±0.5
1-year-old elite ewe lambs	326	3.9±0.03	2.52	17.4±0.1
1-year-old first class ewe lambs	646	3.6±0.02	2.22	16.0±0.1

Source: Ajibekov (1995).
Note: SE: Standard error.

Outlier rams and ewes were found to produce up to 11-13 kg of wool, while outlier replacement rams produced up to 8-9 kg and ewes up to 5.5-6.5 kg of wool. As with all sheep breeds, wool production is affected by range conditions; fleeces produced in favorable years can weigh 9.8-20.9% more than those produced during average years (Ajibekov 1995).

The wax content of this breed's clean wool ranges from 9.1% to 12.5%, while the depth to which dust penetrates the fleece ranges from 46.8% to 62.2% of the depth of the wool at the sides of the body, and from 55.7% to 77.4% at the level of the spine. The wool produced contains 2 to 3 curls per centimeter of staple length, and fiber diameters are reasonably uniform. Clean yields reach 67.7-70.3%. Tien-Shan wool is used in the production of knitted goods, carpets, and specialized high-quality fabrics. At present wool prices are low; mutton has therefore become an economically more important product.

Skin measurements and quality

Druzhenkova *et al*. (1991) and Ajibekov and Konurbaev (1992) studied the skin morphology of Tien-Shan sheep. The skin layer containing the hair follicles constitutes 57.7-62.3% of the entire skin of each sheep. Fiber density does not differ from that of sheep of other semi-fine breeds (Table 37).

Table 37. Skin traits of Tien-Shan sheep.

Skin traits	5-month-old lambs	14-month-old rams
Total skin thickness (μm)	1,885	3,299
Thickness of follicle bearing layer (μm)	1,175	1,905
Thickness of reticular layer (μm)	686	1,383
Fiber density (fibers/mm^2).	31.6	30.1
Secondary/primary follicle ratio	7.17	10.15

Sources: Druzhenkova *et al*. (1991); Ajibekov and Konurbaev (1992).

Blood polymorphisms

Studies of Tien-Shan sheep have identified twelve blood antigen factors distributed within six genetic systems: A, B, C, D, M, and R. The frequency of the incidence of antigens varied from zero to 77.3%. The Aa antigen occurred almost twice as often in males (38.6-45.5%) as it did in females (23.3-37.5%), while the Ab antigen occurred a little more often in young animals (Gafarov *et al.* 1986).

Five antigens were found in system B: Bb, Bc, Bd, Bt and Bq. Factor Bb was the most widespread, having a frequency of 45.7-77.3%. The Bc antigen is related to the sex chromosome, therefore it occurs more frequently in ewes and ewe lambs, displaying an average frequency of 11.0-18.8%. This is 1.5-4.2 times higher than the frequency displayed in rams. Antigens Ca, Da, R, Bc, and Bd were rarely found in the group of young animals studied (Gafarov *et al.* 1986).

The results of a study of polymorphism in hemoglobin types, transferrins, and potassium levels in blood, are presented in Table 38.

Table 38. Polymorphism of blood proteins of Tien-Shan sheep raised on stud farms.

		Gene frequency							
		Hemoglobin		Potassium		Transferrins			
Type of animal	n	A	B	HK	LK	A	B	C	D
Rams	115	0.062	0.938	0.295	0.705	0.297	0.269	0.390	0.044
Ewes	86	0.035	0.965	0.187	0.813	0.317	0.244	0.378	0.061
Lambs	88	0.115	0.885	0.395	0.605	0.216	0.352	0.398	0.034

Source: Chortonbaev *et al.* (1999).

As was the case in the Kyrgyz Fine-Wool breed, the incidence of hemoglobin B was found to be high in comparison to the incidence of hemoglobin A, which occurred at a low frequency. Among the stock of the stud farms, the high potassium level allele HK was found to occur at a relatively higher frequency than that associated with low potassium level. Transferrins A and B occurred at a similar level of frequency, and were more common than D, which has a low rate of occurrence.

Genetic and phenotypic parameter estimates

Several researchers have studied the phenotypic and genetic variability of important production traits in Tien-Shan sheep (Druzhenkov and Druzhenkova 1972; Kaziev 1979; Ajibekov 1995, 1997). However, these estimates pertain to the population that existed during the time of the Soviet Union. New estimates of phenotypic and genetic variability of these traits should therefore be made using the new methodologies now available.

Ajibekov (1995) studied the effects that age has on body weight and fleece weight in Tien-Shan sheep. After 2 years of age, body weights seem to vary less, as demonstrated by the smaller coefficients of variation found for sheep of older ages (Table 39).

Table 39. Body weights and fleece weights at different ages in Tien-Shan sheep.

	Body weight						Fleece weight					
	Rams			Ewes			Rams			Ewes		
Age	n	Mean (kg)	CV (%)	n	Mean (kg)	CV (%)	n	Mean (kg)	CV (%)	n	Mean (kg)	CV (%)
At birth	60	4.9	16.6	338	4.1	15.2	na	na	na	na	na	na
At 4-5 months	75	48.8	7.9	560	32.4	9.6	na	na	na	na	na	na
1-year-old	80	73.0	15.4	586	46.2	11.2	79	5.5	18.7	658	3.7	13.9
2-year-old	82	98.0	7.0	586	55.9	10.0	80	8.1	15.8	645	4.1	13.7
3-year-old	82	103.7	7.9	494	61.7	8.1	80	8.4	16.6	203	4.1	13.2
4-year-old	82	106.3	7.5	297	65.2	7.2	77	8.1	18.1	306	4.0	11.9
5-year-old	73	105.4	10.0	149	65.6	6.0	70	8.3	21.1	194	3.9	13.2
6-year-old	41	103.7	7.8	36	65.7	5.8	42	7.8	18.3	66	3.6	14.8
7-year-old	15	105.1	7.5	na	na	na	13	8.0	22.0	na	na	na

Source: Ajibekov (1995).
Notes: na: not available; CV: Coefficient of variation.

Correlations between measurements taken at different ages were used to assess the repeatability of body weight and fleece weight. The highest repeatabilities for body weight were found between the ages of 2 and 3 years as well as between the ages of 2 and 4 years. The repeatability of fleece weight was low (Table 40).

Table 40. Repeatability of body weight and fleece weight of Tien-Shan sheep.

	Body weight		Fleece weight	
Ages that were compared	Rams	Ewes	Rams	Ewes
Birth and 4 months	0.28	0.29	na	na
Birth and 1 year	0.40	0.34	na	na
4 months and 1 year	0.14	0.07	na	na
1 and 2 years	0.26	0.20	0.34	0.23
1 and 3 years	0.18	0.08	0.06	0.14
1 and 4 years	0.34	0.12	0.06	0.06
1 and 5 years	0.28	0.15	0.20	0.16
2 and 3 years	0.41	0.53	0.09	0.36
2 and 4 years	0.44	0.25	0.29	0.08

Source: Ajibekov (1995).
Notes: Repeatabilities were calculated as phenotypic correlations between different animal ages; na: not available; number of records was not available.

Heritabilities were estimated as two times the daughter–dam regression (Ajibekov 1997). The results obtained were in agreement with those reported in the international literature even though the data set used was extremely small (Table 41).

Weak positive phenotypic correlations (r < 0.3, in the majority of cases) between body weight and fleece weight, and between fleece weight and wool length have been found. However, no association was found between body weight and wool length (Table 42).

Table 41. Heritability of traits in Tien-Shan sheep (n=63 pairs).

Trait	Heritability
Body weight	0.38
Wool yield	0.42
Wool length	0.50

Source: Ajibekov (1997).

Table 42. Phenotypic correlations between some production traits in Tien-Shan sheep.

Type of animal	n	Body weight and fleece weight	Fleece weight and wool length	Body weight and wool length
Rams	71	0.21	0.14	-0.03
Ewes	130	0.35	0.26	0.05
Yearling rams	105	0.35	0.21	-0.01
Yearling ewes	127	0.59	0.30	0.03

Source: Ajibekov (1995).

Current structure of breeding programs

The Tien-Shan breed is based on four specialized bloodlines derived from specific sires through progeny selection. The production traits of the bloodlines are shown in Table 43.

Table 43. Performance of Tien-Shan bloodlines.

Type of animal	Bloodline	n	Body weight (kg)	Fleece weight (kg)	Wool length (cm)
Sires	3929	26	103.4	8.97	16.9
	6143	18	106.8	10.2	15.1
	6827	21	112.4	8.80	15.3
	7442	23	106.5	8.98	15.9
Ewes	3929	346	63.5	4.03	14.8
	6143	263	63.4	4.54	13.0
	6827	90	68.5	3.93	13.3
	7442	202	61.3	3.99	13.8
Ewe lambs	3929	150	51.4	4.00	18.3
	6143	37	54.4	4.32	16.1
	6827	42	52.5	4.60	16.9
	7442	85	51.7	4.20	18.1

Source: Druzhenkova and Ajibekov (1991).

The Kyrgyz Research Institute of Livestock Production is in charge of the Tien-Shan breeding program, which is undertaken at the Tien-Shanskiy stud farm in the Kara-Kujur Valley (2700-3000 m a.s.l.). About 1500 animals within the program are subject to genealogical control.

The Alay Medium-Coarse-Wool Sheep

The development and improvement of the breed

The Alay black-and-chestnut fat-tailed sheep, a breed native to Kyrgyzstan, has been subjected to a breeding plan that began in 1934. At that time, ewes of this breed were brought to the All-Union Agricultural Academy of Agricultural Sciences (VASKHNIL) station to constitute the foundation flock. In 1938, the Alay ewes were crossed with Précoce sires. In 1940, the first Précoce × fat-tailed generation was intercrossed. After 10 years of selection, the average body and fleece weights of rams reached 103.3 and 4.1 kg, respectively, while those of ewes reached 69.0 and 2.6 kg, respectively.

In 1952, Sarajin rams from Turkmenistan were crossed with part of the stock discussed above, to improve wool traits and develop the Alay's fat tail. In 1962, Sarajin rams were also crossed with Alay ewes; however, these crosses mainly involved commercial stock.

The breeding efforts undertaken resulted in two different groups of animals being produced, one derived from selected Précoce × fat-tailed crossbreeds, and the other from crossbreeding with Sarajin sheep. Both groups were then crossed with white fat-tailed sires.

These breeding efforts produced an Alay sheep that combined high levels of meat, fat, and wool productivity, with a high level of adaptability to year-round rangeland grazing conditions, and a white fleece and top hair. The presence of small colored spots was considered acceptable. The production standards that Alay sheep are required to meet are shown in Table 44.

Table 44. Production standards for first-class Alay sheep.

Trait	Rams	Ewes
Adult live weight (kg)	90	60
12-month live weight (kg)	65	48
Adult fleece weight (kg)	4.0	2.5
12-month fleece weight (kg)	3.0	2.2
Clean yield (%)	60-65	60-65
Down fiber length (cm)	10	8
Wool fiber length (cm)	20	15

Source: Botbayev (1982).

Long-term selection resulted in the development of a fat-tailed sheep with a white, medium-coarse, wool. In 1981 the flock produced was approved as a breed by the State Expert Commission of the USSR's Ministry of Agriculture. At that time, approximately 107,000 head met the standards set for the breed.

Appearance

Alay sheep are meat-, fat-, and wool-producing animals with a distinguishable phenotype. The coat is white and semi-bright. The wool of the fleece is long and curly, and has a tipped structure. The tail is fat and brindled. Brindled coloring is also present on the ears, face, and extremities. The ears are large and hang downwards.

Individuals are large with a comparatively light but strong frame. The skin is elastic and dense. The body is wide, with a compact neck of normal length. The chest is deep and muscular and the spine is straight; the musculature of the whole body is well developed. All these features are consonant with those of meat-producing animals. The head has a slightly Roman profile. Rams are horned and ewes are polled. The legs are of medium length, and are well formed with strong, shiny hoofs. In 79% of individuals the fat tail is large and wide, like the fat tails of Sarajin sheep and of sheep indigenous to Kyrgyzstan. Some animals have a fat tail that hangs downwards.

The body, head, belly, fat tail, and legs possess a good level of wool coverage. The breed does not shed its wool. White is the color preferred in this breed and is currently the most common color: 75% or more of individuals are white, and the proportion of white animals is increasing each year. The conformation of Alay sheep is adapted to walking and grazing on the rangelands of cold, alpine semi-desert areas. In the winter they graze on rangelands covered with snow.

Alay lamb

Alay rams

Alay ewe

Body weight, growth and carcass traits

Alay sheep are heavy, attaining a body weight second only to that reached by Jissar sheep, the largest and heaviest sheep of Central Asia (Table 45).

The average weight gain from birth to weaning (at 4.0-4.5 months of age) in different years ranges from 267 to 330 g/day in rams and from 243 to 269 g/day in females. Alay lambs grow quickly and by 5 months of age can reach 80-90% of the weight of a 1.5-year-old sheep, while the weight of 1.5-year-old sheep is approximately 90% that of a mature sheep.

Table 45. Body weights of Alay sheep.

Type of animal	Class	n	Mean (kg)	SD (kg)	CV (%)	Range (kg)
Sires	Elite	89	105.2	6.16	5.8	95-129
Replacement rams	Elite	36	75.4	6.05	8.0	66-86
Ewes	Elite I	1,567	62.3	5.15	8.3	55-83
Selected ewes	Elite	639	68.2	3.28	4.8	65-83
1.5-year-old ewes	Elite I	886	50.1	2.78	5.5	45-64
Ram lambs at birth	Non-elite	648	5.1	0.60	11.7	3.1-7.0
Ram lambs at weaning	Non-elite	1,370	36.1	4.87	13.5	29-50
Ewe lambs at birth	Non-elite	727	4.9	0.43	5.8	3.0-6.3
Ewe lambs at weaning	Non-elite	626	32.7	3.50	10.7	22-45

Source: Botbayev (1982).
Notes: SD: Standard deviation; CV: Coefficient of variation.

Alay sheep yield adequate amounts of meat and fat, the latter being a trait favored by Kyrgyz consumers (Table 46).

Alay carcasses are wide and rounded with a well-developed musculature, particularly in the hind quarters. The ratio of muscle weight to bone-and-tendon weight ranges from 3.8 to 6.0. The fat tail accounts for 4-5% of the weight of the carcass, weighing 2-3 kg in ewes and 3-8 kg in rams. In fattened animals, the fat tail can weigh as much as 12-18 kg.

Table 46. Production of meat and fat by Alay sheep.

		Rams			
Trait	Adult ewes	Adult	1.5-year-old	5-month-old	8-month-old
Pre-slaughter weight (kg)	53.5	71.3	51.5	36.8	42.8
Carcass weight (kg)	27.1	41.7	25.7	18.5	20.7
Fat tail weight (kg)	2.0	3.4	2.5	2.0	2.0
Muscle weight (kg)	18.6	30.6	16.8	12.3	13.9
Bone and tendon weight (kg)	4.5	5.1	4.4	3.1	3.6
Dressing percentage (%)	50.6	58.4	50.0	50.1	48.4
Muscle/(bone+tendon) ratio	4.1	6.0	3.8	3.9	3.9

Source: Botbayev (1982).

Studies of the chemical composition of the meat of Alay sheep of different sexes from various age groups have shown that the dry matter content of Alay meat varies from 30.5% to 52.6%. The meat's fat content ranges from 13.0% to 28.9%, protein content ranges from 12.8% to 21.0% and ashes ranges from 0.40% to 1.03% (Botbayev 1982).

Reproductive performance and milk production

According to Botbayev (1982), under the conditions found in high mountain valleys (3000 m a.s.l.) the breed demonstrates a prolificacy of 106.1%; the survival rate of lambs from birth until weaning is 95.9%. The same study recorded abortion and stillbirth rates of 4.9% for Alay sheep and of 6.3% for Kyrgyz Fine-Wool sheep. The fertilization success rate of artificial insemination was found to be 80% in ewe hoggets (Botbayev 1982).

Wool production

Due to the special emphasis that was placed on wool productivity during all stages of the breed's development, wool production by Alay sheep is superior to that of other fat-tailed sheep of the region. The weights of the fleeces obtained from different types of Alay sheep are shown in Table 47.

Table 47. Fleece weights of Alay sheep.

Type of animal	Class	n	Mean greasy fleece weight (kg)±SE	SD (kg)	CV (%)	Clean fleece weight (kg)
Sires	Elite	97	6.3±0.15	1.50	23.4	3.9
Teaser rams	Elite 1	186	4.9±0.08	1.12	22.5	3.0
Replacement rams	Elite	50	3.8±0.07	0.48	12.5	2.5
Ewes	Elite 1	1546	3.2±0.01	0.59	18.1	2.1
Yearling ewes	Elite 1	275	2.6±0.03	0.56	21.9	1.7
Lambs at weaning	Non-elite	393	0.97±0.01	0.17	17.7	0.7

Source: Botbayev (1982).
Notes: SE: Standard error; SD: Standard deviation; CV: Coefficient of variation.

In the early years of the breed's development (1940-1943), the Alay fat-tailed sheep produced three types of fibers: strong guard hairs (with a fiber diameter of more than 100 µm), top hairs, and fine wool fibers. Guard hairs were removed after about 10 years of breeding, leaving only the finer top hairs (about 50 µm in diameter) and fleece wool (25-32 µm in diameter). The fraction of fine fibers in terms of weight is 48-58%, and in terms of the number of fibers is 83-86% (Botbayev 1982). The proportions of top hair and wool fibers produced in the fleece are within the ranges desirable for use in carpet-making. In rams, top fibers have an average length of 28.8 cm while wool fibers have an average length of 13.3 cm; in ewes these average values are 27.6 cm and 13.0 cm, respectively. In comparison with single shearing, double shearing of Alay sheep increases wool yield by 300-500 g.

The fleece consists of a mixture of fibers: 51.7% white and 48.3% light-gray. The wool produced by this breed is elastic and bright with a clean wool yield of 66.6%. Alay sheep wool resembles Sarajin wool, but is finer in appearance. On average, 85.5% of Alay sheep wool is classified as first class. In the case of the highest grade of Alay wool, soft fine fibers make up 74.7% of the fleece. This type of wool is used to produce worsted yarns for knitted fabrics as well as some other fabrics used to produce clothing. Alay wool is also suitable for carpet production.

In commercial flocks, contamination with dandruff, brown wool tips, colored fibers, dead fibers, dry fibers, and fibers shorter than 3.0 cm are considered shortcomings in Alay sheep fleeces.

Current structure of breeding programs

Five bloodlines, developed by selection and moderate inbreeding, can be distinguished within the Alay breed. The productivity of rams and ewes of these bloodlines is shown in Table 48.

Table 48. Productivity of Alay sheep bloodlines.

	Rams			Ewes		
Bloodline	n	Body weight (kg)	Clean fleece weight (kg)	n	Body weight (kg)	Clean fleece weight (kg)
Combined "sary-kulak"	34	106.5	4.16	617	64.0	2.31
Improved wool "buurul-kulak"	21	99.5	3.89	504	62.3	2.38
Early maturing "kara-kulak"	17	95.2	3.46	511	64.0	1.97
Woolen	30	99.9	4.47	565	60.3	2.34
Non-pigmented	11	101.3	4.41	504	60.0	1.90

Source: Botbayev (1982).

Research and breeding work involving Alay sheep used to be conducted at the Kashka-Suu pedigree plant. Now, however, scientists from the Livestock

Research Institute conduct breeding work on private farms. The Alay breed is considered to be established, as it produces progeny which are relatively homogenous in terms of appearance and performance.

Indigenous Kyrgyz Coarse-Wool Sheep

The Indigenous Kyrgyz Coarse-Wool sheep is one of the indigenous breeds that falls within the country's larger population of fat-tailed sheep, which evolved as a result of their long association with the nomadic people of Eastern Mongolia. In fact, it is assumed that fat-tailed sheep were brought to Kazakhstan and Kyrgyzstan by Mongolian tribes (Lushikhin 1964).

The Indigenous Kyrgyz Coarse-Wool sheep have a long head, a hawk-like nose and long ears. They have a medium length neck. In this breed, the horns of the ewes are not well developed, while those of the rams are quite large and spiral shaped. The body is well developed and either rectangular or barrel-shaped with a slightly acuminate crest. The back of the breed is straight and slightly elongated, and individuals have well developed, broad chests and a strong muscular rump.

This type of sheep is quite large, having a crest height of 70-79 cm (Lus 1970). The live body weight of rams ranges from 74 to 88 kg, while that of ewes ranges from 57 to 68 kg (Lushikhin 1964).

In terms of meat and fat productivity, only the large Jissar and Edilbaev breeds are better than the Kyrgyz Coarse-Wool sheep. The meat is tender, with no odor, while the fat, according to local people, tastes better than butter (Botbayev 1982).

Including both the spring shearing (1.4-1.5 kg) and the fall shearing (0.8-0.9 kg), total wool production per year is 2.2-2.4 kg. The wool is coarse, and can be red, reddish, black or a combination of these main colors (Shahnazarov 1908, cited by Botbayev 1982).

According to Loboda (1948) the mortality rate at birth is zero and survival rate of lambs up to 4 months of age is 93.1%.

Kyrgyz Coarse-Wool ram

Kyrgyz Coarse-Wool ewe

Goat Breed Characterization

Only two synthetic breeds of goats are found in Kyrgyzstan: the Kyrgyz Cashmere and the Kyrgyz Mohair. Both breeds were developed by crossbreeding native goats that no longer exist in the country. Characterization of these breeds has not focused on an in-depth and complete analysis of production performance, although detailed records were kept that covered many years. However, these records are no longer available, as most have been lost. Estimates made of the genetic parameters of the breed and of the effects of environmental causes of variation are very limited, and are based on few observations. Furthermore, both the ownership of flocks and the management conditions under which the breeds are kept have changed dramatically since the dissolution of the Soviet Union. This has led to chaos both in the production and marketing of the breeds in the breeding programs implemented. There is, therefore, a clear need to assess current conditions and identify breeding schemes that would benefit end-users.

The Kyrgyz Cashmere Goat

In 1999, 90,200 Kyrgyz Cashmere goats remained in Kyrgyzstan (Table 1). Most of these animals are kept by small producers, who own 5-10 animals each and who are mostly located in the Batken (Osh) and Jalal-Abad regions. At present, the management of these animals is inadequate, and limits their productivity.

The development and improvement of the breed

The Kyrgyz Cashmere breed was developed by multiplying and selecting Kyrgyz × Pridonskaya crosses on-farm in the Aksyiskiy district of the Jalal-Abad region and the Batkentskiy district of the Batken (Osh) region.

Between 1981 and 1990, the Kysil-Tuu stud farm disseminated more than 53,000 Kyrgyz Cashmere goats (3000 bucks and 50,000 does) to other regions of Kyrgyzstan and to Kazakhstan. Purebred flocks were maintained in various districts and used to produce bucks, which were then mated with native and improved goats kept on collective farms, state farms, and individual farming units. This resulted in a population of Kyrgyz Cashmere goats with different levels of upgrading.

Appearance

Kyrgyz Cashmere goats are distinguished by their strong constitution and the ability to adapt well to the management regimes used in highland ranges. Their legs are strong, with well developed hooves. Both male and female goats have horns, the shape of which varies from individual to individual. Both female and male goats have a beard and forelock. The breed’s ears are long, and either hang down or directed out to the sides.

Kyrgyz Cashmere buck (5 years old)

Kyrgyz Cashmere doe and kid

The skin of the breed is thin and strong; muscle and fat tissues are well developed. The legs, body, neck, and the head (to the level of the occipital ridge) are covered with fleece hair. Short cover hairs grow on both the head and the lower parts of the legs.

The most common colors in this breed are black and white. White individuals possess white cover hair, top hair, and cashmere; the intensity of the shade of white varies. Dark animals posses black cover hair and top hair, and the body and neck are black; however, the fur hair is either light-gray, dark-gray or, less commonly, brown.

Males are larger than females, and have a more developed chest, a thick neck, a heavy head, and large horns. Their skin is rough, and they possess large clusters of guard hairs, which form a mane and run along the backbone. With the exception of pelvis width, the body measurements of bucks aged 2.5 years or more are larger than those of female goats (Table 49).

Table 49. Autumn body measurements of adult male and female Kyrgyz Cashmere goats.

	Bucks		Does	
Trait (cm)	Mean±SE	Range	Mean±SE	Range
Height at ridge	66.6±1.06	61-75	65.7±0.53	60-73
Diagonal body length	71.7±1.42	62-79	64.9±0.55	58-73
Height at sacrum	68.6±1.42	61-78	67.5±0.47	60-74
Chest depth	33.6±0.60	27-38	28.2±0.26	26-31
Chest width at shoulder-blade joints	20.6±1.27	18-24	17.9±0.28	15-21
Chest girth behind shoulder blades	86.1±0.93	80-90	80.9±0.99	70-88
Width of pelvis	15.7±0.40	14-19	16.0±0.38	12-19
Metacarpus circumference	9.4±0.15	9-10	8.0±0.13	7-9

Source: Almeyev (1994).
Note: SE: Standard error.

Comparisons of the data displayed in Table 49 with measurements made of other breeds, pedigree groups and indigenous goats with down hair (Lebedj 1948; Alkov 1985 and Misharev 1963) have demonstrated that Kyrgyz Cashmere goats are taller at the crest and rump; however they have shorter body and smaller chest depth. They are also superior to native Kyrgyz goats with regard to pelvis width and width at the shoulder-blade joints.

Body weight, growth and carcass traits

Body weight at birth ranges from 2.2 to 2.8 kg. The body weight of mature sires is 60-65 kg while that of mature does is 36-38 kg. All animals reach their mature live body weight by 5.5 years of age. At 1.5 years of age, individuals attain 64% of their mature weight, while at the age of 2.5 years and at the age of 4.5 years individuals reach 88% and 97% of their mature weight. Following fattening on summer rangelands, the dressing percentage of castrated bucks slaughtered at 1.5-3.5 years of age is 46-51% (Almeyev 2000).

Reproductive performance and milk production

Under year-round rangeland grazing, Kyrgyz Cashmere does display a good rate of reproduction. Prolificacy stands at 125 to 130 kids per 100 does kidding. At the third and fourth kidding, kid output is higher than during previous kiddings and cases of triplets have been reported. The breed produces 80-90 liters of milk per lactation period, which is sufficient to feed one or two kids.

Fiber production

On most parts of the body, cashmere is the dominant fiber in the fleece of pedigree animals, accounting for 60-75% or more of the total fleece weight. On most parts of the body, cashmere fibers are 1.5 to 2 times longer than the top hair. In both adult goats and yearlings, cashmere fibers are 8-10 cm long and 18-21 μm in diameter. Cashmere is the main output of these animals and the main source of the income derived from them. On average, 600-700 g of cashmere are combed from sires, while 450-500 g of cashmere are combed from pedigree female goats. Light-gray, dark-gray and white are the most common colors of cashmere, which is used to produce various machine or hand-knitted items (e.g. felt products). The major characteristics of the cashmere produced by Kyrgyz Cashmere goats conform to international standards (Almeyev 2000).

On stud farms, the cashmere content (by weight) of the fleece is high, averaging 83% (range 71-91%). The fibers of the cashmere produced have an average diameter of 18.8 μm (range 17.2-20.5 μm) and most adult animals produce cashmere fibers which are 8-10 cm long; however, some individuals produce fibers as long as 15.0-16.5 cm (Almeyev 2000).

The amount of combed cashmere produced by animals kept at the Tegirmen-Bashi stud farm during favorable years (1996, 1997) and unfavorable years (1998, 1999) is shown in Table 50. A severe snowy winter in 1998 and lack of supplementary feeding with concentrated fodder during the winter of 1999 are reflected in these figures. In general, cashmere production has declined as a result of environmental factors and inadequate management after the downfall of the Soviet Union.

Animals may be grouped into specialized types and classes which produce different amounts of combed cashmere (Table 51).

Nowadays the cashmere produced in Kyrgyzstan is sold mainly to external markets (China and Europe) through brokers. Cashmere is in high demand and its price has risen.

Table 50. Cashmere production of Kyrgyz Cashmere goats at the Tegirmen-Bashi stud farm in favorable years (1996 and 1997) and unfavorable years (1998 and 1999).

	Cashmere production (g) in different years			
Type of animal	1996	1997	1998	1999
Sires	700	710	560	406
Replacement 1-year-old bucks	370	393	na	na
Does	530	532	489	406
1-year-old does	350	360	285	330
Adult castrated males	347	796	720	576
1-year-old castrated males	302	376	267	230
Overall average	490	523	448	445

Source: Almeyev (2000).
Notes: na: not available; number of records was not available.

Table 51. Cashmere production of Kyrgyz Cashmere goat types.

Sex and age	Type†	Class	n	Mean±SE (g)	Range (g)
Sires	LSDP	Elite	21	795±39	500-1000
Sires	LSDP	1	44	653±28	480-950
Sires	LTP	Elite	22	791±39	500-1000
Sires	LTP	1	26	675±44	450-1000
Ewes (2-year-old)	LSDP	Elite	61	735±20	500-1000
Ewes (2-year-old)	LSDP	1	132	538±11	400-950
Ewes (2-year-old)	LTP	Elite	39	696±12	500-950
Ewes (2-year-old)	LTP	1	76	569±20	400-800

Source: Almeyev (2000).
Notes: †LSDP: gray long cashmere, LTP: dark cashmere; SE: Standard error.

Current structure of breeding programs

The Tegirmen-Bashi state stud farm in the Batkentskiy district of the Batkent region (previously known as Osh) is the main Kyrgyz Cashmere goat stud farm. This stud farm was established following the restructuring of a cooperative farm of the same name in 1997. In 1998 it was included in the Ministry of Agriculture and Water Management's list of official sheep- and goat-breeding facilities (Almeyev 2000).

At the start of 1999, the Tegirmen-Bashi state stud contained 4,410 head, including 177 sires and replacement bucks and 2,812 does (Almeyev 2000). The animals kept on this farm are subject to selection; approximately 70-75% of the progeny produced posses the desired characteristics. At present, about 900 animals on the farm are subject to performance control by the Kyrgyz Livestock Production Research Institute.

The Chon-Kemin cooperative stock company pedigree farm in the Chui region also breeds Kyrgyz Cashmere goats. The breed was introduced to the farm in 1993 from the Kysil-Tuu State stud farm in the Aksyiskiy district of the Jalal-Abad region. The Chon-Kemin cooperative farm now owns 150 goats, including 77 does and 4 sires, half of which display the characteristics desired in the breed. The hair of the elite does on this farm grows to a length of 10.6±0.38 cm (range 7.5-12.5 cm), has an average cashmere content of 73.9% (range 64.1-82.4%) and an average cashmere diameter of 19 µm (range 18.2 to 20.1 µm).

Four lines were developed in the process of forming the breed: LTP or dark-haired, LSDP or gray long-haired, LSEP or gray elastic-haired, and LBTP or white fine-haired. Using white goats, a white elastic-haired line (LBEP) is now being developed. The flock kept at the Tegirmen-Bashi state stud farm consists of individuals from the following different lines: LTP (25.5%), LSDP (33%), LSEP (20.4%), LBTP (13.4%) and LBEP (7.7%). Work to improve these lines is ongoing.

The Kyrgyz Mohair Goat

In 1999 there were 60,100 Kyrgyz Mohair goats in Kyrgyzstan (Table 1). As was true in the case of the Kyrgyz Cashmere goat breed, most of these animals are in the hands of small producers who in average own 5-10 animals each and are located mainly in the Batken (Osh) and D-Abad regions. Again, these animals are not being adequately managed.

The development and improvement of the breed

The first phase of the breed’s development (1937-1953) was undertaken on a number of farms in the Kadamjaiskiy district of the Batken (Osh) region. This involved crossing native Kyrgyz goats with Angora bucks imported from the USA (Texas). Crosses were continued for up to three generations. During the next phase (1953-1970), animals with a high body weight and good fiber characteristics were selected and interbred.

The final phase of the breeding program (1970-1993) was performed by researchers from the Kyrgyz Livestock Breeding Research Institute using the pedigree flocks kept by the Lenin and Orozbekov state farms in the Kadamjaiskiy district. Pedigree breeding was followed in these flocks using a large number of sires that were sold to farmers along with does and kids. These animals were introduced to farms in Laylakskiy district (Batken region), Toktogulskiy district (Jalal-Abad region), Leninpolskiy district (Talas region), Jumagulskiy district (Naryn region), and some other districts of the Republic.

In pure breeding flocks, at least one-third of the progeny produced by this breed can be classed as having the characteristics desired in the breed; however, little is known of the results obtained in private flocks, showing the need of further research. This breed of goat has not been well characterized, as the production performance of the breed has not been properly documented.

Kyrgyz Mohair buck

Kyrgyz Mohair doe (4 years old)

Appearance

Kyrgyz Mohair goats are medium-sized and have a strong constitution. The head of this breed is not large, and both male and female goats are horned. The animals produce a white fleece, and wool cover on most parts of the body consists mainly of transient hair fibers and an insignificant number of coarse top hairs (kemp). The fleece consists of long white tips which form spirals of bright curls. All the body measurements of Kyrgyz Mohair goats are superior to those of Angora goats (Kalilov 1982). With regard to diagonal body length and ridge and sacrum height, the breed is smaller than Kyrgyzstan's native goats (Table 52).

Table 52. Body measurements of 3-year-old Kyrgyz Mohair males.

Trait (cm)	Average	Range
Height at ridge	57.5	52-65
Height at sacrum	60.1	55-67
Diagonal body length	62.1	54-68
Chest width	16.0	15-18
Chest girth behind shoulder blades	79.8	73-84
Chest depth	28.8	26-31
Width at pelvis	15.3	13-17
Metacarpus circumference	7.7	6.4-8.8

Source: Kalilov (1982).

Kyrgyz Mohair goats can walk long distances and are adapted to the conditions and climates found in the semi-desert and rocky rangelands they graze.

Body weight, growth and carcass traits

On average bucks weigh 56-58 kg, while does weigh 35-37 kg (Kalilov 1982). At weaning, the weight of female kids ranges from 26 to 29 kg. Depending on their age and fatness, does of more than 3 years old exhibit a dressing percentage of 40-45% and a carcass yield of 77% meat, 21% bones, and 2% tendon (Kalilov 1982).

Reproductive performance and milk production

Very few reports are available which describe the performance of Kyrgyz Mohair goats. However, Kalilov (1986) has summarized information gathered early in the development of the breed. The breed has also been studied using animals kept on farms in the Kadamjaiskiy district, Batken Province. Available reports indicate that the prolificacy of the breed ranges from 105% to 115% (Kalilov 1982). Other reproduction traits such as fertility and survival rates have not been documented.

Kyrgyz Mohair goats yield low levels of milk, producing only 87-90 kg of milk during their lactation period. This quantity is sufficient to raise one or two kids (Kalilov 1982).

Fiber production

Mohair is the major product yielded by this breed. On average, the fleeces of males weigh 2.5-2.8 kg, while those of females weigh 1.5-2.0 kg. In adult bucks and does, the fibers produced can be 20-22 cm in length and can have a diameter of 32-33 µm. The breed's clean fleece yield ranges from 80% to 86%. Mohair, distinguished by its elasticity and strength, is a valuable material which is used to produce carpets, soft clothing, knitted items, and other hand-crafted products. Kyrgyz mohair is similar to that produced by regular Angoras, though the fleeces produced by the Kyrgyz Mohair goat weigh somewhat less than those produced by these Angoras.

Kyrgyz Mohair goats are sheared once a year, in late March or early April. However, animals which are to be sold and slaughtered for meat are also sheared in autumn, before they are marketed, providing farmers with an additional source of income.

Current structure of breeding programs

The Kyrgyz Mohair flocks bred at the Lenin and Orozbekov state stud farms displayed a complex genealogical structure before the farms were privatized. During the development of the breed, both Kazakh Mohair and Australian Angora sires were crossed with native Kyrgyz does and Angora does imported from America. On the Lenin state stud farm, line-breeding of outstanding sires resulted in the development of four bloodlines (Table 53).

Table 53. Features of Kyrgyz Mohair goat bloodlines.

Bloodline	Main features of foundation sires	Selection priority
L-1 Uzun	6.6 kg fleece weight, 28 cm fiber length, 68 kg body weight	Long fiber
L-2 Takyz	6.9 kg fleece weight, high wool density, 70 kg body weight	Dense fleece
L-3 Salmak	5.8 kg fleece weight, 78 kg body weight	High weight
L-4	Late shedding	Late shedding

Source: Compiled by authors.

What was formerly the pedigree flock of the Lenin collective farm consisted of 5400-5600 head, with an average fleece weight of 1.3-1.36 kg. Elite sires produced 3.1 kg of mohair, while outstanding animals produced up to 4.3-4.5 kg. The average fleece weight of pedigree yearlings was 1.8 kg, while that of outstanding individuals was 2.5-2.8 kg. Does of more than 3 years of age produced fibers which were 19.2 cm long. The average body weight of 3-year-old males was 59.5 kg, while the average body weight of 3-year-old does was 36.8 kg (Kalilov 1986).

Analysis of the fibers produced by these animals showed that mohair accounted for 98% of the fleece weight of sires and 97.4% of the fleece weight of does. Top hair (kemp) accounted for 2.0% and 2.6% of the fleece weight, respectively. The difference in hair length at the shoulder blades and at the britch was 1.5 cm (Kalilov 1986).

At present, due to the restructuring of Kyrgyzstan's mohair production sector, most pedigree animals are kept on individual farming units and subsidiary farms. Eight private pedigree farms in the Kadamjaiskiy district account for 1500 head, including 900 does. On these farms, the average fleece weight of females aged 3 years or more is 1.5-1.9 kg, while the number of kids alive per 100 does stands at 90 to 100. There is a shortage of highly productive sires on these farms. The Kyrgyz Livestock Production Research Institute controls only 275 pedigree goats.

Indigenous Goats

Very little information is available regarding indigenous Kyrgyz goats. The only reference material available is that written by Kaliev and Almeyev (1987). According to these authors, the phenotype of the indigenous goat is similar to that of indigenous goat breeds from Central Asia and Kazakhstan. These animals graze on rangeland, have a strong constitution, and are sturdy and adaptable. Their bones are strong and their bodies are long and deep. The animals have horns, which vary in length from individual to individual. The dominant colors are black and white. Goats from the south of Kyrgyzstan weigh more than those from other parts of the country, and a 3-year-old does can weigh up to 42.6 kg.

In this type of goat, twinning rates average 24.6%, while an average of 90 kg of milk is yielded over an 8-month lactation period.

The average fiber yield of animals aged 3 years or older is 0.47 kg (range 0.10-1.21 kg) in the case of females and 0.7 kg (range 0.21-1.41 kg) in the case of males. Coarse guard hairs account for 76% of the fleece, while the remaining 24% consists of fine down. These fibers range in length from 5 to 11 cm. In south Kyrgyzstan the average yield of down per animal per year stands at 166 g (range 50-280 g), whereas in the north 116 g of down are yielded on average (range 20-240 g).

Prospects for Small Ruminant Production in Kyrgyzstan

Sheep and goats play an important role in the economy of the Republic of Kyrgyzstan. In some regions these animals are the only source of cash, food, and fiber available to rural families. Therefore, the maintenance of a viable and competitive small ruminant sector is crucial to Kyrgyzstan's economy.

The economic structure of the country has changed and with it the breeding organizations which control the genetic improvement and management of the various breeds. Large production units have given way to small production units that breed and manage their animals inefficiently. The current condition of the small ruminant sector needs to be assessed and appropriate measures need to be implemented to ensure that it is developed sustainably. Though the country has a tradition of centralized breeding, such management options no longer function efficiently, as public institutions simply do not have the funds to keep large flocks. As a result, the country must rely on farmer organizations if it is to build an efficient small ruminant industry. The issue of markets should therefore be considered very carefully in this regard.

Mutton and lamb production should be increased to meet the very high level of demand set by the internal market. This level of internal demand provides farmers with the opportunity to produce and graze animals before slaughtering at 7-8 months of age. Potential income-generation opportunities are also provided by cull animals, which could be slaughtered after intensive grazing or fattening. A good market will always be available for carcasses weighing 18-20 kg and containing sufficient amounts of fat. Therefore, attention should be paid to implementing forms of range management that will allow strategic feeding, as the country's ranges still produce high-quality feed if well managed. Care should therefore be taken to ensure that these rangelands are not overstocked. The optimum number of sheep that could be kept in the Kyrgyz Republic is 6.5 million head, of which 70% should be ewes.

Current sheep breeding efforts, initiated through the collaboration with the Kazakh Livestock Research Institute and the University of Wisconsin, aim to increase prolificacy in sheep, particularly in those areas where higher levels of prolificacy could be sustained without causing problems. This is causing farmers to target the market demand for lambs.

Wool production should be increased and its quality improved to meet the level of demand set by the local processing industry. Fine wool should have an average fiber diameter of 19.5-23 µm, and should consist of fibers at least 6.5 cm long. Semi-fine crossbred wool should have an average diameter of 25.1-30.0 µm and should consist of fibers at least 11.0 cm long. In total, local industry requires 8500-9000 tons of wool per year; any additional wool produced could be exported at prices which would vary depending on its quality.

The number of Kyrgyz Cashmere, Mohair, and milk goats in the country should also be increased. The goat population kept on all forms of farms could be increased by 500,000 head by the year 2005. Of these, 255,000 should represent improved breeds (150,000 Cashmere goats, 100,000 Mohair goats and 5000 dairy goats). The government's development strategy anticipates that by 2010 the country's sheep population will have doubled and its goat population tripled. The yearly gross output of goat products therefore has the potential to rise to 60 tons of cashmere, 100 tons of mohair, 4500 tons of milk, 3500 tons of goat meat, and 80,000-90,000 goat skins, for leather and fur production.

The national goals concerning sheep population growth and productivity require improvements in the marketing of both meat and wool. There is a healthy internal market for meat, but not for wool. Producers receive very low prices per kilogram of wool, a factor which is having a detrimental effect on sheep breeding. The Ministry of Agriculture, Water Management and Processing Industries should implement a special nationwide breeding program, as well as a program to improve the quality of all small ruminant-derived products in general, and of wool in particular. To achieve this, scientists at research organizations such as the Kyrgyz Research Institute for Animal Breeding, Veterinary Science and Range and the Kyrgyz Agrarian University must develop modern methods which can be used to improve the breeds. Eventually they should develop new breeds according to the market opportunities that exist. This should be coupled with the development of low-cost sheep feeding and management technologies, the prevention and control of animal diseases, and techniques for the rational use of rangelands, especially those near to villages. These institutions should also work on capacity building, by involving farmers in short-term courses and seminars covering issues such as improved feeding, reproductive management, the improvement of wool quality, and animal health.

In our opinion, international research centers with a mandate which covers small ruminants could help Kyrgyzstan's national agricultural research system, by undertaking collaborative research and by taking part in adaptive projects that aim to improve the genetic resources and productivity of the country's small ruminant population.

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Tajikistan

Chapter Four

Small Ruminant Breeds of Tajikistan

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Introduction

Tajikistan is a mountainous country, and foothills, highland plateaus, alpine landscapes and valleys account for 93% of its territory. Small ruminant breeds adapted to local conditions are kept in these areas and on the lowland plains, and the fiber and milk they produce constitute vital sources of income for people in rural areas. In fact, small ruminant production is the only source of income available to some, particularly those living in inaccessible highland areas.

In 2000, the forestry and the agricultural sectors accounted for 27.4% of Tajikistan's total gross domestic product (GDP). In 1992, however, these sectors accounted for 29.2% of the country's GDP, rising to 36.7% in 1995 (Government Statistical Agency, 2001). In 2000, small ruminants contributed 5.8% to the total amount generated by the country's agricultural sector. However, this constitutes a sharp decrease since 1992, when small ruminant production accounted for 12.9% of the total amount generated by Tajikistan's agricultural sector (Table 1).

Table 1. Gross Agricultural Product (GAP) components (in thousand US$).

Gross Agricultural Product	1992		1995		2000	
	US$	Percentage of total	US$	Percentage of total	US$	Percentage of total
Total agriculture	451,492.1	100.0	255,921.1	100.0	271,859.6	100.0
Livestock	219,303.5	48.6	65,035.7	25.4	47,765.5	21.9
Small ruminants	58,334.5	12.9	17,299.2	6.8	12,705.5	5.8

Source: Government Statistical Agency (2001).
Note: Prices as of 2000. Exchange rate 1 US$=2.55 somonee.

Prior to the period of economic reforms which followed the dissolution of the Soviet Union, sheep and goat ownership was concentrated on state farms and cooperative farms, all of which targeted large-scale wool, mutton and goat meat production. Following these reforms, livestock tenure was transferred to poor and often landless farmers who kept small flocks and herds. These producers face severe financial problems and benefit little from what they produce as they lack bargaining power and so are paid low prices for their products. Though Tajikistan's government supports the development of a new livestock private sector, no mechanisms yet exist to stimulate the effective development of sheep and goat production. This explains why the contribution this sector makes to the economy of Tajikistan has decreased.

Sheep and Goat Population Size and Distribution

By 2001, Tajikistan's total population of sheep and goats consisted of about 2.2 million head, having decreased by 30% in less than fifteen years (Table 2). The decline occurred during the political and economic transition precipitated by the break up of the Soviet Union, apparently stabilized in 1998. Sheep stocks fell by 39%, in contrast to goat stocks which were more stable. Sheep now represent 67% of Tajikistan's small ruminant population, while goats account for the remaining 33%.

Table 2. Sheep and goat population (as of 1st January 2001, in thousands).

Year	Sheep	Goats	Total
1985	2,436.0	748.6	3,184.6
1996	1,815.7	677.8	2,493.5
1998	1,554.0	667.6	2,221.6
2000	1,472.2	705.8	2,178.0
2001	1,477.9	743.8	2,221.7

Source: Government Statistical Agency (2001).

During the transition period the country experienced after the dissolution of the Soviet Union, new types of farm ownership were developed as a result of the fragmentation of large state and cooperative farms; however, a few state and cooperative farms still operate. Table 3 shows the fall in the number of large agricultural enterprises (state and cooperative farms) and the associated increase in the number of smallholdings that occurred between 1996 and 2001. As a result of this shift, by 2001, 74% of Tajikistan's sheep and goats were kept on smallholdings (Table 3).

Table 3. Sheep and goats in different production systems (as of January 2001, in thousands).

	1996		2001	
Farm categories	n	%	n	%
All categories of farms	2,493.5	100.0	2,221.7	100
State and cooperative farms	1,020.3	41.0	572.5	26
Dehkan (individual) farming units	4.9	0.2	83.4	4
Private subsistence farms	1,468.3	58.8	1,565.8	70

Source: Government Statistical Agency (2001).

The different farm categories and their main characteristics are described in Table 4.

Table 4. Current farm types and characteristics.

Farm types	Flock size	Farms	Percentage of all farms	Main features
State farms	3,000-5,000	13	0.005	The animals kept are used as a source of pedigree stock, are subject to genealogical control, and are included in breed improvement plans. These institutions face severe financial problems.
Pedigree cooperative farms (held under lease agreements)	2,000-4,000	17	0.006	The animals kept are used as a source of pedigree stock, are subject to genealogical control, and are included in breed improvement plans. These institutions face severe financial problems.
Cooperative farms (under leasing from the government)	3,500-4,000	202	0.077	These institutions produce under technological support and have access to cropped areas used to produce forage. Could implement intensive fattening and milk production and milk-processing systems; however, they face severe financial problems.
Private *Dehkan* or individual farming units	50-100	1,270	0.484	These types of farm are owned by poor farmers who have access to some cropped areas. Potential exists to increase the size of the flocks kept, and to amalgamate the flocks of different farmers to create commercially viable flocks if seasonal grazing is combined with fodder production for winter feeding.
Private landless subsidiary farms	≥15	260,800	99.427	This type of production unit is owned by extremely poor farmers who own only household plots. Ranges around villages are intensively grazes by animals, resulting in range degradation. Livestock products are used mainly for home consumption.

Source: Compiled by author.

Regional Distribution of Sheep and Goat Breeds

Five breeds of sheep are kept in Tajikistan: the Gissar, the Jaidara, the Karakul, the Tajik and the Pamir (or Darvaz). The most important sheep breeds are the Gissar and Jaidara, which represent 39% and 29% of the total sheep population, respectively. Both are specialized meat-producing breeds. Two goat breeds are found in the country: the native goat and the Soviet Mohair. The most common breed is the indigenous or native goat, which accounts for 69% of Tajikistan's goat population. Table 5 shows the distribution of these sheep and goat breeds by region. More sheep and goats are found in regions III and II than in the other regions. As of January 1, 2001, in total, there were 229,000, 743,000, 845,000 and 405,000 head of small ruminants in regions I, II, II and IV, respectively. The geographical distribution of sheep and goat breeds is also included in Figures 1-7.

The native goat population reported in table 5 includes the cashmere-producing Pamir goat, a breed estimated at 58,000 animals with little information available on its current economic and sotial role, characteristics, management features and production performance.

The native goat population reported in Table 5 includes the cashmere-producing Pamir goat, a breed estimated at 58,000 head with little information available on its current economic and social role, characteristics, management features and production performance.

Table 5. Population of sheep and goats by breed and region (as of January 2001, in thousands).

	Regions									
	I. Pamir (Badkhshan) (eastern)		II. Sogd (north)		III. Khatlin (south)		IV. Gissar (central)		Total	
Breed	n	% of breed	n	% of breed	n	% of breed	n	% of breed	n	% of all breeds
Sheep										
Gissar	0	0	55	9	348	61	171	30	574	39
Jaidara	0	0	422	100	0	0	0	0	422	29
Karakul	0	0	6	4	148	96	0	0	154	10
Tajik	0	0	0	0	63	47	70	53	133	9
Pamir	133	68	0	0	62	32	0	0	195	13
Goats										
Native	58†	11	65	13	224	44	164	32	511	69
Mohair	38	16	195	84	0	0	0	0	233	31

Source: Compiled by author.
Note: †Pamir Cashmere goat breed.

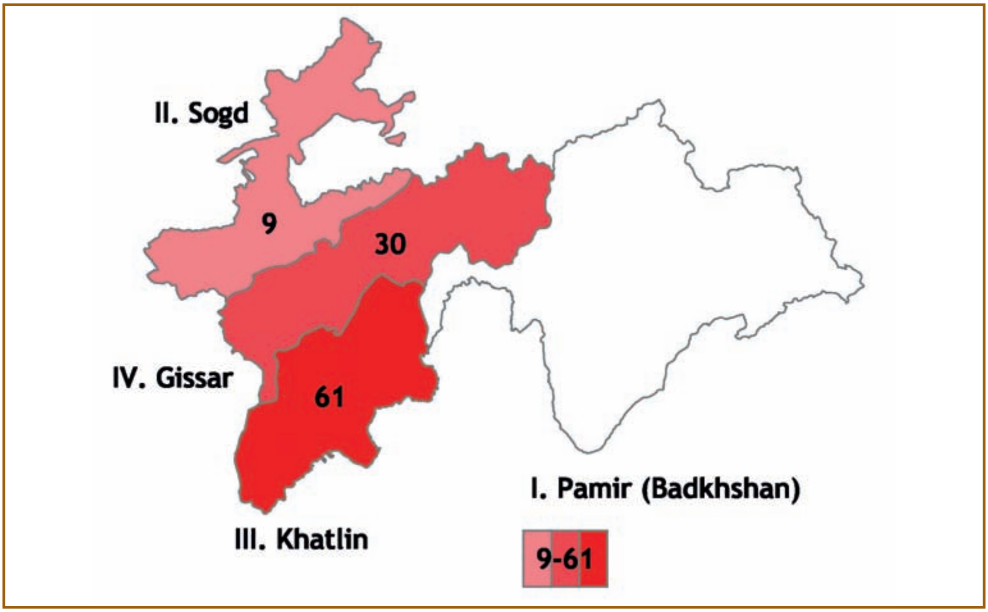

Figure 1. Geographical distribution of Tajik Gissar sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by author. Numbers represent percent distribution of the breed in the different provinces of Tajikistan.

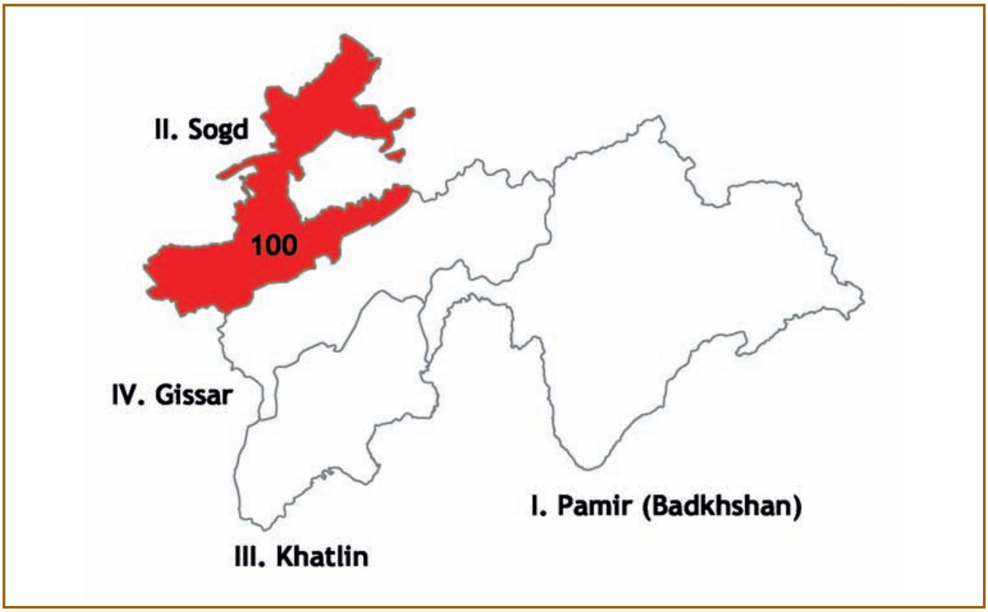

Figure 2. Geographical distribution of Tajik Jaidara sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by author. Number represents percent distribution of the breed which occurs mostly in Sogd.

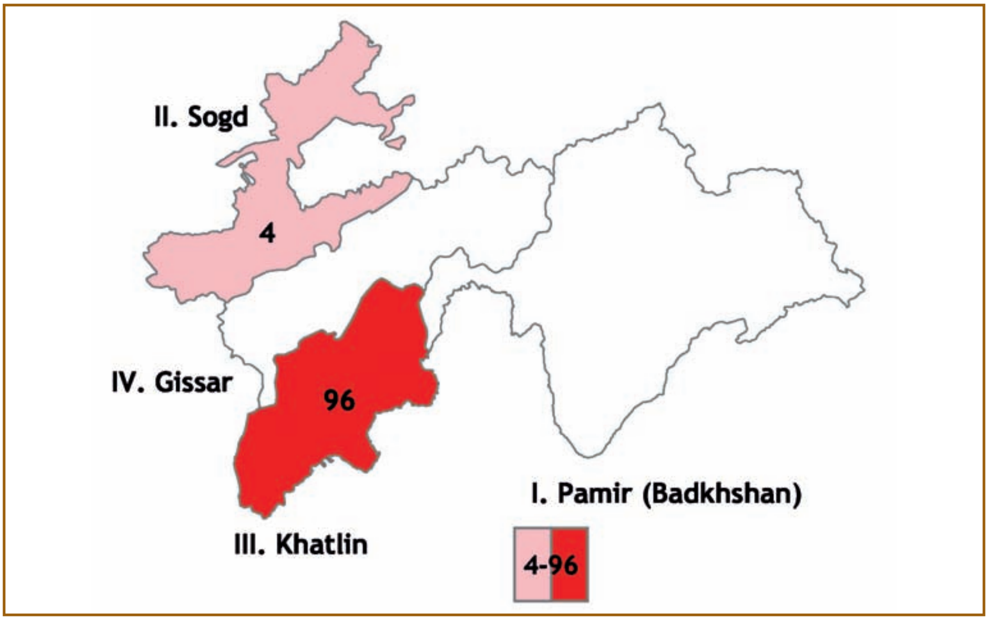

Figure 3. Geographical distribution of Tajik Karakul sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by author. Numbers represent percent distribution of the breed in the different provinces of Tajikistan.

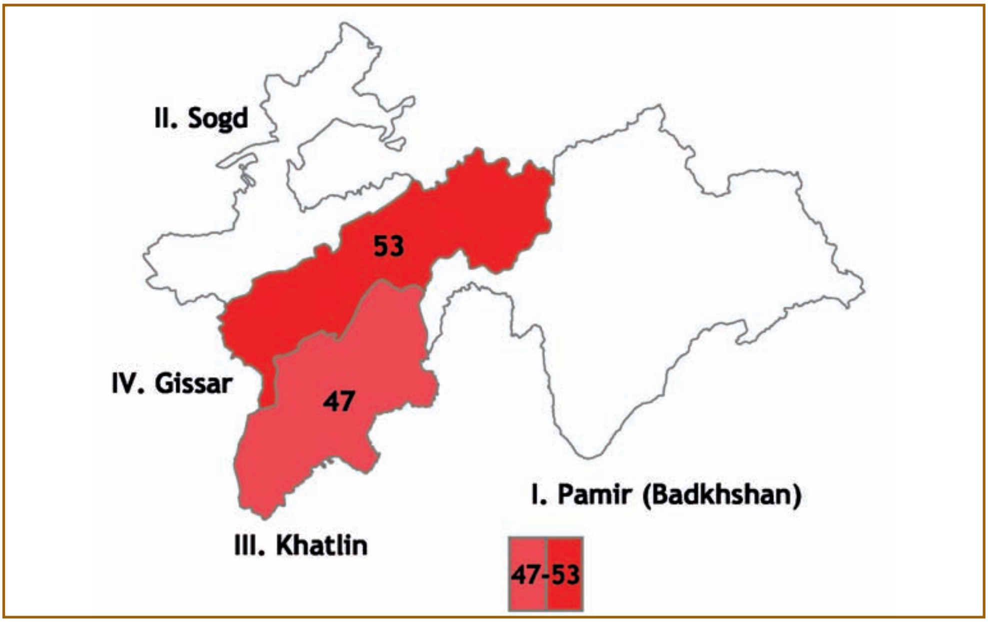

Figure 4. Geographical distribution of Pamir (Darvaz) sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by author. Numbers represent percent distribution of the breed in the different provinces of Tajikistan.

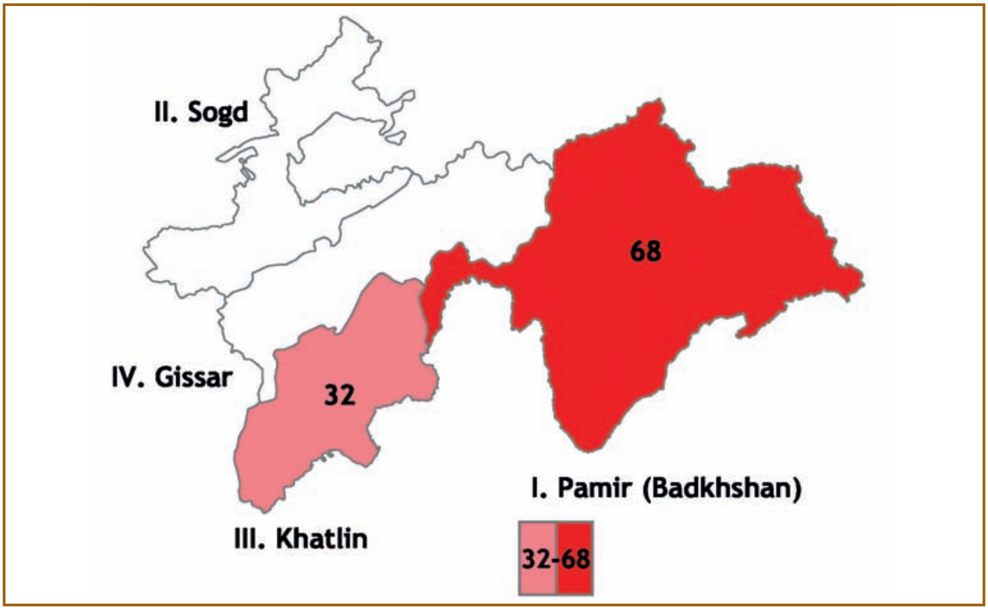

Figure 5. Geographical distribution of Tajik sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by author. Numbers represent percent distribution of the breed in the different provinces of Tajikistan.

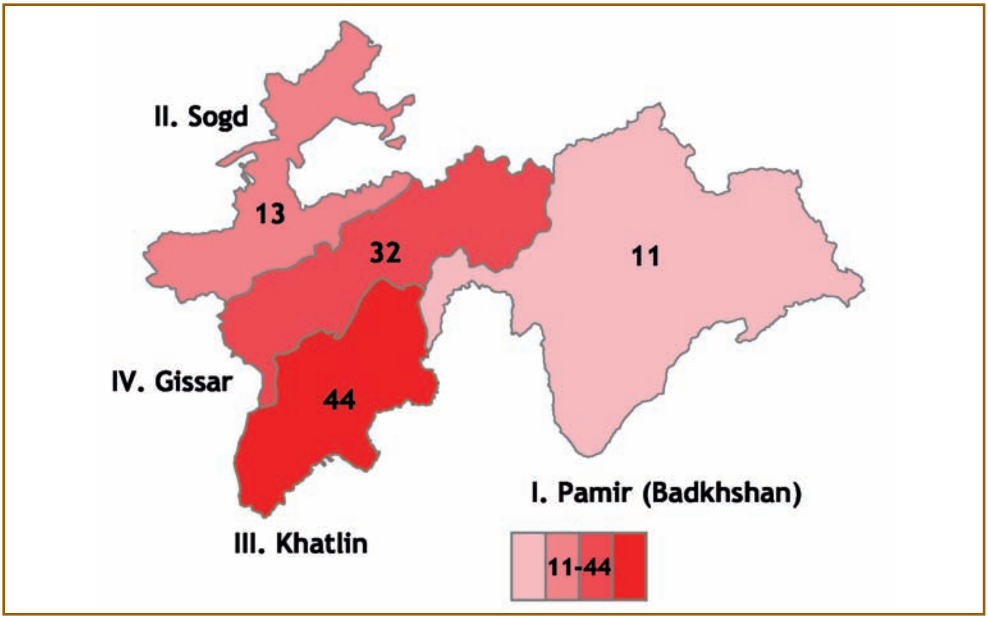

Figure 6. Geographical distribution of Native coarse fiber goats of Tajikistan.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by author. Numbers represent percent distribution of the breed in the different provinces of Tajikistan.

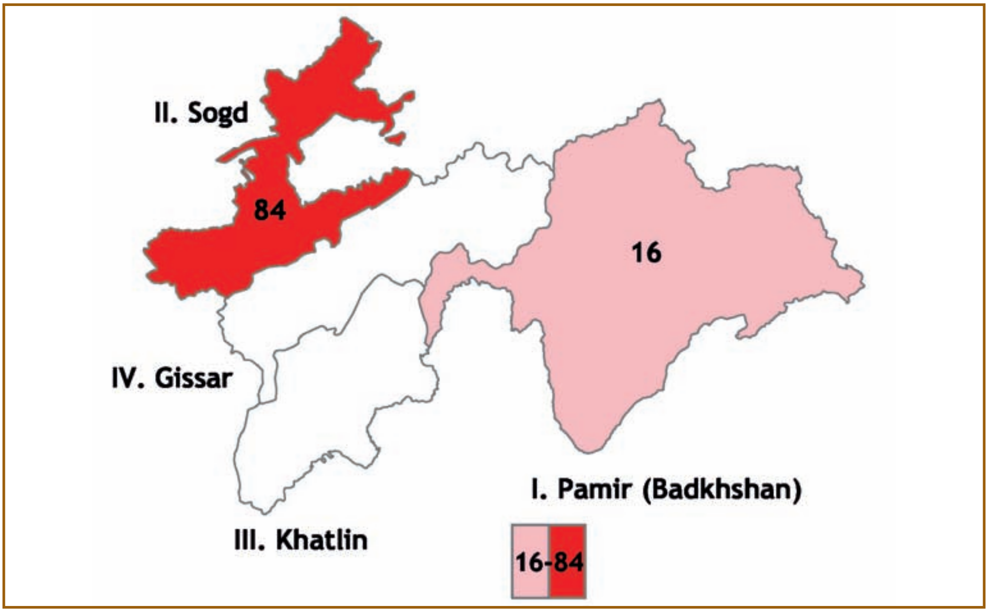

Figure 7. Geographical distribution of Tajik Mohair goats.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by author. Numbers represent percent distribution of the breed in the different provinces of Tajikistan,

Main Production Characteristics of Tajikistan's Sheep and Goat Breeds

Table 6 shows the main characteristics of the different sheep and goat breeds raised in Tajikistan.

Table 6. Appearance and production characteristics of Tajik sheep and goat breeds.

Breed	Size	Size rank†	Tail type	Tail size rank‡	Ears	Fiber type	Main produce
Sheep							
Gissar	Large	5	Long, fat	5	Long, hanging	C	Meat, fat
Karakul	Medium	1	Long, fat	2	Hanging	MC	Meat, wool, pelts
Jaidara	Large	3	Fat	3	Long	C	Meat, fat
Tajik	Large	4	Long, fat	4	Long, hanging	MC	Meat, wool, fat
Pamir	Medium	2	Thin	1	Medium length	MCT	Wool, meat
Goats							
Native	Large	3	na	na	Long, hanging	C	Meat
Pamir	Medium	1	na	na	Short, hanging	C, Cash	Meat, cashmere
Mohair	Small	2	na	na	Short, hanging	M33	Fiber

Source: Compiled by author.
Notes: na: not applicable. †Size rank: 1 the smallest and 5 the largest (in sheep) or 1 the smallest and 3 the largest (in goats); ‡Fat-tail size rank: 1 thin-tail and 5 fattest.
C: Coarse; MC: Medium Coarse; MCT: Medium coarse and thin; Cash: Cashmere; M33: Mohair with 33 µm diameter fibers.

The Gissar is the largest Central Asian sheep breed. It is used to produce meat and fat, as are most of Tajikistan's sheep breeds. The Tajik sheep produces high-quality wool and, as in neighboring Uzbekistan, Karakul sheep are kept for their pelts. The fine wool sheep kept in Tajikistan are mainly derived from the Pamir (Darvaz) breed. Neither the sheep nor the goat breeds kept are specifically exploited for milk production. The main breeds and their associated products are given in Table 6, along with the features of the breed. Note that, with the exception of the Pamir, all the sheep breeds are fat-tailed.

Livestock producers milk their sheep and goats only to obtain milk for family consumption.

Sheep and Goat Products: Prices and Markets

Both sheep and goat meat are in high demand and command good market prices (Table 7). This is particularly true in the case of meat and fat of the Gissar, Tajik and Jaidara fat-tailed (or *kurdyuk*) sheep, which are widely used in the local cuisine. However, farmers do not benefit from this high level of demand because the markets are unregulated and they are treated unfairly by the traders who buy their products. Organized groups of traders illegally set low farm-gate prices for the meat and control its transportation. Poor producers suffer, as their profit margins are much lower than those of the traders they sell to.

Table 7. Prices of small ruminant products per kilogram (in somonee).

Breed	Meat	Fat of fat tail	Wool/fibers
Gissar sheep	4.0	4.5-5.0	0.30
Jaidara sheep	3.8	4.0-4.5	0.50
Karakul sheep	3.8	na	0.50
Tajik sheep	4.0	4.5-5.0	2.0
Pamir (Darvaz) sheep	3.8	na	1.7
Native coarse fiber goat	2.5-3.0	na	0.9-1.0
Tajik Mohair goat	2.5-3.0	na	4.0
Cashmere fiber goat	na	na	8.0

Source: Ministry of Agriculture (2001a).
Notes: Prices as of August 2001. Exchange rate 1 US$ = 2.5 somonee; na=not applicable.

Buyers who monopolize the market by buying large volumes of produce also negatively affect farmers' incomes, by isolating them from market opportunities. This is particularly true in Tajikistan's main cities, where intermediaries inflate prices by up to 50% without sharing the profits with producers. In most cases livestock owners are unable to sell their products independently, either because of transportation costs or the large numbers of traders that will take steps to deter them from directly taking advantage of the market.

There is no market for wool within Tajikistan (either coarse, medium or fine), as this sector is experiencing a complete recession. The major wool buyers are outside Tajikistan. However, no partnerships have yet been established with processing enterprises. Because of this, wool stocks have accumulated on farms over the last 5-6 years.

There is also no market for animal skins in Tajikistan, and the country's skin-processing plant is no longer operating. Significant quantities of sheep and goatskins used to be exported to skin-processing plants in Russia; however, this is no longer the case.

In the past, approximately 200,000 Karakul lambs were slaughtered per year for their pelts. The pelts were then delivered to Uzbek and Turkmen factories for processing. However, Karakul lambs are no longer being slaughtered and Karakul pelt production is stagnating.

Market strategies need to be developed to ensure the competitive production of large volumes of small ruminant products. Anecdotal information based on available animal stocks and growth suggests that there is potential to produce 2500-3000 tons of wool per year, 200,000 to 300,000 pieces of animal skins per year and 80,000-100,000 Karakul pelts per year.

Main Climatic Features

Tajikistan is located in the most mountainous southeasterly corner of Central Asia and the Caucasus and occupies part of the Pamir, one of the highest mountain ranges in the world. In general, the plains of southern Tajikistan experience hot summers and winters, which are less cold than those experienced in the rest of the country. The winters are colder in the central and northern valleys and the summers are moderately hot. In the high plateaus and mountains of the Pamir, cold weather and permanent frosts prevail (Nabiev *et al*. 1974). Sheep and goats are raised in most of these climates.

The plains of south Tajikistan

Intensive solar radiation, aridity and a continental climate characterize the plains of south Tajikistan. Temperatures depend on altitude. According to data from the Sha'artuzskaya meteorological station, the average winter temperature is above zero at noon in the plains. The coldest month is January, when temperatures range from 4°C to 6°C on the plains and in the foothills at a range 300-800 m above sea level (m a.s.l.). At higher elevations (1100-1200 m a.s.l.) the average temperature in January is 1°C. In July, summer temperatures reach 31.5°C on average, with the minimum being 27°C and the maximum 45°C. On average, there are 243 frost-free days per year (maximum 280 days). Annual rainfall ranges from 180 to 335 mm in this region.

Central Tajikistan

Central Tajikistan, including the Gissar Valley, is a mountainous region (1100 to 4000 m a.s.l.). At 2000 m a.s.l., the climate is warm in summer and reasonably mild in winter. In January, temperatures range from 0°C to -6°C, and from 24°C to 28°C in July. Average annual rainfall is 1200 mm. At altitudes above 2000 m a.s.l., summers are moderately warm and winters are more severe. Temperatures in January range from 8°C to -12°C, and average 20°C in July; annual rainfall ranges from 600 to 1600 mm.

North Tajikistan

In north Tajikistan, summer temperatures can reach 42°C, while winter temperatures can drop to -27°C. Average annual rainfall is 140-160 mm. Rainfall is distributed unevenly over the autumn, winter and spring months. No rain falls occur during the summer, when the relative air humidity is 28-33%.

The Pamir region

The Pamir region is a yak- and goat-keeping area. Winters last from 40 days (at altitudes of 1400 m a.s.l.) to up to 220 days (at altitudes of above 3500 m a.s.l.). Minimum air temperatures can fall to -34°C. In the north, annual rainfall can be as high as 400 mm, while in the south and east of the region less rain falls (90-140 mm and 70-120 mm, respectively). The central and eastern areas of the Pamir region are characterized by extreme cold, with temperatures falling as low as -39°C; in the area around Bulunkul lake, temperatures can fall to -63°C. In the west of the Pamir region, snow cover lasts from 40 to 160 days, depending on the altitude. On the glaciers (4000 m a.s.l.) snow cover is permanent.

Rangelands Associated with Small Ruminant Production

The variety of climatic conditions found in Tajikistan result in distinct vegetation and soil types in different areas. These, in turn, determine the specific types of rangelands that occur. Such rangelands are the main source of feed for small ruminants. It is estimated that rangelands constitute 77.1% of the agricultural land found in the Republic, and contribute 80% of the feed small ruminants consume each year, through grazing or through the use of hay as a feed. Until 2000, a proportion of the rangeland in neighboring countries was still being used by Tajik flocks. However, in 2000, this stopped as a result of inter-governmental agreements on the common use of grazing land. Tajikistan's rangeland remains state property, and has not been privatized or transferred to farming units.

In Tajikistan, the ranges are grazed on a rotational manner according to the season. In this process, flocks are moved to different types of ranges for different periods (Table 8).

Table 8. Natural ranges and the periods for which they are used during the year.

Types of range	Utilization period		Duration
	Beginning	End	(days)
Winter ranges	1 October	30 April	212
Passage ranges	1 May	15 June	46
Summer, subalpine and alpine belts	15 June	31 August	77
Low mountains, foothills, mid-mountains	1 September	30 September	30

Source: Akhmedov (1978).

Winter and spring ranges

The ranges grazed in winter and spring include the country's *Artemisia* – ephemeroid ranges. *Artemisia* is mainly grazed in autumn and winter, while ephemeroids such as sedges (*Carex* spp.), meadow grass (*Poa pratensis*) and ephemerals are grazed in spring.

The winter and spring ranges of Southern Tajikistan provide green fodder only in spring (February-April). For the rest of the year the livestock graze on dry grass stands which contain ephemerals and ephemeroids. The winter ranges of the eastern Pamir cover vast areas of cold alpine desert, and are composed of *Artemisia* species or a mixture of *Artemisia* and winterfat (*Krascheninnikovia lanata*).

The palatable biomass yields of winter and spring rangeland range from 0.15 to 0.35 tonnes of dry matter (DM) per hectare. Due to fluctuations in climatic conditions and the deterioration of grass stands (as a result of overgrazing and plowing to produce cereal crops) these yields vary considerably from year to year. An acceptable stocking rate for these ranges is 2 sheep/ha, though the current stocking rate is about twice that.

Passage ranges

Currently, about 30 livestock routes, or passages, are used to move sheep and goats between ranges in foothills and those in the mid-mountain belts. These passages contain many species valuable for grazing and hay production. Examples of such useful range species include wild barley (*Hordeum* spp.), bulbous meadow grass or *khardumma* (*Poa bulbosa*), dew-grass (*Dactylis glomerata*), couch grass or *okchoy* (*Agropyron repens*), brome grass (*Bromus inermis*), wild blue alfalfa (*Medicago sativa*), and sainfoin (*Onobrychis sativa*).

Summer ranges

The summer ranges are located in alpine (2300-4200 m a.s.l.) and sub-alpine (2800-3000 m a.s.l.) belts. These highland ranges are grazed for about 2.5 months, when the weather is moderately warm or cool.

Summer ranges include alpine meadows and steppes. Meadows contain herbaceous perennial plants which lie dormant in winter and which require moderate temperatures and moderate levels of moisture in order to develop. The types of vegetation typically found in these areas include meadow foxtail (*Alopecurus seravshanicus*), meadow grass (*Poa pratensis*), wild barley (*Hordeum* spp.), *Bergenia ugamica*, brome grass (*Bromus* spp.), and ryegrass (*Lolium perenne*). As a result of uncontrolled grazing, unpalatable weeds have invaded the alpine ranges. Thus, while gross dry matter yields are rather high (reaching 2-3 t/ha), the amount contributed to this total by palatable species does not surpass 0.7 t/ha. Swamps containing herbaceous vegetation occur in wet areas, such as those found in the eastern Pamir. These provide summer rangeland grazing for 3 to 4 months of the year.

Tajikistan's steppe-land summer ranges are located in the country's sub-alpine zone. On these ranges, the dominant plant species include fescue (*Festuca orientalis*), meadow grass (*Poa pratensis*), *Koeleria* spp., feather grass (*Stipa pennata*), and *Leucopoa olgae*, as well as legumes such as *Trigonella*, vetch (*Vicia*) and *Astragalus* species. These types of ranges are grazed for 2-3 months during the summer. They yield less dry matter than meadow ranges, but contain proportionally more palatable plants. The total dry matter yield of this type of range is 0.7-1.0 t/ha, of which 0.3-0.5 t/ha consists of palatable species.

Late summer ranges

Tajikistan's late summer ranges cover a rather small strip of the country's alpine ranges (3000-3500 m a.s.l.). Short grasses predominate; these include sheep's fescue (*Festuca ovina*), salt-marsh-grass (*Puccinellia* spp.), crazyweed (*Oxytropis lambertii*), motley grass (*Artemisia* spp.), cinquefoil (*Potentilla repens*) and *Adonis* spp. These ranges are grazed during the second half of summer. Gross dry matter yield ranges from 0.3 to 0.9 t/ha, including 0.15-0.35 t/ha of palatable matter.

Haylands

There are about 78,000 ha of permanent hayland in Tajikistan. On average, the dry matter yield of these areas is 1.18 t/ha of hay. Most of these areas are located in the country's foothills and mountains, and the fodder they produce is usually harvested and conserved as hay to provide winter feed.

Management of Sheep and Goats

In Tajikistan, sheep are managed under an extensive system. From March to April, animals are both kept and fed in pens and grazed on winter and spring ranges. Between May and September they are moved to alpine summer ranges. In the autumn (October-November) they are grazed on valley ranges and stubbles. In winter (December-February) a system which combines pen and range feeding is followed.

Grazing only ceases in winter when conditions are extreme. Lambs are born early in spring and sheep are then shorn before they are moved to summer ranges. Shearing is also sometimes undertaken during the autumn on the summer ranges, or while flocks are being moved from the summer ranges to the autumn and winter ranges.

On the summer ranges, sheep flocks are distributed throughout various fixed locations and are supplied with salt. Most sheep are mated while the flocks are being grazed in the intermediary valleys and on the winter ranges. A summary calendar of the management regime applied in Tajikistan is given in Table 9.

Table 9. Activity calendar for sheep and goats of Tajikistan.

	Months											
Events and seasons	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Grazing of winter and spring ranges				■	■							
Grazing alpine-summer range						■	■	■	■	■		
Grazing winter ranges	■	■	■								■	■
Stubble grazing†											■	■
Supplementary feeding‡	■	■	■	■	■							
Mating											■	
Lambing				■								
Weaning								■				
Fattening ram lambs											■	■
Fattening culled animals											■	■
Shearing						■				■		
Drenching					■							
Dipping						■				■		
Seasons	Winter			Spring			Summer			Autumn		

Sources: Farsikhanov *et al.* (1985); Tajik Livestock Research Institute (1985; 1990).
Notes: †cereal stubbles include cotton crop residues; ‡in winter and spring supplementary feeding includes roughage such as range hay and straw (0.5-1.0 kg/head) and concentrates or grains (0.2-0.3 kg/head) when required.

Goats are managed in a similar way to sheep both at the level of individual farms, which keep sheep and goats together, and at the level of larger goat-breeding farms.

Small Ruminant Genetic Resources and Breeding Programs

In Tajikistan, the Tajik Research Institute for Livestock Breeding is officially responsible for sheep breeding work through its breeding department. The branch of the Institute which is in the Sogd region studies goat breeds. In general the Institute runs pedigree farms upon which the animals kept are subject to genealogical control. It also runs a number of pedigree farms used to multiply breeds. Breeding plans exist for each sheep and goat breed and are overseen by a principal investigator. All the pedigree records of highly valuable animals are stored at the Tajik Research Institute.

Nucleus pedigree flocks of Gissar, Jaidara, Karakul, Tajik, and Pamir (Darvaz) sheep, as well as nucleus pedigree herds of different goat breeds, have been established in Tajikistan in order to allow researchers to conduct genetic improvement work. The institutions and breeds involved in this are shown in Table 10. The flocks indicated in Table 10 were still available in 2003.

Table 10. Breeds and nucleus pedigree flocks used for genetic improvement work.

Breed	Location	Research Institution
Gissar sheep	Dushanbe	Tajik Research Institute for Livestock Breeding
Karakul sheep	Dushanbe	Tajik Research Institute for Livestock Breeding
Tajik sheep	Dushanbe	Tajik Research Institute for Livestock Breeding
Jaidara sheep	Khujand	Tajik Research Institute for Livestock Breeding (Sogd)
Pamir sheep	Kulyab zone	Tajik Research Institute for Livestock Breeding
Tajik Mohair goat	Khujand	Tajik Research Institute for Livestock Breeding (Sogd)

Source: Compiled by author.

Table 11. Network of Tajikistan experimental stations involved in small ruminant breeding.

Breed	Pedigree breeding plants	Pedigree breeding farms	Pedigree breeding stations	Total	Total stock (as of 2001, in thousands)
Gissar sheep	2	2	1	5	26.5
Karakul sheep	2	3	0	5	90.9
Jaidara sheep	0	1	2	3	12.3
Tajik sheep	1	1	2	4	6.9
Pamir sheep	1	3	0	4	12.4
Tajik Mohair goat	1	2	3	6	24.7

Source: Ministry of Agriculture (2001b).

A large network of experimental stations, which operate as pedigree breeding farms, are associated with those farms which possess nucleus pedigree flocks (Table 11).

Pedigree breeding plants work to improve existing breeds and develop more valuable lines and types. To achieve this, intra-line selection and various degrees of inbreeding are used to fix, in their offspring, desirable characteristics and performance potential.

Pedigree breeding farms and stations usually multiply the pedigree animals produced, using a nucleus flock, so that they can be distributed to farmers. The stock kept on these farms is inferior to that kept by pedigree breeding plants; nonetheless, these animals are also purebred, and have a high value pedigree. Usually pedigree breeding plants and farms sell highly productive sheep and goats to farmers both inside and outside the Republic.

All types of experimental stations (pedigree breeding plants and farms) are associated with the Tajik Research Institute for Livestock Production. In accordance with a 1997 Governmental resolution, such farms are under the control of the Ministry of Agriculture.

Currently the Institute is working to

- Improve the production traits of sheep kept at the Parkhar pedigree breeding plant
- Develop the Shakhrinau-Regar Gissar sheep
- Improve the reproductive potential of Gissar sheep
- Improve production traits of Tajik sheep
- Improve production traits of Pamir (Darvaz) Fine Wool sheep

- Improve the production traits of the black and gray Kabadian and Tajik Sur Karakul sheep
- Breed Tajik Mohair goats.

However, the research that is being undertaken in the country is being severely affected by a funding crisis. The amount of research funds available is minimal and, as a result, conditions in the breeding plants have deteriorated. As a result, the animals kept at the plants are now poorly fed and insufficient breeding work is being undertaken. In addition, there are few young researchers and the equipment available is obsolete. These problems are compounded by the fact that the scientific approaches used are still being influenced by the planning strategies used in the past, the major goal of which was to increase productivity through genetic improvement. New approaches are required to identify and overcome the difficulties faced by newly emerging production systems. Steps also need to be taken to reevaluate production orientations and, eventually, to diversify production, goals which imply the need to produce adequate and pertinent breeding plans.

As a result of the various problems outlined above, Tajikistan is at risk of losing the progress already made by efforts to genetically improve the Tajik Mohair goat and the Gissar, Tajik, Jaidara, and Pamir (Darvaz) sheep breeds.

Threats to genetic diversity

Table 12 summarizes the decreases that have occurred in Tajikistan's sheep and goat populations over a period of about 10 years and contains an assessment of the risk each population faces in terms of its genetic diversity. All populations decreased in number between 1999 and 2001. The largest declines leading to smaller populations were observed in the numbers of Tajik and Pamir sheep. Genetic diversity in these breeds is assumed to face a high level of risk. Only the Pamir goat seems to face a considerable risk to its genetic diversity in view of a small decreasing population.

Table 12. Small ruminant breeds of Tajikistan, populations (in thousands), changes in populations, and risks to genetic diversity.

Breeds	Population in 1990	Population in 2001	Percentage change	Risks to genetic integrity
Sheep				
Gissar	760.5	574.4	-24.5	Low risk
Jaidara	625.5	422.0	-32.7	Low risk
Karakul	478.9	253.8	-47.0	Low risk
Tajik	69.0	32.9	-52.3	High risk
Pamir	380.0	94.7	-75.1	High risk
Goats				
Native	530.4	460.9	-13.0	Low risk
Pamir	72.4	50.0	-30.9	High risk
Tajik Mohair	375.6	232.9	-38.0	Low risk

Source: Compiled by author.

Sheep Breed Characterization

The Tajik Gissar Sheep

The development and improvement of the breed

The Gissar is one of Central Asia's indigenous sheep breeds and is preferred in many mountainous regions of Central Asia because of its ability to utilize efficiently high and low altitude ranges and grow. These animals are characterized by their adaptation to various ecological and geographical conditions, including those found on semi-arid rangelands at about 500 m a.s.l. and on highland rangelands at 3500 m a.s.l. They are well adapted to the prolonged annual migrations they undertake to reach high-altitude summer ranges.

The breed has a coarse fleece and is mainly raised to produce meat and fat. There are approximately 574,000 Gissar sheep in Tajikistan. These animals are mainly distributed throughout the Khatlin (61%), Central Gissar (30%) and Sogd regions (10%) (Table 5).

Appearance

The Gissar is one of the largest breeds in the world. Half of Tajikistan's Gissar (49%) are red and brown in color, while more than one-third (37%) are black; a further 2% are white, while the rest are spotted (Farsikhanov 1981). Typically, animals of this breed have well developed occipital and parietal bones, giving rise to three head shapes: (1) slight with a straight profile, (2) medium-sized with a slightly Roman profile and nose, and (3) heavy with a pronounced Roman profile and nose. The ears of the breed are long (18 cm length) and drooping. As a rule, Gissar ewes have no horns, while sires either have rudimentary horns (1 to 4 cm in length) or horns which are 10 to 15 cm long. The hooves of these animals are very strong, and are suited to walking long distances and to rocky ground.

Tajik Gissar light brown rams in a fattening system

Tajik Gissar ewe with lamb

The fat tail (*kurdyuk)* of this breed is well developed; however, it does not hang in a way that hinders movement. The size of the fat tail falls dramatically shortly before and during winter as the fat it contains is consumed to cope with feed shortages. Well-developed fat tails can be compact and raised or can hang. The size and shape of the tail varies considerably between individuals. The characteristics of this breed are compared with those of Tajikistan's other breeds in Table 6, above.

Body measurements

According to Farsikhanov (1981), the average height of 3- to 4-year-old sires at the ridge is 87 cm, while 3- to 4-year-old ewes are 79 cm tall at the ridge on average. Average diagonal body lengths are 85 cm (sires) and 75 cm (ewes), while the average width behind the shoulder blades is 22 cm. Average chest depths in this breed are 35.5 cm (sires) and 34 cm (ewes).

Body weights, growth and carcass traits

The Gissar is known for its outstanding meat and fat production performance. If able to consume an adequate amount of feed on the range, the Gissar sheep can grow larger than other sheep breeds and produce more meat and fat. Table 13 gives the average weights of Gissar sheep at different ages.

The best performing ewes fattened at pedigree plants can reach 125 kg, while sires can reach 173 kg or more. Azarov and Brigis (1930) reported three sires with a live body weight of 196 kg each. On average, the fat tail of a ewe weighs 15 kg, while that of a ram weighs 25 kg, reaching 35-40 kg in exceptional cases. At weaning (5-6 months) they achieve a live body weight of around 50-60 kg. At 1.5 years, they reach 80-90% of their adult weight taken at 3.5 years (Table 13). The weights of Gissar sheep of different ages have also been reported by a more recent study (Farsikhanov 1981; Table 14).

Male Gissar carcass traits are shown in Table 15. Carcass yields average 41-47% of the live weight of the slaughtered animal, depending on its age. The fat tail represents between 3% and 15% of the weight of a live adult animal and makes a major contribution to the live weight of younger animals. At most ages, fat accounts for 14% to 34% of the carcass weights of individual animals, the exception being the 6-year-old age group (Table 15). Carcass traits vary with age. Carcass weight, fat-tail weight and the weight of an animal's body fat all increase within the first few months of life, before lambs are weaned at 6 months. After weaning, these weights decrease until individual animals are taken to the summer ranges, when their body weights once more begin to increase.

After their first summer, the pre-slaughter live body weights and carcass weights of 1.5-year-old ram lambs are similar to those of 2-year-old animals after they have survived the winter (Table 15). However, significant differences exist in relation to the weight of the fat tail (5.7 vs. 4.3 kg). This is because of poor feeding during the winter, when live body weight fails to increase, and in some cases decreases due to the loss of fat reserves.

Table 13. Live weight of male and female Gissar sheep of different ages.

	Rams				Ewes			
Age	n	Average (kg)	Range (kg)	% adult weight	n	Average (kg)	Range (kg)	% adult weight
At birth	4,075	5.6	3-8	5	4,069	4.8	3-7	6
3 months	215	34	25-45	33	225	31	30-29	40
6 months	1,144	50	30-70	49	1,775	47	30-65	60
1.5 year	870	82	70-115	80	1,550	73	55-110	94
2.5 year	75	98	75-137	96	560	77	58-112	99
3.5 year	285	102	85-173	100	3,130	78	58-125	100

Source: Lebedev (1952).

Table 14. Body weights (kg) of different breeds in Tajikistan, by sex and age.

	Sheep					Goats	
Age and sex	Gissar	Jaidara	Karakul	Pamir	Tajik	Native	Tajik Mohair
Males							
At birth	6.0	4.5	3.8	4.1	5.3	3.2	3.0
At weaning	49.0	31.5	28.0	32.0	41.7	19.0	16.0
1.5 years	85.0	52.5	48.0	58.0	75.0	33.0	29.0
Adult (4-5 years)	130.0	70.0	65.0	87.0	125.0	56.0	52.5
Females							
At birth	5.6	3.7	3.6	3.9	5.0	2.9	2.4
At weaning	42.5	28.0	26.0	30.0	39.2	17.0	14.0
1.5 years	72.0	42.5	40.0	49.0	55.0	27.0	25.5
Adult (4-5 years)	82.0	52.5	48.0	55.5	75.0	40.5	37.5
Authors	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Sources: (1) Farsikhanov (1981); (2) Djurabaev (1998); (3) Akhmedov (1978); (4) Lebedev (1957); (5) Aliev (1967); (6) Dadabaev (1993); (7) Kasimov (2000).
Note: Number of observations was not provided.

Table 15. Carcass traits of male Gissar sheep of different ages (at different times of slaughter).

			Carcass		Fat tail		
Slaughter age	Slaughter date	Live weight (kg)	Weight (kg)	%	Weight (kg)	Percentage of live weight	Percentage of carcass weight
1 month	April	22.8	10.7	47	3.5	15	33
2 months	May	30.3	13.6	45	4.4	15	32
5 months	August	49.4	21.0	43	7.2	15	34
6 months	September	47.1	19.5	41	6.1	13	31
9 months	December	44.1	18.2	41	3.8	9	21
14 months	May	43.7	19.9	46	2.7	6	14
1.5 year	September	56.0	24.0	43	5.7	10	24
2 years	March	55.5	23.8	43	4.3	8	18
2.5 years	September	74.3	32.3	43	7.3	10	23
3.5 years	September	91.8	40.9	45	10.7	12	26

Source: Farsikhanov (1981).
Note: Number of observations was not provided.

Reproductive performance and milk production

Table 16 gives data on the fertility of various sheep breeds, including the Gissar, kept at State and Koljoz (cooperative) farms and managed using artificial insemination. Unfortunately, it is not known how many animals were observed when compiling this data. Gissar fertility values are low in comparison to those of all other Tajik breeds except the Pamir. The proportion of barren ewes increases with age, regardless of the breed, though it is particularly noticeable in the Gissar and Fine Wool breeds.

Farsikhanov *et al.* (1985) and the Tajik Livestock Research Institute (1985; 1990) both state that Gissar, Tajik and Jaidara sheep exhibit low levels of prolificacy, which range from 100 to 110% (Table 17). However, lamb mortality is also low in the Gissar (3-4%; Table 16), probably as a result of the breed's low levels of prolificacy and the fact that its levels of milk production are reasonably high.

Table 16. Fertility rates and birth-to-weaning lamb mortality rates of sheep breeds of Tajikistan.

Reproductive traits	Age (years)	Gissar†	Jaidara‡	Karakul§	Tajik¶	Pamir (Darvaz) fine wool††
Proportion of ewes that lambed per 100 mated	2	84.7	75.9	84.6	86.5	77.1
	4	69.6	89.6	92.5	77.4	61.9
	5	65.6	71.2	75.4	78.1	64.2
	6	52.3	61.1	57.6	64.8	56.8
Barren ewes (per 100)	2	15.3	24.1	15.4	13.5	22.9
	4	30.4	10.4	7.5	22.6	38.1
	5	34.4	28.8	24.6	21.9	35.8
	6	47.7	38.9	42.4	35.2	43.2
Prolificacy (no. of lambs born per 100 ewes lambed)	2	105.5	101.9	109.9	105.5	100.0
	4	111.8	101.7	101.6	108.8	106.4
	5	101.3	103.6	101.1	102.2	107.8
	6	105.9	na	na	na	na
Lamb mortality (per 100)	All ages	3-4	3-4	5-8	6-9	8-10

Sources: †Farsikhanov *et al.* (1985); ‡Osipov (1992); §Akhmedov (1978); ¶Aliev (1967); ††Lebedev (1957).
Notes: na: not available; number of observations was not provided.

Farsikhanov (1981) found that within 2 months of lactation, Gissar ewes have been observed to produce 123 kg of milk. Most of this milk was produced during the second month of lactation. Furthermore, the same author found that Gissar milk consists of 7-8% fat and 5.4-5.7% protein.

Wool production

The only shortcoming of the Gissar sheep is the breed's low wool yield. The wool produced is very coarse, and consists of down (38-80%), medium fibers (13-28%), coarse top hairs, and dead and dry hairs (18-30%) (Farsikhanov 1981). The

Gissar wool with high proportion of coarse top hairs and dead and dry hairs is of a much lower quality than that produced by other coarse-wool sheep breeds and is used mainly to produce rough felt. Sheep are shorn twice a year, in spring and in autumn. The staple length of spring-shorn wool is 8-12 cm. Gissar lambs produce wool which is of a higher quality than that produced by adult animals. Rams produce fleeces which weigh 1.3-1.6 kg, while the fleeces of ewes weigh 1.0-1.4 kg and those of lambs weigh 0.4-0.5 kg. The breed has a clean fleece yield of 60-70% (Farsikhanov 1981).

Table 17. Prolificacy and birth weights of Tajikistan's small ruminant breeds.

Breed	Prolificacy per 100 ewes lambed	Birth weight (kg)	
		Female	Male
Gissar	100-110	5.0-6.0	5.5-6.5
Karakul	115-120	3.5-3.8	4.0-4.2
Jaidara	100-110	3.5-4.0	3.8-4.3
Tajik	100-110	4.5-5.0	5.0-5.5
Pamir (Darvaz) sheep	120-128	3.8-4.0	4.0-4.3
Tajik Mohair goat	100-110	2.5-3.0	2.8-3.5
Indigenous coarse fiber goats, including the Pamir breed	115-125	2.8-3.2	3.0-3.8

Sources: Farsikhanov *et al.* (1985); Tajik Livestock Research Institute (1985, 1990).
Note: Number of observations was not provided.

Estimates of the breed's genetic parameters and current improvement programs

No estimates are available of the genetic parameters of this breed, or of the value of the Gissar in crossbreeding programs. A general description of the current breeding approach is provided above, in the section entitled "Small ruminant genetic resources and breeding programs".

The Tajik Jaidara Sheep

The development and improvement of the breed

The Tajik Jaidara sheep is a native fat-tailed breed. It was developed through the selection and mating of animals based on fast fattening characteristics and the amount of fat accumulated in the fat tail. This sheep breed has the second largest population in the country, with 422,000 specimens of the breed being distributed over the Sogd region alone (Table 5). The breed is mainly raised to produce meat, fat and a coarse fleece.

Appearance

In appearance, this breed is similar to the Gissar. A peculiarity of Jaidara sheep is their short legs and long body; this is likely to be a factor that is responsible for their great capacity to grow fat when conditions are favorable. Individuals of this breed are large, and have a strong frame and a well formed body. Most have a slightly Roman nose, and a long head and long ears. The neck is short, straight and rather muscular. The crest is wide and, as a rule, the spine is straight and solid. The rump is wide and slopes slightly downwards. The chest is wide and deep. The breed's fat tail is wide and the fat accumulates upwards. Some sheep have a fat tail which hangs down slightly. The breed's legs are strong and have strong hooves. Wool coverage is good. The fleece may be various tones of black, chestnut or brown.

Tajik Jaidara ram

Tajik Jaidara ewe

Body measurements

In rams aged three years or more the average height at the ridge is 76.3 cm (range 68-84 cm), the average diagonal body length is 80.8 cm (range 73-88 cm), while the average chest girth is 96.2 cm (range 87-107 cm) (Tajik Livestock Research Institute 1985).

Body weights, growth and carcass traits

Jaidara sheep are fast growing: growth is nearly complete by 2.5 years of age. By 1.5 years of age, some animals reach nearly 84-90% of their adult body weight and dimensions (Table 18). Data on the body weights and growth of this breed at different ages are give in Table 14 and Table 18, the latter being based on more recently gathered information.

Table 18. Live weights of Jaidara sheep at different ages and growth.

	Ram weights			Ewe weights		
Age groups	Average (kg)	Range (kg)	Percentage of mature weight	Average (kg)	Range (kg)	Percentage of mature weight
At birth	5.6	3.5-9.0	5	5.2	3.5-7.5	7
4 months	44	36-64	42	41.3	30-56	56
1.5 years	88	64-90	84	66.3	42-80	90
3-4 years	105	95-128	100	73.6	60-84	100

Source: Ernst *et al.* (1994).
Note: Number of observations was not provided.

It should be noted that the birth weights given in Table 18 are definitely higher than those reported for the same breed in Table 17 (3.8-4.3 kg and 3.5-4.0 kg for male and female lambs, respectively).

Ernst *et al.* (1994) reported that ram lambs aged 1.5 years with an average live weight of 80 kg produce a 45 kg carcass, which is equivalent to 56%, on average (range 52-56%), of the animal's live weight. In the same report, the dressed carcass of an adult animal (≥3 years) consisted of 22% fat, while that of young animals consisted of 15% fat.

Reproductive performance

Jaidara fertility levels reach 76% and 90% in 2-year-old and 4-year-old ewes, respectively (Table 16). The breed demonstrates a low level of prolificacy (100-110%; Table 17) and a low lamb mortality rate (Table 16). No estimates of milk production are available for this breed in Tajikistan.

Wool production

Jaidara sheep produce heterogeneous and staple wool. It contains down (46-61%), medium fibers (7-18%), top hair (21-26%) and dead hair (9-10%). Adult sheep (≥3.5 years old) produce straight wool. The staples produced are 8-11 cm long. The clean fleece yield of this breed ranges from 56% to 60% (Ernst *et al.* 1994; Farsikhanov *et al.* 1985).

The average weights of the fleeces produced by adult animals (≥3 years of age) range from 2.0-2.5 kg in the case of ewes to 2.8-3.5 kg in the case of rams (Ernst *et al.* 1994). The wool produced is used to make clothes, felt boots, felt, and rough carpets and other hand-made items.

Estimates of the breed's genetic parameters and current improvement programs

No breeding improvement programs were applied to the Jaidara in Tajikistan during the Soviet Union period, and the genetic parameters of the breed have not been estimated. Flocks are available which could be used as the foundations of future genetic improvement programs. For an account of these flocks and the difficulties associated with such improvement programs, see the section entitled 'Small Ruminant genetic resources and breeding programs' and Tables 10 and 11, above.

The Tajik Karakul Sheep

The development and improvement of the breed

Karakul sheep first appeared in Tajikistan in the 9th century, when they were brought to the south of the country (Djilikul district) from Turkmenistan and Uzbekistan. Originally, the breed did not produce a good quality pelt, due to poor breeding work. Plans for the genetic improvement of the breed began in 1930. By 1937 the Kabadian and Dangara Karakul breeding farms had been established. Later, between 1950 and 1960, large production farms were also established in the

Asht, Urotube, and Pyand districts of the country. Researchers from the Tajik branch of the All Union Research Institute of Karakul Breeding targeted the improvement of gray Karakul. As a result, gray Karakul production increased and a type of blue Karakul pelt was created. By 1975, first-class Karakul accounted for 75% of the country's Karakul pelt production, and 30% of all pelts produced were of the jacket variety. By the same token, 20% of the pelts produced were from gray Karakul. By 1978, flocks of gray Karakul had also been established (Akhmedov 1978). In 2000, Tajik researchers also established flocks of Tajik sur-colored Karakul and began working to improve the black and gray Kabadian Karakul.

The Karakul sheep breed is indigenous to Central Asia, and is raised under the severe conditions found in deserts and semi-deserts. They have a strong constitution, a solid frame, and a strong musculature. They also show exceptionally high levels of mobility and endurance. These features mean that Karakul sheep can be raised in both hot tropical conditions and in areas where the winters are very cold (-40°C). Most (96%) of Tajikistan's 154,000 head of Karakul sheep are raised in the Khatlin region; the remaining 4% are kept in the Sogd region (Table 5). At present 70% of Tajikistan's Karakul stock is concentrated on farms within the Vakhsh valley, a zone which produces fine-fiber cotton. The breed is raised to produce pelts, meat, and medium-coarse wool.

Appearance

Karakul sheep vary greatly with regard to their appearance. Most rams have horns, though 20-30% are polled; ewes are usually hornless. The most common type of Karakul has a fine boned, slightly elongated head with a semi-Roman nose and rather a deep body. It has a strong frame and relatively longs legs, which are covered with bright, curly or wavy hair which reaches to below the hock. The tail is wide and fat and ends in an S-shape with a thin curved tip that is typical of the breed. Ewes are 62-70 cm tall at the ridge, while sires are 72-78 cm tall at this point. The characteristics of this breed are compared with those of Tajikistan's other breeds in Table 6, above.

Black Karakul ram

Sur Karakul ram

Grey color karakul ewe

Blue color Sur karakul ewe

Body weights, growth and carcass traits

At birth, the average live body weight of ewe lambs ranges from 3.5 to 3.8 kg, while that of ram lambs ranges from 4.0 to 4.2 kg (Table 17). Additional body weight data is provided in Table 14. Akhmedov (1978) reported that, depending on the feed supplies available on the range, the average weights of adults aged 3- to 4-years ranged from 45 to 50 kg in female Karakul and from 60 to 70 kg in the case of male Karakul. The same author stated that the average live weight of adults ready for mating ranges from 75 to 90 kg in the case of males, and from 55 to 60 kg in the case of females.

According to Akhmedov (1978), 3- to 4-year-old Karakul sheep sold for meat have an average live weight of 48.7-50.4 kg. In black Karakul, the dressing percentage was found to be 55.8%, while in gray Karakul it was recorded as 54.4%. In that author's view, the higher dressing percentage associated with black Karakul results from the animals' higher body weight and the fact that they possess more internal fat than gray Karakul. Table 14 shows the changes that occur in the live weight of Karakul of different sexes at different ages, and allows these figures to be compared with the equivalent data for Tajikistan's other sheep breeds (Akhmedov 1978).

Reproductive performance and milk production

The data in Table 16 shows the high levels of fertility found in Karakul sheep (85% and 93% in 2- and 4-year-old-ewes, respectively). Table 17 shows that the breed displays a relatively high level of prolificacy (115-120%). Correspondingly, Karakul lamb mortality (5-8%) is also slightly greater than the figures recorded for the less prolific Gissar and Jaidara breeds (Table 16).

Karakul ewes raised under the conditions found in Tajikistan do not produce large amounts of milk per day (0.4-0.5 kg/ewe) (Akhmedov 1978). The same author reported that over 45-60 days, milk yields amount to 25-30 kg. The milk itself has a milk fat content of 7-10%, a protein content of 4-5% and a lactose content of 3.5-4.5%. The abomasum, or rennet bag, contains a valuable raw material used in cheese making and in the pharmaceutical industry. Previously, the Republic produced 100,000 abomasums per year.

Wool production

Karakul sheep produce medium-coarse wool. Individuals are first sheared at 7-8 months of age, producing 0.6-1.0 kg of wool (Akhmedov 1978). At the age of one year wool yield has increased to 0.8-1.2 kg. By 2-5 years of age individuals produce 2.6-4.0 kg per shearing. Wool yield varies according to the type of animal being considered. The wool yield of animals with a strong constitution is 2-3 kg, in animals with a medium build constitution it is 2.3-3.5 kg, and in animals with a fine constitution it is 1.8-2.2 kg (Akhmedov 1978).

Rams produce 15-20% more coarse wool than ewes. Gray animals produce 5-10% more wool than black animals, while black Karakul produces 10-15% more than Sur Karakul (Akhmedov 1978).

Pelt and skin production

Karakul pelts are the major product of the Karakul sheep breeding industry, and are mainly produced using newly born lambs. At this age, the pelts are covered with a dense, elastic, silky, and glossy hair. The hair forms curls of various shapes and sizes. Zakirov and Karimov (1967) classified the pelts produced by adult black Karakul sheep into four categories: *guzamay*, *ak-gul*, *nazyk* and *kryk*.

Karakul sheep come in various colors, though black is the most common. Akhmedov (1978) found that 75-80% of the animals are black, 13-17% are gray, 5-7% are sur, and 3.1% are another color. Karakul sheepskins used to be exported to processing enterprises in Russia and Azerbaijan, where they were used to make fur coats; however, export has now ceased.

Estimates of the breed's genetic parameters and current improvement programs

No estimates of the genetic parameters of this breed are available. Flocks are available that could provide the foundations of future efforts to improve the genetics of this breed. These are described in the section entitled 'Small Ruminant genetic resources and breeding programs' and in Tables 10 and 11. That section also describes the pitfalls associated with such breeding programs.

The Pamir (Darvaz) Sheep

The development and improvement of the breed

The Pamir sheep (also known as the Darvaz sheep) was developed in the alpine areas of Tajikistan by crossbreeding extremely low productivity Darvaz ewes with Würtemberg and Kyrgyz sires. The resulting offspring were then crossed with Caucasian fine wool rams; this was followed by further selection to produce the desired type. The resulting genotype combines the viability of the Darvaz breed, the meat-producing capabilities of the Würtemberg and Kyrgyz breeds, and the wool-producing abilities of the Caucasian breed.

Tajikistan's Pamir (Darvaz) Fine Wool sheep population amounts to 195,000 head, most of which are distributed throughout the Badkhshan region (68%) and the Khatlin region (32%) (Table 5). The breed's well-developed frame and strong constitution, coupled with endurance and the ability to adapt to local conditions, means that Pamir sheep are well suited to mountainous areas, where they are able to make efficient use of the rangeland available. This breed is able to move quickly and easily, and can graze ranges at high altitudes, ranging from 1000 m a.s.l. to 3500-4000 m a.s.l.

Appearance

The Pamir is the only Tajik breed with a thin tail. These animals have a strong constitution and a large body. The chest is deep and wide, and the back is straight and wide; the rump is wide and inclines slightly. The haunch is well-built with a strong musculature. Rams have 1-2 folds on their neck, while ewes have less developed folds on their necks. The head of the breed is medium-sized and narrows slightly, having large nostrils and a Roman profile. The breed's ears are medium-sized. As a rule, rams are all horned and ewes are hornless. The head is covered by fleece up to the eye line. The breed's legs are also covered by fleece, which reaches to the hocks. The fleece is white and contains fine wool. This breed combines good meat and wool traits.

Pamir (Darvaz) sheep are divided into three typical constitution types (C, C1 and C2) on the basis of their skin wrinkles. C animals are characterized by few skin wrinkles, a strong constitution, a well-developed frame, sufficient wool coverage, and long but not dense wool. They are a meat-producing type. C2 animals have 2-3 folds of skin on the neck. They have a good reserve of wool and good wool coverage. The wool they produce is thick with dense staples. However, they are smaller than the C classification of Pamir and their meat-production features are not well developed. C1 animals have a moderate number of skin wrinkles and, in terms of their characteristics, may be described as intermediate relative to the other two classifications of Pamir (Darvaz). Their bodies weigh less than those of C-type Pamir, and their fleeces weigh less than those of the C2-type Pamir. C-type animals are the preferred variety.

Pamir (Darvaz) ram

Body weights, growth and carcass traits

On Tajikistan's pedigree breeding stations, ewe lambs have an average birth weight of 3.8-4.0 kg, while ram lambs have an average birth weight of 4.0-4.3 kg (Table 17). At weaning (4-5 months) the live weights of the two sexes are 30 kg (ewes) and 32 kg (rams) (Table 14). At 18 months of age, ewe and ram hoggets weigh 49 kg and 58 kg, respectively (Table 14), while adult ewes and rams (≥3.5 years) weigh 55-56 kg and 85-90 kg, respectively. The best performing ewes and rams weigh 75 and 120 kg, respectively (Lebedev 1957). Dressing percentages have been reported to be 51-52% in the case of non-fattened animals and 57% in the case of fattened sheep (Lebedev 1957).

Reproductive performance

Of the Tajik breeds, Pamir sheep display the lowest level of fertility. Fertility levels reach 77% and 62% in 2-year-old and 4-year-old-ewes (Table 16). Under good feeding conditions, the prolificacy rate of this breed can reach 125-128 lambs per 100 ewes lambed (Table 17), the highest prolificacy rate displayed by the breeds kept in Tajikistan. Consequently, lamb mortality rates among this breed (8-10%) are also higher than those of other Tajik breeds (Table 16). No estimates of milk production are available for this breed.

Wool production

Pamir sheep are shorn once a year, in spring. On average, the fleeces of adult animals (≥3.5 years) weigh 4 kg in the case of ewes and 7 kg in the case of rams (Lebedev 1957). The same author reported fleece weights in the best performing animals ranging from 7.0 to 11.5 kg. Wool of a worsted length has a uniform fiber diameter averaging 21-22 µm.

Estimates of the breed's genetic parameters and current improvement programs

No estimates of the genetic parameters of this breed are available. Flocks are available which could be used as the foundations of future genetic improvement programs. For a general account of these flocks and the difficulties associated with such improvement programs, see the section entitled 'Small Ruminant genetic resources and breeding programs' and Tables 10 and 11, above.

The Tajik Sheep

The development and improvement of the breed

The Tajik breed is a semi-coarse fat-tailed breed which was developed between 1949 and 1963 by A.G. Aliev at the Livestock Production Research Institute's experimental farm. The first step involved crossing Sarajin rams and Gissar ewes. The F1 generation produced was then intercrossed under a selection plan. This was followed by crosses with Lincoln sheep and then by further selection. The resulting composite combined the meat and milk traits of the Gissar and the wool characteristics of the Sarajin with the luster of the wool produced by Lincoln sheep. The breed produces meat, fat, and medium-coarse wool. The country's 133,000 head of Tajik sheep are equally distributed throughout the Khatlin region (47%) and the Gissar Central region (53%) (Table 5).

Appearance

The Tajik sheep is a large animal. It has a large fat tail, a solid constitution and a fine but strong frame. The dominant fleece colors are white (69.9%) and light gray (30.9%). Other colors, such as chestnut and brown, occur only occasionally (0.1%) (Aliev 1967). The breed has a large head which has long drooping ears and is well covered by wool. The head of this breed is longer than that of Gissar sheep, but is still in proportion relative to its body. Individuals have a hooked nose with wide nostrils. The neck is long with a very strong musculature and is covered by fleece (Aliev 1967). Both males and females are polled. There are three types/lines within this breed. A new line has recently been developed which produces lambs that have a straw-colored wool coat at birth. The characteristics of this breed are shown in Table 6, where they may be compared with those of Tajikistan's other breeds.

Tajik ram

Tajik ewes

Body measurements

The tail of this breed is wide and large. In elite 3-year-old ewes and rams, the fat tail can reach a circumference of 97 cm and 111 cm respectively. In the same age group, the length of the fat tail averages 26.4 cm in the case of ewes and 33.3 cm in the case of rams (Aliev 1967).

The body type of Tajik sheep is similar to that of Gissar sheep. The height at the withers in 1-year-old rams and ewes averages 77.4 cm and 74 cm, respectively; the height at the rump averages 78.2 cm (rams) and 74.3 cm (ewes) (Aliev 1967). Rams and ewes also display, respectively, an average chest width of 23.9 cm and 22.2 cm, a chest depth of 31.7 cm and 30 cm, and a diagonal body length of 82.8 and 78.0 cm. In rams and ewes the girth of the chest is 99 cm and 93.7 cm, respectively, while that of the metacarpus is 9.9 cm and 8.9 cm respectively (Aliev 1967).

Body weights, growth and carcass traits

At birth, male lambs weigh 5.0-5.5 kg and female lambs weigh 4.5-5.0 kg (Table 17). When they are weaned, at 4.5-5.0 months of age, rams weigh 41.7 kg (range 40-45 kg) and ewes 39.2 kg (range 38-40 kg) (Table 14). At one year, ewes weigh 55-60 kg and rams weigh 65-70 kg. Average weight of adults (>3-year-old animals) is 70-80 kg in the case of ewes and 120-130 kg in the case of rams (Aliev 1967; see also Table 14).

Under favorable conditions of feeding and maintenance, 1.5-year-old ewes weigh 80-90 kg, and 1.5-year-old rams 90-100 kg (Aliev 1967). The average weight of specially fed adult ewes (3-4 years old) is 100 kg or higher, while that of similarly raised males is 150 kg or higher. Record body weights of 143 kg (a ewe) and 177 kg (a ram) have been recorded (Aliev 1967, 1970).

Table 19 shows the changes that occur in the body weights of male and female Tajik sheep as they age.

Table 19. Body weights of Tajik ewes and rams at different ages.

	Rams			Ewes		
Age	n	Average weight (kg)	Range	n	Average weight (kg)	Range
At birth	1235	5.3	3.0-7.8	1107	5.0	2.6-8.2
At weaning (4.5-5.0 months)	543	41.7	24-63	714	39.2	26-48
1 year	100	60.0	44-76	65	49.5	34-74
2.5 years and older	17	123.9	97-139	3804	70.0	56-124
4 years and older	18	131.0	118-162	34	87.2	72-103

Source: Aliev (1967).

The Tajik breed is distinguished by the large amounts of meat and fat individuals produce. Aliev (1967) found that, at 7.5 months, 13 months and 18 months of age, ram lambs weighed in average 56.1 kg, 71.4 kg and 85.3 kg, respectively; ram carcasses weighed in average 26.6 kg, 34.5 kg and 38.6 kg in each respective age group, while the fat tails of ram lambs weighed in average 5.6 kg, 6.98 kg and 9.7 kg. The average dressing yields (carcass plus fat tail) of these three age groups were found to be 32.2%, 41.5% and 46.3%, respectively.

The meat produced by the breed consists of between 14% and 17% inter-muscular fat, which results in it being ‘juicy’ when cooked. High volumes of fat can accumulate in the fat tail. On average, the fat contained with the fat tail weighs 10-12 kg, but can weigh as much as 30-40 kg in the case of over-fed animals. The feed to weight conversion efficiency of this breed is high, and animals fatten quickly.

Reproductive performance and milk production

Two-year-old and 4-year-old Tajik ewes display fertility levels of 87% and 77%, respectively (Table 16). Table 17 shows that the breed has a low level of prolificacy (102-109%); however, the breed's lamb mortality levels (6-9%) are higher than those of the other breeds recorded as exhibiting a low level of prolificacy (Table 16). No estimates of milk performance are available for this breed.

Wool production

The coats of newborn lambs vary in color, from light gray to dark brown. A few days after birth, pigment development slows and quickly ceases. At first shearing, at the age of 4.5 months, the wool of these lambs is either white or light gray.

Tajik sheep are sheared twice per year: in April and in August. The wool produced normally consists of the following fibers: fine undercoat fibers of 20-20.5 µm in diameter (75-81% of the total); medium fibers of 27.3-40.6 µm in diameter (17-21%); and top hairs of 54.0-65.0 µm in diameter (2.0-3.7%) (Aliev 1967).

Aliev (1967) also reported that, when weaned at 4.5 months, lambs produce 1.2-1.5 kg wool. Ewes of more than 2 years of age were reported to produce 2.9-3.5 kg of medium-coarse wool, while rams in the same age range produced 4.5-5.0 kg of medium-coarse wool. In either case, the clean yield varied between 68% and 76%.

Between 1961 and 1962, Moscow's Kalinin wool plant, located at the All Union Livestock Production Research Institute and Trading and Standardization of Wool Laboratory, studied the wool produced by Tajik sheep. The wool produced by this breed is strong and elastic and has some luster. It differs from the wool produced by Sarajin sheep and other indigenous breeds in that it contains no dandruff. Down accounts for 74.9% of the fibers and transitional hair for 21.3%; 3.8% of the fibers are guard hairs. The fibers produced are 28.9 µm in diameter, on average, which is consistent with semi-coarse wool (Aliev 1967). The fiber diameter of transitional hair averages 39-40.6 µm, while that of guard hairs averages 60.5-61.4 µm.

Most modern wool breeds do not produce heterogeneous wool, a feature that is prevalent in the breeds developed during the Soviet Union. Heterogeneous fleece consists of fine and semi-fine fibers along with mixed coarse and semi-coarse fibers. Homogeneous fleeces contain similar fibers.

Fine wool is homogenous and consists only of undercoat fibers, with an average thickness of no more than 25 µm. Semi-fine wool is also homogeneous, but contains more coarse fibers than fine wool as it consists of a mixture of coarse undercoat and very fine transitional hairs, which are very similar to down fibers.

The average thickness of semi fine wool is 25-27 µm. Semi-coarse hair is not homogeneous, and is obtained by crossing coarse wool ewes with fine and semi-fine rams and fat-tailed rams. Semi-coarse wool differs from coarse wool with regard to a number of traits which are typical of fine and semi-fine fibers: it has a high suint content, a clearly shaped and more desirable form of waviness, and a higher proportion of thin guard hairs. Coarse wool is mixed (non-homogeneous) and consists of down fibers, and transitional and guard hairs. Very often, it also contains a mix of dry and dead hairs (Sheifer 1981).

Skin production

An interesting feature of this breed is that at birth the pelts produced resemble those of Karakul lambs. The curls are usually preserved for 10-12 days, and then gradually lose their form. Tajik sheep skins are very light, with firmly attached hairs that provide good thermal insulation. They are suitable for use in the production of highly valuable fur coats and other high-cost items.

Estimates of the breed's genetic parameters and current improvement programs

No estimates of the genetic parameters of this breed are available. Flocks are available which could be used as the foundations of future genetic improvement programs. For a general account of these flocks and the difficulties associated with such improvement programs, see the section entitled 'Small Ruminant genetic resources and breeding programs' and Tables 10 and 11, above.

Goat Breed Characterization

Little information is available on the goats of Tajikistan, as the various aspects of goat production in Tajikistan have received a minimal level of attention. The production performance of these animals has not been characterized and most of the information that is available is anecdotal, having usually been gathered by the few researchers who work with these breeds.

The Native Coarse Fiber Goat of Tajikistan

There are approximately half a million native goats in Tajikistan, including 58,000 Pamir Cashmere goats. These indigenous goats are distributed throughout all the regions of the country; but, they are found in larger concentrations in the Sogd and the Gissar Central regions, where they account for 44% and 32% of the native goat population, respectively (Table 5). These types of goats play an important role in meat production in Tajikistan, especially in the country's mountainous areas.

The development and improvement of native breeds

Since time immemorial, Tajikistan's native goats have been raised by the country's farmers and used as multipurpose meat-, fiber-, and milk-producing animals. Currently most of Tajikistan's native goats are owned by farming households. Because of their strong constitution, high levels of mobility and ability to adapt to mountain conditions, native goats were used to develop highly productive crossbreeds in Soviet times. For example, during the development of Soviet Mohair goats, native goats were crossed with Angora bucks. By the same token, when developing Cashmere animals, breeders crossed native does with Pridonskaya Cashmere bucks. However, no strict program to systematically improve the native goat using selection was developed.

Appearance

Native goats are small and have a comparatively compact body which has good fiber coverage. Most animals have strong horns which have a dull grainy surface; in Tajikistan up to 99% of native goats have horns. The ears of native goats are long and hanging. Most animals are black; however, gray individuals also occur. Such animals have top hairs which are uniformly gray, and which do not fade as a result of age or seasonal changes. A small number of chestnut animals, some with spots and a black head and neck, also occur. The fiber produced by these animals is coarse and individuals are mainly exploited for their meat.

Adult Native buck of Tajikistan in the Gissar region

Native Tajik doe

Body measurements

No data are available on the body measurements of native goats, except those that relate to the body proportions which are peculiar to this breed. For example, the rump is 1-2 cm higher than the ridge, while the diagonal body length of individuals is up to 1-2 cm longer than the ridge height. Together, these physical characteristics make these animals appear very compact.

Body weights, growth and carcass traits

At birth, female kids average 2.9 kg (range 2.8-3.2 kg) and male kids 3.2 kg (range 3.0-3.8 kg) (Tables 14 and 17). Both sexes are slow growing and exhibit very low weight gains during the suckling period. Does continue to increase in size until they reach 6.5 years age, while bucks continue to grow until they are

4-5 years old (Ernst *et al*. 1994) . Bucks weigh 1.5 times more than does, due to the well-pronounced dimorphism between the sexes. Table 14 provides data on the weights attained at different ages. The weights of adult (3-year-old) goats have also been recorded by Ernst *et al*. (1994), who reported that, in autumn, after fattening, does weigh 43-45 kg and bucks 56-58 kg. That author also reported that average body weights of 3-year-old bucks in improved flocks can be as high as 60-65 kg.

The meat produced by these animals tastes good. Almost all categories (kids, castrated males and culled does) are slaughtered for their meat.

Reproductive performance and milk production

No information is available on the reproductive performance of these animals other than that displayed in Table 17, which shows a prolificacy level of 115-125%. Kasimov (2000) also noted that many goats kid twice per year.

Lactation usually lasts for 5-6 months, from April to September. Average milk yields during the whole lactation period vary from 90 to 160 kg (Ernst *et al.* 1994). The 1994 report of Ernst showed that, as in other species, goats bearing twins produce 10-15% more milk than those producing only a single kid.

Fiber production

The coat contains both long shiny top hairs and short down fibers (cashmere). Top hair grows uniformly throughout the year, reaching an average length of 15-17 cm. These fibers have a diameter of 70-90 µm. The undercoat fibers of adult goats, which grow both in autumn and in summer, are 4-5 cm long and 13-14 µm in diameter. All native goats shed their down fibers when the summer begins. Average fleece yields seldom exceed 500 g, including transitional hairs, guard hairs, and down. The proportion of down in the coat ranges from 16% to 35% and it is possible to obtain 50-150 g of down by combing an animal (Kasimov, 2000).

Estimates of the breed's genetic parameters and current improvement programs

No information is available regarding the genetic parameters of this breed. No flocks are available, either at government stations or at any institution owned by other organizations, for genetic improvement work. A specific breeding plan for the improvement for this breed does not exist.

The Pamir Cashmere Goat

According to Table 5, about 58,000 Pamir Cashmere goats are found in the Badkhshan region. This type of goat is bred mainly in the Ishkashim and Shugan districts of Pamir. These animals are characterized by a strong constitution, displaying high levels of adaptability when faced with severe conditions, and have the ability to graze the rangelands all year round. Fiber production, however, is low. Very little information is available on this cashmere-producing breed.

Brief account of the development and improvement of the breed

Work began to develop the Pamir Cashmere goat in 1975. Native Pamir goats produce high-quality cashmere, although the yield is low (70-170 g). Initially, therefore, these goats were crossed with white Mohair bucks, mainly to obtain a white coat. The resulting crossbred does were then successively crossed with Pridonskaya Cashmere bucks (Dadabaev 1993). The coats of the crossbred animals produced contained a high proportion of down fibers (cashmere) and could yield 350-400 g, considerably more than the 70-150 g yielded by native goats. Work to improve cashmere yields is somewhat disrupted, to the point that the author was unable to find herds of pure animals of this breed.

The breed obtained as a result of the above work displayed both a high level of adaptability and a high cashmere yield, as the amount of cashmere fiber in the coat had increased to 35% from the 24.9% present in the coats of unimproved goats. Researchers plan to continue backcrossing the current Pamir population with Pridonskaya animals, to obtain an even higher yield of cashmere (Ergashev 1977; Dadabaev 1993). International literature refers to these goats as 'Pamir Cashmere goats' because they are "raised in Pamir and in some parts of [the] Fergana district [which] borders … Pamir" (Kiyatkin and Malinovitch 1972).

Appearance

The head of this breed is medium-sized, with a wide forehead and a straight nose. The ears are medium-sized, fine, and covered with fleece. They hang down slightly. Both female and male goats are horned. Several types of horns may be observed. About half of the goats of this breed have horns which grow upwards before curving back; their tips then turn out towards the side. Other types of horns are crescent-shaped, straight, or spiral-shaped. The proportion of hornless goats in the population is low (1%). The fleece is white or light gray.

Pamir goats have strong bones and limbs and solid hooves. These characteristics allow them a high degree of mobility and mean that they are able to adapt readily to mountainous and harsh areas.

Body measurements and production performance

In general, Pamir Cashmere goats are larger than Mohair goats but slightly smaller than native goats (see Table 6). For four-year-old bucks, the ranges of measurements obtained for height at the withers, diagonal body length, and chest girth were 75-80 cm, 79-82 cm, and 85-90 cm, respectively; the corresponding measurements for does of the same age were 65-67 cm, 62-67 cm and 67-70 cm, respectively (Ergashev 1977; Dadabaev 1993).

Body weights, growth and carcass traits

Little information is available regarding this breed's growth, fattening and milk-production abilities or the body weights achieved. According to Table 5, studies found that the weights of male and female kids at birth ranged from 2.8 to 3.2 kg and from

3.0 to 3.8 kg, respectively. Four-year-old bucks ranged from 60 to 65 kg in weight, while does of the same age weighed 45-50 kg (Ergashev 1977; Dadabaev 1993).

Reproductive performance and milk production

The data available on prolificacy is reported in Table 17, where the prolificacy of the Pamir Cashmere goat is quoted as being the same as that of the native goat: 115-125%. No data is available regarding the milk production of this goat.

Fiber production

Typically the body of the Pamir goat is covered by thick coarse fibers 8-9 cm in length. On average, bucks yield 0.38 kg of fleece and produce 6.8-cm-long top hairs with a diameter of 87.6 µm. When combed, bucks yield 70-170 g of cashmere with a fiber length of 4.7 cm and a fiber diameter of 16.9 µm (Tajik Livestock Research Institute 1985).

In terms of cashmere production, crossbreeding Pamir does with Soviet Mohair sires rendered poorer results in comparison to those obtained by crossing Pamir does with Pridonskaya Cashmere sires. The latter crosses increased cashmere combing production to 350 g, considerably more than the 40 g produced by indigenous animals.

The cashmere produced by crossbred animals is bright, silky, light, and white or light-gray, and is considered sufficiently long and fine (18-20 µm). These fibers can be used to produce high-quality yarn. Washed fiber output of the first white cashmere combing is 94%, while that of the second combing is 90%. The first and second combings of gray and light-gray fibers provide a washed fiber output of 93% and 90%, respectively.

Estimates of the breed's genetic parameters and current improvement programs

There is no information available on estimates of genetic parameters for the Pamir Cashmere goat. There are also no breeding plans currently being implemented which aim to further improve this breed. However, due to the urgent need to develop income-generating activities in the short term in the Pamir region, there is great interest among the farmers there, and among researchers in the country as a whole, in its breeding. It is felt that the Pamir goat could be a good foundation for developing a highly specialized cashmere production system in the Republic (Ergashev 1977; Dadabaev 1993).

The Tajik Mohair (also known as the Soviet Mohair) Goat

Tajikistan's Tajik Mohair goat population currently stands at 233,000 head (Table 5), Most of which are distributed throughout the Sogd region (84%) and in the Badkhshan region (16%). Very little information is available concerning this breed. However, it is known that the animals are well adapted to feeding over long distances on the range.

The development and improvement of the breed

The Tajik Mohair breed was formed by crossing native Tajik does with Angora bucks. Work began in 1982 in the Sogd region at the Kushatova, Tuychi Ergiyshtov, Kalinin, and Garufov breeding farms. The effort was overseen by a branch of the Tajik Livestock Research Institute. The resulting offspring were then backcrossed with Angora goats. In 2004 the Tajik Mohair goat was accepted as a breed.

Appearance

Tajik Mohair goats are the smallest of the Tajik goat breeds (Table 6). The head is small, and the breed has small, hanging ears and, particularly in bucks, large horns. The coat lacks folds, having a white fiber cover which has a uniform luster. No information is available regarding the body measurements of this breed.

Tajik Mohair buck

Tajik Mohair doe

Body weights, growth and carcass traits

The birth weights of female and male kids are 2.5-3.0 kg and 2.8-3.5 kg, respectively (Table 17). Table 14 includes Kasimov's (2000) measurements of the weight of this breed at different ages. That author also reported that the weights at weaning (4-5 months of age) of female and male lambs were 16-18 kg and 18-20 kg, respectively. According to Kasimov (1993), at the age of 1.5 years the weights of female Tajik Mohair goats averaged 25.5 kg (range 24-27 kg) while those of males averaged 29 kg (range 28-30 kg). In the case of 4- to 5-year-old animals, the average weight of does was 37.5 kg (range 35-40 kg) and that of bucks was 52.5 kg (range 50-55 kg) (see also Table 14, above). Some does can reach 55 kg and some bucks 70 kg. The average dressing percentage of this breed is 40-45% when animals undergo a standard level of fattening, and 50% when individuals are well fattened (Kasimov 1993).

Reproductive performance and milk production

Tajik Mohair goats are characterized by a low level of prolificacy (100-110%; see Table 17). The milk yield of the breed is also low, averaging 60-65 liters over a five-month lactation period. Over the same five-month lactation period, the best animals have produced up to 120 liters of milk (Kasimov 2000).

Fiber production

Goats are shorn once a year, in spring. In autumn only those animals intended for slaughter are shorn, provided that their fleece grows sufficiently for the production of furred goat skins.

The fiber (mohair) produced consists mainly of transient hair and an insignificant quantity of thin, elastic top hair, which forms curly tips. The fibers of this breed are comparatively uniform in length and in diameter (30-35 µm). The breed gives a clean yield of 70-80% (Tajik Livestock Research Institute 1985; Farsikhanov *et al.* 1985).

It has been reported (Tajik Livestock Research Institute 1985; Farsikhanov *et al.* 1985) that, on average, the fleeces of yearling females weigh 0.6-0.8 kg, while those of yearling males weigh 0.9-1.0 kg. The average fleece weights of 2-year-old animals range from 1.4-1.6 kg in the case of does to 1.8-2.0 kg in the case of bucks. In adult animals (≥3.5 years) fleece weights range from 1.8-2.0 kg (does) to 2.5-3 kg (bucks). Top producing does and bucks can produce fleeces weighing 4.0 kg and 6.0 kg, respectively (Tajik Livestock Research Institute 1985; Farsikhanov *et al.* 1985). Fiber length usually averages 15-18 cm, but can reach up to 25 cm in the case of the best producing animals (Tajik Livestock Research Institute 1985).

The local Mohair goat population includes not only white animals but also Mohair goats with mixed colors, sometimes in large proportions in individual flocks.

Estimates of the breed's genetic parameters and current improvement programs

There is no information available pertaining to genetic parameter estimates. There are very few flocks available that could be used as the basis for the genetic improvement of this breed; these occur at a pedigree nucleus farm (Table 10, above), and at six experimental stations (Table 11). Furthermore, there are many general limitations to the success of any improvement plan, such as a lack of funds for research, for up-to-date equipment, and for animal feed at these locations (see section "Genetic resources of small ruminants and breeding programs").

Prospects for Small Ruminant Production in Tajikistan

Tajikistan's economy was severely damaged by the dissolution of the Soviet Union and little recovery has occurred since then. Since these changes, the Republic's livestock production sector has changed markedly. Previously it was founded on relatively well-organized production systems which were based on large holdings and the management of large flocks and herds. Now, however, the sector has become fragmented, and most of the country's small ruminants are owned by new privatized units whose future is uncertain. As indicated above, small ruminant production is poorly supported and farmers fail to benefit from market opportunities because farm-gate prices and market opportunities are controlled by traders. These problems are compounded by the fact that markets for traditional Tajik products, such as wool, are lacking.

During the transition from Soviet control the country's small ruminant stocks were considerably reduced. This was a cause for concern, particularly in the case of sheep. However, the situation seems to have stabilized, so that no real threats are currently posed to the valuable native genetic resources contained within these populations. In contrast, the situation for wool-producing sheep will be that of a continuous decline in numbers unless the market demand for wool will change and adequate marketing strategies will be in place.

Though there is no market for other small ruminant products, there is a high demand for goat and sheep meat. However, for small ruminant producers to benefit from this, programs need to be reoriented to support meat production and create market conditions that will allow farmers to sell their produce without having to rely on organized traders, who currently capture all the available benefits. Considerable efforts may be needed to organize systems which help individual farmers produce and market their products. Above all, policies are required to regulate the market and control speculation.

Work to identify market opportunities has to be undertaken to offer poor farmers concrete income-improvement options. The fact that Tajikistan is a landlocked country and its neighbors are also striving to improve their small ruminant production systems should be taken into account to avoid false expectations. In this regard products with high value should be considered as income-generating options, i.e. production of high quality cashmere.

Food security is also a problem, particularly in regions that are not easily accessible. In these areas, the production of even a little milk could improve the diets of rural people. Efforts should be made to help people in these areas produce goat and sheep milk and transform it into easily transportable forms that can be conserved without the need to invest in equipment. Markets should also be explored to identify potential niches for these products.

The ownership of rangelands is an issue that requires careful management. Tajikistan's rangeland makes a substantial contribution to the diets of the country's sheep and goats, and needs to be managed sustainably. Transferring the ownership of rangeland from the state to individuals or communities is one potential policy option; however, this will not work unless it is accompanied by well-thought-out policies which dictate the use of this valuable resource. Addressing rangeland ownership will require a tremendous effort, and research will play an important role in addressing this critical issue.

Research and technology-transfer systems have also been affected by Tajikistan's economic slump. Institutional strengthening is required to bring skills to the required level for introduction of modern technologies to boost productivity with a market orientation. Above all, however, research organizations need to work with farming communities. Currently they are failing to do this because, in the past, programs targeted other types of production organizations and those involved now lack the knowledge required to make the necessary transition.

Furthermore, the genetic diversity found in Tajikistan's small ruminant population needs to be managed through sound, modern, breeding programs. The knowledge generated in the past should not be ignored, and future actions should build on available experience. The need to decentralize breeding schemes managed by the state is becoming more and more pressing, as a lack of public funds will jeopardize the future of even the most effective system. Breeding programs owned by farmers, which consider their own needs, but which are supported by solid research organizations, should be viewed as a key ingredient in the development of a sound small ruminant industry that will benefit Tajikistan's poor.

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Turkmenistan

Chapter Five

Small Ruminant Breeds of Turkmenistan

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Introduction

Sheep production plays an important role in the economy of Turkmenistan and is recognized as an important sector of production. This is reflected in the fact that one of the aims of Turkmenistan's program for economic development for the period 2000-2010 is to approximately double the country's sheep population to 16 million head.

Turkmenistan's major sheep products are, in order of importance, meat, wool, and Karakul pelts. In 2000, meat production was estimated to be 37,380 tons; production is expected to reach 46,100 tons by 2010. In 2000, wool production was estimated to be 21,900 tones; by 2010, production is expected to reach 46,100 tons. In 2000, some 282,860 Karakul pelts were produced; this figure is expected to have increased to 410,510 by 2010.

Sheep Population Statistics

Population changes

As of 1999, the populations of sheep and goats in Turkmenistan stood at 7,092,500 and 102,200 head, respectively. These numbers are slightly higher than those quoted by FAO (2004).

Unlike those of the other republics of Central Asia, the sheep and goat populations in Turkmenistan remained relatively stable in terms of size during the post-Soviet period. The distribution of animals between the public and private sector has changed due to the gradual application of reforms, with a fall in the number of animals kept on State and Cooperative farms, and a rise in the numbers of privately owned animals (Table 1).

Table 1. Population of small ruminants in Turkmenistan (in thousands).

		Including	
Year	Total population	State-owned farms	Private sector
1992	6,265.0	3,995.3	2,269.7
1995	6,574.0	3,286.8	3,287.2
1999	7,194.7	2,529.1	4,665.6

Source: Turkmen National Institute of Statistics and Forecasting (2000).

Breeds and their distribution

Two indigenous sheep breeds account for most of the sheep in Turkmenistan: around 7 million head, or 98% of the total sheep population. In addition, the country contains 13,000 synthetic fine fleece sheep, which were developed during the Soviet Union. Most goats are indigenous, and the total goat population is around 100,000 head (Table 2).

Karakul sheep are distributed throughout all the Viloyats (provinces) of Turkmenistan, and make up 85% of the country's sheep population (Table 2). Most of Turkmenistan's sheep are concentrated in Central and South-Eastern Karakum, while in the Southwest and in the North populations are smaller because vegetation is sparse on the rangelands of these areas (Table 3 and Figures 1 and 2).

The population of Sarajin sheep accounts for about 15% of the Turkmen's sheep population and is is concentrated in suburban districts of Akhalskiy province, namely the Ashgabatskiy, Geok-Tepinskiy, Bakhardenskiy, and Guyarskiy districts. Fine-fleece sheep and goats are raised in Turkmenistan's mountainous areas, in the Bakhardenskiy, Gyzil-Arvatskiy (now Serdar), and Karrykalinskiy districts.

Table 2. Population of sheep and goat breeds (in thousands).

Breed	Population	Percentage of total population of sheep or goats
Sheep		
Karakul	6052.0	85.3
Sarajin	1027.3	14.5
Fine wool crossbreds	13.2	0.2
Total sheep	7092.5	100.0
Goats		
Indigenous Turkmen goats	102.2	100.0

Source: Turkmen National Institute of Statistics and Forecasting (2000).

Table 3. Distribution of Karakul sheep in Turkmenistan (in thousands).

Province	Karakul population	Percentage of Karakul population	Sarajin population	Percentage of Sarajin population
Akhalskiy	1374	22.7	426.3†	41.5
Balkanskiy	980	16.2	323.6	31.5
Dashoguzskiy	508	8.4	0	0
Maryiskiy	1992	32.9	28.8	2.8
Lebapskiy	1198	19.8	248.6	24.2
Total	6052	100.0	1027.3	100.0

Source: Compiled by authors.
Note: †Of this number, 156,700 head (equivalent to 15.3% of the total Sarajin population) are found in the state sector.

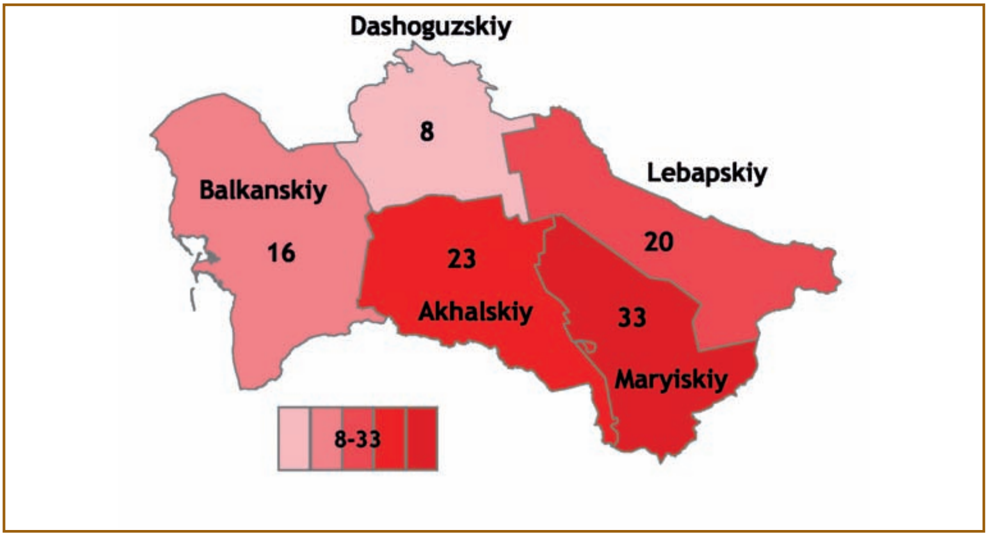

Figure 1. Geographical distribution of Karakul sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by authors.
Numbers represent percent distribution of the breed in the different provinces of Turkmenistan.

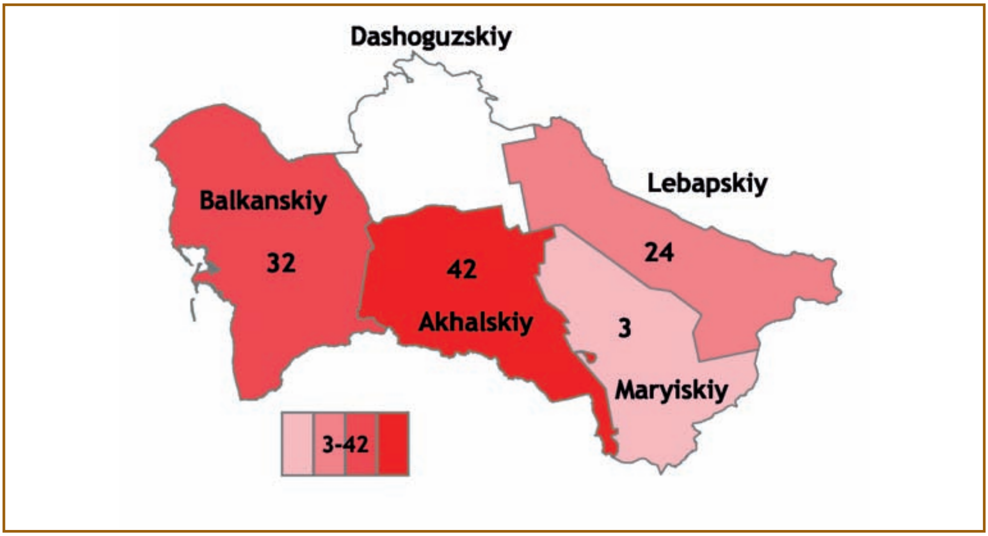

Figure 2. Geographical distribution of Sarajin sheep.
Source: Map was drawn by Piero Daltan—ICARDA, 2006, based on information provided by authors.
Numbers represent percent distribution of the breed in the different provinces of Turkmenistan.

Small Ruminant Products

The most important sheep-derived product in Turkmenistan is meat, which is valued highly by local people and is in high demand. Wool, pelts, and skins are also important, though less so.

Karakul pelts are exported, with the main buyers being Russia and the Baltic countries. The wool of Sarajin sheep is sold in Turkmenistan's domestic markets, because the Sarajin is the only sheep breed that produces wool suitable for use when making the world-famous Turkmen carpets. There is some evidence, though it is not very well substantiated, that both Karakul and Sarajin wool are also sold to Russia. The meat and fat of both these sheep breeds is sold only on the domestic market (Table 4). The prices of main products derived from small ruminants are shown in Table 5.

Table 4. Turkmenistan's major sheep products.

Breed	Major products	Current market demand
Karakul	Pelts	Very high
	Sheep meat	High
	Sheep skins	High
	Wool	Low
Sarajin	Carpet-type wool	High
	Sheep meat and fat	High
	Sheep skins	High

Source: Compiled by authors.

Table 5. Prices of small ruminants and derived products in Turkmenistan (in Turkmen manat and US dollars).

Product	Sheep	Goats
Live lamb/kid (manat)	3.8-4.5	2.7-2.9
Live 2- to 4-year-old female (manat)	Karakul: 47,300 Sarajin: 56,800	37,300-40,700
Live 2- to 4-year-old male (manat)	Karakul: 64,400 Sarajin: 69,600	44,600-56,800
Meat (manat/kg)	Lamb: 37,000	40,000
Wool/hair (manat/kg)	Karakul: 4000 Sarajin: 6000	25,000 (down)
Skins (manat/unit)	40,000	25,000
Black pelt (US$/unit)	12-15	na
Brown pelt (US$/unit)	8-10	na
Sur pelt (US$/unit)	20-25	na

Source: Compiled by authors.
Notes: na: not applicable.
Official exchange rate: 1 US$=5300 manat, as of October 2005.
Unofficial exchange rate: 1 US$=24,500 manat, as of October 2005.

Small Ruminant Breeding Environments

Sarajin breeding environments

Sarajin sheep are grazed on the plains around the foothills of Kopet-Dag. These areas have a pronounced continental climate, characterized by very hot, dry summers and cold winters; very often, nighttime and daytime air temperatures differ greatly. Average daily temperatures range from 12 to 14°C, while the absolute minimum air temperature falls as low as -22 to -25°C. On average, the frost-free period in the area amounts to 231 days.

Annual rainfall ranges from 200 to 230 mm and occurs in the form of rain and snow. Range grazing is the main source of feed for Sarajin sheep, contributing nearly 90% of the feed consumed by this breed annually. Sheep graze the range all year round, except for unfavorable periods in the winter when ranges are covered with a thick layer of snow; sometimes these periods of snow cover last for 30-45 days. In such cases, supplementary feed is provided to the sheep. The supplementary feeds used include alfalfa hay, hay cut from the range, and concentrates, given at rate of 2.0, 2.5, and 0.5-1.0 kg per head, respectively. These feeding strategies are based on general experience, as the feed requirements of this breed, in terms of the amounts of supplementary feed or dry matter of range vegetation needed, have not been estimated.

On average, annual fodder production on the range varies between 0.15 and 0.33 t dry matter (DM)/ha; however, yields are not stable and fluctuate in response to climatic conditions. In favorable years, range productivity can reach twice the average annual yield, while in unfavorable years productivity can fall to only 50-60% of the average yield.

On the range, animals are mainly provided with water by means of wells and bore-wells. The depth of wells varies between 12 and 150 m, while the depth of bore wells varies between 16 and 230 m. Sarajin sheep have a fixed water requirement; the norm ranges from 0.7 to 5.0 liters per day, depending on the season.

Karakul sheep-keeping environments

Karakul sheep are mainly kept in the Karakum desert area, where the climate is continental. Maximum air temperatures in July range from 45 to 48°C, while the minimum air temperature is -16°C. Annual precipitation is 210-220 mm, which occurs mainly in the form of rain in spring and sleet in winter. Heat and drought usually occur during a period of 4-5 months.

The average annual fodder supply on the range varies between 0.13 and 0.25 t DM/ha, and fodder yields again depend on the rainfall regime. Being less demanding than the Sarajin, the Karakul sheep thrives under these rather more extreme conditions.

More than 90% of the diet of a Karakul sheep typically consists of range fodder. Range feeding is practiced all year round, except during climatically unfavorable periods, when the sheep are fed with roughage and concentrated fodder.

The average annual feed requirement of Karakul sheep is 425 feeding units, or 899 kg of dry matter per head. Taking into account the average number of days that are not suitable for grazing (30 days per year) and fodder requirements, the 'insurance' feed supply available per head should consist of 50 kg of roughage and 15 kg of concentrated fodder.

In general, different types of supplementary fodder are used in different geographical areas. These fodders include barley grain, barley bran, cottonseed cake, and hay made from range vegetation, particularly motley grass (*Artemisia* spp.) and camel thorn (*Alhagi persarum*). During critical periods of the year, sheep are given supplementary fodder at a rate of 0.5-0.6 kg, for concentrated fodder, and 1.2-1.5 kg, for roughage, per head per day.

In the Karakum desert zone, *Artemisia* spp. and camel thorn are the main plants cut for winter fodder. This is done between June and September. On the plains, plants are cut using standard grass-mowers; On dunes, however, *Artemisia* spp. and camel thorn are collected manually, using shovels and hoes. Farmers who grow crops for use as livestock feed in Turkmenistan produce barley (with yields of 2.0-2.2 t/ha) and alfalfa (with green matter yields of 30-35 t/ha and hay yields of 6.6-6.8 t/ha). Farmers also produce maize, sorghum, fodder watermelons, and fodder pumpkin.

With regard to the daily water requirements, the recommendations for desert areas per head of sheep are 3-4 liters in spring, 6-8 liters in summer, 5-6 liters in autumn, and 4-5 liters in winter. When water has to be delivered to flocks of grazing sheep, it is provided at these rates. However, when wells, bore-holes and canals are available the sheep receive more water, and are given as much as they can drink.

Goat and fine wool sheep environments

The zone of Turkmenistan in which goats and fine-fleece sheep are raised has a subtropical climate. Annual precipitation in this zone amounts to 250-350 mm, while average annual air temperatures range from 10 to16°C.

There are three main types of range in this zone: ranges dominated by coach grass (*Agropyrum tenerum*); ranges dominated by cereals; and, ranges dominated by motley grass (*Artemisia* spp.). Ranges of the first type have a high level of species diversity and are located at an altitude of 1000-1500 m above sea level (m a.s.l.) in the dry mountainous semi-desert zone.

Motley grass- and cereal-dominated ranges are located in upper mountain areas at an altitude of 1500-2000 m a.s.l. On more level land, *tipchak* (*Festuca sulcata*) is the dominant grass (cereal).

Yields of range vegetation are directly correlated with the amount and distribution of precipitation. Supplies of palatable range fodder vary according to season and average 0.16-0.77 t/ha.

Springs are used to water the livestock kept on mountain ranges; however, there are often not enough springs to allow the whole of an area of mountain rangeland to be grazed. The Sumbar river is also used to water animals in this zone.

General Management of Sheep and Goats

Table 6 summarizes the main features of sheep management in Turkmenistan. Both Sarajin and Karakul sheep are weaned at 4-4.5 months and natural mating prevails in the flocks. In general, there are no differences between the two breeds in terms of management. The management activities presented in Table 6 also apply to goats.

Table 6. Main sheep management activities in Turkmenistan, by season.

	Months											
Events and seasons	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Range grazing												
Stubble grazing												
Supplementation												
Mating												
Lambing												
Shearing												
Vet. treatments			H		SP	EP	EP		B			
Seasons and main features	Winter 78.8 mm rainfall, mean 3.2°C temperature			Spring 90.7 mm rainfall, mean 21.3°C temperature			Summer 1.5 mm rainfall, mean 31.7°C temperature			Fall 34.2 mm rainfall, mean 16°C temperature		

Source: Compiled by authors.
Notes: H: anti-helminth treatment; SP: vaccination against small pox; EP: treatment against ectoparasites; B: check for brucellosis.

The Diversity of Small Ruminants and Breeding Programs

Turkmenistan's indigenous small ruminant population is increasing (Table 1), and this trend is expected to continue. Therefore, there appears to be no threat to the integrity of the country's small ruminant genetic resources. There are no breeding plans for Karakul and Sarajin sheep in Turkmenistan, and no institutions have flocks with controlled genealogies.

Only 13,000 head of the fine-fleece synthetics developed during the Soviet Union exist in the country. This small population is likely to disappear (being replaced by the indigenous breeds), because production of such wool is not an economically viable activity. The live weight of this breed is no more than 30-35 kg. Currently, the potential benefits of crossing this breed with the Jissar breed are being considered, with the aim of improving meat production. Very little is known about Turkmenistan's goats and their characteristics. However, it is known that goat numbers are also increasing.

Sheep Breed Characterization

The Karakul Sheep

In Turkmenistan, Karakul sheep are raised under conditions of feed scarcity because the ranges of the Karakum desert on which they are kept are sparse and have a low level of productivity. In this region, flocks need to move long distances to find feed; it is not uncommon for sheep to walk 18-25 km per day and drink salty (and even very salty) water. The flocks quickly consume the scarce range vegetation available, including fallen stems and dry grass leaves; they also graze on stubbles and ears left after cereal crops have been harvested. On the Karakum range, rough-stemmed shrubby vegetation (i.e. branches of saxaul, salsola and *Artemisia*) is usually the sole source of fodder available for grazing in autumn and winter. If ranges dominated by *Artemisia*-ephemeral and salsola are available, they are used to fatten sheep. Karakul sheep also eat thorny, aromatic and bitter-tasting vegetation, such as camel thorn. It has been estimated that Karakul sheep consume significantly fewer nutrients per kilogram of weight gain than do other breeds (Vinogradova 1975; Kherremov 1996).

Much has been said about the adaptive capacity of the Karakul sheep, but much study is also still required. Alexeyeva (1960) suggested that a thinning of the blood during the hottest part of the year is an important adaptation. Vinogradova (1975) and Kherremov (1995) have also suggested the breed has the ability to reduce water loss from the body.

The origins of the Karakul breed

The Karakul is an important breed in Turkmenistan as, of all the livestock kept, it contributes most to the livestock sector in terms of production. The origins of this breed are controversial, and the issue has captured the attention of many researchers in the past. Opinions are diverse, and often speculative and unscientific, as illustrated by the theory that the breed arose as a result of a mutation. Some scientists have stated that the breed was developed in ancient times in Lesser Asia and then brought to Central Asia by the Arabs (Adamets 1931). Others believe that it was bred in ancient times in the territory of Bukhara Khanate (Ivanov 1935; Dyurst 1936). Some even attribute its origins to a mutation which occurred more recently, when different breeds were being crossed (Perepelkin 1915; Vasin 1944).

A more reasonable hypothesis was forwarded by Gubanov (1934), who suggested that the Karakul sheep resulted from the crossing of different breeds. Stoyanovskaya (1966) agreed with this hypothesis, and argued that the breed was developed during the 8th century in the Bukhara Khanate territory, by crossing indigenous fat-tailed sheep with pelt breeds imported from Arabia. During this process Karakul sheep would have inherited their black coloring from the Arabian sheep used and their gray-brown and Agouti colorings from fat-tailed sheep from

Central Asia. The transfer of Agouti to a black background would have resulted in the development of the Bukhara Sur color, while the Karakalpak Sur color would have originated from the red Karakalpak fat-tailed sheep.

The Amu-Darya river area and the districts bordering Afghanistan (i.e. Burdalyk, Sayat, Karabekaul, Chardzhow and Darganata districts) are, historically, the main Karakul sheep breeding areas (Manukyan 1948). The first effort to introduce Karakul sheep to the more western areas of Turkmenistan was made in 1895 on the instructions of Lieutenant General Kuropatkin, governor of the former Zakaspiyskaya oblast. A total of 91 Karakul sires were brought from Bukhara for this purpose. However, Karakul sheep breeding failed to become established in this area (Ponyatovskiy 1923). According to Manukyan (1948), it was only after the delimitation of the Central Asian Republics in the 1920s and 1930s that the Karakul began to spread gradually to the northern and western parts of Turkmenistan. Karakul sheep are currently being raised in all five provinces of Turkmenistan (Table 3).

In the early 1930s, Pospelov (1931) suggested that the Karakul sheep was not a homogenous breed; and, in fact, there is a high level diversity within the breed in terms of animal and pelt production. In the opinion of Koshevoy (1975) this has been caused by the need to meet the particular requirements of consumers of various countries.

The diversity obvious within the breed is also associated with a complex flock structure that includes a range of genetic groups and types (Dyachkov 1974). This range includes the following:

(1) Animals from pedigree and commercial stocks;
(2) Flocks with different colorings (black, gray, sur, white, and brown);
(3) Flocks with different pelt types (jacket, ribbed, flat, and Caucasian types) and different conformation types (strong, rough, and fine);
(4) Flocks from different ecological zones (southern sandy desert type, southern gypsum desert type, foothill desert type, foothill semi-desert type, northern desert type, desert-steppe and mountain plain type);
(5) Flocks with intra-breed types such as the prolific Askania, which was developed by crossbreeding Karakul sires with Romanov ewes, and the prolific Myaninskiy type, which was developed through selection;
(6) Flocks associated with breeding farms in Turkmenistan (e.g. the Uchadzhinskiy and Ravninskiy black sheep, the Talimardzhan sur, and those animals of the Sarajin gray color which were named after S. Niyazov).

Appearance

Though the breed is difficult to characterize definitively because of the significant variability for most characteristics (Ivanov 1936), Karakul sheep do have distinguishing features. Most sheep have a long face, a slightly humped nose, and hanging ears. Ewes are usually polled, while rams have well-developed horns. The body is medium-sized with strong, rather short limbs. The hoof horn of the breed is also strong. A strong skeleton is an adaptation which allows the Karakul to cope with severe desert conditions. The tail is fat, though thin and S-shaped at the end. Karakul wool is coarse and non-homogeneous. According to their constitution, three types of animals can be distinguished: ‘strong’, ‘rough’ and ‘tender’.

Most Karakul sheep are black at birth. Gray Karakul lambs are the second more frequent class and other colors are less frequent as indicate later. The fleece of all Karakul adults becomes gray with variations of gray according to the color of the animal when born.

Karakul ram

Karakul ewe

Body measurements

Reports on body measurements can be traced back to the 1920s (Table 7). The information from different studies is not necessarily comparable because of age differences and the conditions under which the data was recorded were not described. An arbitrary arithmetic average, presented in the bottom row of Table 7, shows that these animals are smaller than those of the Sarajin breed considered later (see Table 10 below) in terms of all the measurements made.

Table 7. Linear body measurements (cm) of Karakul ewes.

Author	n	Age, years	Height at ridge	Height at sacrum	Diagonal body length	Chest girth	Metacarpus girth
Ponyatovskiy (1923)	50	2.5	65.5	65.5	77.0	79.0	7.5
Ivanov (1940)	50	1.5	66.6	65.0	68.4	86.9	8.1
Konstantinova (1944)	80	1.5	67.4	67.7	65.0	83.5	6.9
Taganov (1986)	60	2.5	71.6	73.7	74.2	83.9	9.5
Ataev (1988)	50	2.5	69.3	70.4	69.1	78.0	10.0
Average			68.0	68.5	70.7	82.3	8.4

Linear measurements made of lambs at birth and at the age of 6 months are presented in Table 8. Note that at weaning Karakul lambs had attained 90-92% of the height, and 87-89% of the length, of adult animals.

Table 8. Linear body measurements (cm) in Karakul lambs and measurements expressed as a percentage of size at maturity.

Sex and age	Height at ridge	Diagonal body length	Chest girth	Metacarpus girth	Author
Rams at birth	40.6	32.7	37.2	6.1	Taganov (1986)
	41.5	30.7	38.5	7.6	Ataev (1988)
	37.5	31.3	39.5	6.6	Kherremov (1996)
Average	39.9	31.6	38.4	6.8	
% mature size†	59.0	45.0	47.0	81.0	
Rams at 4 months	60.0	61.6	59.6	6.9	Taganov (1986)
	68.9	68.6	73.8	10.4	Ataev (1988)
	58.9	58.6	70.8	8.4	Kherremov (1996)
Average	62.6	62.9	68.1	8.6	
% mature size†	92.0	89.0	83.0	102.0	
Ewes at birth	40.3	32.0	36.9	5.9	Taganov (1986)
	41.3	30.5	38.2	7.5	Ataev (1988)
	36.1	30.8	39.2	6.5	Kherremov (1996)
Average	39.2	31.1	38.1	6.6	
% mature size†	58.0	44.0	46.0	79.0	
Ewes at 4 months	59.0	60.0	59.6	6.2	Taganov (1986)
	68.4	67.5	73.0	10.0	Ataev (1988)
	57.3	56.9	70.0	8.0	Kherremov (1996)
Average	61.6	61.5	67.5	8.1	
% mature size†	90.0	87.0	82.0	96.0	

Notes: †For data on mature sizes, see average values in the bottom row of Table 7; no information provided on numbers of animals involved in the measurements.

Body weight, growth, and carcass traits

Several authors' estimates of body weight at different ages are shown in Table 9. Karakul sheep are referred to as late-maturing animals, because live body weights continue to increase until the age of nearly 6 years (Table 9). The weights of 5.5-year-old animals have been taken to represent mature weights; however, it is not known whether these weights are representative of the weights of all mature animals, because such details were not recorded in the various studies.

Relatively large and heavy lambs at birth, an extended period of prenatal development, and intensive growth during the preweaning months, are all advantageous adaptive characteristics displayed by Karakul sheep. Lambs grow rapidly whenever feed is available, particularly in the spring; this rapid growth continues until the start of the hot weather, when the range vegetation dries and water becomes scarce.

Using data from Table 9, the average growth rates of lambs from birth to 1 month were calculated to be 341 g/day for males and 308 g/day for females; from birth to the age of 4 months (or weaning), average growth rates were 221 g/day for males and 209 g/day for females.

Based on the non-weighted averages calculated in Table 9, Figure 3 shows the growth of rams and ewes until the age of 5.5 years.

Table 9. Body weights (kg) of Karakul sheep by sex and age.

Sheep age	n†	Rams	Ewes	Author
At birth	75	5.3	5.0	Nikolskiy, 1927
	100	5.1	4.8	Vinogradova *et al.*, 1985
	100	4.5	4.3	Taganov, 1982
	100	5.1	4.9	Kherremov, 1995
1 month	150	13.7	13.0	Manukyan, 1948
	100	16.0	14.7	Ataev, 1988
	100	16.0	15.0	Kherremov, 1995
4 months	150	29.2	28.0	Manukyan, 1948
	100	32.0	31.0	Vinogradova *et al.*, 1987
	100	33.3	30.5	Kherremov, 1995
2 years	100	47.8	41.1	Kuznetsov,1945
	100	51.2	40.7	Taganov, 1986
	100	60.4	48.5	Kherremov,1995
3 years	150	65.0	48.0	Gubanov, 1936
	75	61.0	46.4	Konstantinova, 1944
	80	59.8	46.1	Bekirov and Miloshevskaya, 1948
	150	64.3	41.8	Manukyan, 1948
3.5 years	100	72.0	55.7	Kherremov, 1995
5 years	80	65.3	47.5	Bekirov and Miloshevskaya,1951
	150	65.7	47.0	Manukyan, 1948
5.5 years	100	77.5	59.0	Kherremov, 1995

Note: †The same number applies to each sex.

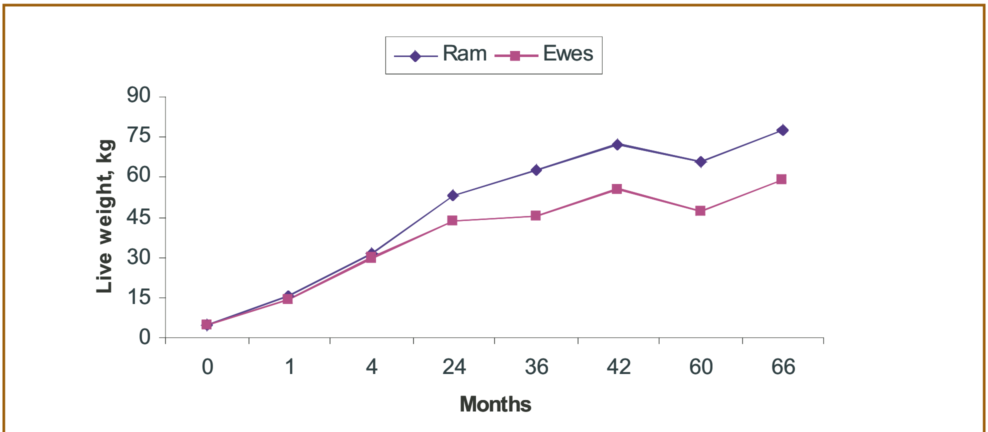

Figure 3. Growth of Karakul sheep.
Note: Organized by authors using data from Table 9.

To produce meat, producers mainly slaughter castrated lambs and ram lambs; however, culled ewes and rams are also used. Meat production per animal can be increased by fattening sheep. It was reported by Kuznetsov (1945) that Karakul sheep meat is a highly caloric food which contains 35-55% dry matter, 10-12% protein, and 15-45% fat. One kilogram of Karakul sheep meat with an average fat content contains about 1500 calories. Meat quality is not related to pelt type in Karakul sheep.

According to Kherremov (1992), the slaughter weight of Karakul ram lambs (n=30) killed at the age of 8 months was 19.5 kg; carcass yield was 49.6%, visceral fat weight was 0.3 kg, and fat tail weight was 1.5 kg. In the case of castrated ram lambs (n=30) the corresponding values were 21.7 kg, 51.5%, 0.5 kg and 1.9 kg, respectively.

When lambs are slaughtered for Karakul pelts, the slaughter weight of their carcasses varies from 1.5 to 3.0 kg. The meat produced is usually cooked and eaten by shepherds.

Reproductive performance and milk production

Karakul sheep have an extended gestation period: 151 days on average. This is slightly longer than that of the Romanovskaya breed (148 days) and the semi fine fleece-meat sheep (145-147 days) (Vasin and Vasina-Popova 1971).

In Turkmenistan, Karakul sheep do not exhibit a high level of prolificacy (100.3-105.0% on average). However, Vinogradova *et al.* (1994) reported that selection resulted in a flock with a higher twinning rate of 1.26 lambs per ewe lambed. Unfortunately this flock no longer exists. No lamb mortality data is available, so it is not possible to compare mortality in the two flocks used in the study, which had different prolificacies.

Milk is considered to be a by-product of Karakul sheep production, and is mainly used to feed lambs. Maximum milk yields are obtained during the first 30 days following lambing. The average yield is 450-500 g/day, and the fat content of the milk is 8.3-8.5% (Ataev 1988; Kherremov 1995). Milk production depends on the ewe's age, level of body fat, and constitution type, as well as on the size of the litter and the condition of the range vegetation.

Mary ewes (ewes whose lambs have been slaughtered at birth) produce 35-40 kg of milk in total during the lactation period, while ewes with lambs produce 58-65 kg. Average daily milk yield ranges from 200 to 1400 g, with an average of between 600 g and 800 g being produced by the whole flock (Kherremov and Vinogradova 2003).

The people of Turkmenistan use milk and dairy products all year round; however, most are used in the spring and summer, when these products are in abundance. A Turkmen national proverb reads "in spring take care not to be without dairy products and in fall not to be without vegetables and melons".

Pelt production

The coloring of Karakul sheep has biological and commercial importance, and is therefore an important aspect of breeding. There exist a great diversity of colors within the breed, including black, gray (light-gray through to black-gray); different tones of sur; different tones of brown, and pink, white, and other less frequent colors.

The distribution of pelt colors throughout the population is as follows: black, 72.3%; gray, 20.8%; sur, 5.3%; and mixed colors, 1.6% (brown, pink, white and other mixed colors) (Turkmenmollari Association 2000).

Different-colored sheep differ in terms of their adaptability, prolificacy, wool productivity, fattening capacity, and ability to deposit fat when faced with unfavorable environmental conditions. Black Karakul animals, which constitute the base of the breed, are the strongest and most well-adapted to severe desert conditions.

Lambs from flocks of homogeneous gray and brown colors have a 25% lower survival rate than those from black Karakul flocks; in addition, some albino lambs also occur, but die without reaching maturity. The survival rate of black lambs can be as high as 97.2%. Sur colored sheep have a weak constitution and are less adapted to harsh conditions.

Dyachkov (1980) studied approximately 30 histological and morphological skin indicators associated with wool curl, and pigment and color variations in the skin and in the wool. The number of groups into which the Karakul breed can be divided according to color and pelt type was found to be 128. According to State standards, there are 430 Karakul pelt grades and sizes, a figure which does not even consider the various classifications of defective, rejected and non-standard materials.

Karakul lambs are slaughtered for their pelts during the first three days following birth. Usually ram lambs (with the exception of pedigree lambs) and nonviable female lambs are used to produce pelts. At present, lambs born weak and still-born lambs are also used to produce pelts.

Pelt processing follows a standard procedure. The fresh pelts are covered with around 600-800 g of salt and are kept in this state for 5-7 days, before being straightened and placed to air-dry on a flat, clean and dry solid-wood surface in a shelter . During the air-drying process, the pelts are turned over systematically. Once dry, they are again straightened; the areas covered with fibers are then cleaned. After they have been cleaned, the pelts are stacked on top of each other for 3-4 days. This process yields pelts of good quality.

The mothers of those lambs slaughtered to produce pelts are milked, to avoid mastitis. In general, however, ewes should not be milked after their first lambing, because at that age they are still growing. Sick and weak ewes are also not milked.

Wool production

The wool of Karakul sheep generally becomes gray as each sheep ages. Black lambs will acquire a smoky-blue tone, while gray and sur sheep will acquire a whitish, lighter tone.

Karakul sheep are shorn twice a year: in spring (April-May) and in autumn (August-beginning of September). Young animals are shorn for the first time at the age of 5-6 months. The average wool yield ranges from 0.8 to 1.0 kg in young animals, from 3.0 to 3.2 kg in rams of 2.5 years or more, and from 2.8 to 3.0 kg in ewes of 2.5 years or older.

Baranov (1937) reported that the wool of Karakul sheep is made up of heterogeneous fibers and that, depending on the wool grade, the down content can vary between 21.5% and 71%, the remainder being top hair. Gorbovtsev *et al.* (1939) reported that Karakul sheep wool consists of top hair (0.8-4.9%), down fibers (28.0-55.6%) and transient fibers (43.6-59.7%). Manukyan (1945) also states that Karakul sheep wool is heterogeneous, and contains top hair, down and transient hair, as well as mixed-type fibers. That author did not, however, indicate the percentage of mixed-type fibers found.

The changes which occur in the pelts and wool of Turkmenistan's Karakul sheep in relation to age were studied in detail by Kherremov (1983). That author reported that the wool of mature sheep consists of 61.0-74.2% down, 12.0-17.2% transient hair, and 12.1-23.9% guard or top hair. Variation in the content of the different types of fiber depends mainly on age, season, and temperature. The fiber diameter of the down produced ranges from 22 to 30 µm, while the diameter of the transient hairs produced ranges from 35 to 47 µm; the fiber diameter of the guard hairs produced ranges from 55 to 77 µm, with an overall average of 44 µm (Kherremov 1981).

Karakul wool yields depend on each lamb's pelt type. Yields are higher for the Caucasian and jacket pelt types (3.7 kg and 3.5 kg, respectively) than they are for ribbed pelts (2.7 kg) or pelts with flat curls (2.6 kg). Black Karakul sheep yield around 0.3-0.5 kg more than gray and sur sheep. On average, a mature Karakul ram yields 3.2-3.5 kg of wool, while a mature ewe yields 3.0-3.2 kg.

In recent years the demand for Karakul wool has fallen dramatically. This is mainly because of a drop in the production of winter uniforms (especially coats and felt boots) for the military after the collapse of the Soviet Union. The felt produced traditionally in Turkmenistan has always been made from Karakul wool.

At present, Turkmenistan's farmers sell the Karakul wool they produce to intermediaries, who represent private and state wool-processing plants in Russia. There is no uniform wool classification system and no raw wool quality-testing service in Turkmenistan. Unfortunately, this limits the export of wool.

Estimate of genetic parameters

Kherremov (1996) estimated genetic and phenotypic parameters for Karakul sheep. He obtained positive phenotypic correlations (r=0.86-0.88) between udder size and milk yield; between udder size and the frequency with which twins were produced (r=0.72-0.80); between milk yield and the live body weight gain of lambs during the suckling period (r=0.81-0.94); and between milk yield during the first period of lactation and the entire lactation period (r=0.83-0.87). The heritability of the natural twinning rate ranged from 0.22 to 0.26. The heritability of jacket-type pelts was high overall (h^2=0.44-0.69), but was higher in twin lambs (0.68±0.03) than in single lambs (0.56±0.05). High heritabilities were also found with regard to curl size (h^2=0.91) and curl length (h^2=0.58-0.64). The heritability of live body weight (h^2=0.41) fell within the range usually found for all sheep breeds.

Breeding plans

Pure breeding is the main breeding strategy used with Karakul sheep. In fact, black, gray and sur Karakul sheep are raised only in flocks where all the animals are the same color. However, crossbreeding has been used to develop new types of Karakul. Thus, for example, crossing Askania Karakul sires with Romanovskaya ewes resulted in the development of the prolific Askania Karakul line (Sukharkov 1987). Another example is offered by the Samarkand type, which was derived from crosses between ermine white Karakul ewes and white Afghan fat-tailed rams (Gigineishvili 1956). By the same token, to improve the viability of gray Karakul sheep, Gigineishvili (1973) crossed Karakul ewes with wild sires from the Babatag Mountains in Uzbekistan.

Breeding plans for the Karakul are currently being developed jointly by the Livestock Research Institute and the breeding department of the Turkmenmollari Association. The aim is to develop high-quality pelt lines which produce average-sized pelts with evenly distributed long curls; particular emphasis is being laid on the production of long semi-circular curls.

The Sarajin Sheep

The Sarajin is a valuable sheep breed which is indigenous to Turkmenistan. Its value lies in the fact that it combines good meat and fat production traits with wool traits which are considered good for a *kurdyuk* (fat-tailed) sheep. This means that it is possible to produce semi-coarse wool in desert and semi-desert areas.

Ivanov's (1940) classified Sarajin sheep as fat-tailed sheep of the meat and fat producing type. With regard to wool production, they are classified as a semi-rough wool type.

Pedigree Sarajin sires from Turkmenistan have been used to improve the production of *kurdyuk* rough-wool sheep in the republics of Central Asia and Kazakhstan. Sarajin sheep were also used in Kyrgyzstan to develop the Tajik semi-coarse wool breed and the Alay breed.

The breed's origins

The first steps in the production of the Sarajin breed were taken in Turkmenistan's Mary province, where producers bred the Saraja sheep from which the Sarajin was developed. In the opinion of Manukyan (1948), Sarajin sheep were initially developed from white fine fleece sheep, probably from Lesser Asia, and the Turko-Mongolian *kurdyuk* sheep. Evidence for this is found in the character of the fleece and the composition of the wool of Sarajin sheep. These features are similar to those of Merino–fat-tailed crosses. Further evidence is offered by the temporary dominance of brown coloration, which is typical of crosses between white and brown sheep; the occurrence of this trait indicates an intermediate position between *kurdyuk* and fat-tailed sheep.

By contrast, Geldiyev *et al.* (1956) and Vasilyev and Tselyutin (1990) all suggest that the Sarajin breed was developed in ancient times in the southeastern areas of Turkmenistan, through breeding efforts undertaken by local people. These efforts, these authors suggest, involved the pure breeding of the best offspring of indigenous fat-tailed sheep.

When animals were being selected during the breeding efforts which produced the Sarajin, much attention was paid to the quality of their wool. This was because the people who lived in those areas which were suitable for sheep rearing had, since ancient times, been involved in the production of Turkmen carpets, which were in great demand even in countries far away from Turkmenistan. For carpet-making, people required white, semi-rough wool containing high levels of fur hair and thinner top hair. It also needed to have curly tips and a high level of shine.

Appearance

Apanasenko (1939), Gubanov (1936), and Manukyan (1948) have all described Sarajin sheep. According to these authors, there are two clear types of Sarajin sheep, as distinguished by their wool and conformation. The first type consists of those animals which have long legs, a relatively strong constitution, and a low level of wool coverage on their head and legs. This type is also distinguished by the fact that it has a white fleece, but legs ears and a head which are mainly dark. The second type consists mainly of animals with short legs, compact bodies, and a more delicate constitution than the first type. They have a white fleece, but a light-brown head, and light-brown legs and ears. Both types were mixed and run together on collective and State farms.

Most (70%) of Sarajin sheep have heads that are well covered with wool. The ears of the breed are wide, long and not very mobile; they also hang downwards in the direction of the corners of the mouth. The neck is rather short and thin while the chest is quite deep but narrow. The ribs are flat but well rounded, and the back is narrow. In comparison with other fat-tailed sheep, the body of the Sarajin sheep is rather short. In general, the legs of Sarajin sheep are of medium length; however, short- and long-legged animals do also exist. The legs of the breed are well proportioned but are positioned rather close together, probably because of the breed's narrow chest and body. As a rule, the animal's belly is covered with a very thin fleece; the head and legs are generally covered with a long thin fleece with reddish or and dark brown tones.

The fleece of Sarajin sheep is predominantly white with a good degree of luster. Only a few sheep have a dark brown fleece; black Sarajin sheep do not occur. All Sarajin sheep are hornless, except for the 2-4% of rams which have rudimentary horns.

Sarajin sheep usually have 5-6 tail vertebrae, though some animals have 12-15. In the latter case, the fat tail hangs down from the rump in the form of a 'pillow' which contains the extra vertebrae.

Sarajin ram

Sarajin ewes and lambs

Body measurements

The first reports concerned with the body measurements of this breed arose from early sheep research in the 1930s (Table 10). There is little difference in the size of those animals measured in the 1930s and those measured in the 1960s (Table 10). Sarajin sheep are taller and heavier than Karakul sheep: the live body weight of adult (3-year-old) Sarajin rams is around 80-85 kg, while that of ewes is about 55-60 kg.

After the 1960s, the Ashgabad Sarajin line was developed through intra-breed selection which was undertaken at two collective farms: the Soviet Turkmenistany farm and Forty Years of the Turkmen Soviet Socialist Republic farm (Geldiyev and Logvinov 1973). This line was similar in terms of size to earlier types of Sarajin sheep (compare Table 11 with Table 10).

The growth of Sarajin lambs at an early age was studied by Grigoryants (1969), who measured various parameters from birth to the age of 12 months (Table 12).

At one year of age, the diagonal length and the metacarpus diameter reached by individuals are over 90% of what these measurements will be once the animal is mature (Table 13). Ewes also attain over 90% of their mature height by this age; however, at this point, their chest diameter is still increasing.

Body weight and growth

Manukyan (1948) and Grigoryants (1969) reported the live weights of Sarajin sheep, which show marked sexual dimorphism after the age of 1 year (Table 14).

Plotting the live weight data (Figure 4) showed that the weight of ewes changed only slightly from 2 years of age onwards. By contrast, the weight of rams continued to increase until the age of 4 years. From birth to the age of 3 months, ram lambs and ewe lambs grew at a rate of 214 and 206 g per day, respectively. Sarajin lambs are weaned at the age of 4 months; unfortunately no information is available on the weights of animals from the time of weaning to 1 year of age.

Table 10. Linear body measurements (cm) of male and female Sarajin sheep at different ages.

	Authors						
	Apanasenko (1939)	Gubanov (1936)		Yesaulov and Litovchenko (1963)			
Trait (cm)	3-year-old ewes (n=350)	5-year-old rams (n=50)	5-year-old ewes (n=200)	1-year-old ram lambs (n=150)	1-year-old ewe lambs (n=275)	5-year-old rams (n=75)	5-year-old ewes (n=250)
Height at ridge	77.5	88.4	76.5	72.7	70.4	81.4	74.8
Diagonal body length	77.3	79.7	73.9	66.7	68.1	78.0	70.5
Chest girth	97.3	91.5	86.5	83.7	78.8	95.3	70.5
Chest depth	35.8	35.7	32.5	31.0	30.3	37.0	33.8
Metacarpus girth	9.9	9.0	8.1	9.1	8.4	10.6	9.3

Table 11. Linear body measurements (cm) of sheep of the Ashgabad Sarajin line on two collective farms.

	Soviet Turkmenistany Farm n=100			Forty Years of TSSR Farm n=100		
Trait	5-year-old rams	5-year-old ewes	1.5-year-old ewes	5-year-old rams	5-year-old ewes	1.5-year-old ewes
Height at ridge	81.3	71.9	71.0	79.8	72.2	69.1
Diagonal body length	76.1	73.1	73.3	79.3	75.2	71.8
Chest girth	104.1	93.1	87.4	96.7	90.1	84.2
Chest depth	38.5	33.8	32.4	36.0	32.9	31.3
Metacarpus girth	9.2	8.3	8.0	9.1	8.5	8.1

Source: Geldiyev and Logvinov (1973).

Table 12. Linear measurements (cm) of Sarajin lambs from birth until 1 year of age (Mean±Standard error).

	Age					
Sex and traits	At birth	1 month	2 months	3 months	4 months	12 months
Ram lambs, n	233	154	120	106	11	83
Height at ridge	39.4±0.2	48.8±0.2	58.4±0.3	58.7±0.3	62.6±0.4	68.3±0.5
Diagonal body length	34.4±0.1	50.0±0.2	60.3±0.3	60.9±0.4	65.3±0.4	72.0±0.6
Chest girth	38.3±0.2	57.4±0.2	69.5±0.3	70.1±0.3	75.0±0.3	85.5±0.7
Metacarpus girth	6.3±0.02	7.4±0.02	7.5±0.03	7.6±0.03	8.1±0.05	8.3±0.05
Ewe lambs, n	244	124	115	109	102	87
Height at ridge	39.0±0.2	48.0±0.2	57.1±0.3	57.4±0.3	62.6±0.3	66.3±0.3
Diagonal body length	34.4±0.2	48.5±0.2	58.8±0.3	59.3±0.3	63.6±0.3	69.6±0.5
Chest girth	37.9±0.01	55.2±0.02	65.5±0.2	67.5±0.2	72.3±0.4	82.3±0.4
Metacarpus girth	6.1±0.04	7.0±0.01	7.1±0.1	7.2±0.03	7.3±0.05	7.9±0.04

Source: Grigoryants (1969).

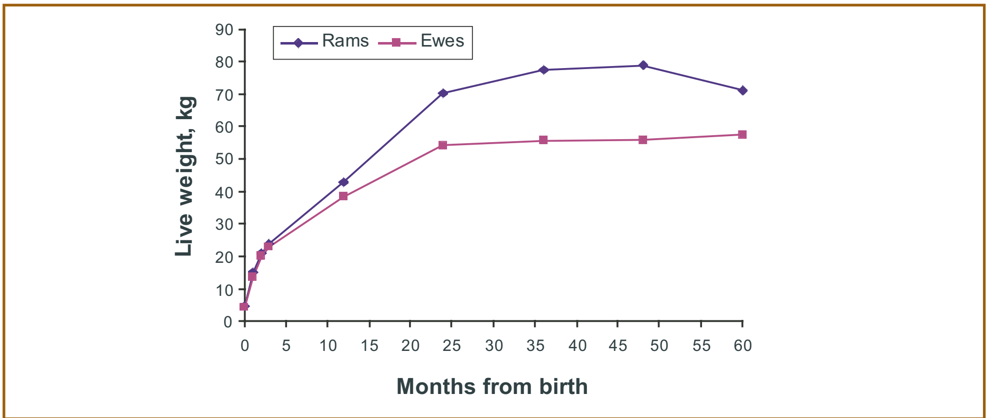

Figure 4. Growth of Sarajin sheep from birth to 5 years.
Source: Organized by authors, using data from Grigoryants (1969) from birth to one year of age and Manukyan (1948) from 2 years of age onwards.

Table 13. Size of Sarajin lambs at different ages expressed as a percentage of the size of mature (3-year-old) sheep.

	Ram lambs			Ewe lambs		
Trait	At birth %	4 months %	12 months %	At birth %	4 months %	12 months %
Height at ridge	48	77	84	54	87	92
Diagonal body length	45	86	95	47	87	95
Chest girth	37	72	82	41	78	88
Metacarpus girth	68	88	90	73	88	95

Source: Organized by authors using data from Grigoryants (1969).
Note: No information was provided on the number of records involved in these estimates.

Table 14. Live weight (kg) of Sarajin sheep at different ages.

	Rams			Ewes			
Age	n	Mean±SE	M%	n	Mean±SE	M%	Author
At birth	233	4.7±0.05	6	244	4.5±0.04	8	Grigoryants (1969)
1 month	154	15.2±0.05	20	124	13.6±0.20	24	
2 months	120	21.0±0.07	27	115	20.0±0.04	36	
3 months	106	24.0±0.07	31	109	23.0±0.03	41	
1 year	83	40.5±0.52	52	87	36.8±0.48	66	
1 year	24	45.3±0.74	58	305	40.0±0.53	71	Manukyan (1948)
2 years	23	70.2±0.93	91	275	54.2±1.11	97	
3 years	102	77.5±0.35	100	210	55.5±0.26	100	
4 years	31	78.9±1.08	102	175	56.0±1.03	101	
5-6 years	5	71.0±1.21	92	150	57.3±0.82	102	

Notes: M%: 'Maturity percentage': live weight expressed as a percentage of live weight at maturity (3 years of age); SE: Standard error.

Sarajin sheep mainly depend on range vegetation for feed. However, the quantity and quality of range vegetation fluctuates considerably, both throughout the year and from year to year. Extra fodder is therefore required at particular times, such as during the winter or during periods of drought.

Sarajin meat and fat production have not been studied in any depth, and data on these subjects are only available in the reports of Kuznetsov (1939) and Grigoryants (1969). The meat and fat yields of Sarajin wethers, obtained from a carcass analysis, are shown in Table 15.

This information shows that the carcass of a Sarajin sheep contains more muscle and bone tissue than the carcasses of other fat-tailed sheep kept in the same region. This is an extremely interesting point and, in our opinion, should be studied in more detail.

The 1969 report by Grigoryants includes an evaluation of different parts of the carcasses of Sarajin wethers of different ages (Table 16). The clean meat percentage of these carcasses ranged from 58% to 61%, while the proportions of bone and fat were found to be 19-22% and 10-15%, respectively. The ratio of meat to bone therefore ranged from 2.7 to 3.1.

Table 15. Live weights and carcass traits of Sarajin wethers at different ages.

Age	n	Live weight (kg)	Carcass weight (kg)	Fat tail		Mesenteric fat		Carcass and fat	
				Weight (kg)	%†	Weight (kg)	%†	Weight (kg)	%†
1 year	5	43.6	19.6	3.6	9.1	1.7	3.8	25.3	57.9
1.5 years	5	59.8	25.0	3.6	6.0	1.6	2.6	30.2	50.4
2 years	5	61.2	26.8	4.6	7.4	1.9	3.1	33.3	54.4
3 years	5	61.2	27.6	4.6	7.5	3.3	5.4	40.6	66.4

Source: Kusnetsov (1939).
Note: †Percentage of body weight.

Table 16. Components of Sarajin wether carcasses.

Observations by age	Components					
	Carcass	Meat for sausage	Fat	Bones	Kidneys	Waste and losses
9 months (n=7)						
Weight, kg	12.0	7.0	1.2	2.6	0.2	0.2
%†	100.0	58.3	10.0	21.7	1.7	8.3
16 months (n=7)						
Weight, kg	20.0	12.1	3.0	3.8	0.3	0.8
%†	100.0	60.5	15.0	19.0	1.5	4.0
21 months (n=7)						
Weight, kg	20.0	12.3	2.7	4.3	0.2	0.5
%†	100.0	61.5	13.5	21.5	1.0	2.5

Source: Grigoryants (1969).
Note: †Percentage of carcass weight.

Babaeva (1960) found that, under favorable conditions, the fat of 5-day-old Sarajin lambs can account for 2.9% of their body weight. This fat weighs more than any of the viscera except the alimentary tract (which accounts for 4.2% of the body weight).

Meat production in Sarajin sheep is determined by the breed's well-developed muscle and fat tissues, which are characteristic of the breed and which reflect its ability to grow fat on even poor-quality range in Turkmenistan. The accumulation of fat reserves in the tail is a biological peculiarity of desert animals and a highly important adaptive trait. Manukyan (1948) reported fat-tail weight ranges of 3.7-4.9 kg in 1.5-year-old Sarajin ewes of medium fatness, and 8.5-10 kg in 1.5-year-old wethers.

Reproductive performance and milk production

Sarajin sheep do not display a high level of fertility. Geldiyev *et al.* (1965) reported that the average number of lambs obtained per 100 ewes exposed to ram on the collective farm Forty Years of the Turkmen Soviet Socialist Republic in the years 1959 to 1964, was, per year, 72.3, 57.0, 40.0, 72.8, 86.7 and 94.2, respectively. On the Leningrad collective farm, the corresponding figures for lambs produced per 100 ewes mated were 69.7, 79.0, 58.0, 64.8, 84.8 and 88.1, respectively. According to Logvinov (1985), the twinning rate of Sarajin sheep is around 8-10%. Reproductive success depends greatly on the condition of the range vegetation available and on the availability of fodder.

Sarajin milk production deserves special attention. Based on the data gathered by Apanasenko (1939), Ivanov (1940) concluded that the breed has a high milk-production potential. The 1939 Apanasenko study showed that, within the first month of lactation, Sarajin sheep produce 500-700 g of milk per day; it also showed that the milk produced has a fat content of 6.2-7.1%. Gubanov (1936) reported that the daily milk yield obtained from milking ranged from 250 to 800 g.

Manukyan (1945) observed that, in April 1944, daily milk production ranged from 185 to 280 g in the Sarajin being studied. The average daily milk yield in the first month of lactation was found to be 213 g, although individual ewes produced between 50 and 550 g. That author suggested that milk production could not be developed in the desert and semi-desert areas of central and western Turkmenistan, where Sarajin and other type of fat-tailed sheep are reared, because not enough feed is available. Sarajin sheep (like other types of livestock) can only produce high levels of milk when kept in areas with a temperate climate in which feed is abundant.

In a more recent study, Kherremov (2002) found that the average daily milk yield of Sarajin ewes within the first month of lactation was 213 g (range 185-280 g); the daily yield per ewe ranged from 50 to 550 g. During the first, second, third, and fourth month of lactation, the average milk yields were 16.0, 12.6, 5.4 kg and 2.4 kg, respectively. The average total milk yield per ewe was 36.4 kg (range 28.0-40.8 kg).

Wool production

Manukyan (1935, 1947), Geldiyev *et al.* (1956), Logvinov (1971), Vasilyev and Tselyutin (1990), highlighted that Sarajin lambs at birth have various colors of wool cover, from light- to dark-brown. At the age of 25-30 days, pigments stop reaching the growing wool, and by the age of 5 months, after the shearing of lamb wool, white wool grows with low (up to 5%) content of pigmented hair (Logvinov, 1971). The initial color is preserved only on the head and extremities.

With regard to wool yield and wool quality, Sarajin sheep are superior to other fat-tailed sheep. The annual wool yield of rams is 3.7 kg and that of ewes 3.2 kg. Manukyan (1947) did, however, observe greater yields on the Saraja state farm in 1938. In that study, elite animals produced up to 4.53 kg wool per year, while first-class animals produced 4.25 kg, second-class animals 4.21 kg, and third-class animals 3.99 kg of wool per year. Exceptional ewes and rams in this flock produced annual wool yields of 6.5 kg and 7.3 kg, respectively, in the 1940 shearing (Manukyan 1947).

According to Vasilyev and Tselyutin (1990), the wool of Sarajin sheep is semi-coarse and has a structure which resembles plaits. In spring wool these plaits are 14-16 cm long, while the down produced is 6.8 cm long. Sarajin wool consists of 56-75% down, 21-26% transient hair, and 4-18% top hair. Clean wool yields are between 55% and 60% (Vasilyev and Tselyutin 1990).

Ninety tonnes of Sarajin sheep wool were evaluated at Turkmenistan's Central Research Institute for Wool, where it was found to contain strong wool fibers (Geldiyev 1979). Trial spinning yielded 200 ends down per 1000 spins per hour, while spinning using other semi-coarse wools yields 300-600 ends down per 1000 spins per hour. Tests at the Moscow Veterinary Academy (Geldiyev 1979) indicated that the felting capacity of lamb wool and autumn wool of Sarajin sheep was better than that of other semi-coarse wool sheep.

Estimates of genetic parameters

Logvinov (1971) estimated correlation coefficients for wool traits, as well as the repeatability and heritability of wool and body weight. The phenotypic correlation between the depth of primary and secondary fiber follicles, and fiber and down length was found to increase with age. The ranges of correlation coefficients (r), at birth, at 5 months, at 13 months, at 2 years, and at 3 years, were 0.17-0.19, 0.21-0.24, 0.37-0.40, 0.56-0.61, and 0.58-0.63, respectively. The strength of the correlation between the number of secondary fiber follicles and fiber diameter also increased with age, as the estimated correlation coefficients at 1 month, 5 months, 13 months and 3.5 years were 0.15, 0.22, 0.40, and 0.50, respectively.

At 13 months of age the phenotypic correlations between (1) annual wool yield and fiber fineness, (2) annual wool yield and fiber length, and (3) fiber length and fiber fineness, were 0.13, 0.38, and 0.51, respectively (Logvinov 1971).

The heritability estimates (h^2) of body weight at birth, 5 months, 13 months, and 3.5 years of age, were 0, 0.37, 0.63, and 0.52, respectively. The heritability estimates obtained for greasy fleece weight, clean fleece weight, wool fineness, and wool length were 0.49, 0.13, 0.39, and 0.43, respectively. The heritability for the breed's prolificacy rate was h^2=0.13.

Repeatability of live body weight was also estimated; correlations between weights at birth and at 5 months, weights at 5 months and 13 months, and weights at 13 months and 3.5 years, gave coefficients of 0.17, 0.13, and 0.52, respectively. Repeatability of wool yield was also studied. The coefficients of correlations between wool weights at 5 months and 13 months, and wool weights at 13 months and 3.5 years were 0.34 and 0.42, respectively.

Breeding plans

As is the case with Karakul sheep, current Sarajin breeding plans are being developed jointly by The Livestock Research Institute and the breeding department of the Turkmenmollari Association. The plans aim to improve the following traits in this breed: body weight, wool productivity, the length and fineness of wool, the length of down fiber, and wool density. Scientists are also studying the natural prolificacy of the breed. At present, the best flocks of Sarajin sheep are kept on pedigree breeding farms in the Ashgabad region.

Fine Wool Crossbred Sheep

Although considerable efforts were made to develop synthetic breeds in Kazakhstan and Kyrgyzstan during the Soviet Union, this was not the case in Turkmenistan. The only such effort involved importing fine wool sheep from Groznenskaya, Stavropolskaya, the Caucasus, and southern Kazakhstan to the Saivan State Farm in the mountain ranges of southwest Kopet-Dag. Because the climate of this region is sub-tropical, Erman and Lemayeva (1971) recommended that imported animals should only be used in crossbreeding plans, not in pure breeding plans. Thus, in the 1980s, the fine wool population consisted of crossbreeds of different origins.

Practically no data is available on the productivity of fine wool crossbred animals. However, it is estimated that the population of fine wool crossbred animals is less than 1000 head in private flocks in Turkmenistan. It is likely that these animals will decline progressively in number because, in comparison with the country's indigenous breeds, they have little relevance to Turkmenistan's sheep industry. No research on fine wool sheep is currently being conducted in the country.

Goat Breed Characterization

The Indigenous Turkmen Goat

Indigenous Turkmen goats have, thus far, been little studied. Little if anything is known about the types of goat that currently exist in the country, or about their productivity and their economic importance. It is known, however, that goats are an integral part of some sheep flocks. Only in the southern areas of the country have attempts been made to develop mohair production, and these have now ended. Of the improved mohair-producing herds developed, only a few dozen animals can now be found on private farms.

Indigenous Turkmen goats are hair-producing animals. According to Erman and Shustova (1955), until 1937, Turkmenistan's goat herds were concentrated mainly in the Geok-Tepinskiy, Bakhardenskiy, Kara-Kalinskiy, and Gyzil-Arvatskiy districts of the mountainous and foothill zones of the Republic.

In an attempt to develop mohair production, purebred Angora sires were imported into the region in 1937 and used on a large scale until 1947. Research and development activities related to mohair goats were carried out on the Voroshilov and Kaganovitch collective farms located in the Bakhardenskiy district. The second phase (1946-1952) of this mohair production development work involved pedigree breeding. This aimed to improve the adaptability, body conformation, and body weight of indigenous goats and to combine these traits with the high fiber-quality traits of the Angora breed.

Turkmen Indigenous buck

Appearance

The Indigenous Turkmen goat is characterized by a strong constitution, strong bones, and a good level of mobility. Black colored pelts prevail but faces are often with small white spots and lines of white and yellow colors on the black background.

The head of female goats is small and has a straight profile. By contrast, the heads of bucks are large, quite

Turkmen Indigenous doe

irregular, and hawk-nosed. Both, female and male goats have well developed horns. Native goats are characterized by rather long legs with medium-sized body and high rump (sacrum). Native goats have also a well-developed chest, suitable for animals grazing in mountainous areas.

Productivity

Little information on the productivity of goats has been published; the largest amount of data available is contained in a publication by Erman and Shustova (1955). During the 1950s, both indigenous and mohair goats were kept in year-round range-grazing systems. The weights of both breeds were observed to be similar, although in southwestern Turkmenistan, the average weight of 3-year-old mohair goats was 35 kg: slightly greater than that of the indigenous hair-producing goats of the same age (33 kg).

The body weight of improved animals kept on pedigree farms is presented in Table 17. These data indicate that the animals considered grew rather slowly, as 3.5-year-olds were only 90% of the weight of mature 4.5-year-old goats. Researchers found that growth rates from birth to the first month averaged 213 g/d for males and 197 g/d for females, while growth rates from birth to 6 months of age averaged 114 g/d for males and 92 g/d for females (Erman and Shustova 1955).

The carcass weights of indigenous goats are similar to those of mohair-producing Angora crossbred goats (Table 18). However, the Angora crosses have a slightly greater accumulation of fat (Table 18).

Table 17. Body weight and growth of mohair-producing goats.

	Bucks (n=50)		Does (n=50)	
Age	Live weight (kg)	%M	Live weight (kg)	%M
At birth	2.9	6	2.7	7
1 month	9.3	18	8.6	22
6 months	23.4	45	19.3	49
1 year	25.9	50	22.3	56
1.5 years	27.5	53	25.9	65
2.5 years	38.1	73	31.7	80
3.5 years	47.0	90	35.5	90
4.5 years	52.3	100	39.6	100

Source: Erman and Shustova (1955).
Note: %M: live weight expressed as a percentage of live weight at maturity (4.5 years of age).

Table 18. Goat meat productivity indices.

Type of goats	Fattening level	Live weight, kg	Carcass yield %	Carcass and fat kg	Carcass with no fat kg	Fat in carcass %
Indigenous Turkmen	Medium	36.1	46.6	16.8	14.1	16
Mohair-producing	Medium	34.1	50.7	17.3	14.1	19

Source: Erman and Shustova (1955).
Note: No information provided on numbers of animals involved in the measurements.

The prolificacy levels of both indigenous and mohair-producing goats have also been reported to be similar, falling within the range 131.0-134.4 kids per 100 does (Erman and Shustova 1955).

Erman and Shustova (1955) also considered the amount of mohair produced by goats of different ages. Yearling, 2-year-old, 3-year-old, 4-year-old, and 5-year-old crossbred goats were found to produce 1.11, 1.45, 1.41, 1.55 and 1.52 kg of mohair, respectively. The mohair produced was of a quality which resembled that of the mohair produced by purebred Angoras. These assessments however were not coupled with actual measurements of fineness and other quality traits.

Prospects for Small Ruminant Production in Turkmenistan

As discussed previously, sheep and goat production is a very important part of Turkmenistan's agricultural sector. The country has 38 million ha of natural rangeland which is used to raise small ruminants and, due to favorable climatic conditions, grazing and production are possible almost all year round. The national development plans formulated by Turkmenistan's President in the late 1990s included the goals of increasing the country's sheep population to 31.5 million head by 2020, and producing 75,000 tons of wool and 1.235 million tons of mutton per year. In the short term, the primary aim of these plans is to make the country self-sufficient in meat, not to increase the export of livestock products.

Turkmenistan's sheep and goat population numbered 15.7 million head in 2004, more than double the size of the population in 1999 (Turkmen National Institute of Statistics and Forecasting 2004). Most of these animals (80%) were being kept by the private sector. Goat production is also increasing: by 2000 the goat population was 1.892 million head (85% of which were owned by the private sector), and goat numbers had increased by a factor of 3.8 during the period 1990-2000.

Mutton is the main product derived from sheep, and constitutes more than 50% of the total amount of meat produced in the country. Mutton production is encouraged by the relatively high market prices it commands, as the meat is always in demand. Furthermore, demand is expected to rise in the future as people's purchasing power increases. By contrast, a low demand for wool, coupled with low prices, has led to wool production stagnating. As a result, over 30,000 tons of wool are now stored on farms and cannot be sold.

With regard to wool production, farmers face a variety of problems, including the fact that the quality of the wool produced is very low and no wool grading or classification system exists. Furthermore, farmers don't have the facilities needed to prepare wool lots for market, and, because they keep relatively small flocks, their returns per flock are negligible. Finally, the wool produced is mainly sold to intermediaries who pay low prices. In fact, it should be noted that the prices now paid for wool do not even cover half the wool-production costs incurred by individual farmers. However, the market demand for wool is currently changing and prices are increasing. Demand for Karakul sheep wool is higher than that for Sarajin sheep wool, and farmers are able to obtain 55 US$ cents per kilogram for washed Karakul sheep wool.

There is also little or no demand for goat cashmere and mohair; again, market prices are so low that they do not cover even half the production costs involved. By contrast, goat meat and milk are very popular, which has resulted in a rapid increase in herd sizes. There is also still some demand for Karakul pelts on the international market. However, greater marketing efforts are needed if Turkmenistan is to capture more of this market.

The fact that Turkmenistan is landlocked constrains its exports. However, it is also the only one of the Central Asian republics that is linked to the Persian Gulf by a railway. The authors of this chapter therefore suggest that developing and producing competitive sheep-derived products would be worthwhile, as they could be exported by this route in the future.

Under the general market conditions described above, it is clear that small ruminant production in Turkmenistan should focus primarily on sheep and meat production. However, this will require serious improvements in (i) the feeding systems used and the amount of feed available, (ii) the management, breeding and health of the flocks, and, very importantly, (iii) the way that production is organized in the country. In addition, the recovery observed in the market for wool also indicates the need to consider the particular wool traits that are in demand.

Increased flock sizes per farmer will lead to feed-supply problems. However, steps are already being taken to ensure that, in the future, a good supply of fodder is available from the rangelands, the main source of feed for the country's small ruminants. One such step was the government's decision to provide rural areas with natural gas, which is now used for heating and cooking. This decision meant that people did not have to use desert shrubs as fuelwood, and led to a clear improvement in the condition of the vegetation on the ranges. This was not only due to the recovery of the shrubs themselves; it also resulted from the fact that the newly recovered woody species created a microclimate suitable for the establishment of ephemerals, which further increased vegetative cover.

Other changes have also benefited Turkmenistan's small ruminant sector in recent years. For example, the area cropped with cotton has expanded to 750,000 ha, while that cropped with cereals has expanded to 850,000 ha. Farmers living near to these cropped areas benefit, as they have access to stubbles and crop residues which they can use to feed their animals during the fall. This livestock-feeding option is becoming increasingly important in the country. However, for those other producers who do not have access to cropping areas, such as those in the central Karakum desert region, the problem of fodder shortages in the fall still remains. Furthermore, all farmers need to consider how to secure fodder for use during the winter, which is the most critical period of the livestock production calendar. This is an area in which research will play a crucial role in the future. Issues which need to be carefully addressed include the need to reduce feeding costs, improve the management of crop–livestock interactions, and explore the use of agroindustrial by-products and other unconventional sources of fodder. At the same time, more fodder species need to be planted, including those tolerant to drought (i.e. cactus) or saline areas (halophytes).

Improved management techniques are also necessary. Some such techniques (i.e. early lambing and strategic feeding) have been successful used as part of a recent collaborative effort involving Turkmen research organizations and the International Center for Agricultural Research in the Dry Areas (ICARDA). These techniques therefore constitute obvious entry points for dissemination and development. Linked to such action is the urgent need for efforts to ensure the appropriate epidemiological management of sheep flocks and goat herds. For such management to be successful, the actions taken will have to be synchronized with national plans for epizootic control, and must include the implementation of management practices which aim to reduce health problems at the flock level. Issues of animal health will therefore demand more national investment and greater efforts in the future.

As there are no comprehensive, national breeding strategies in Turkmenistan, the establishment of new and effective nationwide breeding schemes managed by farmers is a priority. However, researchers will need to be involved in the design and implementation of these schemes. The two main sheep breeds, Karakul and Sarajin, should be managed in their natural environments. This will allow full advantage to be taken of their adaptability and their ability to produce meat and other products demanded by local people. Due to the popularity of the Sarajin sheep, it is likely that their numbers will increase to a greater extent than those of the Karakul. However, the Karakul will retain its dominance in the ecological niches to which it is well adapted.

Finally, efforts need to be made to diversify production. Successful fattening options, as well as the possibility of producing processed sheep's milk products, have already been successfully tested with farmers as part of a collaborative program involving ICARDA. These options contributed substantially to the incomes of the farmers involved. However, implementing them on a wider scale will require further investment and action, including the organization of marketing and processing efforts.

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Uzbekistan

Chapter Six

Small Ruminant Breeds of Uzbekistan

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Introduction

Livestock production is a major component of the agricultural sector of the Republic of Uzbekistan, providing food products and raw materials for industry. Livestock production includes intensive dairy cattle, beef cattle, swine and poultry production systems, and extensive camel, goat and sheep production systems.

Small ruminants hold a special place in the country's economy, allowing the economic utilization of rangelands and serving as an important and, often the only, livelihood option for rural people.

Two production systems characterize mainstream sheep production: Karakul sheep breeding in desert and sandy areas, and fat-tailed (*kurdyuk*) sheep breeding in foothills and on highland ranges. Karakul sheep supply meat and valuable pelts, while fat-tailed sheep supply meat and fat. Two native fat-tailed sheep breeds can be distinguished: the Jaidara and the Gissar. Synthetic sheep breeds based on native fat-tailed sheep have also been developed to improve the production of certain outputs; these include mutton–wool and mutton–fat–wool breeds.

Sheep products, such as mutton, wool, skins, fat and milk, are mainly used to meet the requirements of the internal market, though a small proportion are exported. Mutton, fat, and milk are in high demand in local markets, while there is a moderate demand for Karakul pelts and sheepskins, and a low demand for wool.

Goats are bred all over the country. Goats supply cashmere, mohair, skins, milk, and meat. Three types of goats can be distinguished: cashmere-producing goats, mohair-producing goats, and a variety of native goats.

Table 1 summarizes the Uzbek sheep and goat breeds along with the main products and associated market demand.

Sheep and Goat Population Size and Distribution

Uzbekistan's sheep population consists of 7.6 million head and accounts for 89% of the country's small ruminant population. The country's goat population consists of 973,700 head, and accounts for the other 11% of Uzbekistan's small ruminant population. The regional distribution of sheep and goats is shown in Table 2. Uzbekistan's various sheep populations include, from largest to smallest, Karakul (3,882,100 head), Jaidara and crossbreds (3,317,500 head), and Gissar (413,400 head), representing 51%, 44% and 5% of the total sheep population, respectively.

More than 20% of Uzbekistan's sheep are raised in the Kashkadarya region, whereas each of the Navoyi, Samarkand, Surkhandarya and Bukhara regions accounts for approximately 10-12% of Uzbekistan's sheep population. Most of goats are concentrated in Kashkadarya, Surkhandarya, and Karakalpakstan. The geographical distribution of sheep and goat breeds is also depicted in Figures 1-4.

Table 1. Main produce of sheep and goats and their market demand.

Breed	Major products	Current market demand
Sheep		
Karakul	Pelts	Medium
	Mutton	High
	Wool	Low
Jaidara	Meat	High
	Wool	Low
Gissar	Mutton	High
	Wool	Very low
Mutton-wool synthetics	Mutton	High
	Wool	Medium
Mutton-fat-wool synthetics	Mutton	High
	Wool	Medium
Goats		
Uzbek Native	Skins and meat†	High
Uzbek Mohair	Skins and meat‡	High
Uzbek Black Cashmere	Meat, milk, skins	High

Source: Compiled by author.
Notes: † Low demand for mohair; ‡ Almost no demand for cashmere.

Table 2. Regional distribution of sheep and goats (1999, in thousands).

	Sheep					Goats	
Regions	Karakul	Gissar	Jaidara and crosses	Total	%	Total	%
Karakalpakstan	257.9	0	67.7	325.6	4.3	107.0	11.0
Andizhan	0	26.4	433.8	460.2	6.0	3.1	0.3
Bukhara	719.0	0	14.4	733.4	9.6	46.0	4.7
Jizak	299.0	0	365.0	664.0	8.7	50.4	5.2
Kashkadarya	968.2	23.0	539.0	1530.2	20.1	275.9	28.3
Navoyi	898.9	0	7.6	906.5	11.9	63.3	6.5
Namangan	0	0	414.2	414.2	5.4	73.9	7.6
Samarkand	374.9	5.1	385.6	765.6	10.1	85.4	8.8
Surkhandarya	162.0	303.3	290.0	755.3	9.9	195.0	20.0
Syr-Darya	0	22.0	103.2	125.2	1.6	10.1	1.0
Tashkent	3.7	3.0	340.0	346.7	4.6	51.4	5.3
Fergana	0	30.6	357.0	387.6	5.1	8.9	0.9
Khorezm	198.5	0	0	198.5	2.6	3.3	0.3
Total	3882.1	413.4	3317.5	7613.0	100.0	973.7	100.0

Source: Ministry of Agriculture and Water Resources of Uzbekistan (2000).

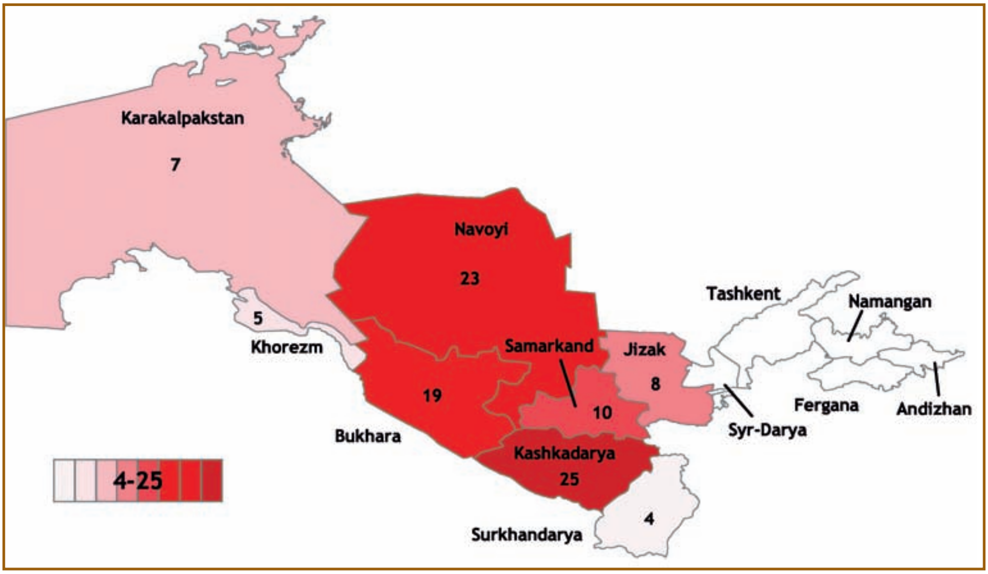

Figure 1. Geographical distribution of Karakul sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by author.
Numbers represent percent distribution of the breed in the different regions of Uzbekistan.

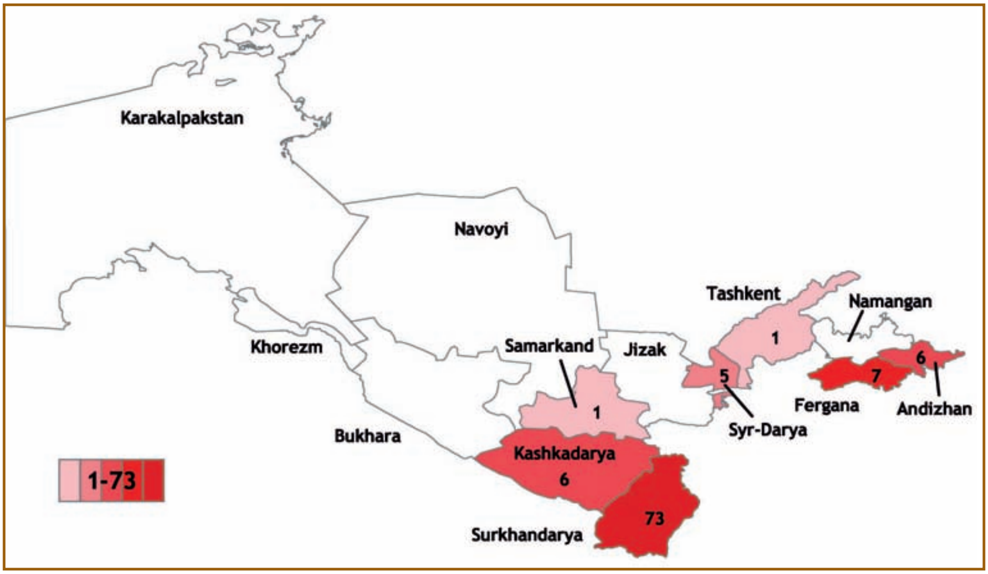

Figure 2. Geographical distribution of Gissar sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by author.
Numbers represent percent distribution of the breed in the different regions of Uzbekistan.

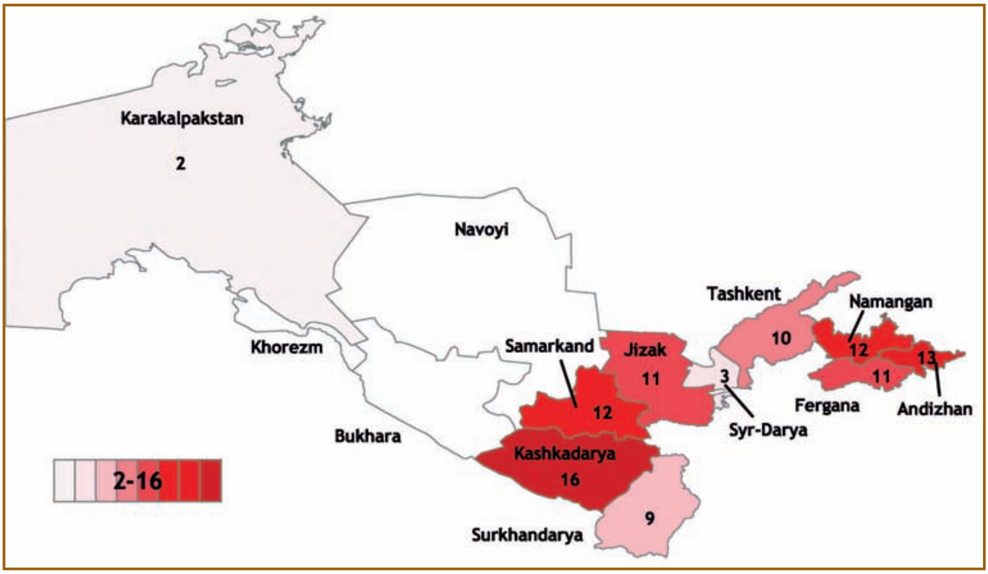

Figure 3. Geographical distribution of Jaidara sheep and Jaidara crosses.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by author.
Numbers represent percent distribution of the breed in the different regions of Uzbekistan.

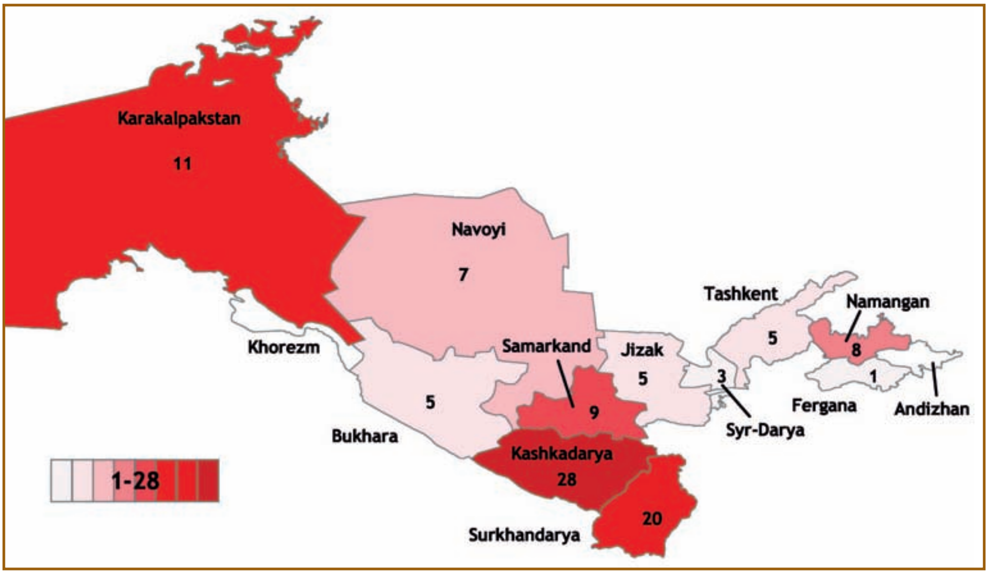

Figure 4. Geographical distribution of goats.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by author.
Numbers represent percent distribution of Uzbek goats in the different regions of Uzbekistan.

Changes in the livestock production structure

Rangelands used to graze sheep and goats make up 52% of the total area of the country. During the Soviet Union period, livestock production was concentrated on state farms, state pedigree-breeding farms, and state plants. Ranges, and land in general, were state property. Since independence, livestock production has been privatized and livestock are now owned by private individuals or cooperative farming units (*shirkats*). Farmers are entitled to keep their livestock on their own household's land, establish farming units, or join the *shirkats*. Land for fodder production or grazing is leased from the state for up to 50 years, depending on requirements. Special Governmental Resolutions exempt farmers from land and water taxes for the first three years of the lease and farmers are eligible for state subsidies. The small ruminant holdings of the three farm types are presented in Table 3.

As of 2001, the average household land holding consisted of 0.15 ha used to produce forage for one livestock unit (equivalent to one head of cattle or 10 sheep/goats). These holdings could be as large as 0.30-0.45 ha in irrigated areas and 2 ha in rainfed areas. Farms with less than 30 livestock units are categorized as 'households', while those with more than 30 livestock units are referred to either as 'individual farming units' or *shirkats*.

The economic reforms of the 1990s resulted in profound changes in livestock numbers and the distribution of different breeds among the different farm types. This period of transition caused the sheep population to decline by 1.5 million head, though the goat population remained relatively stable at about 1 million head. As a result of the changes in ownership that occurred, the number of small ruminants kept by cooperatives declined dramatically, whereas the amount of stock held by individual farming units increased slightly (Table 3).

Table 3. Number of sheep and goats in different types of farms (in thousands).

	1991		1999	
Farm type	Sheep	Goats	Sheep	Goats
Cooperative (*shirkat*)	4,943.7	192.7	2,968.5	165.3
Farming units	4.5	2.0	164.4	17.4
Individual farming units	4,243.8	722.8	4,480.1	791.0
Total	9,192.0	917.5	7,613.0	973.7

Source: Ministry of Agriculture and Water Resources of Uzbekistan (2001).

Figure 5 shows the changes that occurred in small ruminant ownership between 1991 and 1999.

Analysis of census data (Ministry of Agriculture and Water Resources of Uzbekistan 2001) also shows that in 1991 Karakul sheep accounted for more than 52% of Uzbekistan's sheep population; 36% of the population consisted of Jaidara and Jaidara crosses, while Gissar sheep accounted for a further 3%. The remaining 9% consisted of synthetic wool breeds.

Between 1993 and 2001, the Karakul sheep population declined by 6.7%, while the numbers of animals of the Jaidara and Gissar breeds increased by 1.5% and 2.9%, respectively. The stock of these two breeds increased because of the expansion of individual farming units, which produced meat and fat to meet the high level of market demand. By contrast, the population of synthetic, wool-producing sheep developed during the Soviet era declined sharply, by around 50% or 60%. During this period, the population of native goats increased slightly, while the population of fiber-producing goats declined (Ministry of Agriculture and Water Resources of Uzbekistan 2001).

Table 4 shows the changes that occurred in sheep and goat populations between 1991 and 2001 and gives the main reasons why some breeds are at risk of disappearing. Only the specialized fiber-producing breeds are considered to be at risk of extinction.

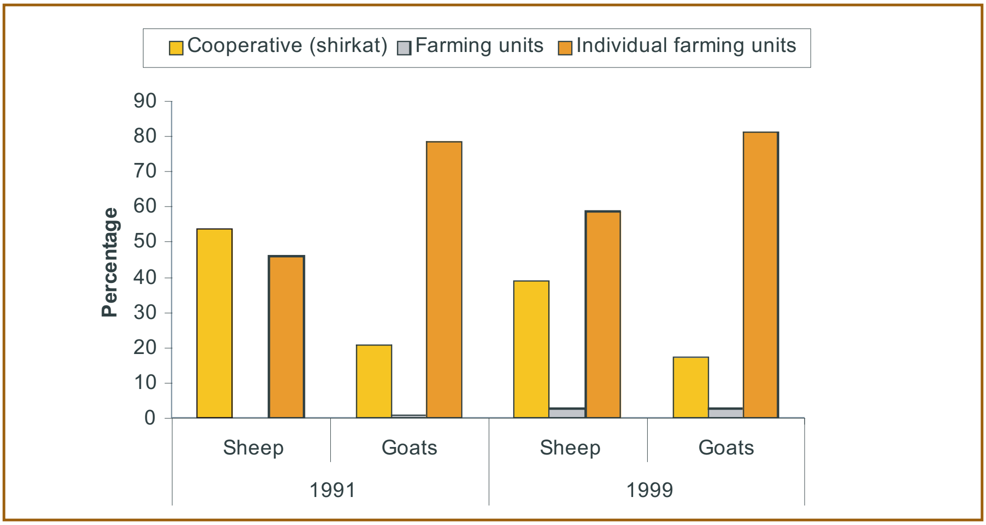

Figure 5. Distribution of ownership of sheep and goats, by farm type, in Uzbekistan.
Source: Ministry of Agriculture and Water Resources of Uzbekistan (2001).

Characteristics of Uzbekistan's Sheep- and Goat-Producing Areas

Climate

Uzbekistan has a strongly continental climate, and an average air temperature of about 14°C. On the plains and in foothill areas winters are cold and of varying length, though frosts are long-lasting and intense. Snow cover does not last for long; only once or twice in a decade will snow remain on the ground for more than 30 days. Sometimes snow cover consists only of patches of snow in shady places or on the northern slopes of hills. Summers are uniformly hot and extremely dry. Maximum rainfall occurs in spring, and minimum rainfall occurs in winter. About 3-5% of annual rainfall falls sporadically over the summer, though in some years up to 300-400 mm of rain can fall during the summer.

Table 4. Risks to the integrity of genetic resources.

Species and breeds	Population (in thousands) In 1991	In 2001	Change trends (1991-2001) %	Degree of risk	Reason for risk/ further information
Sheep					
Karakul sheep	4,876.4	4,231.2	86.8	None	Only genetically selected colored lines and lines of a rare color require attention
Jaidara sheep	3,023.6	3,321.4	109.8	None	High demand for mutton; popular among small producers
Semi-fine and coarse wool crossbred sheep†	130.3	46.4	35.6	High	Lack of demand for wool
Gissar sheep	385.5	428.6	111.2	None	High demand for mutton; popular among small producers
Total sheep	8,415.8	8,027.6	95.4		
Goats					
Mohair and Black Cashmere goats	314.0	97.4	30.9	High	Absence of markets for fiber High demand for meat, and goats are easy to maintain
Total goats	906.5	1,457.9	160.8		

Source: Compiled by author.
Note: †Synthetic sheep formed by crossing native breeds with different European breeds, as well as other exotic sheep breeds.

More rain falls in Uzbekistan's foothills. In these areas summer temperatures are more moderate and more moisture is preserved in the soil for longer periods. In July (summer), average air temperature in the foothills is 28°C, while average relative humidity is 41%. There is a marked difference between diurnal (40-44°C) and nocturnal (18-20°C) air temperatures at this time. The highlands receive 400-500 mm of rain per year, particularly on hillsides exposed to the wind. On alpine rangelands, the average air temperature in July is 17-18°C during the day, falling to 8-10°C at night. Relative humidity in the mountains is significantly higher than in the foothills. Thus, in the mountainous areas where fat-tailed sheep are reared, the foothills are hot while the air temperatures are relatively low in the highlands. By moving their sheep from the foothills to the mountains while the snows are melting and the annual vegetation is maturing, sheep producers are able to take advantage of relatively good grazing conditions during the summer.

Rangelands

As mentioned above, Karakul sheep production occurs in Uzbekistan's sandy desert and foothill areas. Fat-tailed sheep production, by contrast, occurs in foothill and highland areas. The types of rangeland occurring in these different areas and the major forms of vegetation associated with each are considered below.

a) Desert and foothill areas

Ephemeral rangelands consist of ephemeral plants (annuals) and ephemeroid plants (perennials). This type of rangeland covers vast areas, and mostly occurs on loess, where Sierozem soils are formed. The grass stands on these ranges include desert sedge (*Carex physoides*), poa (*Poa bulbosa*), *Bromus* spp., *Malcolmia* spp., legumes (i.e. Fabaceae), broad-stemmed herbs such as *karrak* (*Cousinia resinosa*), *ak-kuray* (*Psoralea drupacea*), and camel thorn (*Alhagi pseudoalhagi*). Annual species go through a vegetative growth phase during winter and spring and dry out in late April and May. Such species can yield up to 0.2 tonnes of dry matter per hectare (t DM/ha) when growing on sand, and 0.3-1.2 t DM/ha under the semi-desert conditions found in foothills. Ephemeral rangelands have a short-term value, in that they provide good grazing during the spring and for part of the summer.

Semi-shrub–ephemeral rangelands are widespread. The grass-dominated stands on this type of range usually consist of two levels: a lower level which contains annual and perennial species, and an upper level that consists of 'semi-shrubs' (herbaceous species with some non-permanent woody parts) such as *Artemisia* spp., *Astragalus unifoliatus*, glorybind (*Convolvulus*), and *kuiruk* (*Salsola orientalis*). On average, these rangelands produce 0.3-0.5 t DM/ha per year, and can be grazed year-round.

Shrub–ephemeral rangelands are widespread in sandy deserts. The upper level of vegetation consists of shrubs such as *saxaul* (*Haloxylon aphyllum*), *cherkez (Salsola richteri)*, and *Calligonum* spp. Annual yields vary, ranging from 0.07 to 0.4-0.5 t DM/ha.

Salsola rangelands are a valuable source of livestock feed. The vegetation present includes *balykuz* (*Climacoptera lanata*), *donashur* (*Gamanthus gamocarpus*), *kharidandan* (*Halimocnemis villosa*), *kuyanjun* (*Halocharis hispida*), and semi-shrubs such as *keireuk* (*Salsola orientalis*). All *Salsola* species have a long vegetative growth phase, as they grow over a period of 7-8 months. Rangelands with stands of *Salsola* spp. occur in all types of desert, and are grazed seasonally during the autumn and at the beginning of spring. Livestock do not graze this type of rangeland during the summer. Ephemeral-*Salsola* rangelands occupy significant areas of the country's semi-desert foothills.

Unsuitable rangelands comprise about 2 million ha of the Uzbek deserts. These areas are subject to different salinization processes and are mostly covered by *sarsazan* (*Halocnemum strobilaceum)* and *yulgun* (*Tamarix hispida*).

b) Foothill and highland rangelands

Foothill and highland rangelands occur in high mountainous areas (*adyrs*) and include alpine meadows at 500-4000 m above sea level (m a.s.l.). Natural vegetation in these areas is exceptionally diverse, and can be divided into four belts which are defined by altitude. Five types of rangeland may be distinguished.

Mountain and flood plain rangelands. The vegetation which grows on these types of range includes sedge (*Carex physoides*), bulbiferous meadow grass (*Poa *bulbosa*), ephemeral grasses such as brome grass (*Bromus* spp.), *kyltyk* (*Taeniatherum crinitum*), wild wheat, and perennial grasses such as *kekre-shashyr* (*Centaurea picrus*). These types of rangeland yield 0.4 t DM/ha.

Mountain and desert rangelands occur in the lower foothills and have a well developed and fertile soil cover. On these types of range, the vegetation consists of ephemeral plants and ephemeroids (*Carex physoides*), bulbiferous meadow grass (*Poa bulbosa*), wild wheats, *kyltyk* (*Taeniatherum crinitum*), British timothy (*Phleum paniculatum*), legumes (Fabaceae), and crucifers. Perennial herbaceous plants with deep root systems are also widespread, including *Aeluropus litoralis, Alhagi pseudoalhagi*, *ak-kuray* (*Psoralea drupacea* Bunge), glorybind (*Convolvulus arvensis*), and *kozykulok* (*Phlomis thapsoides*). However, most of these plants are either not edible or are not palatable while green. Bulbous barley (*Hordeum bulbosum*) grows in ravines in these areas, and can yield up to 3 t DM/ha. *Artemisia* species and *andyz* (*Inula* spp.) can also be found in these areas. These rangelands can be used year-round, yielding 0.5-0.6 t DM/ha on average.

Foothills and steppe rangelands occupy the upper parts of foothills and the lower parts of mountains. Couch grass (*Elytrigia* spp.) formations occur here, and contain plants such as *Agropyron trichophorum*, *Artemisia* spp., bulbous barley (*Hordeum bulbosum*), vetch (*Vicia* spp.), *Astragalus* spp., *Inula* spp., and *Ziziphora tenuior*. On the southern slopes in these areas, grass cover consists of ephemeral plants and ephemeroids, and perennial grasses which have a long growing period such as *kekre* (*Centaurea picrus*) and *Hypericum perforatum*. Shrubs are represented by almonds (*Amigdalus communis*) and cherries (*Cerasus vulgaris*). Plants grow late in spring. These rangelands are suitable for sheep grazing during late spring, summer and, in some places, in autumn. Fodder yield ranges from 0.8 to 1.8 t DM/ha.

Mountains and meadow steppe rangelands are grazed during the summer and are characterized by the presence of species such as *Dactylis glomerata, Bromopsis inermis, Artemisia* spp., and *Carex turkestanica*. Fodder yield ranges from 0.5 to 1.5 t DM/ha.

Highland-type rangelands are used only in summer. Sheep fescue or *betaga* (*Festuca valesiaca*) is the most widespread species on these rangelands, which provide a fodder yield of about 0.4 t DM/ha.

Note that a single sheep (or head) requires 400-425 feed units or 800-900 kg DM of fodder per year.

Thus, summer rangelands are located in the mountains, while spring, autumn, and winter rangelands are located in the foothills and cover a significantly smaller area. Moreover, within recent years, the area of these foothill rangelands has been significantly reduced by the expansion of cereal cropping. In favorable years, rangelands can meet 80-85% of a sheep’s fodder requirements, but only 50-60% in unfavorable years. As a result, serious attention needs to be paid to the preparation of emergency fodder reserves for use in winter. These should be able to provide 80-100 feed units per sheep.

Sheep Breed Characterization

The Karakul Sheep

The development and improvement of the breed

The Karakul is an ancient breed and has long been used to produce pelts and meat in Uzbekistan. In the past, milk, wool, and sheepskins were not considered important. However, some of these products, particularly milk, could play an important role under current market and production conditions.

Karakul sheep are raised in desert and semi-desert zones under dry, hot conditions. Individuals of this breed can walk up to 20-25 km per day when searching for food. The animals' thermoregulation abilities are excellent, allowing them to tolerate extreme temperature changes. They can also tolerate feed shortages and irregular access to water during the winter, during which period they make use of the fat reserves accumulated during more favorable seasons.

Appearance

Karakul sheep have a long and 'S'-shaped fat tail, which is completely different from the fat tails of the true fat-tailed (*kurdyuk*) sheep which will be described later.

There is a marked dimorphism between the sexes, rams being 10% to 30% bigger than ewes depending on age. Karakul sheep have long bodies and short legs. Most rams have large, twisted horns; ewes are usually polled. The head has a roman profile and thin lips. The head, ears, and extremities are covered with lustrous hair which is the same color as that of newborn lambs. At birth about 55-60% of the born lambs are monochrome black, 15-20% are sur (with fiber having different colors, dark in the base and lighter on the top) and 10-12% are gray (determined by a mix of white and black hair). Other colors do occur, with a frequency less than 8%, these including chestnut, pink, and white, as well as a few other less-common colors (Yusupov 1991). When adults the color of the fleece changes.

About 55-60% of the lambs born are black, while 10-12% are gray.

Management

The main management features of Karakul sheep are shown in Table 5.

Karakul flocks are managed by individual farming units (households), private farming units, and cooperatives (*shirkats*). We estimate that, at the beginning of 2001, about 2 million head of Karakul sheep were kept by *shirkats*. About the same number were kept by individual households, while another 200,000 head of sheep were kept on private farms.

Body measurements

Linear measurements from birth to the first year of age are shown in Tables 6 and 7 for the three most common colors of Karakul. No differences in body measurements seem to be associated with color. The table also shows that individual Karakul sheep are, in general, small.

Gray Karakul ram

Gray Karakul ewe

Black Karakul ram

Black Karakul ewe

Sur Karakul rams

Sur Karakul ewe and lamb

White Karakul ram

White Karakul ewe

Body weight, growth and carcass traits

Adult Karakul ewes weigh 40-45 kg and adult rams 60-70 kg (Table 8). Again, no differences in weights are apparent among the differently colored lines. Ewes mature more quickly than rams, as at 1.5 years of age they weigh about 87% of their adult weight while rams weigh only 69% of their adult weight.

Table 5. Karakul sheep management calendar.

	Months											
Events/Season	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Mating										■	■	■
Lambing			■	■	■							
Weaning								■	■			
Shearing						■			■			
Range grazing	■	■	■	■	■	■	■	■	■	■	■	■
Stall feeding†	■	■	■									
Drenching						■			■			
Seasons and main features	Winter‡ Jan 2°C to -1°C 80-100 mm rain			Spring Mar 4.2-12.6°C Apr 4.4-19.4°C May 20-25°C 50-60 mm rain			Summer Day 40-50°C Night 18-20°C 5-10 mm rain			Fall 27.8-32.1°C 5-20 mm rain		

Source: Compiled by author.
Notes: †Supplementary feeding in winter amounts to 80-100 feed units per head. However, sheep are not stalled throughout the entire winter, because weather conditions allow them to graze outside in December, January and February. ‡In winter, temperatures can fall as low as -15°C and frost can occur.

Table 6. Linear body measurements (cm) of young Karakul sheep of different color and age (Mean±Standard error) .

	At birth (n=90)			At weaning† (n=90)			1 year (n=90)		
Trait	Black	Gray	Sur	Black	Gray	Sur	Black	Gray	Sur
Height at withers	41.3±0.6	41.1±0.6	39.1±0.7	59.1±0.2	58.7±0.3	57.9±0.2	67.3±0.3	63.2±0.4	62.5±0.4
Height at sacrum	43.6±0.7	42.4±0.8	40.3±0.8	60.3±0.3	60.7±0.3	59.5±0.3	64.8±0.4	65.1±0.4	63.6±0.5
Diagonal body length	33.1±0.9	33.6±0.7	33.0±0.7	57.3±0.3	58.4±0.3	56.8±0.3	66.4±0.2	69.3±0.4	65.8±0.1
Chest girth	37.3±0.4	38.2±0.4	36.7±0.4	84.4±0.5	85.7±0.3	83.5±0.3	90.4±0.4	88.4±0.5	88.3±0.4
Chest depth	18.2±0.2	19.1±0.1	17.7±0.2	31.1±0.2	30.8±0.2	20.3±0.2	34.1±0.3	33.4±0.2	32.8±0.2
Chest width	12.2±0.3	12.4±0.3	9.7±0.5	20.3±0.2	21.4±0.3	19.8±0.2	23.1±0.2	22.7±0.2	21.3±0.2
Metacarpus girth	6.8±0.2	7.4±0.1	6.7±0.1	8.3±0.1	8.4±0.2	8.2±0.1	8.5±0.1	8.6±0.1	8.3±0.1
Head length	12.6±0.3	13.1±0.2	12.0±0.3	20.6±0.2	21.1±0.3	20.4±0.2	22.1±0.2	21.8±0.2	21.5±0.2
Forehead width	8.1±0.2	8.5±0.2	7.9±0.2	10.5±0.2	10.8±.0.2	10.3±0.2	10.6±0.1	10.8±0.1	10.5±0.1

Source: Yusupov (1991).
Note: † 4.0-4.5 months.

Table 7. Linear body measurements (cm) of 3.5-year-old Karakul sheep of different color (Mean±Standard error).

Trait	Black (n=90)	Gray (n=90)	Sur (n=90)
Height at withers	69.5±0.30	67.2±0.47	66.4±0.41
Height at rump	67.8±0.37	66.3±0.41	66.0±0.39
Diagonal body length	69.4±0.29	68.8±0.4	68.1±0.41
Chest girth	93.4±0.47	90.3±0.51	89.7±0.44
Chest depth	36.3±0.28	34.8±0.21	34.6±0.20
Chest width	25.1±0.21	23.4±0.19	24.3±0.17
Metacarpus girth	9.2±0.17	9.0±0.21	9.1±0.19
Head length	23.1±0.18	22.9±0.31	21.6±0.17
Forehead width	10.9±0.13	10.7±0.16	10.3±0.15

Source: Yusupov (1991).

Table 8. Body weight (kg) of Karakul sheep of different color genotypes (Mean±Standard error).

Sex/Age	Weights by color line, kg			Mean, kg	% adult weight
	Black	Gray	Sur		
Females					
At birth	4.6±0.13	4.4±0.15	4.3±0.12	4.4	10
At weaning	28.6±0.2	29.4±0.1	28.2±0.2	28.7	64
1.5 years	38.7±0.3	39.3±0.3	38.5±0.3	38.8	87
2.5-4.5 years	44.9±0.8	45.3±0.7	44.2±0.8	44.8	100
Males					
At birth	4.8±0.14	4.7±0.13	4.7±0.14	4.7	7
At weaning	30.1±0.2	30.4±0.2	30.1±0.2	30.2	46
1.5 years	44.6±0.3	45.1±0.3	46.2±0.3	45.3	69
2.5-4.5 years	66.3±0.9	64.7±0.8	65.1±0.9	65.4	100

Source: Yusupov (1991).
Note: Number of animals involved was not provided.

Table 9. Meat and fat production of 4- to 5-year-old Karakul ewes.

Trait	Color lines		
	Black (n=15)	Gray (n=15)	Sur (n=15)
Live weight (kg)†	50.8±0.10	47.2±0.08	48.1±0.07
Carcass weight (kg)†	22.5±0.11	21.3±0.09	22.3±0.01
Carcass (%)	49.6	50.6	51.6
Meat and bones weight (kg)	22.5	21.3	22.3
Meat and bones (%)	44.3	45.1	46.4
Tail weight (kg)	1.9	1.8	1.8
Tail (%)	3.7	3.8	3.7
Internal fat weight (g)†	836±3.4	802±3.5	699±10.6
Internal fat (%)	1.6	1.7	1.5

Source: Yusupov (1991).
Notes: †Mean±Standard error; ewes were slaughtered after 70 days of fattening.

Culled animals and young rams with poor-quality pelts are slaughtered for meat at 7-8 or 18-20 months of age. The carcass yield is 50-51%. The fat-tail weight averages 1.8-1.9 kg in weight, representing 3.7-3.8% of the animal's weight, while mesenteric fat accounts for 1.5-1.7% of the animal's weight (Yusupov and Zakirov 1991). Further results by Yusupov (1991) are shown in Table 9.

Reproductive performance and milk production

Puberty occurs at the age of 6-7 months; however, it is recommended that the first mating should not occur until the lambs have reached 16-18 months of age, when they will have reached 80% of their adult body weight. At the first mating, the reproductive efficiency of ewes is 80% (Yusupov 1991). The breed is not prolific and usually produces single lambs; twinning rates are not greater than 10% and triplets usually do not occur. Pregnancy lasts 148-152 days. The percentage of barren ewes, depending on maintenance and feeding conditions, generally fluctuates between 2% and 3%. About 3-5% of ewes produce dead lambs. Usually ewes are mated until the age of 6-7 years.

Fertility values are high (above 90%). Prolificacy is low, fluctuating between 100% and 110%. Lamb and adult mortality rates are both low. The reproductive performance of individuals has not been found to differ among the main color lines of the breed (Table 10).

The lactation period of ewes whose lambs were slaughtered for pelts (Mary ewes) is 120-130 days. The fat content of the milk can reach 6-7% and the milk yield is 120-140 kg per lactation. Milk yield can reach 45-50 kg within 45-60 days of lactation in years when fodder production is good (Yusupov 1991). Table 11 shows the data obtained for milk production during the first 70 days, divided into 10-day periods (Yusupov 1991). Note that milk production peaks in the second 10-day period following lambing and then declines; at the 70th day, production is less than 25% of the volume produced when at the start of lactation. The total amount of milk produced per ewe during the 70 days of lactation was 48.5 kg.

Table 10. Fertility, prolificacy, and mortality rates in Karakul ewes and lambs of different colors.

Color lines	Mated ewes	Lambed ewes n	Lambed ewes %	Barren ewes, %	Lambs born n	Lambs born %	Twinning rate, %	Dead lambs† n	Dead lambs† %	Dead ewes, %
Black	252	246	98	2	258	105	4.9	6	2.3	3.2
Gray	255	242	95	5	252	104	4.1	9	3.6	4.3
Sur	435	420	97	3	447	106	6.4	13	2.9	3.4

Source: Yusupov (1991).
Note: †Birth to weaning.

Table 11. Milk production by 4- to 6-year-old Karakul ewes during their first 70 days of lactation.

Milking period: Dates	Milking period: 10-day period	n	Daily yield†, g	Yield per 10-day period: kg	Yield per 10-day period: % of 1st period
20 Mar - 29 Mar	1st	50	852.3±0.87	8.52	100.0
30 Mar - 08 Apr	2nd	50	963.2±0.91	9.63	112.3
09 Apr - 18 Apr	3rd	50	929.4±0.88	9.29	108.7
19 Apr - 28 Apr	4th	50	813.5±0.84	8.13	95.4
29 Apr - 08 May	5th	50	652.3±0.67	6.52	76.5
09 May- 18 May	6th	50	423.9±0.53	4.23	49.6
19 May- 28 May	7th	50	213.2±0.33	2.13	24.5

Source: Yusupov (1991).
Note: †Mean±Standard error.

Karakul pelt production

The curled hairs which characterize Karakul lambs are formed during the development of the fetus. This important characteristic lasts for only a very short time after lambing. As result, pelts should be harvested within the first three days of birth. The curls produced can take different forms, including ‘pipe’, ‘shallow’, ‘ring’, and ‘pea’ curls. Karakul pelts can be classified according to the presence of these differently shaped curls, such as semicircular pipe curls (‘jacket’ type), flat pipe twisted curls (‘flat’ type), and ribbed pipe twisted curls (‘ribbed’ type), and the presence of an overgrowth of hair (‘Caucasian’ type).

Karakul lamb pelts come in a diversity of colors and tones. Black, white, and brown pelts are monochrome, while gray pelts contain a mix of white and black hairs; sur pelts contain fibers which have a dark base and light top. These colors can be of different intensities and, accordingly, different tones. According to the above, the pelts are categorized as white Afghan, gray, black, sur, and brown.

The most valuable pelts are those which have clear patterns, long, dense curls of short, silky, lustrous hair, and thin, dense leather (Yusupov and Zakirov 1991).

Three types of Karakul pelts are produced: those from 128- to 135-day-old embryos, those from 136- to-145-day-old embryos, and those from 1- to 3-day-old lambs. These pelts exhibit different levels of development on their haired side. The best quality pelts are produced from 131- to 135-day-old embryos produced by 6- to 7-year-old ewes which cannot later be used for breeding. Only at this age of embryonic development is it possible to obtain the maximum density of curls. This means that the ewes have to be sacrificed before lambing to obtain the valuable embryos. Most ram lambs are used for pelt production, although surplus female lambs may also be used to produce pelts.

Wool production

Karakul wool has a stapled structure, and consists of top hairs (17-20%), medium-length hairs (20-26%) and down or undercoat fibers (55-60%). Fleeces average 0.6-0.8 kg in weight in lambs, 1.8-2.2 kg in ewes, and 2.5-3.0 kg in rams. Staples are, on average, 8-15 cm in length. Sheep are shorn twice a year, in May and August. The wool obtained is used to produce rough cloth, carpets, and felt. Other Karakul wool traits are described in Table 12.

Genetic parameter estimates

Estimates of genetic parameters for pelt traits are provided in Table 13. Heritability estimates (offspring-mother regression) for body weight ranged between 0.5 and 0.6 (Gaziev 1989).

Current structure of breeding programs

A national state-managed Karakul breeding program is operating and is planned to continue until 2010. The breeding work undertaken is controlled by the Uzbek Scientific Research Institute of Karakul Sheep Breeding and Desert Ecology (UzNIIKEP) in collaboration with the Uzbek Karakul Company. Some of the flocks involved are subject to genealogical control.

Table 12. Wool characteristics of different Karakul genotypes.

Traits/Shearing	Black	Gray	Sur
Fleece weight (kg)†			
Spring	1.20±0.02	1.28±0.02	1.09±0.02
Autumn	0.86±0.02	0.88±0.02	0.76±0.01
Annual	2.06±0.07	2.17±0.08	1.80±0.06
Wool length (cm)†			
Spring total	14.9±0.41	15.2±0.47	16.6±0.51
Spring undercoat	5.7±0.32	6.2±0.41	5.8±0.57
Autumn total	6.9±0.42	7.2±0.52	7.2±0.59
Autumn undercoat	5.1±0.29	5.4±0.36	4.8±0.28
Proportion of fiber type (%)†			
Spring undercoat	54.2	52.3	63.6
Spring transient hair	28.4	27.3	9.5
Spring top hair	17.4	20.4	26.9
Autumn undercoat	51.7	48.8	49.3
Autumn transient hair	29.1	25.7	23.3
Autumn top hair	19.2	25.5	27.4
Fiber diameter (μm)			
Undercoat	23.0	23.0	23.4
Transient hair	38.2	38.0	38.1
Top hair	58.4	59.3	59.4

Source: Yusupov (1991).
Notes: †Mean±Standard error; number of animals involved was not provided.

Table 13. Heritability estimates of pelt traits.

Trait	Heritability
Curl types†	0.27-0.80
Semicircular pipe curl‡	0.23-0.54
Ribbed pipe curl‡	0.41-0.78
Flat pipe curl‡	0.38-0.70
Feather-shaped curl‡	0.50-0.70
Curl length‡	0.42-0.72
Curl width‡	0.35-0.65
Pattern of fleece cover†	0.44-0.90
Curl density†	0.20-0.42
Luster of hair cover†	0.27-0.38
Silkiness of hair cover†	0.21-0.40
Intensity of pigmentation of hair cover†	0.22-0.35

Source: Uzbek Scientific Research Institute of Karakul Sheep Breeding and Desert Ecology (2000).
Notes: †Based on qualitative visual ranks; ‡based on quantitative measurements (in mm). Heritability estimates were estimated by doubling daughter–dam regressions. The range of values given here cover the results obtained from different studies; number of animals involved was not provided.

Box 1. General notes on fat-tailed (*kurdyuk*) sheep

Origin

Fat-tailed (*kurdyuk*) sheep are distributed from the Don River and the lower Volga to Mongolia, from the Caspian Sea to the Himalayas, and from Siberia to Arabia. Fat-tailed sheep are believed to have originated in Central and Northern Asia (Kiyatkin 1968a). In the Ukraine and the Crimea these animals are known as Chuntuck sheep, while on the Don river and in the northern Caucasus they are referred to as Manych sheep; in the Lower Volga and the Urals they are known as Kalmyk sheep. In Uzbekistan, there are two *kurdyuk* breeds: the Jaidara and the Gissar. A number of hypotheses have been put forward regarding their origin. Archeological findings suggest that this type of sheep was being bred in Central Asia 4000 to 5000 years ago (Gromova 1935).

Evidence exists which supports the belief that the territories of Central Asia and adjacent areas of Iran were a center of wild sheep domestication efforts, where fat-tailed sheep may have developed (Gromova 1935). *Kurdyuk* sheep are similar to wild Argali mountain sheep in terms of their behavior, size, and fleece characteristics. *Kurdyuk* sheep carry a deposit of fat on a short tail which has a dock that protrudes upwards in line with the body, and which consequently looks like an odd extension of the animal s body. The size and form of the tail varies greatly, depending on the breed, sex, age, and fatness of the individual sheep. A large thick dock is typical in sheep carrying a large amount of fat. In emaciated sheep, the dock is covered with wrinkled skin rather than being thick.

Karakul sheep are not classified as true *kurdyuk* sheep. *Kurdyuk* sheep accumulate fat around their rumps and have 5-7 poorly developed tail vertebrae. Karakul sheep, however, have a fat oblong tail, which hangs down below the hock and has 30-32 vertebrae.

There has been much speculation about the genetic factors which control the development of the fat tail. It has, for example, been proposed that the fat tail results from the expression of a mutation (Yermekov 1966; Kiyatkin 1968a). The trait does disappear in crossbreeds produced using thin-tailed breeds and is difficult to restore in its original shape, even after successive backcrosses with *kurdyuk* sheep (Kiyatkin 1968a).

Distinguished features

The animals of this group are meat producers, and their meat and fat are in great demand in Uzbekistan. These animals also exhibit high levels of fertility. According to Kiyatkin (1968a), barrenness affects 0.7% to 7% of *kurdyuk* sheep, while abortion levels range between 1% and 4.3%. Twinning rates range from 1.5% to 10.7%, though they may sometimes rise as high as 12-16%. Cases involving triplets seldom occur. Kiyatkin (1968a) also reported that lamb mortality rates range from 0.1% to 3.4%.

Kurdyuk ewes yield large amounts of milk each day. During the first 10 days of the lactation period, ewes yield 1.4-1.6 kg of milk (Kiyatkin 1968a). During the second 10-day period milk yield rises to 1.7-1.9 kg. In the third 10-day period milk production stands at 1.9-2.0 kg, and then declines thereafter. Ewes with a single lamb produce 140-160 liters of milk on average, while those with twins produce 180 liters of milk. At the beginning of the lactation period, the milk produced has an average fat content of 6%, which rises to 8% by the end of the lactation period. However, there is no market for the milk of *kurdyuk* sheep, though shepherds use it for home consumption (Kiyatkin 1968a).

General management

Kurdyuk sheep, a classification which includes the Gissar and Jaidara breeds, are grazed year-round on natural rangelands. Whenever possible, sheep are moved to different grazing areas according to the season. This grazing system has been used since ancient times in areas where rangeland is available, and where the land is not suitable for agricultural production. According to Abulgazi, a sixteenth-century historian from Khiva, Uzbek tribes over-wintered around the lower reaches of the Syr-Darya river and spent their summers around the upper reaches of the Ural river, taking their flocks with them.

Exact data on the distribution of sheep populations by farm types are not available. However, about 80-85% of the *kurdyuk* sheep kept are raised by households, where flocks can reach up to 300 head in size. A further 8-10% of the *kurdyuk* sheep population are kept on private entrepreneurial farms, where flock sizes range between 300 and 400 head. Finally, 5-7% of Uzbekistan s *kurdyuk* sheep are kept by cooperatives.

The Jaidara Sheep

The Jaidara sheep breed is Uzbekistan's main fat-tailed (*kurdyuk*) breed (see Box 1). Jaidara sheep are well-adapted to semi-desert environments, as they are able to tolerate hot climates and graze on shrubs and desert plants (Kiyatkin 1968a). They have been raised in all Uzbekistan's regions since ancient times. However, most are kept in the country's foothills and in mountainous areas, including the Fergana Valley, and in household units in suburban zones.

Appearance

In the case of Jaidara sheep, both ewes and rams are hornless, though a few rams have rudimentary horns or underdeveloped, disfigured horns.

Purebred Jaidara sheep are relatively large, with a short barrel-shaped body and short legs. They have a thick, medium-sized dock which dangles slightly. The ears of the breed are large and hairy. Most Jaidara sheep are uniformly black; chestnut-colored individuals also occur. Very occasionally, gray, white, and skewbald individuals are also produced.

Black Jaidara lambs are covered by bright black wool. Short, lustrous hair covers the head and legs. The hair on the back and rump curls into small crests, containing waves and rings. As these animals age, the fleece changes color and becomes brown or dark brown. All parts of the bodies of chestnut or gray individuals are covered by chestnut or gray hair which does not change color as they age. However, the wool on the faces and legs of these individuals is a slightly lighter color than that found on the body. The down of this breed, whatever the color of the individual, is always lighter than the top hair.

Jaidara ram

Jaidara ewe with lamb

Jaidara sheep differ from region to region. In Surkhandarya and Kashkadarya regions these animals resemble the Gissar breed. However, in Samarkand region and the Jizak region they resemble the Karakul. In Tashkent region and the Fergana valley they are similar to the breeds of sheep kept in the south of Kazakhstan and Kyrgyzstan.

Management

Jaidara and Gissar sheep graze Uzbekistan's rangelands all year round. In spring, Jaidara sheep kept in the Jizak and Syr-Darya regions graze desert rangelands, while in the Fergana valley and in Tashkent region they are grazed in high mountainous areas (*adyrs*) in semi-desert zones, where shoots of *Artemisia* spp. emerge early in spring, and ephemeral herbs, grasses (Poaceae), legumes (Fabaceae), and motley grass (*Artemisia* spp.), emerge later. Table 14 summarizes the management calendar for Jaidara and *kurdyuk*, and the feed resources available to them.

Table 14. Jaidara and Gissar sheep management calendar.

	Months											
Event/Seasons	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Mating												
Lambing												
Weaning												
Shearing												
Range grazing												
Stall feeding												
Drenching												
Seasons and main features	Winter† Jan 2 to -3°C 150-180 mm rain			Spring Mar 4-10°, Apr 12-15°, May 15-20°C 100-150 mm rain			Summer Day 25-30°C Night 15-18°C 20-50 mm rain			Fall 25-27°C 20-50 mm rain		

Source: Compiled by author.
Note: †In winter temperatures can reach -15°C to -20°C and frost and snow cover on grazing pastures can last for 30 days.

Sheep grazed on spring rangelands rapidly increase in weight and restore the fat lost in winter. Lambing occurs from February to April, at this time milk is abundant and lambs grow rapidly. By about 15-17 days after lambing, lambs have doubled their weight and, at about this time, begin to nibble green grass (Yusupov and Zakirov 1992). Within 6 to 8 weeks of lambing, ewes recover from lambing and lambs reach a body weight of 18-20 kg. After shearing, in mid- to late May, flocks are driven into the mountains to take advantage of summer grazing.

In summer, grazing is available in the highlands and on alpine rangelands (up to 4000 m a.s.l.). In the Surkhandarya region, flocks are driven to the Obizarang and Sangdarak river basins. In the Jizak and Samarkand regions, they are driven to the upper reaches of the Sangzar River and zones of the Turkestan mountain range. In the Fergana valley the flocks are driven to Chon-Alay and areas of the Chatkal mountain ranges. In Tashkent region, flocks are driven to the Maidan-Tal river basin and onto the high Angren plateau (Kiyatkin 1968a).

Vegetation growth in the mountains begins later than in the valleys and continues for almost the whole summer, as water is provided by rain and by the snow which remains on the north-facing slopes and in hollows. In addition, the air temperature is moderate and relative humidity is high. Under these conditions, sheep grow fat and lambs continue to grow and gain strength. In the mountains, sheep graze only during the day. Lambs are weaned at 4-5 months of age late in summer. Lambs are then shorn and old ewes are culled for mutton, after preliminary fattening. Flocks of ewes are then reformed on large farms. In some regions, sheep kept on alpine rangelands are mated early. Early mating is most often practiced on private farms, and in such cases the lambs are weaned in the middle of the summer.

In the autumn, flocks are moved into the foothills so that they can graze cereal stubbles and fodder crops. They begin grazing early in the morning. This is followed by a long break near small water courses. Grazing then resumes until late at night. During this period, all the animals to be culled, either because of their age or because of other factors, are removed from the flock. Producers then reform flocks in preparation for the coming year (Farsykanov 1981).

In the winter, flocks are kept on the plains and in the foothills, where the weather is relatively warm and there is little snow. On snowy days, these sheep do not graze outside. Instead, they are kept in barns and provided with stored feed.

In the alpine and foothill zones, melting snows provide enough water to satisfy the needs of the sheep kept there. However, flocks need to be provided with mineral supplements containing table salt at an average rate of 5 g per head per day.

Due to the reduction in rangeland area and the intensification of sheep production, supplementary feeding using concentrates and roughage is being introduced during the winter and spring months. In an average year, 20-25 kg of concentrate fodder is fed to each sheep, as well as 100-120 kg of roughage. However, in years when rangeland feed is scarce, sheep are provided with 30-40 kg of concentrate fodder and 150-200 kg of roughage per head. Experiments have shown that providing sheep with additional feed in winter improves survival rates, increases lamb outputs, improves lamb growth, and increases the amount of wool yielded (Farsykanov 1981).

Recently, producers have begun to construct winter shelters with roofs and, in some cases, even heating. This allows mating to begin in August and September, so that ewes lamb early. Early lambs are able to graze the range for longer in their first year of life, reaching a body weight of 40-45 kg by the autumn, which means they can easily endure their first winter. If necessary, and if conditions are appropriate, they can even be mated. However, this technology is used only in large specialized flocks. In small household units sheep are kept on land close to the village and are fed on domestic waste and the weeds that grow in crop fields. Lambing occurs in winter (December and January) and early spring (February). Often animals initiate their reproductive life earlier at the age of 9-10 months. In these systems the periods between lambings are shorter, resulting in three lambings over a two-year period. This is possible only as long as it is possible to provide adequate amounts of feed throughout the year.

Sheep are commonly kept all year round on the rangeland. Variations in fodder availability over different seasons are common and typically affect all sheep. As a rule, during the spring and summer sheep gain weight and store fat. During the winter, when little fodder is available, the condition of these animals then deteriorates and they lose the fat stored in their tails. Seasonal fattening followed by emaciation is a pattern which is repeated every year from one generation to the next.

A common feature of Jaidara and all *kurdyuk* sheep is their ability to efficiently utilize feed whenever it is available, quickly improving their condition. Conversely, when feed is harder to find, they are able to confine themselves to small rations, improving their efficiency of feed is assimilation, becoming less active and losing weight, without seriously harming their health.

Body measurements

The body measurements of animals of 1.5 years of age differ little from those of animals aged 2.5 years, though the latter have a more ample chest (Table 15).

Body weight, growth and carcass traits

Jaidara rams are larger than Jaidara ewes, a difference that becomes pronounced as the age of the animals increases. The fat tail is wide, with slightly taut skin and contains 6-8 kg of fat. The breed produces meat with a dressing percentage of 55-60%. Table 16 shows the growth pattern of Jaidara sheep.

In commercial flocks, ewes at birth, and at 6 months, 1.5 years and 2.5 years of age, had attained 8%, 57%, 81% and 97% of the weight at 3.5 years, respectively. In the case of rams the corresponding values were 6%, 49%, 84% and 96%, respectively.

The carcass measurements of Jaidara wethers of various ages are provided in Table 17. Carcass yield fluctuates from 54% to 58% and seems to fall as the animal gets older. The weight of the fat tail ranges from 2.3 kg to 5.5 kg, and accounts for 6-8% of the body weight, twice as much as in Karakul sheep. Mesenteric fat accounts for about 3% of body weight, also nearly twice higher than Karakul, except in older animals.

Table 15. Body measurements of Jaidara sheep.

	1.5-year-old ewes			2.5-year-old ewes		
Trait (cm)	n	Mean±SE	Range	n	Mean±SE	Range
Height at withers	50	67.8±0.31	63-72	50	69.0±0.35	61-76
Height at sacrum	50	68.8±0.33	64-73	50	69.6±0.32	62-75
Diagonal body length	50	66.6±0.28	62-70	50	66.9±0.32	60-72
Chest girth	50	77.2±0.53	67-88	50	80.5±0.37	75-85

Source: Ismailov and Abdirov (1967).
Note: SE: Standard error.

Table 16. Body weight (kg) of Jaidara sheep in the Tashkent region.

	Commercial flocks				Pedigree breeding flocks			
	Ewes		Rams		Ewes		Rams	
Age	Mean	Range	Mean	Range	Mean	Range	Mean	Range
At birth	4.6	3-6	4.8	4-7	4.8	4-6	5.1	5-7
6 months	33	28-44	37	30-44	35	28-44	37	33-44
1.5 years	47	42-56	63	58-70	54	43-63	80	75-87
2.5 years	56	40-60	72	61-83	58	47-71	85	75-92
3.5 years	58	48-73	75	71-93	63	54-75	86	80-94

Source: Kiyatkin (1968a).
Note: Number of animals involved was not provided by Kiyatkin.

Table 17. Carcass measurements in Jaidara wethers.

	Age							
	3.5 years		2.5 years		1.5 years		7 months	
Trait	kg	%	kg	%	kg	%	kg	%
Body weight	72.9	100	71.0	100	58.7	100	35.5	100
Carcass weight	42.3	58	39.9	56	32.7	56	19.2	54
Carcass no fat†	34.7	48	32.3	46	26.5	45	16.6	47
Fat-tail weight	5.5	8	5.6	8	4.6	8	2.3	6
Mesenteric fat	2.1	3	2.0	3	1.6	3	0.3	1

Source: Kiyatkin (1964).
Note: †Carcass without fat tail and mesenteric fat. No estimates of the variation in the data and sample size involved were provided by Kiyatkin.

Reproductive performance and milk production

This breed is allowed to mate naturally in all cases. Gestation lasts 148-152 days, and about 95-105 lambs are born per 100 mated ewes. The proportion of barren ewes ranges from 7% to 9%, and about 10-15% of pregnant ewes produce twins (Kiyatkin 1968a). These data represent average values obtained for different flocks and different years, and reflect the results of observations made during the 1950s and 1960s. Recent data are not available.

About 98% of lambs born survive to their weaning age (4.0-4.5 months), while about 96% reach one year of age (Kiyatkin 1968a). Animals are first mated at 16-18 months of age, when they reach 80% of their adult weight. Lactation lasts for 5-6 months, though Jaidara lambs are weaned before that time period ends. Jaidara sheep are not milked.

Wool production

Jaidara sheep are usually shorn once a year. The fleeces produced by adult animals weigh 0.8-1.5 kg, while those produced by yearlings weigh 0.4-0.6 kg. Only in experimental flocks are sheep shorn twice a year (Table 18).

Table 18. Fleece weight (kg) of Jaidara sheep in experimental flocks.

Age	Ewes	Rams
Lamb (5-6 months)	0.56	0.50
12 months:		
Spring shearing	0.87	1.00
Autumn shearing	0.43	0.50
Total	1.30	1.50
2 years:		
Spring shearing	0.90	1.17
Autumn shearing	0.59	0.69
Total	1.49	1.86

Source: Kiyatkin (1968a).
Note: No numbers of observations were given by Kiyatkin.

The wool produced by the breed is coarse, and is used to make felt and carpets. It is composed of long top hairs (20-26%), a short thin undercoat (45-60%), medium-length hairs (7-18%) and coarse dead hairs (9-16%). The wool's staples are 8-11 cm long. The wool of Jaidara lambs contains more undercoat fibers and a lower percentage of top hair than that of adult sheep. The breed provides a clean yield of 68-80% (Table 19).

Table 19. Wool characteristics of Jaidara sheep.

	Fiber types					
	Undercoat		Transient hair		Top and dead hair	
Trait/Age	Mean	Range	Mean	Range	Mean	Range
Fiber-type (%)						
Lamb (5-6 months)	43	31-66	6	2-11	51	30-59
12 months (spring)	51	34-73	12	2-23	37	13-59
2 years	55	33-72	16	2-29	29	9-54
2.5-4.5 years (ewes)	55	45-75	20	2-83	25	3-63
2.5-4.5 years (rams)	68	57-74	7	3-12	24	9-46
Fiber diameter (µm)						
Lamb (5-6 months)	18	12-30	37	30-50	66	46-90
12 months (spring	18	12-24	36	26-50	66	50-100
2 years	22	14-30	43	30-60	76	50-100
2.5-4.5 years (ewes)	21	17-27	48	40-58	108	66-163
Staple length (cm)						
Lamb (5-6 months)	8.1	6-9	9.6	6-15	10.4	8-13
12 months (spring)	7.2	6-10	9.4	5-17	10.1	7-13
2.5-4.5 years (ewes)	12.4	6-14	17.2	11-21	16.0	13-23

Source: Kiyatkin (1968a).
Note: No numbers of observations were given by Kiyatkin.

Current structure of breeding programs

No breeding programs exist for the improvement of this breed in Uzbekistan. Some pure and unimproved specimens of the breed are maintained, mainly in small flocks in main production areas of the breed. A genetic improvement plan is currently being developed, but no genetic parameter estimates are available for this breed.

The Gissar Sheep

Gissar sheep are raised in highland areas, where conditions are appropriate, as well as on the plains where there is abundant pasture. The districts of Baisunskuyi, Sary-Asiyskiy and Shurchinskiy ot the Surkhandarya region are known area where Gissar sheep is raised, however they could also be found in the Fergana, Andizhan, Khaskadarya and Syr-Darya regions. In general, these animals are not exposed to extreme heat or cold. Different varieties of this breed exist. The largest type, particularly with regard to its fat tail, is found in the Surkhandarya region. The general information given above on *kurdyuk* sheep (Box 1) applies to the Gissar as well as to the Jaidara.

Appearance

Gissar sheep, the largest sheep breed of Uzbekistan and central Asia, differ from other fat-tailed breeds in size and shape, character, and type of wool. Sheep of this breed are large and tall and have a small abdomen. The crest, backbone, and sacral bone form a straight line. The neck is thin and flat, the head is narrow around the forehead zone, and the face is long with a Roman nose. The ears are large and hang downwards. The legs are long and have strong hocks. The body is long and barrel-shaped. The fat tail has a semicircular shape and sits high on the rump; when the area has a high level of fat deposits, the tail is significantly wider than the pelvis and spine. The top of the fat tail is covered with coarse hair, while the lower side is hairless.

White Gissar ram shorn

Gissar ewe with lamb

Ewes and rams are polled and usually one color. According to Kiyatkin (1968a), in the Surkhandarya region 68-74% of Gissar sheep are black or brown, while 24-30% are chestnut, and 2-3% another color. The hair covering the head and legs is always one color, while the fleece becomes browner and lighter with age. Wool is available only on the spine and flanks; there is no wool on the neck, abdomen, dock, or legs.

The best specimens of this breed can be found in cooperative, farming units and household farms in the Baisunskiy, Denauskiy, Saryasiyskiy, and Shebadskiy districts of the Surkhandarya region.

Management

The management of Gissar flocks follows largely the same pattern as that of Jaidara sheep (see Table 14, above).

In spring, Gissar sheep in the Surkhandarya region graze on the foothills of Babatag and Baisuntau ranges, where loess soils allow for the abundant growth of ephemerals, and where green grass emerges at the end of February and beginning of March or, in some years, even earlier.

The body weight of animals kept on spring rangeland increases rapidly, and individuals quickly restore the fat deposits lost in the winter. Lambing takes place from February to April, and the lambs born grow rapidly. After shearing, in middle or late May, the flocks are driven to the mountains where they remain for the whole summer, grazing in the highlands and the alpine ranges (up to 4000 m a.s.l.). As indicated above, plant growth in the mountain ranges begins significantly later than in other areas, which means that abundant amounts of green grass are available during most of the summer. During this period, the sheep gain weight and the lambs continue to grow. As was the case with Jaidara sheep, Gissar sheep only graze during the daytime on these ranges.

In the mountains, lambs are weaned late in summer at the age of 4-5 months. The flocks are then moved to the foothills, where they can graze crop stubbles. At this point, sheep begin grazing from early in the morning until late at night. In winter the animals are kept on the plains and in the foothills, where the climate is relatively warm and there is little snow. On snowy days they are not allowed to graze outside, and are kept in barns and provided with stored feed.

In small household units sheep are maintained on land close to the village, and are fed on domestic waste and on the weeds which grow in crop fields. Lambing occurs in winter (December and January) and early spring (February).

Body measurements

According to Kiyatkin (1968a), adult Gissar sheep in the Surkhandarya region are, on average, 76.2 cm (range 69-82 cm) tall at the crest, and 76.7 cm (range 72-84 cm) tall at the sacral bone, with a diagonal body length of 77.3 cm (range 70-83 cm). Table 20 shows the height of these animals at birth, weaning, and 1.5 years of age.

Table 20. Body measurements (cm) of Gissar sheep.

Age	Sex	n	Height at withers	Diagonal body length	Chest depth	Chest girth	Dock perimeter at the base
At birth	Ram lambs	124	42.2	34.8	14.8	45.3	34.0
	Ewe lambs	58	41.3	32.6	13.9	43.8	31.2
5 months	Ram lambs	29	70.2	66.4	29.7	90.5	101.6
	Ewe lambs	42	69.6	65.1	29.3	88.9	100.5
1.5 years	Rams	26	78.4	77.7	35.6	104.1	104.5
	Ewes	34	74.3	73.8	34.1	96.5	91.4

Source: Farsykanov (1981).
Note: No estimates of the variation in the data were provided by Farsykanov.

Table 21. Body weight (kg) of Gissar sheep.

	Kiyatkin (1968a)				Farsykanov (1981)			
	Ewes		Rams		Ewes		Rams	
Age	Mean	Range	Mean	Range	Mean	Range	Mean	Range
At birth	na	na	na	na	5	4-6	5.4	na
6 months	45	32-60	54	44-67	44	38-49	47	40-56
1.5 years	68	45-90	82	65-100	60	55-68	72	62-76
2.5 years	72	53-95	100	88-112	na	na	85	77-90
3.5 years	75	56-100	102	88-115	69	64-81	112	91-125

Notes: No estimates of numbers of measurements involved in the data presented here were provided in the original studies; na: data not available.

Body weight, growth and carcass traits

Meat and fat are main products yielded by Gissar sheep. Data on the body weights of Gissar sheep of different ages are given in Table 21.

Kiyatkin (1968a) showed that 6-month-old, 1.5-year-old and 2.5-year-old ewes attained 60%, 91%, and 96% of the weight of a 3.5-year-old ewe, respectively; the corresponding values for rams were 53%, 80%, and 98%, respectively. The 1981 study by Farsykanov records different maturation rates from those recorded by Kiyatkin (1968a). This probably reflects differences in rearing conditions (Table 21).

Gissar sheep mature early, and Gissar lambs grow quickly during the lactation period. The rapid growth and fast rate of fattening observed in lambs during the lactation period results from the high milk output of the ewes and the fact that the lambs are not weaned until 5-6 months of age, though this late weaning still occurs before lactation ends. In most cases lambs stop growing or even lose weight after weaning, as they receive lower levels of nutrition once they begin grazing.

According to Farsykanov (1981) wether lambs can achieve daily weight gains of 373-410 g with a feed conversion rate of 5.7-7.2 feed units per kg of weight gain. Dressing percentages of wether lambs were found to be within the range 49.8-60.3%, while those of ewes ranged from 52.5% to 61.0%.

The estimated carcass traits given in Table 22 reflect the size of this breed, which, as indicated earlier, is the largest of the Central Asian sheep breeds. Carcass yields increase with age and range from 53% to 61%; the carcasses of 3- to 5-year-old animals can be as heavy as 56 kg. The fat tail averages over 9% of the body weight, and can account for as much as 12% of the body weight of some animals.

Table 22. Carcass traits in Gissar sheep.

	Age					
	1.5 years		2.5 years		3-5 years	
Trait	kg	%‡	kg	%‡	kg	%‡
Live weight	56.0	100	74.3	100	91.8	100
Carcass weight	29.9	53	41.3	56	56.0	61
Carcass no fat†	24.0	43	32.2	43	41.9	45
Fat tail	5.2	9	7.3	10	10.7	12
Mesenteric fat	0.69	1	1.83	3	4.36	5

Source: Farsykanov (1981).
Notes: †Carcass without fat tail and mesenteric fat; no estimates of the variation and numbers of measurements in the data presented here were provided by Farsykanov; ‡ Propotion of a given trait in relation to liveweight taken as 100%.

Reproductive performance and milk production

Farsykanov (1981) reported that this breed displayed a low rate of fertility (77%) under artificial insemination. Prolificacy in the breed ranges from 101.7 to 103.0 lambs per 100 lambed ewes. Lambs reach puberty at 5-6 months of age, and the first mating occurs at the age of 16-18 months. No further information is available concerning the reproductive performance of this breed.

Milk production in the first two months of lactation ranges from 104.3 to 122.9 liters. The lactation period lasts 5-6 months. The amount of fat in the milk ranges from 6% to 7%, and increases towards the end of the lactation period.

Wool production

According to the data obtained by Kiyatkin (1968a), ewe lambs and ram lambs yield 0.45 and 0.44 kg of wool on average, respectively. Female and male yearlings produce 0.81 kg and 0.9 kg of wool, respectively, while 2-year-old females and males produce 0.77 and 1.11 kg of wool, respectively. The wool produced is mainly composed of undercoat fibers and dead hair and contains only a small proportion of top hair and medium-length transient hair (Table 23). Wool staples are 8-10 cm long. Two shearings per year yield only 0.8-0.9 kg (Kiyatkin 1968a), and the wool mantle deteriorates with age and becomes shorter.

Intensive wool growth occurs in summer and winter. This is because, in the former case, the animals are better fed in spring, while in the latter case they benefit from being fed while housed in barns. In spring and late summer the animals shed their wool. The wool of this breed does not have any particular use because of its low quality.

Table 23. Wool characteristics of Gissar sheep.

	Undercoat		Transient hair		Top hair		Dead hair	
Traits/Sex	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Fiber-type (%)								
Ewes	42	38-62	13	5-28	17	9-38	28	8-50
Rams	39	37-59	17	4-61	14	10-18	30	29-57
Fiber diameter (μm)								
Ewes	26	12-45	42	28-60	67	47-123	152	52-250
Rams	23	12-42	38	31-60	60	47-173	172	72-315
Fiber length (cm)								
Ewes	5	3-8	6	5-10	7	5-11	4	2-6
Rams	8	5-15	10	5-15	10	5-15	6	3-10

Source: Kiyatkin (1968a).
Note: No estimates of the variation and numbers of measurements in the data presented here were provided by Kiyatkin.

Current structure of breeding programs

Genetic parameter estimates have not been obtained for this breed in Uzbekistan. Likewise, no breeding programs exist to improve this breed in the country. The breed is only maintained in a pure and unimproved form in the main areas were the Gissar breed is raised However, plans exist to develop such a program in the near future and establish genealogically controlled flocks on farms such as Baysun.

Mutton–Wool Synthetic Sheep

In order to improve wool quality, efforts were made to establish Merino sheep in Uzbekistan. However, these efforts failed as the breed was not able to adapt to the new environment and produced only small amounts of meat and fat. Efforts to improve the wool produced by native fat-tailed sheep through crossbreeding with mutton-wool producing breeds resulted in the development of two synthetic breeds: a mutton–wool, and a mutton–fat–wool breed.

According to Tapilskiy (1974), Merino-type sheep were first imported by the first Russian migrants in the 1870-90s. This was followed by unregulated crossbreeding with native sheep. However, all the crossbred sheep produced were killed during the years of the Revolution and Civil War which followed.

The first planned import of fine wool sheep occurred in 1927, when Lincoln, Hampshire, Rambouillet, and Precoz Sires and ewes were delivered to the Abolinskaya Experimental Station in Samarkand. Later, in 1929, more than 500 head of Merino sheep were imported to this station. In 1930, 2100 Caucasus-type Merino rams were also imported from the northern Caucasus and used in crossbreeding trials which were initiated in the Fergana valley, as well as in the Tashkent, Jizak and Samarkand regions. However, this work was suspended at the beginning of the Second World War.

Work to upgrade *kurdyuk* fat-tailed sheep using Merino began in 1955. Jaidara

× Merino crosses produced wool of a significantly better quality than Jaidara sheep, and wool yields also increased. However, these animals displayed a poor level of adaptability. Efforts to upgrade animals to allow them to produce Merino-quality wool were therefore abandoned in favor of the development of mutton–wool and mutton–fat–wool genotypes (Tapilskiy 1974).

The efforts made to develop mutton–wool and medium-coarse wool sheep breeds were most successful on farms in the Parkent, Akhangaran, and Gallya-Aral districts.

In general, the synthetics developed during the Soviet era are subject to indiscriminate crossing with native sheep, as the breeding programs have been discontinued. This situation is aggravated by the fact that coarse wool has little or no value, which results in animals being kept only because of the meat they produce.

The Akhangaran mutton–wool sheep

The Akhangaran mutton–wool sheep was developed on the Akhangaran State Farm, between the 1960s and 1980s, by crossing Merino sires with indigenous sheep. The F1 generation produced was then crossed with Lincoln sires. The offspring produced by this cross were then subjected to selection in order to consolidate the characteristics required in the desired type (Tapilskiy 1974). However, this type of sheep was not approved as a breed during the Soviet Union.

Rams and ewes of this sheep-type are hornless, and have a relatively short neck and deep, broad chest. The ribs are rounded, while the crest is broad and the spine straight. The legs of these animals are strong and of medium length. Akhangaran mutton–wool sheep have a relatively strong constitution, and a large, but not broad, frame. Tapilskiy (1974) recorded the average body weight of adult pedigree ewes as 58.9 kg. That of 1.5-year-old ewes was found to be 47.3 kg, while 4.5-month-old ewe lambs were found to have a body weight of 28.4 kg. To reach these weights, animals required 7.5-8.0 feed units per kg of weight gain.

The head, abdomen and legs of the Akhangaran are covered with hair. The wool of the fleece is uniform, with a staple length of 8 to 12 cm. On average, the fleeces of 2.5- to 4.5-year-old ewes and rams weigh 3.5 kg and 5 kg, respectively (Tapilskiy 1974). Staple structure resembles that of Lincoln fleeces. The fibers produced are 25-30 μm in diameter, while the density and the wool grease levels of the fleece can both be described as ‘medium’.

This type of sheep has a prolificacy of 103-107 lambs per 100 ewes. Most individuals of this type were kept on farms in the districts of Akhangaran and Bostanlyk, Tashkent region. Unfortunately, however, within the last 10-15 years this type of sheep has largely disappeared. The loss of this sheep is the result of a lack of directed breeding work and a lack of appropriate feeding and management conditions.

The Parkent mutton–wool sheep

The Parkent mutton–wool sheep was created by crossbreeding indigenous Jaidara sheep with imported Lincoln sires and then interbreeding F1 and F2 animals produced in communal farming units near Baykozon (Kiyatkin 1964, Kurbanov *et al.* 1977). This new type of sheep was developed under highland conditions, and combined the adaptations of the indigenous breed with the high productivity of the imported Lincoln breed.

Parkent mutton-wool ewe

Parkent sheep are large, early maturing, and highly productive in terms of the amounts of meat and wool they produce. They can be kept on good natural rangelands all year round in the foothills and mountains, where summer temperatures are high and the air is dry. According to Kurbanov *et al.* (1977) average body weights of Parkent ewes and rams in pedigree flocks range from 68 to 70 kg and 84 to 100 kg, respectively. The average body weights of the breed at different ages are shown in Table 24.

On average 2.5- to 4.5-year-old ewes and rams yield 2.6 kg and 3.0 kg of wool, respectively (Kurbanov *et al.* 1977). The wool is heterogeneous, with a fiber diameter in the range of 30-33 µm, which is similar to that of the Lincoln breed. The fibers produced are long, white and lustrous, and are arranged in staples.

Unfortunately, within recent years the Parkent sheep population has declined, and the remaining stock is characterized by the production of relatively poor wool which has practically no value. There is a high rate of interbreeding with indigenous sheep, and it is likely that the Parkent breed could disappear, although less quickly than Akhangaran.

The average body weights, at different ages, of both the Akhangaran sheep and the Parkent mutton–wool sheep are given in Table 24.

Table 24. Average body weight of Akhangaran and Parkent mutton–wool dual-purpose sheep developed in Uzbekistan.

	Body weights (kg)							
	At birth		4-5 months		1.5 years		2.5-4.5 years	
Breed	Ewe lambs	Ram lambs	Ewe lambs	Ram lambs	Ewes	Rams	Ewes	Rams
Akhangaran†	4.5	4.9	31	34	44	59	54	80
Parkent‡	4.0	4.3	30	33	44	57	55	75

Sources: †Tapilskiy (1974) ‡Kurbanov *et al.* (1977).
Note: No estimates of the variation and numbers of measurements in the data presented here were provided by authors.

Mutton–Fat–Wool Synthetic Sheep

Very little information is available concerning mutton–fat–wool synthetic breeds. However, like the mutton–wool synthetic breeds, they are likely to be lost as a result of a lack of breeding programs, crossing with native fat-tailed sheep, and the low price of wool.

The Keles mutton–fat–wool sheep

Over the last 20 years, in the Akhunbabayev and Jambul farming units in the Tashkent region (Keles tract), the Keles mutton–fat–wool sheep was developed by crossbreeding native *kurdyuk* ewes with medium-coarse wool *kurdyuk* sires of the Saraja (or Sarajin) breed. This work was done under semi-desert rangeland conditions. Pure Sarajin sheep were also bred on the farms at the same time, using sheep imported from Turkmenistan.

The newly established synthetic breed was characterized by the ability to adapt well to year-round rangeland grazing under the semi-desert rangeland conditions found in Keles. In terms of its mutton and fat productivity, the newly formed breed was not inferior to the parental breeds. Moreover, its wool traits were superior to those of Jaidara sheep, though slightly inferior to those of the Sarajin (Kalantarov 1987).

Kalantarov (1987) found that, in pedigree flocks, the body weight of Keles rams averaged 70-75 kg, though the heaviest was found to weigh 98 kg. Ewes weighed 50-55 kg on average, with the heaviest weighing 68 kg. Average body weights for this breed are given in Table 25.

On average, Keles fleeces weigh 2.3-3.0 kg; the wool produced does not contain dead hairs (Kalantarov 1987). The wool of this breed has been classified as medium coarse with a tipped structure. It is suitable for carpet-making, and grows to a length of 20 cm in 12 months. The guard hairs found on the head and on the extremities of this breed are chestnut and dark-red. Newborn lambs are of\different shades of brown. However, this wool loses its pigmentation as the lamb ages, resulting in adults which are either white or light gray. The breed has been used to improve native sheep kept on farms in the Chinaz, Yangi-Yul, and Zangiata districts of the Tashkent region.

The risk of extinction faced by this breed is not as high as that faced by other synthetic breeds.

The Sanzar mutton–fat–wool sheep

The Sanzar mutton–fat–wool sheep breed was developed in the foothills and mountainous areas around the Sanzar farming unit (Jizac region). This involved crossbreeding native with Merino sheep, Jaidara x Merino and Degress semi-fine-fleece breed, a semi-fine wool producing and fat-tailed sheep imported from Kazakhstan. The crossbreeds produced in the first and second generations displayed excellent characteristics (Yusupov 1972). However, the poor level of nutrition provided to livestock during the winter affected the productivity of these generations. It was therefore decided that Sarajin sires should be included in the breeding program. By the time the program was discontinued in 1990s, it had an influence on 12,000-15,000 animals.

Data on the body weights of both the Keles and the Sanzar mutton–fat–wool crossbreeds are provided in Table 25.

Table 25. Average body weight of the Keles and Sanzar mutton–fat–wool sheep.

	Body weights (kg)							
	At birth		4-5 months		1.5 years		2.5-4.5 years	
Breed	Ewe lambs	Ram lambs	Ewe lambs	Ram lambs	Ewes	Rams	Ewes	Rams
Keles†	4.2	4.5	30	33	40	45	50	70
Sanzar‡	4.2	4.6	32	36	48	58	56	75

Sources: †Kalantarov (1987); ‡Yusupov (1972).
Note: No estimates of the variation and numbers of measurements in the data presented here were provided by authors.

At the age of 2.5-4.5 years, Sanzar ewes and rams produce an average of 2.8 and 3.2 kg of wool per year, respectively (Yusupov 1972). It is estimated that this breed is quickly disappearing; no information is available about its current distribution or numbers.

Goat Breed Characterization

Goats are kept on all the different types of rangeland, and under all the climatic conditions found in Uzbekistan. They are able to graze on shrubs and on poor rangeland where edible grass is scarce and feed is insufficient for and horses. Goats are less often affected by lung and intestinal helminthes than sheep. Even when infection does occur, the mortality rate is not high, and the problem is usually overcome with veterinary treatment. Contagious pleuropneumonia is the biggest problem for goat breeders, as it results in a high mortality rate if preventive treatments is not given. Necrobacillosis causes a certain amount of economic losses, and affects the udders of does and faces of kids (Kiyatkin 1968b).

Before 1937, only native goats, mostly black, were kept as multipurpose animals. Most of the products were marketed at local villages – except for skins, which were either processed at special plants or part-processed by shepherds to provide clothing. Dairy products and meat were consumed by shepherds, while those fleeces containing a small proportion of undercoat fiber were used to produce ropes (Kiyatkin 1968b).

Mohair- and cashmere-producing goat breeds were developed using the country’s native goat populations as a base. Within recent years the number of goats in

Uzbekistan has fluctuated around one million. Approximately 90% are native coarse-fiber goats, while 6-7% are Uzbek Mohair goats (also known as the Soviet Wool Goat); most of the remaining 3-4% are Uzbek Black Cashmere goats. In addition, a very small number of goats which produce outstanding amounts of milk are raised on private farming units in the Tashkent region. This type of goat is large and has a well-developed, bowl-shaped udder. Its lactation period lasts for 6-7 months, and milk yields can reach 300-400 liters. Unfortunately, there are no goat-breeding farms in Uzbekistan that specialize in milk-production, and mechanized milking systems are not used.

In 1999 Uzbekistan's goat population was 973,700 (Table 2), distributed all over the country, but more concentrated in the Kashkadarya, Surkhandarya, and Karakalpakstan regions. No population statistics are available regarding Uzbekistan's three goat breeds;and only limited information, some of it generated during the Soviet Union, is available on breed characteristics. These breeds urgently need to be assessed and characterized.

In Uzbekistan, goats and sheep are raised separately only on specialized goat farms, which account for 15-20% of the country's total goat population. The remaining goats are raised in mixed flocks alongside Karakul, Jaidara, and Gissar sheep. Goats account for about 5-8% of the animals in these mixed flocks. Very often goats are the leaders of these flocks.

The Uzbek Native Coarse-Fiber Goat

The development and improvement of the breed

The Uzbek goat is an indigenous breed which produces down and has the potential to be used for cashmere production. However, the fleece yield is low, and thefleece contains considerable amounts of coarse fibers. Native goats have been subjected to improvement work in the past, but most of the population remains unimproved. On some state breeding farms in the Namangan, Samarkand, Kashkadarya, and Surkhandarya regions, such as the Galaba, Altynsay, and Baysun breeding farms, past improvement plans targeted mohair production by crossbreeding native goats with Angora goats. Another direction was followed to target cashmere production on the Baysun state farm. In this farm Uzbek native goats were crossed with Uzbek native × Angora crosses. The crossbreeds produced were then upgraded by crossbreeding them with Pridonskaya sires for two generations. The herd was then closed and selection for high fiber production was undertaken. This process resulted in the production of the Black Cashmere goat; goats displaying other colors were culled.

Appearance

Those goats native to Central Asia and Kazakhstan are similar to each other in terms of their productivity and morphological characteristics. Most are black and brown with spots of other colors. Animals have horns, a small, thin head and a

Uzbek Native buck

Uzbek Native doe

straight profile. The ears of these types of native goat are long and hang downwards. The neck is narrow and thin, while the crest and chest are wide. The spine is straight, and the body is barrel-shaped with a steep ribcage and a voluminous abdomen. The legs are short and have strong hooves.

Management

All of Uzbekistan's goats are managed similarly and graze the rangeland all year round. In spring they graze early-growing plants and ephemerals produced on rangeland in the foothills, while in summer they graze on rangelands dominated by motley grass (*Artemisia* spp.). In autumn and in winter, they graze on late-growing plants. On some winter days, producers do provide weak and emaciated animals with supplementary feed. A summary of the management regime applied to goats is given in Table 26.

Table 26. Goat management calendar.

	Months											
Event/Seasons	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Mating												
Kidding												
Weaning												
Shearing												
Range grazing												
Stall feeding												
Drenching												
Season and main features	Winter† Jan 2 to-3°C 150-180 mm rain			Spring Mar 4.2-10°C Apr 12-15°C May 15-20°C 100-150 mm rain			Summer Day 25-30°C Night15-18°C 20-55 mm rain			Fall 25-27°C 20-50 mm rain		

Source: Compiled by author.

Note: †In winter temperatures can fall to -15 to -20°C, and frost and snow can cover the grazing pastures for 30 days.

Body measurements

The body measurements of Uzbekistan's native goats, along with those of the country's other goat breeds, are detailed in Table 27. The Uzbek native goat and the Uzbek Black Cashmere are similar in size; the Uzbek Mohair, however, is shorter in height and has a shorter body length.

Body weight, growth and carcass traits

Under the conditions associated with rangeland feeding, goats in Uzbekistan only achieve a reasonably good physical condition during the autumn. In spring, body weights are usually low as a result of the loss of condition that occurs over the winter. The average body weights of Uzbek native goats, Uzbek Mohair goats and Uzbek Black Cashmere goats at different ages are shown in Table 28. The native goat is distinguished from Uzbekistan's other goat breeds by being heavier.

Data on the carcasses of Uzbek goats are included in Table 29. Note that the value for internal fat assigned to the native goat is quite high in comparison with the values recorded for the two other breeds.

Table 27. Body measurements (cm) of goats of Uzbekistan.

	Traits				
Goat breeds	Height at withers	Height at sacrum	Diagonal body length	Chest girth	Author
Native	65.5	67.7	67.6	78.2	Kiyatkin (1940)
Black Cashmere†	65.1±0.7	68.6±0.8	76.1±0.7	88.3±1.2	Mamadaliev (1991)
Mohair†	58.3±0.8	61.1±0.8	60.1±1.0	77.5±1.5	Mamadaliev (1991)

Notes: † Mean±Standard error; no numbers of measurements were provided by authors.

Table 28. Body weight (kg) of Uzbek goat breeds.

	Native goats		Mohair goats		Black Cashmere goats	
Age	Ewes	Rams	Ewes	Rams	Ewes	Rams
At birth	2.9	3.1	2.4	2.7	2.5	2.7
0.5 years	16.6	18.2	14.9	16.0	15.0	16.0
1.5 years	30.9	41.1	25.9	37.0	27.0	35.0
3.5 years	42.5	60.4	33.2	50.0	34.0	54.0

Source: Kiyatkin (1968b).
Note: No estimates of the variation in the data and number of measurements involved were provided by Kiyatkin.

Table 29. Meat production of Uzbek goat breeds.

	Live weight	Carcass weight		Internal fat		
Goat breeds	(kg)	(kg)	%	(kg)	%	Author
Native	53.0	28.6	54	4.40	8.0	Kiyatkin (1940)
Black Cashmere	36.4	15.3	42	0.82	2.3	Mamadaliev (1991)
Mohair	32.3	12.9	40	0.74	2.3	Mamadaliev (1991)

Note: No estimates of the variation in the data and number of measurements involved were provided by the authors of the three studies.

Reproductive performance and milk production

Goats are more prolific than sheep and, overall, have a higher reproductive capacity. This is because they are less affected by season than sheep, which makes it possible for them to kid three times in two years. Estimates of the reproductive performances of Uzbekistan's goat breeds are included in Table 30.

In goats, lactation lasts for 150-200 days, yielding 120-200 liters of milk in total (Kiyatkin 1968b).

Table 30. Reproductive performance of Uzbek goat breeds.

				Survival %		
Breed	Twins %	Triplets %	Barren does, %	birth to weaning	birth to 1 year of age	Author
Native	27-31	5-7	6-9	94	88	Kiyatkin (1968b)
Black Cashmere	5-7	0	6-8	93-94	87-88	Mamadaliev (1991)
Mohair	2-3	0	6-8	90-91	85	Kiyatkin (1968b)

Note: No estimates of the variation in the data and number of measurements involved were provided by the authors.

Fiber production

The face and legs of native goats are covered with short, bright, hairs. Hair grows on the body throughout all the seasons of the year; undercoat fibers grow intensively in autumn and winter. Early in spring, individuals shed their wool.

The fleece of this type of goat is thin and contains a mixture of fibers. In Uzbekistan, the undercoat of cashmere or down fibers produced by goats was not combed until recent times. In the spring, the undercoat is shorn away together with the hair and the mixture is then separated manually. On average, each animal yields 100-300 g per year of combed down. Down fibers are 4-5 cm long, and have a diameter of 12-15 μm (Kiyatkin 1968b). No indication of the variability in this data was presented by that author.

Current structure of breeding programs

No reliable data are available describing the current genetic structure of the Uzbek native goat population. The Uzbek Institute of Animal Breeding is developing a breeding plan for this breed, which is expected to be approved in the near future. At the Altynsay farm in the Namangan region, the institute plans to record the performance of a herd which it will be subject to genealogical control. However, no genetic parameter estimates are available for this breed yet.

The Uzbek Mohair Goat (also known as the Soviet Wool Goat)

The development and improvement of the breed

In the 1930s, work to breed a new type of fiber-producing goat began in Uzbekistan. This involved upgrading up to four generations of native goats by crossing them with Angora sires imported from Turkey and the USA. After this upgrading period, the resulting population was subjected to selection which focused on producing white animals. The work was concentrated on farms in the Namangan, Samarkand, and Surkhandarya regions (Kiyatkin 1968b).

The goal was to obtain an animal with a strong constitution and a good reproductive capacity which produced homogeneous white mohair. This work finished in the 1960s, and the new breed was legally recognized throughout the whole of the Central Asia and Caucasus region under the common name ‘Soviet Mohair’. During the 1960s and 1970s, about 100,000 head of this breed were bred in Uzbekistan, with the best specimens being produced on farms in the Pap and Chust districts of Namangan region.

Appearance

Uzbek Mohair goats have been very well described in the book produced by Kiyatkin (1968b). The animals have the same characteristics as the Angora and the Uzbek native goat, but are white. The tail is short and stands up, as in Angoras. The mohair fibers produced have a ponytail structure which takes the form of twisted locks.

This breed is white, with a body which is rather smaller than that of the native goat. The breed produces small horns. Individuals are shorn once per year. The fiber produced is semi-fine, and has an average level of waviness and a lustrous shine. Currently, demand for this fiber is very low in Uzbekistan. Local people use the fiber for making scarves and different kinds of coats.

Uzbek Mohair buck

Uzbek Mohair doe

Management

This breed is grazed year-round in the semi-deserts of the foothills and on the steppe rangelands of highlands. Other management features are presented in Table 26.

Body measurements

The only information available on the body measurement of this breed is presented in Table 27, which shows that the breed is the smallest of the Uzbek goat breeds.

Body weight, growth and carcass traits

With regard to body weight, this breed is lighter than Uzbekistan's native goat. The only information available on the body weight of the breed is presented in Table 28, while the available information on carcass characteristics is provided in Table 29, where the low body weight of this breed contrasts with the body weights of the other breeds considered.

Reproductive performance and milk production

Uzbek Mohair does display a maximum twinning rate of 6%. The level of prolificacy they display is lower than that of native Uzbek goats. In addition, the disease incidence of the breed is higher than that of the native goat (Kiyatkin 1968b). Estimates of the reproductive performance of this breed are included in Table 30. This breed of goat is not milked.

Fiber production

In the past, animals kept on pedigree farms had a uniform, homogeneous, covering of mohair on their bodies. However, pedigree herds are no longer as pure as was previously the case. The fiber produced by young animals has a diameter of 25-27 µm, while that produced by adults has a fiber diameter of 33-37 µm. All the hair produced is of the same length, and includes neither layers nor staples. In adult bucks, fibers average 19-20 cm in length on average, while in adult does they average 17-20 cm. One-year-old kids produce fibers with an average length of 17-21 cm. Rapid fleecing and shedding of fibers in spring when it becomes warm, is an undesirable trait, which has largely been bred out of this breed. Adult bucks yield 2.6-2.8 kg of mohair on average, while does yield an average of 1.7-2.0 kg. The average mohair yield of one-year-old kids stands at 0.9 kg.

Current structure of breeding programs

No genetic parameter estimates are available for this breed. In addition, no reliable data is available that describes the current genetic structure of this goat breed.

Within recent years, the number of Uzbek Mohair goats has diminished dramatically, particularly those of highly productive pedigree stock. No accurate figures are available that give the present number of does and bucks in Uzbekistan's breeding flocks. The best stock is still that kept on farming units in the Pap and Chust districts of Namangan region.

There are no plans for the improvement of this breed. However, a breeding plan is currently being developed and may soon be brought into operation. The plan includes the use of genealogically controlled flocks in the Chust, Namangan, and Navoiy regions.

The Uzbek Black Cashmere Goat

The development and improvement of the breed

The Uzbek Black Cashmere goat was created from crosses which had already been developed by crossing native goats with Angora goats. These crosses were upgraded, using Pridonskaya sires, for two generations. This process was followed by selection for undercoat yield. Only after selection had been undertaken were some flocks mated to Pridonskaya bucks, in order to improve certain traits (Kiyatkin 1968b).

Black Cashmere goats are distinguished from other breeds by the down fibers, or cashmere, and skins they produce. They also possess a number of other very important biological peculiarities which distinguish them from white Mohair goats. They are, for example, better able to endure high temperatures and direct sunlight, and are also better adapted to a hot dry climate than un-pigmented goat breeds are (Kiyatkin 1968b).

Appearance

Black Cashmere goats differ from white Mohair goats in size and body shape; they are bigger than white Mohair goats, and may be classified as falling between the native and Angora goats in terms of size. The head and legs of the breed are small, while the horns are thin and short (Mamadaliev 1991).

Uzbek Black Cashmere buck

Uzbek Black Cashmere doe

Management

This breed is grazed year-round on the range (see details in Table 26).

Body measurements, body weight, growth and carcass traits

The body measurements of this breed (linear measurements, weights, and carcass performance) are, generally, intermediate between those of native and Mohair goats (see Tables 27, 28 and 29).

Reproductive performance and milk production

The reproductive performance of the Black Cashmere goat is better than that of the Mohair goat; it also has a lower incidence of barren ewes. Table 30 includes some values concerned with reproductive performance. It is known that the twinning rate of this breed can reach 13-18. The average milk yield of the Black Cashmere goat is greater than that of the white Mohair goat (Kiyatkin 1998b).

Fiber production

In terms of the structure of their fleece and the physical characteristics of the down fibers they produce, Uzbek Black Cashmere goats are similar to other cashmere-producing breeds, such as those from the valley around the Don River, and those from the Altay highland and Kyrgyzstan. The fleece produced by the Uzbek Black Cashmere goat is not uniform; it is clearly divided into coarse, very bright and short top clothing hairs, and thin lusterless down or cashmere fibers. Both the top hairs and the down grow on all parts of the body except the face and extremities, which are covered with clothing hair. The down produced is longer than the clothing hair and uniformly covers the whole body.

The down hair produced by does has an average length of 8-9 cm, while that produced by bucks averages 9-10 cm in length. Down fiber diameters range from 15 to 21 µm, averaging 17 µm in the case of does and 19 µm in the case of bucks. The down fibers produced by kids are 1-2 µm finer than those produced by adult animals.

At birth, kids are covered with bright straight hair. By the time they are 1-2 months old, both top hair and down hair have grown on the body; the top hair is pure black, while the fine down hair or cashmere is dark gray to light gray. Some animals have brown hair.

As the weather becomes warmer in spring, individuals rapidly shed their down hair. They are therefore combed in early March, before they start to shed. The average amount of down hair yielded by Black Cashmere goats varies from 500 to 600 g in the case of adult animals and from 300 to 400 g in the case of young animals at first combing. The fibers produced are used to make scarves. There are no regular buyers for the fiber; however, occasionally, traders sell some of the fiber they produce to China.

Current structure of breeding programs

According to Mamadaliyev (1991), the best Uzbek Black Cashmere flocks were to be found on the farming units in the Pap district of the Namangan region and on the Baysun farming unit of the Surkhandarya region. During the late 1990s and early in this century, the number of goats kept on these farms declined. At present, no accurate data are available regarding Uzbekistan's goat population.

A breeding plan is being developed for this breed. However, at present, only the Baysun farming unit, which does not undertake genealogical control and does not record the performance of its herd, is considering attempting the genetic improvement of the breed.

Prospects for Small Ruminant Production in Uzbekistan

Despite receiving little support, small ruminant production will remain, for the next two decades at least, an important aspect of Uzbekistan's agricultural production systems. This prediction is based on the fact that the country's population is expected to grow and its purchasing power is expected to increase, thus generating a greater demand for meat and milk products. This increase in demand should be met, through the use of effective production techniques, by poor farmers, as this group owns most of the country's small ruminants. According to national agricultural reform programs, Uzbekistan's farmers are expected to significantly increase the amounts they produce in the years ahead. For this to happen, a number of aspects of production need to be addressed systematically.

Available estimates of the population numbers of sheep and goats need to be updated, as do the estimates made of the different breeds' production potentials; any required resources (e.g. winter feed) should also be characterized. Current statistics are unreliable and often misleading. Some breeds are in decline (e.g. synthetic sheep) while others are increasing in number. No information is available that could be used to determine trends in goat populations in the future. Gathering such information will allow more efficient regional production and planning.

Uzbekistan was severely hit by the dissolution of markets which resulted from the break-up of the Soviet Union and the period of transition which followed. Current markets need to be carefully studied and market opportunities identified. On the basis of such a study, priority development areas should be targeted. Such action should be coupled with work to develop markets and increase farmers' access to market information. Unfair market intermediaries will always be present. However, policy action should regulate and eventually control the operation of such traders without jeopardizing the effectiveness of marketing channels. If new market opportunities are to be identified and taken advantage of, the different breeds will have to be carefully assessed, to determine whether they are able to meet the requirements of a particular market niche.

Currently, there is a high market demand for lamb. When assessing this market opportunity, issues such as the production potential of different regions and breeds, proximity to markets, and the possibility of developing enterprises which complement crop production, should all be considered. In this regard, the use of agricultural byproducts has not yet been developed sufficiently, and nor has the potential for rapid fattening exhibited by different breeds. Though Karakul sheep produce high-quality pelts, their lambs grow slowly. Instead, the Jaidara and Gissar breeds represent better options with regard to any efforts to target lamb production. If the high demand for lamb is sustained, measures should be considered which would allow the implementation of more intensive fattening systems.

The issue of Karakul pelt production should be carefully assessed, as should the available Karakul lines. Efforts should be taken to avoid the mismanagement of these lines. Policy makers need to implement careful market studies. The information gathered should then be provided, in a clear form, to farmers and researchers to help them orientate production appropriately. Because they lack information and are not adequately exposed to international trends, most researchers in Central Asia in general, and Uzbekistan in particular, mistakenly believe that the market for traditional produce remains unchanged.

Where there exists a niche for sheep milk production, candidate breeds for improvement should be those synthetics that have lost their market niche in terms of wool production; such a strategy would be advantageous because it would not affect the diversity of native sheep breeds. Improved technologies would be needed to process milk into various products, and quality-control mechanisms would also be needed. The production of goat's milk could also be expanded.

Fine-fiber production by goats is not a strength of Uzbek's small ruminant production systems. However, in those areas where improved Mohair and Black Cashmere goats are established and have a comparative production advantage, it might be possible to develop production systems geared towards the production of these types of fibers. The prices commanded by these products could benefit farmers greatly, provided that market conditions allow them to take advantage of the opportunities available.

A very important issue is the need to adequately manage Uzbekistan's rangelands, which provide a large proportion of the feed consumed by small ruminants. The stability of this valuable resource, which would be affected if too many animals were grazed on the range, should be ensured by means of appropriate policies. However, thus far, Uzbekistan has not developed effective policies. This is an area in which international research and development organizations have a role to play. The tragedy of the degraded rangelands in West Asia and North Africa should be avoided in Uzbekistan, where the rangelands are still productive. More work is needed to develop different feed-production and range-utilization systems, which are appropriate for each season of the year and for each of the different geographical zones in which sheep are kept. Because flock ownership has changed dramatically in recent years, range management needs to be adjusted to these new conditions. However, as yet, no range-management recommendations have yet been produced.

Management of the health of sheep and goats is also an urgent priority, especially with regard to epidemiological issues.

Most of Uzbekistan's indigenous breeds of sheep are increasing in number. The Karakul population has declined a little; however, this is not a cause for concern. Nothing is known of the population fluctuations that may have occurred in the improved Mohair and Black Cashmere breeds; however, it is likely that the breeds and the quality of their produce have deteriorated. This clearly underlines the urgent need to implement sound breeding programs, which should be managed by farmers under the supervision of trained scientists. The lessons learned in other parts of the world, where tenure systems are similar, and where similar economic problems exist, should be capitalized upon and used as entry points by international research and development organizations.

The crossbreeding of synthetic breeds with exotic breeds has continued systematically during the Soviet Union, because of the desire of researchers to further improve the synthetic breeds' characteristics. However, it is clear that Uzbekistan's populations of synthetic sheep breeds are in rapid decline. The loss of these breeds may not mean the loss of valuable indigenous material, but it would mean the loss of the suitable gene combinations obtained during decades of breeding efforts.

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Armenia

Chapter Seven

Small Ruminant Breeds of Armenia

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Introduction

Small ruminant production is an integral part of agricultural production in the Caucasus in general and Armenia in particular. It acquired economic importance in Armenia during the Soviet Union, and still remains important in the country after the collapse of the Soviet Union and Armenia's transition to a new economic system.

Armenia's population amounts to only 3.21 million people (National Statistics Agency 2003). As a result, the market for the main products of small ruminants (meat and processed milk products) is relatively small. However, within Armenia, consumers show a strong preference for such products, which reflects the fact that they have traditionally been consumed in the country. Despite this, however, production levels have fallen as a result of several changes which occurred after the breakdown of the Soviet Union, though it is expected that research and development will eventually restore productivity to levels which will ensure that producers are competitive and thus able to capture market opportunities. This chapter provides an overview of the present status of Armenia's small ruminant production sector, and includes an assessment of the genetic resources available and the threats posed to the genetic diversity of different breeds. The breeds currently found in Armenia are then described on the basis of past information, using information which was mainly gathered during the Soviet Union.

Economic Importance and Role of Sheep and Goats

Sheep and goat production is, traditionally, a major aspect of Armenia's agricultural production sector, being second in importance only to cattle production. According to data provided by the Ministry of Agriculture, in 2000 there were 340,889 peasant farms in Armenia, of which 114,605 (30.9%) kept sheep (Ministry of Agriculture of Armenia 2001b). No estimates exist which may be used to quantify how many of Armenia's farmers keep goats.

Whatever the case, because they have access to only a few sources of income, the livelihoods of these farm households depend to some extent on the contributions made by sheep and goats. The meat, cheese and milk derivatives produced are either consumed by the producer's household or sold to provide an income.

Small ruminant production in Armenia is greatly facilitated by the availability of vast natural mountain ranges which sheep and goats are able to graze, transforming otherwise unused natural vegetation into valuable products such as mutton and milk. Mutton and sheep and goat milk derived products are strongly preferred in Armenia, and have always had a market niche. The production of mutton and milk products now offers income-generating opportunities to the farming sector which is emerging in Armenia following the disintegration of the Soviet Union. It is, moreover, often the only livelihood option available to poor farmers.

It is estimated that a considerable amount of the meat produced in Armenia derives from small ruminant production. In 2001, for example, small ruminant production accounted for 15% of the total amount of meat produced in Armenia. Most of the meat produced is consumed by the producer's family, though some is sold at market; however, no information is available regarding the amounts consumed and sold. Small ruminant milk production in Armenia, by contrast, contributes an insignificant amount to the total amount of milk produced in the country, as sheep and goat milk production does not exceed more than 1.5% of the total amount of milk produced.

Population of Sheep and Goat Breeds

Statistical information is available from Armenia's Ministry of Agriculture regarding the number of small ruminants kept in the country. However, the data does not discriminate between species, and combined figures have instead been produced (Ministry of Agriculture of Armenia 2001a; Ministry of Agriculture of Armenia 2003). This information, combined with that gathered by Marmaryan *et al.* (2000), has been used here to estimate sheep and goat numbers in Armenia. In this way, it was found that, by 1999, Armenia's sheep population amounted to about half a million head, while its goat population amounted to nearly 50,000 head.

Sheep are kept all over the country; however, the major concentrations of sheep occur in the Aragatsotn and Gekharkunik provinces, which contain 15.1% and 17.8% of the nation's stock, respectively (Table 1). Goats are also distributed throughout Armenia; however, they are concentrated in the Vayots Dzor, Ararat, Kotaik, Siunik and Lori provinces (Marmaryan *et al.* 2000).

Sheep numbers in Armenia declined as a result of two factors. One was an earthquake in 1988, which caused the number of sheep in the country to drop from 2.1 million head in 1986 (Rukhkyan *et al.* 1989) to 800,000 head in 1992. The second factor was the privatization of resources that occurred in the 1990s and the problems which resulted from the break-up of the Soviet Union. Armenia's sheep population suffered dramatic changes as a result of these processes (see Table 2 and Figure 1). As a result, by 1999 sheep stocks had fallen to about 60% of their 1992 levels. Curiously, however, the country's rather small goat population increased substantially during that period. In 1999, Armenia's sheep population stabilized, and then, in the years following, increased slightly.

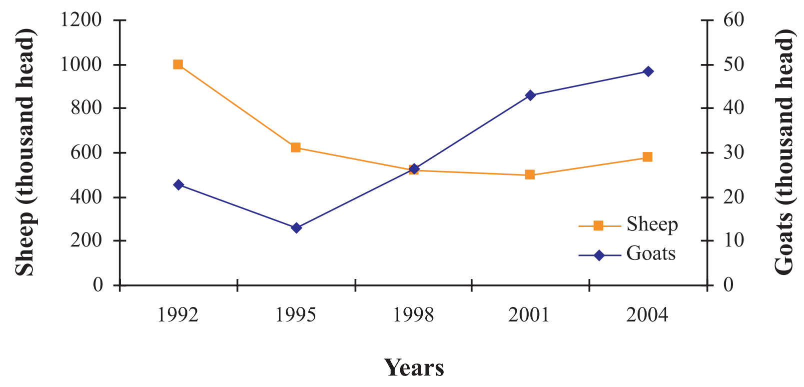

Figure 1. Changes in the population of sheep and goats from 1992 onwards.
Source: Using data from FAO (2004).

Table 1. Distribution of sheep and goat stocks per province (2003).

	Sheep		Goat	
Province	Population (thousand head)	Distribution, %	Population (thousand head)	Distribution, %
Yerevan City	3.2	0.5	0.09	0.2
Vayots Dzor	18.0	3.2	9.80	20.9
Tavush	20.0	3.6	3.74	8.0
Lori	37.0	6.7	4.90	10.4
Armavir	42.0	7.6	0.61	1.3
Siunik	54.0	9.7	5.84	12.4
Kotaik	56.0	10.1	6.07	12.9
Shirak	70.0	12.6	1.96	4.2
Ararat	73.0	13.1	6.77	14.4
Aragatsotn	84.0	15.1	3.83	8.2
Gekharkunik	99.0	17.8	3.31	7.1
Total	556.2	100.0	46.92	100.0

Source: Compiled using information provided by Ministry of Agriculture of Armenia (2003).

Table 2. Armenia's sheep and goat populations (1992 – 1999).

Stock	1990	1992	1995	1999	2003
Sheep	850,800	827,177	557,297	504,900	556,200
Goats	14,100	18,297	32,926	41,400	46,920
Total	864,900	845,474	590,223	546,300	603,120

Sources: Ministry of Agriculture of Armenia (2001a); Marmaryan *et al.* (2000).

As has already been noted, the privatization process that followed the break-up of the Soviet Union affected landholdings, and livestock and agricultural inputs, as the decentralization of production-input manufacturing meant that inputs became too expensive for farmers to afford. In addition, Armenia's newly emerging farmers also had to cope with the critical problems posed by the disintegration of the country's production organizations and a lack of organized, well-regulated markets. Because fodder production had declined significantly and they were unable to feed their animals, some of the country's new livestock owners sold what livestock they had acquired.

The privatization process also resulted in different farm typologies. The largest category consists of poor and subsistence farming households which possess few animals and no land. Thus, while 33,380 of the 114,605 farms that keep sheep in Armenia (Ministry of Agriculture of Armenia 2001b) own more than 10 sheep, the remaining 81,225 farms own fewer than 10 animals. Farms with large flocks are economically stronger than those with smaller flocks, and are establishing themselves in the market. However, there are few such farms, though their numbers are increasing.

In the 1990s and in the early years of this century, a significant increase was observed in the number of goats kept on peasant farms in the Vayots Dzor and Siunik provinces, both of which are areas with topographies and range vegetation which suit this type of livestock. Goats are better able than sheep to use the vegetation which grows on steep and rocky mountain slopes, and which allows almost year-round grazing. Goats also produce more milk than sheep. These factors make goat keeping an option which is suited to subsistence farming systems and which can therefore provide food security and a source of income.

Four Caucasian sheep breeds are found in Armenia: the Mazekh, the Balbass, the Bozakh, and the Karabakh. However, these breeds account for only 24.9% of Armenia's total sheep population; crossbred and synthetic sheep are far more numerous (Table 3).

Table 3. Sheep breed distribution in Armenia (2003).

Breeds	Population, thousand head	Distribution, %
Sheep		
Mazekh	72.00	12.8
Balbass	25.00	4.5
Bozakh	22.00	4.0
Karabakh	20.00	3.6
MCW Martunin	101.00	18.2
MCW Aragat	40.00	7.2
Corriedale crossbred†	50.00	9.0
MCW crossbreds†	226.20	40.7
Total	556.20	100.0
Goats		
Armenian native	45.97	98.0
Crossed with exotic breeds	0.95	2.0
Total	46.92	100.0

Sources: Compiled using information provided by Ministry of Agriculture of Armenia (2003), and by Tamamshev (1930) and Rukhkyan (1948).
Notes: †From 1964 onwards, native sheep were crossed with rams of the North Caucasian Mutton–Wool and Soviet Mutton–Wool breeds. This resulted in a population of semi-fine wool crossbreeds.
MCW: Medium-Coarse-Wool.

Indigenous breeds of goat are kept by most producers in Armenia. The only exotic breeds and their crossbreds in the country are those kept by a crossbreeding improvement program involving European milk breeds which began in 1999 in Vayots Dzor province with the support of the US Department of Agriculture (USDA).

In the case of the country's sheep, crossbreeding programs undertaken using state-owned flocks and run for several decades resulted in the expansion of semi-fine and medium-coarse wool synthetic sheep breeds during the Soviet Union. However, despite this, native sheep kept on individual peasant farms remained relatively pure. Unfortunately, the breeding improvement program was discontinued and the pedigree base of the synthetic sheep was completely lost.

The activities of most state-owned stations and pedigree breeding farms have also been discontinued. The only exceptions to this are (1) a farm in the Aragatsotn province, which specializes in Armenian Medium-Coarse-Wool sheep of the Aragats type, and (2), in the Kotaik province, a training and experimental station which belongs to the Academy of Agricultural Sciences of Armenia and specializes in Corriedale sheep. Data on the distribution of different sheep and goat breeds by province in Armenia is given in Figures 2-6.

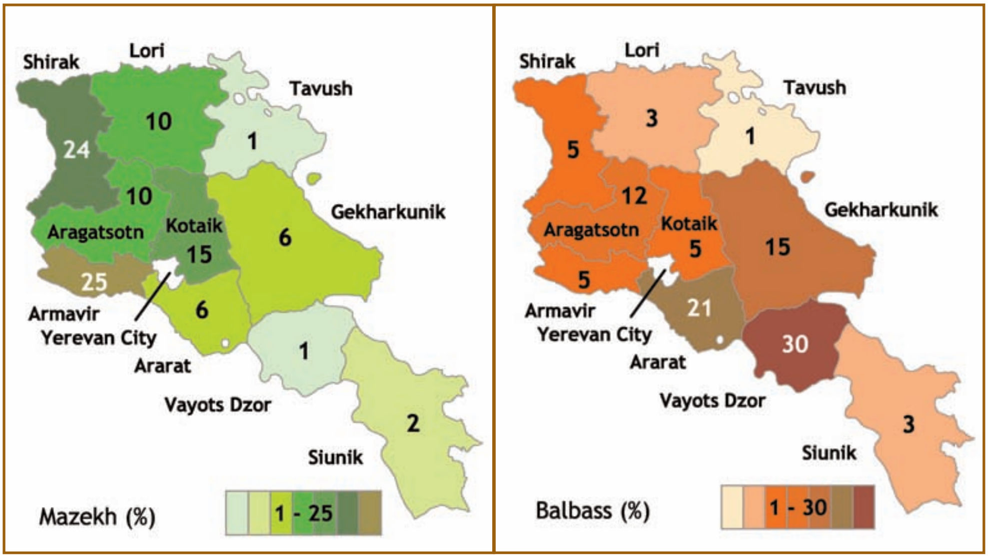

Figure 2. Geographical distribution of Mazekh and Balbass sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different provinces of Armenia.

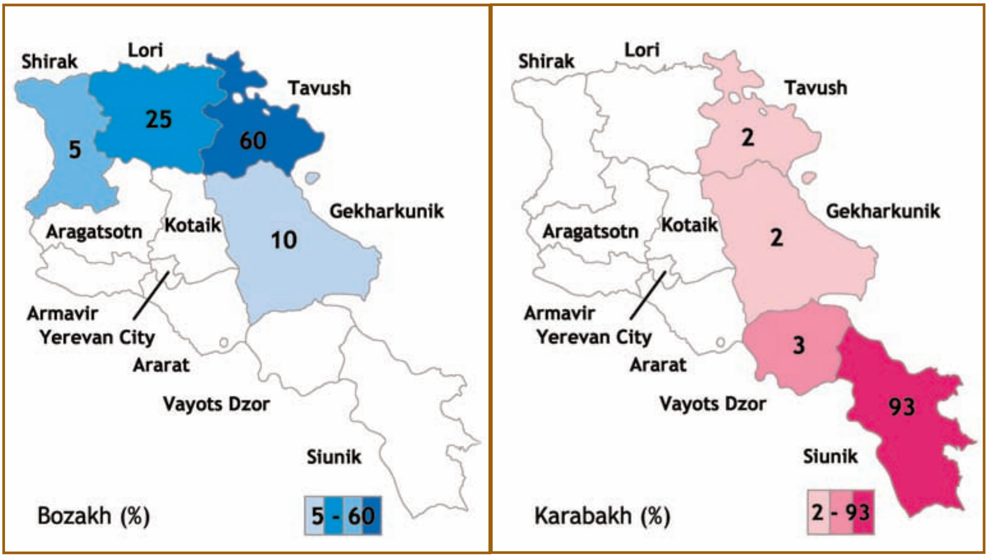

Figure 3. Geographical distribution of Bozakh and Karabakh sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different provinces of Armenia.

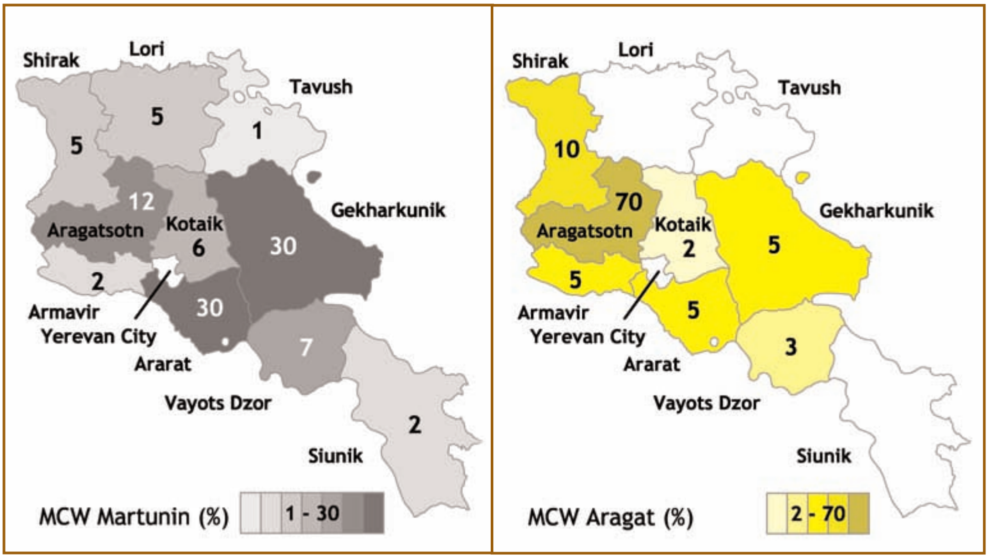

Figure 4. Geographical distribution of Medium-Coarse-Wool Martunin and Aragat sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different provinces of Armenia.

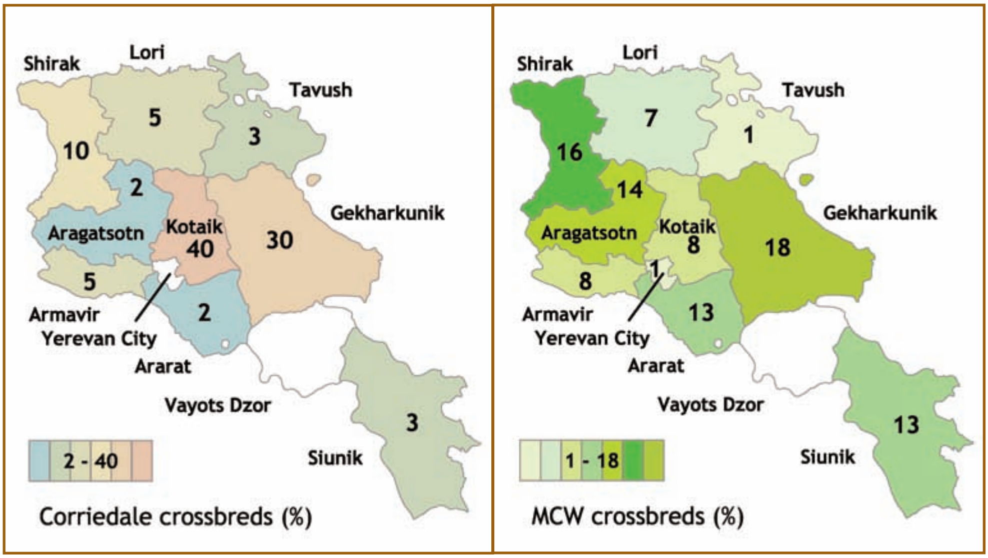

Figure 5. Geographical distribution of Crossbreed sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of crossbred sheep in the different provinces of Armenia.

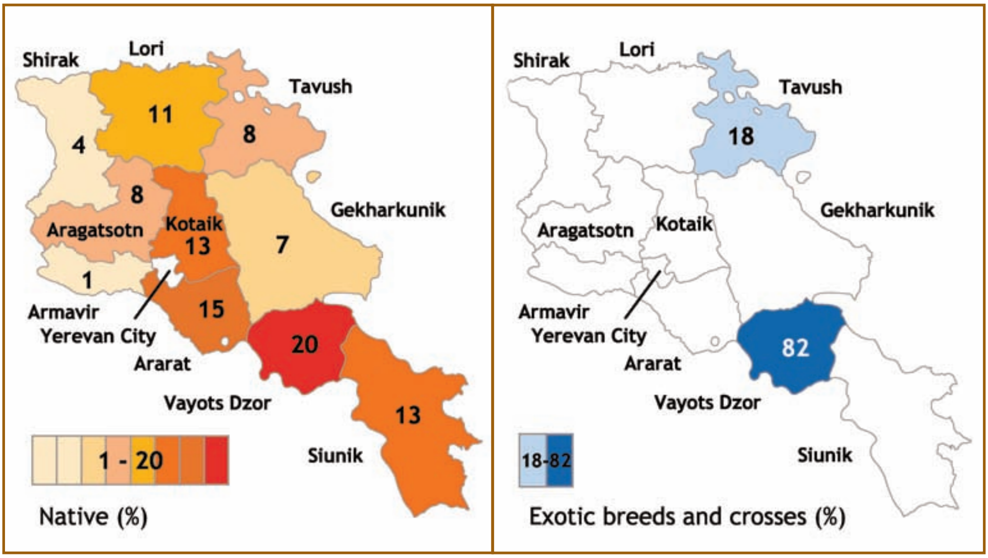

Figure 6. Geographical distribution of Armenian native goats and crosses with exotic goats.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of native goats and crossbred goats in the different provinces of Armenia.

Sheep and Goat Breeding Regions

Geography

Armenia is a mountainous country with an average altitude of 1,890 m above sea level (m a.s.l.). Its 29,960 km² cover a diversity of landscapes, reaching 4,096 m a.s.l. at the summit of Mount Aragats. Only 3.1% of the country's territory is located at an altitude between 500-850 m a.s.l. In fact, 51.71% of it is between 850 and 2000 m a.s.l., while a further 45.22% is more than 2000 m a.s.l. (Rukhkyan 1948). The country's foothills are 400-1000 m a.s.l. and most of its mid-mountain plateaus are 1450-1650 m a.s.l., although its mid-mountain zone extends to 2000 m a.s.l. Armenia's alpine zone begins at 2000 m a.s.l.

Water is scarce in Armenia, though certain regions do have water resources. One example of such is the Sevan Lake basin, the west of which contains the Ararat valley (800-1000 m a.s.l.), and the south of which encompasses the Arpa and Zangezur rivers.

Climate

The plains and foothills of Armenia have a dry, continental climate. Summers are hot and winters are moderately cold. July temperatures average 25°C, with a maximum of 42°C being reached. In January temperatures fall to -5°C. Annual rainfall stands at 200-400 mm, most of which falls during the spring. The growing season for native vegetation in these areas lasts for 6-7 months.

On mountain plateaus and slopes (1400 m a.s.l. and higher), temperatures average 19°C in July and -5°C in January. Annual rainfall is about 500 mm. In these areas, the growing season for native vegetation lasts for 4-5 months.

In the mid-mountains, the climate is moderate: in July and August temperatures average 18°C. Winters are mild and snowy, with average temperature of -5°C in January. Annual rainfall stands at 600-800 mm, with most rain falling at the end of the spring.

In alpine areas (2000-3000 m a.s.l.) summers are cool, with air temperatures which range from 10°C to 15°C. The winters are cold, and January temperatures range from -19°C to -14°C, though they can fall as low as -46°C. In winter, such alpine areas are covered by a thick layer of snow.

The climate in the southeast and northeast of the country is dry and subtropical. Annual precipitation in these areas averages 300 mm.

Rangelands

A detailed description of the range vegetation found in Armenia is given by Magakyan (1952). The country's winter and summer ranges are the main grazing grounds for the different species of livestock kept in Armenia.

Armenia's winter ranges are located in semi-deserts of the Ararat valley and in the foothills adjacent to that valley. They extend to altitudes of up to 1400-1500 m a.s.l. In these areas, the soils are rich in salts. The vegetation in these areas is xerophitic, having developed under strongly continental climatic conditions.

Rocky semi-deserts containing *Artemisia* spp. and a mixture of *Artemisia* and ephemerals are very common in these areas. In the foothills, however, the type of vegetation present changes, as a result of the increase in altitude. In these areas, *Artemisia* is an important background species and perennial grasses, including *Stipa* spp., *Agropyrum cristatum* and *Festuca sulcata*, among others, are widespread. These rangelands are mainly used by sedentary farmers: nomadic forms of small ruminant production are no longer practiced in the country.

Ranges in the mid-mountain zone are characterized by mountain-steppe vegetation. Most of these areas produce low levels of forage. The vegetation present includes thorny perennials and cushion-like shrubs with a low nutritional value.

The country's winter rangelands are mainly used to graze sheep. The areas around villages are used as spring and autumn ranges, though small-scale producers who are unable to move their livestock also use them as summer ranges as well. Locations with taller stands of grass are used to produce hay.

Armenia's summer ranges are located in mountainous areas in the sub-alpine zone and at altitudes of more than 2000 m a.s.l., in the alpine zone. Due to the fact that the summers in the region are rather short, these areas cannot be cropped. However, in summer they are covered with rich vegetation, and provide good grazing for livestock. They are covered with snow until May, and the high-value feed they provide becomes available in June and August. Armenia has a large amount of summer ranges, but a comparatively insignificant amount of winter grazing. As a result, for many centuries, livestock producers have made use of remote ranges.

The ranges in the country's alpine belt are used until the end of August or mid September, while in the mid-mountain belt livestock grazing continues until mid October.

In the foothills, the sheep-grazing season begins in early April. Winter lambing is common in the lowland zones of the southeastern and northeastern regions of the country, while lambs are usually born at the end of the winter and in the spring in the mid-mountain areas. Spring lambing is preferred by producers in the mountainous regions, where most lambs are born in January and February. Ewes in all areas are milked once their lambs reach 2.5 months of age, when large amounts of grass are available on the rangelands.

While most rangelands can be used to graze both cattle and small ruminants, large areas in, for example, Aragatsotn, Gegam, Areguniy and Zangizur, are used mainly for sheep. Cattle cannot be grazed on very steep, stony slopes; such areas are therefore only used to graze sheep and goats. Between 5% and 35% of the total range area in Armenia is very rocky (Tamamshev 1930).

Armenia's most productive ranges are located in its sub-alpine and alpine zones. The vegetation in such areas consists of cereals, legumes, and forbs, with *Artemisia* being the main background species. Such areas are estimated to provide a hay yield of 1.85-2.0 tonnes of dry matter (t DM) per ha. The hay yield of all the different types of rangeland in the country averages 1.4-1.6 t DM/ha.

Not enough watering sites are available on most of Armenia's ranges, and water is particularly scarce on the western slopes of the Gegam mountains, and on the southern and south-western slopes of the Aragat mountains. In these areas, most of the springs available dry up well before the end of the grazing period. This results in producers being unable to make full use of the grass resources available, and often means that they have to move their livestock from the summer ranges before the summer grazing season has ended.

To provide winter feed, farmers mainly harvest hay from natural haylands. They also store straw produced from cereals and food legumes. On some larger farms, alfalfa and barley is grown for fodder. However, a significant proportion of the fodder used by producers is purchased.

Armenia's best rangeland is located in the northern and northeastern areas of the Republic. Ranges located at altitudes of more than 3000 m a.s.l. are adequate only for sheep, irrespective of their vegetation and relief.

Main Management Characteristics

Feeding

Based on the source of feed provided and the feed management techniques used, Rukhkyan (1948) identified the following forms of sheep management in Armenia: (1) stationary mountainous; (2) nomadic seasonal mountainous and (3) nomadic distant mountainous or semi-desert rangeland.

Stationary mountainous sheep management is characteristic of alpine areas. In this type of management system, sheep are grazed on the ranges around the producer's village during the spring, summer and autumn. During the 4- to 5-month-long winters they are kept and fed in pens.

Nomadic seasonal mountainous sheep management is the form of management which is most commonly applied in the mid-mountain and foothill zones of Armenia. In this system, sheep are moved to sub-alpine and alpine summer rangelands in summer (from the beginning of June to September). On average, these summer ranges are 10 to 30 km from the producer's village. During the spring and late autumn, the animals are grazed on the rangelands around the producer's village. From December until the end of March or mid April (a period of about 100-140 days) the animals are kept and fed in pens.

Nomadic distant mountainous or semi-desert rangeland sheep management involves the use of semi-desert ranges during the winter and mountainous areas in the summer. These mountainous areas are located 40 to 60 km from the villages of producers. Producers also prepare reserves of hay and concentrated fodder, which are used as supplementary feeds or as the main feed source if a harsh winter occurs. This form of sheep management is typical of farms in the Ararat valley and in the semi-desert areas of the adjacent foothill zone.

Currently, only farmers with large flocks move their animals according to the availability of seasonal grazing. Small farmers graze their stock on the ranges around their villages. However, some small farmers do sometimes give their sheep to other farmers so that they can be grazed during the summer on more distant ranges. This is not always a profitable practice, however.

During the Soviet Union period, farmers had access to remote rangelands located along the borders with neighboring republics, which they made use of using a system of rotational grazing. However, this is no longer possible now that these areas are part of the territories of different countries. Loss of this grazing resource has resulted in those ranges which are available being overgrazed, a process which, unless it is halted, could lead to severe land degradation.

No reliable information is available regarding the number of farmers practicing each of the three types of management considered above. There is also no information about the number of sheep kept using each of the three management types.

Other management features

All the sheep and goats kept in Armenia are managed in a broadly similar way. Table 4 summarizes the main features of the management cycle.

Table 4. Main features of sheep management in Armenia.

Events and seasons	**Months**											
	Dec	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Range grazing												
Stubble grazing												
Supplementing												
Mating												
Lambing												
Shearing												
Seasons and main features	Winter Very cold and continental			Spring Mild			Summer Hot			Fall Mild		

Source: Compiled by authors.
Notes: Veterinary treatments, though administered throughout the year, are provided mainly in spring and winter. In general, animals mate naturally during the mating season and lambs produced are weaned at 4-4.5 months of age.

Depending on the climatic conditions found in the region concerned, the sheep kept in Armenia are shorn in late April or late June. Some breeds (i.e. the Bozakh and the Karabakh) could be shorn twice a year, in May and September, while other breeds can only be shorn once a year, in spring. Goats are shorn once a year, in spring, approximately one month after sheep are shorn.

Markets for Sheep and Goat Products

According to data gathered by Armenia's Ministry of Agriculture (1997), in 1997 the country produced 83,700 tons of meat of sheep and goats and 435,300 tons of milk (429,400 tons of cow's milk and 5900 tons of small ruminant milk). Per capita annual meat and milk consumption were estimated to be 22.3 kg and 116 kg, respectively, in that year. Based on consumption rates during the Soviet Union, these figures indicate that consumption is declining and people's diets are deteriorating. Currently, these products command high prices; however, prices are expected to fall somewhat in the near future as production becomes more competitive. Despite these high prices, internal demand for these products remains high. In addition, USDA has assessed the possibility of exporting mutton and milk derivatives from Armenia to Russia, the USA, and the Arab Emirates, and has determined that the prospects for such efforts are good.

Wool and sheepskins are in low demand in Armenia, while there is a higher demand for sheep and goat meat and cheese. This demand could be even higher if the purchasing power of Armenia's population increases.

Most of the different breeds of small ruminants kept in Armenia are meat- and milk-producing varieties. Table 5 ranks the different breeds' production abilities and the market prospects for their produce.

Table 5. Ranks of production ability (1=max) and present market outlook for Armenian sheep breeds and goats.

Breed	Wool yield	Meat quality and preference	Milk production	Major product	Prolificacy	Market prospects
Sheep						
Mazekh	5	5	1	Meat, milk	4	Good
Balbass	4	4	2	Meat, milk, wool	4	Excellent
Bozakh	3	2	6	Meat, wool	4	Medium
Karabakh	6	1	5	Meat	4	Medium
MCW Martunin	3	4	3	Meat, milk, wool	3	Good
MCW Aragat	2	3	4	Meat, wool, milk	3	Good
Crossbred	1	3	4	Meat, wool, milk	1	Medium
Goats	7	6	1	Milk	2	Low

Source: Compiled by authors.
Note: MCW: Medium-coarse Wool.

Of the sheep breeds kept in Armenia, the best meat producers are the Karabakh and the Bozakh, and there is a medium level of demand for their meat. The best milk producers are the Mazekh and Balbass breeds, and there is a high demand for their milk. Bozakh sheep produce medium-coarse wool which is used to make felt, carpets and coarse-wool cloths. The Mazekh and Karabakh sheep produce coarse wool. The wool of Mazekh sheep is used to make felt and coarse-wool cloths, while that of Karabakh sheep is used to make felt and carpets. Fine wool is produced only by crossbred sheep in Armenia.

Threats to Genetic Diversity

Because statistical data is not always precise, this study did not rely solely on the data gathered by others and given in Table 3 when estimating population trends. Instead, to obtain realistic estimates of trends in sheep and goat population changes since 1990, specialists in animal production (including the authors) were consulted. As a result, the sheep and goat population estimates for 2000 provided in Table 6 differ from those given in Table 3. However, due to the fact that it is approximated, the data in Table 6 should still be considered with caution.

Since 1990, all the sheep breeds kept in Armenia have declined in number. With regard to Armenia's native sheep breeds, the numbers of both the Bozakh and, in particular, the Karabakh have fallen to such an extent that their population sizes are now marginal and they face the risk of being displaced as a result of crossbreeding, which is not undertaken systematically because different flocks are kept together.

Armenia's synthetic and crossbred sheep populations have also declined dramatically, the former as a result of being crossbred with preferred native breeds. But interestingly, the goat population is now 3.5 times larger than it was in 1990.

Table 6. Risks to small ruminant genetic diversity in Armenia, based on population changes (1990-2003).

Breeds	Population in 1990†, thousand head	Population in 2003‡, thousand head	Change in %	Risks	Risk reasons
Sheep					
Mazekh	93.61	72.00	-23	High	Crossbreeding
Balbass	42.55	25.00	-41	High	Crossbreeding
Bozakh	51.06	22.00	-57	High	Crossbreeding
Karabakh	25.33	20.00	-21	High	Crossbreeding
MCW Martunin	136.16	101.00	-26	Medium	Crossbreeding
MCW Aragat	59.57	40.00	-33	High	Crossbreeding
Crossbred	442.52	276.20	-38	None	Economic reforms§
Goats	14.10	46.92	233	None	None

Sources: †Compiled by authors in consultation with other specialists and using data from Marmaryan *et al.* (2000), Ministry of Agriculture of Armenia (2003) and World Bank (1997).
‡Based on the authors' own experience and data from the Ministry of Agriculture of Armenia (2001a), Tamamshev (1930) and Rukhkyan (1948).
Note: §Changes during the post-Soviet Union, due to fragmentation of production systems and lack of markets for wool.

The population sizes of native breeds in Armenia have fallen to critically low levels (below 93,000 head). Without a controlled mating plan, and if intensive chaotic crossbreeding continues to take place, the diversity of these native breeds is obviously at risk. If this trend continues, it is expected that no native pure breeds will exist in the country in the near future.

The country's synthetic breeds will also be affected by crossbreeding, as producers prefer fat-tailed crosses and, because wool prices are depressed, are not concerned with the wool characteristics of these breeds. This is also true with regard to the semi fine-wool animals included under the category 'crossbred' in Table 6.

Genetic Improvement Programs

Following the collapse of the Soviet Union, almost all of Armenia's breeding programs were dissolved. However, some research work does continue under the direction of the Armenian Agriculture Academy and Research Center for Livestock and Veterinary Sciences. Genealogical control of animals (goats) is only undertaken at the USDA-funded Goat Center in Vayots Dzor province.

Sheep Breed Characterization

Four main coarse-wool, fat-tailed sheep breeds (the Mazekh, the Balbass, the Bozakh and the Karabakh) are indigenous to Armenia. These breeds have been raised in the country since ancient times, both in their pure forms and in the form of crossbreeds.

The Mazekh and Balbass breeds both have a long, curved 'S'-shaped fat tail. Fat is accumulated along the whole length of the tail, including its tip. The Bozakh and Karabakh breeds have either a short or a medium-length fat tail, which curves upwards in the middle before turning downwards at the point below the sacrum. The tip of the tail is thin and points downwards (Tamamshev 1930).

Armenia's indigenous sheep breeds have been described by both Kalantar (1913) and Tamamshev (1930); however, they were most completely characterized by Rukhkyan (1948) during on-station studies undertaken at the Alagez State Sheep Breeding Farm.

As formerly indicated, the only state-owned experimental stations left in the Republic are the Alagez State Sheep Breeding Farm and the Balaovit training and experimental station, which still possess flocks of Armenian MCW Aragat sheep and crossbred sheep, respectively. This report includes measurements gathered at either location. The distinguishing features of each of Armenia's sheep breeds are given in Table 5 complemented by Table 7.

With regard to the production traits of the sheep breeds kept in Armenia, no estimates of genetic variation are available.

The Mazekh Sheep

The Mazekh breed is an indigenous, coarse-wool, fat-tailed sheep. It is kept throughout Armenia, and is also widespread in a number of areas of Azerbaijan and Georgia, both of which share borders with Armenia. Mazekh sheep are also kept in Turkey (where they are known as Kzy-Karaman) and in Iran. In Armenia the breed is mainly raised in the Shirak province, on the Ararat plain, and in the Kotaik province (Table 7). There were approximately 72,000 Mazekh sheep in Armenia in 2003 (Table 3).

Table 7. General features of Armenian sheep.

Breed	Distribution area	Tail	Horns	Specialty
Mazekh	Shirak, Ararat valley, Kotaik	Fat tail	Rams: 24% Ewes: 1.4%	Meat, milk
Balbass	Gegharkunik, Aragatsotn, Ararat, Vayots Dzor	Fat tail	Rams: 17% Ewes: 8%	Meat, milk, wool
Bozakh	North-eastern and northern regions	Fat tail†	Rams: 100% Ewes: 13%	Meat, wool
Karabakh	South-eastern regions and Karabakh	Fat tail‡	Rams: few Ewes: none	Meat
MCW Aragat	Aragat Western and south-western regions	Fat tail	Rams: none Ewes: none	Meat, milk, wool
MCW Martunin	Gegharkunik, Ararat, Vayots Dzor	Fat tail	Rams: none Ewes: none	Meat, milk, wool
Crossbred	Kotaik, Gegharkunik, Shirak, Aragatsotn	Thin tail	Rams: none Ewes: none	Meat, milk, wool

Source: Compiled by authors.

Notes: † Fat tail shorter than Mazekh and Balbass, ‡ Fat tail similar though longer than that of Bozakh.

Appearance

The general features of this breed are included in Tables 5 and 7. The coats of most individuals are brown, though various shades of brown occur. However, gray, red, or brown-red individuals can also be found. The head, neck, belly, and extremities of the breed are darker than the body, and are covered with short, smooth, hairs. The rest of the body is covered by the fleece, which is coarse.

Mazekh ram

Mazekh ewe

The head of this breed is medium-sized, and relatively narrow and thin. The profile is either Roman or straight. Horns rarely occur in ewes (1.4%), but are more common in rams (24%). The horns produced by rams are strong and long. The ears of the breed are long and wide, and earless or short-eared animals are rare. The spine of the breed is rather straight and the rear section of the body stands slightly higher than the forequarters. The legs of this breed are thin.

Mazekh sheep are fat-tailed. The fat tail consists of two 'pillows', the larger pillow being positioned under the smaller. The fat tail is 'S'-shaped, and contains abundant deposits of fat. In 2.5-year-old ewes (n=1,661) the fat tail averages 31.3 cm in width and 28.8 cm in length, while its circumference at the widest point averages 84.3 cm (Tamamshev 1930).

Body measurements

As reported by Tamamshev (1930) and Rukhkyan (1948), among the native breeds of Armenia Mazekh sheep are second in size only to the Balbass breed. In February 2000, measurements were taken from 2.5-year-old ewes kept on one particular farm near Arinj, a village in the Kotaik region. The averages obtained from these measurements are given in Table 8. Note that these measurements show that the body of the breed is comparatively short, as the length to height at ridge ratio is less than 1 (0.93).

Table 8. Body measurements of 2.5-year-old Mazekh ewes kept on a commercial farm (n=16).

Trait (cm)	Mean±SE	Range	SD	CV (%)
Height at ridge	66.4±0.9	63-69	3.5	5.3
Height at sacrum	67.4±0.8	65-69	3.1	4.6
Diagonal body length	61.8±0.8	59-64	3.0	4.9
Chest width	20.1±0.5	15-23	2.1	10.4
Chest depth	31.2±0.5	29-34	1.9	6.1
Chest girth	91.2±1.2	83-98	4.6	5.0
Metacarpus girth	8.8±0.2	8-9.5	0.6	6.8
Head length	19.6±0.2	19-21	0.7	3.6
Maximum forehead width	11.4±0.2	10-12.5	0.6	5.3
Pelvis width	18.4±0.2	15-20	0.9	4.9

Source: Marmaryan (2000, unpublished work).
Notes: SE: Standard error; SD: Standard deviation; CV: Coefficient of variation.

Body weight, growth and carcass traits

According to Kalantar (1913) the Mazekh breed is one of heaviest breeds indigenous to Caucasus, the only heavier being the Balbass. The average live weight of 2- to 5-year-old animals has been calculated to be 51.6 kg (range 45-57 kg) in the case of ewes and 66 kg (57-78 kg) in the case of rams (Tamamshev 1930); exceptional sires can reach 98 kg. However, it should be remembered that feeding conditions and season are the most important determinants of individual weight.

Two- to 6-year-old ewes have been found to average 45 kg (range 35-37 kg) at the end of April (i.e. in spring), 52 kg (range 43-65 kg) at the start of September, and 61.8 kg (range 49-77 kg) at the end of November (Rukhkyan 1948). Table 9 ranks Armenia's indigenous sheep breeds according to weight. The sheep growth data obtained by Rukhkyan (1948) is given in Table 10.

Table 9. Weight rankings of Armenian sheep (1=heaviest).

		Live weight (kg)			
		Ewes		Rams‡	
Breed	Weight rank§	Mean	Range	Mean	Range
Mazekh	2	61.8†	49-77†	66.0	57-98
Balbass	1	61.5†	51-75†	73.7	66-82
Karabakh	4	48.0†	31-61†	56.1	50-58
Bozakh	3	44.2‡	40-45‡	59.8	55-60

Sources: †Rukhkyan (1948), where data refer to 2- to 6-year-old ewes and rams; ‡Tamamshev (1930) where data refer to 2- to 5-year-old ewes and rams.
Notes: §Considering average weights and range over sexes; the number of observations made was not stated in the source material.

Table 10. Growth of Mazekh sheep.

	Body weight (kg)	
Age	Males	Females
At birth	4.0	3.8
At weaning (3.5 months)	24.5	23.2
6 months	30.7	27.5
9 months	38.1	33.7
1 year	42.1	36.9
1.5 years	53.7	46.9

Source: Rukhkyan (1948).
Note: The number of observations made was not stated in the source material.

More recent studies undertaken at a farm near Arinj village, in the Kotaik region, found that male lambs (n=10) averaged 4.12±0.12 kg at birth, while female lambs (n=10) averaged 3.75±0.10 kg. At 2.5 months of age, male and female lambs averaged 17.8 and 15.4 kg, respectively (Marmaryan 2000, unpublished work).

The dressing percentage of 2- to 5-year-old Mazekh sheep ranges from 45% to 66% (Tamamshev 1930). However, the meat produced by the breed is of a lower quality than that produced by Karabakh and Bozakh sheep and is not regarded so highly. Mazekh sheep produce the largest fat tail of all the Armenian breeds. In ewes the weight of the fat tail ranges from 3.1 to 6.1 kg, while in rams it ranges from 7.0-13.5 kg, and can reach up to 16 kg (Rukhkyan 1948).

Reproductive performance and milk production

No reliable information is available regarding the reproductive performance of Mazekh ewes. However, it can be inferred from the data collected by Tamamshev

(1930) that fertility levels in the breed are relatively high, because the percentage of barren Mazekh and Balbass ewes was found to be in the order of 10%, although this percentage was slightly higher than that of Bozakh and Karabakh ewes (5.7%).

The data gathered by Rukhkyan (1948) shows that, on average, this breed exhibits a low level of prolificacy, having an average twinning rate of 12%. As is the case with other sheep breeds, older ewes are more likely to bear twins than younger ewes (Table 11). No data on lamb mortality rates are available. The same report (Rukhkyan 1948) states that, in this breed, pregnancy lasts for 150.0±0.2 days (n=195).

The Mazekh is the best milk-producing breed in Armenia (Table 5). The breed produces 103.6±2.0 kg of milk during one lactation period (n=179) on average, providing 67-72 kg of milk to producers as a result of being milked (Rukhkyan 1948). It should be noted that, in Armenia, all the milk obtained from sheep is transformed into cheese and *matsun* (sour milk); goat milk, on the other hand, may either be transformed into cheese or sold as fresh milk.

Table 12 gives milk production data for each of the sheep breeds kept in Armenia.

Table 11. Relationship between age and twinning rate in Mazekh ewes.

Age	Number of lambed ewes	Number of lambed ewes having: Twins	Singles	Percentage of lambed ewes having: Twins	Singles
2 years	14	1	13	7.1	92.9
3 years	23	2	21	8.7	91.3
4 years	61	9	52	14.8	85.2
5 years	18	2	16	10.0	90.0
6 years	7	1	6	14.3	85.7
7 years	2	0	2	0.0	100.0
Total	125	15	110	12.0	88.0

Source: Rukhkyan (1948).

Table 12. Milk production of 2- to 5-year-old ewes of Armenian sheep breeds.

Breed††	Total milk yield (kg±SE or range)	Lactation length (days±SE or range)	Milking length range (days)	Milk collected range (kg)
Mazekh	103.6±2.0†	168.9±1.6†	90-110	67-72†
Balbass	101.2±3.0†	167.5±1.5†	90-110	65-70†
Bozakh	55-60‡	120-135‡	65-75‡	30-35‡
Karabakh	77.2±5.5†	155±2.5†	80-90	40-45†
MCW Aragat	90-100§	150-175§	120§	65.3§
MCW Martunin	95-105§	150-160§	90-110§	55-60§
Crossbred sheep	114.66¶	150-160¶	90-100¶	40-50¶

Sources: †Rukhkyan (1948); ‡Tamamshev (1930); §Rukhkyan *et al.* (1989); ¶Karamyan *et al.* (1975);
Notes: SE: Standard error; MCW: Medium- coarse-Wool.
††Sample size: Mazekh (n=179); Balbass (n=132); Bozakh (n unknown); Karabakh (n=39); MCW Aragat (n=397); MCW Martunin (n unknown); Crossbred sheep (n=330).

In the case of Mazekh sheep, as is generally true for all the sheep breeds which are milked, milking begins 1.5-2.0 months after lambing and continues for 3.0-3.5 months. From the beginning of milking until weaning (at the age of 4.0-4.5 months), lambs are allowed to suckle their mothers for 0.5-1.0 hour after milking.

Researchers in Armenia have used different methods to determine milk production levels in the country's sheep. Tamamshev (1930), for example, defined the first month following lambing as the initial period of lactation. The two months following this were then defined as the central part of the lactation period, while the weeks that followed were considered to be the terminal period of lactation. During each of these periods, daily milk production was determined by milking for a sample day and then multiplying the amount obtained by the number of days for which the milking period in question lasted.

Rukhkyan (1948) measured milk production in indigenous sheep by control milking every ten days throughout the whole lactation period. First, second and third month production levels were adjusted, based on experimental data, in order to take account of the milk consumed by lambs (Rukhkyan 1936). The data obtained indicate that lambs consume 20-22 kg of milk during the first month of lactation and 12-15 kg during the second and third months.

As was the case for the other sheep breeds kept in Armenia, researchers determined milk production during the suckling period by weighing lambs before and after suckling once every ten days (Minasyan and Japaridze 1975 and Karamyan *et al.* 1975). During the milking period, milk production was determined either by control milking during the middle of each month of lactation (Minasyan and Japaridze 1975), or by multiplying the milk yield obtained during the fourth month of lactation, as determined by control milking, by a coefficient of 7.15 or 7.86 (Karamyan *et al.* 1975).

The data presented in Table 13 demonstrate that the increase in twinning rates which occurs with age is associated with an increase in milk production. It was stated that this increase was due to the stimulation of multiple litters rather than a net increase due to age (Rukhkyan 1948).

Table 13. Relationship between age, milk production over the lactation period, and prolificacy, in Mazekh ewes.

Age	Milk production (kg)	Prolificacy (%)
3 years	79.7	100.0
4 years	97.2	126.3
5 years	102.5	111.4
6 years	111.3	115.9
7 years	115.5	130.7
8 or more years	62.1	110.0

Source: Rukhkyan (1948).

The fat content of the milk produced by the sheep breeds kept in Armenia, along with that of Armenian goat milk, is shown in Table 14. The milk of the best milk breeds, the Mazekh and Balbass, has a rather similar fat content.

Wool production

The Mazekh breed is a poor wool producer (Table 5). Individuals produce coarse, low value wool. Individuals are shorn once a year. Two- to five-year-old ewes yield 1.4 kg (range 1.2-1.6 kg) of wool on average at each shearing, while 2- to 5-year-old rams yield 1.7 kg (range 1.3-2.5 kg) of wool on average (Tamamshev 1930).

Rukhkyan (1948) reported that, in spring, wool yields on the Alagez State Sheep Breeding Farm averaged 1.26 kg in the case of rams (n=230) and 1.12 kg in the case of ewes (n=2300). The percentage of down, intermediate fibers and top hair were 31%, 24% and 33%, respectively. The short top hair percentage was 12%. Some fiber characteristics of this breed are presented in Table 15.

The genetic parameters of this breed have not been estimated, and no Mazekh breeding programs have been established in Armenia.

Table 14. Fat content of milk of Armenian sheep and goats.

Breed	Fat content (%)	Reference
Sheep		
Mazekh	5.3	Rukhkyan (1948)
Balbass	5.4	Rukhkyan (1948)
Karabakh	6.7	Rukhkyan (1948)
MCW Aragat	5.9	Rukhkyan *et al.* (1989)
Crossbred	6.5	Minasyan and Japaridze (1975)
Goats	3.6-6.0	Tamamshev (1930)

Note: MCW: Medium-Coarse-Wool.

Table 15. Wool characteristics of 2- to 5-year-old sheep representing the different breeds kept in Armenia.

			Down‡	
Breed	Sex	Wool yield (kg)	Percent	Diameter (µm)
Mazekh†	Ewes	1.4†	31.2	30.1
	Rams	1.7†	33.2	31.6
Balbass†	Ewes	1.7†	24.7	25.5
	Rams	2.3†	52.7	28.2
Bozakh†	Ewes in spring	1.5†	26.3	30.1
	Ewes in autumn	0.9†	19.7	31.5
	Rams	2.4†	na	na
Karabakh†	Ewes in spring	1.7†	39.1	33.6
	Ewes in autumn	0.7†	34.7	36.3
	Rams	2.2†	na	na
MCW Aragat‡	Ewes	3.3§	66.9	23.3
	Rams	5.7§	51.7	27.1
MCW Martunin‡	Ewes	2.3§	26.4	22.8
	Rams	4.4§	30.9	22.4
Crossbred	Ewes	3.8-5§	na	na
	Rams	6-8§	na	na

Sources: †Tamamshev (1930); ‡Rukhkyan *et al.* (1989); §Rukhkyan (1948).

Notes: MCW: Medium- coarse-Wool; na: Not applicable.

The Balbass Sheep

Within Armenia, the Balbass sheep breed occurs mainly in the Gegharkunik, Aragatsotn, Shirak, Ararat and Vayots Dzor provinces. The breed is also raised in other countries of the region, such is in Azerbaijan, Turkey (where it is known as the Ak-Karaman) and Iran (where it is known as the Iran-Karaman). There were approximately 25,000 Balbass sheep in Armenia in 2003 (Table 3).

Appearance

Balbass sheep are similar to Mazekh sheep with regard to the structure of their fat tail, their live body weight and the amount of milk they produce. However, they differ greatly from Mazekh sheep with regard to the quality of the wool yielded, as the fleece produced by Balbass sheep contains a higher proportion of down fibers. Balbass sheep also yield more wool than Mazekh sheep.

Balbass sheep are white, and have dark spots around the eyes. The tips of the ears are also dark, as are the lower parts of their extremities and their joints. These dark spots are noticeable against the background provided by the white wool which covers the animal's body. Rukhkyan (1948) reported that these spots differ in size, shape, location and color. The heads of individuals can range in color from white to completely black.

The head of this breed is similar in size to that of Mazekh sheep, having a width to length ratio of 1:2. In profile, the head is usually curved, and is seldom straight. The ears of the breed average 13.6 cm in length, though ear length varies greatly between individuals, ranging from 2 to 20 cm. However, short-eared and earless sheep seldom occur. Only 8% of ewes have horns which, when they do occur, are small. Seventeen percent of rams have horns, which, as is the case with Mazekh sheep, are well developed when they occur. The neck of the breed is long and narrow.

The legs are long and the breed's haunches are positioned in such a way that the caps of their joints are close to each other. This breed of sheep has a two-pillow fat tail, the pillows being parallel to each other. The tail ends in an 'S'-shaped tip almost fatless while large amounts of fat are stored in the pillows.

Balbass ram

Balbass ewe

Body measurements

The Balbass is the largest and the heaviest of Armenia's indigenous sheep (Table 9). Linear measurements are given in Table 16. Like Mazekh sheep, Balbass sheep are relatively short, having a length to height at ridge ratio of approximately 0.90 (Table 16). In general rams are larger than ewes. Table 17 gives measurements taken, in February 2000, of ewes kept on a farm in Vedi, a village in the Ararat region of Armenia.

Table 16. Body measurements of Balbass ewes.

	Authors	
Trait (cm)	Tamamshev (1930) (n=264)	Rukhkyan (1948) (n=293)
Height at ridge	69.7	68.9
Diagonal body length	64.8	61.7
Chest width	20.7	20.4
Chest depth	31.8	31.1
Chest girth	93.5	93.9
Metacarpus girth	8.0	8.6

Table 17. Body measurements of 2- to 5-year-old Balbass ewes in a commercial flock (n=15).

Trait (cm)	Mean±SE	Range	SD	CV (%)
Height at ridge	68.1±0.8	64-73	3.0	4.4
Height at sacrum	68.5±1.0	63-74	3.8	5.5
Diagonal body length	64.2±1.0	59-69	4.0	6.2
Chest width	20.2±0.5	16-23	1.9	9.4
Chest depth	31.0±0.5	28-33	2.1	6.8
Chest girth	92.1±1.2	84-101	4.5	4.9
Metacarpus girth	8.3±0.2	7.5-10	0.7	8.4
Head length	11.5±0.2	9.5-12.5	0.7	6.0
Maximum forehead width	20.2±0.2	18-22	0.9	4.5
Pelvis width	18.3±0.2	15.5-21	0.8	4.4

Source: Marmayan (2000, unpublished work).
Notes: SE: Standard error; SD: Standard deviation; CV: Coefficient of variation.

Body weights, growth and carcass traits

According to Kalantar (1913), Balbass sheep range from 39 to 64 kg in weight in the case of ewes and from 54 to 59 kg in weight in the case of rams. Tamamshev (1930), however, has reported higher weight ranges: 53-66 kg in the case of ewes and 66-82 kg in the case of rams.

A more recent study (Avetisyan 1968), estimated that the average live body weight of rams at Mkhchanskaya State Pedigree Breeding Station was 102.5 kg. The same study estimated that the average live body weight of rams at Martuninskaya Station was 101.2 kg. It also found that the average live body weight of elite rams at pedigree breeding and commodity farms was 81.5 kg, while that of first class rams was 73.7-79.2 kg. The same study also found that elite ewes have an average body weight of 52.8 kg in spring, rising to 57.8 kg in autumn. First class ewes display an average body weight of 49.8 kg in spring, a figure which increases to 55.3 kg in autumn. In general, animals reach their maximum weight in autumn (Avetisyan 1968).

Rukhkyan (1948) also found that Balbass sheep attain their maximum body weight at the age of 6 years. The same report recorded similar growth characteristics for young Balbass and Mazekh sheep. Data on the growth of Balbass sheep is provided in Table 18.

Table 18. Growth of Balbass sheep.

	Average weight (kg)	
Age	Rams	Ewes
At birth	4.6	4.4
At weaning (3.5 months)	27.2	25.0
6 months	31.6	28.1
9 months	38.2	32.6
1 year	43.0	37.6
1.5 years	54.8	47.6
2 years	64.9	51.0

Source: Rukhkyan (1948).
Note: the number of observations made was not stated in the source material.

Rukhkyan (1948) reported that single ram lambs weigh 4.01 kg at birth on average, while single ewe lambs weigh, on average, 3.63 kg at birth. The same author also found that, at birth, twinned male lambs weigh 2.90 kg, while twinned female lambs weigh 2.67 kg. Rukhkyan also found that, during the suckling period, average daily weight gain ranged from 190 to 240 g in the case of ram lambs and from 170 to 220 g in the case of ewe lambs. In a later study, Avetisyan (1968) obtained measurements which fitted within the ranges recorded by Rukhkyan (1948). In this later study, birth weights were found to range from 3.5 to 4.3 kg, while average daily weight gain during the suckling period was found to range from 161 to 198 g.

Balbass carcass weight (the weight of a slaughtered animal including viscera, fat and tail) and carcass yield (carcass weight expressed as a percentage of the animal's pre-slaughter weight) average 28.7 kg and 50.1%, respectively, in the case of adult Balbass ewes (>2.5 years old), and 38.1 kg and 51.7%, respectively, in the case of adult Balbass rams (>2.5 years old) (Tamamshev 1930).

Reproductive performance and milk production

As indicated above, no reliable information is available on the reproductive performance of this breed. However, it is known that around 10% of Balbass ewes are barren (Tamamshev 1930); the prolificacy of the breed has been found to range from 113-116% (n=132 ewes) (Rukhkyan 1948).

In Armenia, in terms of milk production, this breed is second only to the

Mazekh (Tables 5 and 12). On average, in this breed, lactation lasts for 167.5 days (range = 114-195 days), and 101.2 kg of milk are produced during that period (range 40-210 kg), of which 65-70 kg are collected (Rukhkyan 1948). In this breed, milk productivity and prolificacy depend greatly on age (Table 19). Balbass milk is 5.4% fat (Table 14).

Table 19. Milk production and prolificacy of Balbass ewes.

Age	Milk production (kg)	Prolificacy (%)
3 years	78.3	105.8
4 years	87.0	115.8
5 years	104.9	125.0
6 years	109.1	116.9
7 years	118.2	111.7
8 years and over	78.0	100.0

Source: Rukhkyan (1948).
Note: the number of observations made was not stated in the source material.

Wool production

The wool produced by Balbass sheep is white and bright, though the fleece may contain some colored wool. Clean wool yields range between 50% and 65%. The wool produced by Balbass sheep is more uniform than that produced by Armenia's other indigenous breeds; it also has a higher down content. The down fibers produced are also finer than those produced by the country's other indigenous breeds (Table 15). In ewes, the down fibers produced on the central portion of the body range from 26.2-26.7 µm in diameter (Rukhkyan 1948).

A negligible phenotypic correlation (r=0.04) was observed between milk productivity and wool yield in Balbass sheep (Rukhkyan 1948).

The genetic parameters of this breed have not been estimated, and no Balbass breeding programs exist in the country.

The Bozakh Sheep

Bozakh sheep are mainly reared by individual farmers in the northeastern and northern areas of the Republic (Table 7). In 2003, there were approximately 22,000 Bozakh sheep in the country (Table 3). The breed has been poorly characterized in Armenia and very little information is available concerning the breed's productivity.

Appearance

Most Bozakh sheep are mainly gray-white or yellow-white in color; however, individuals displaying other colors, including brown and gray, do occur. In this breed, the head and legs are darker than the rest of the body. Most ewes are hornless, while all rams are horned (Table 7).

The fat tail of this breed is smaller than that produced by Mazekh and Balbass sheep. It consists of two comparatively short but wide pillows. The tail tip is small, accounting for one-third of the fat tail's entire length.

The body of the breed is barrel-shaped, being longer than it is high. The udder is small and, as a result, Bozakh sheep produce less milk than the other sheep breeds kept in Armenia (Table 5).

Bozakh ram

Bozakh ewes

Body measurements

Bozakh sheep are small, averaging 61-62 cm in height at the ridge. However, their bodies are longer, relative to their height at the ridge, than those of Mazekh or Balbass sheep.

New data on the body measurements of this breed were obtained in 2000 using animals kept on peasant farms in Katnakhpur, a village in the Tavush region, (Marmaryan, unpublished study). A comparison of this data with that obtained by Tamamshev (1930), shows that the constitution of this breed has changed very little over the last 70 years (Table 20).

Table 20. Body measurements of Bozakh sheep.

	Tamamshev (1930) (n=1,267)		Marmaryan (2000, unpublished) (n=18)	
Trait (cm)	Mean±SE	Range	Mean±SE	Range
Height at ridge	61.7±0.1	53-71	60.7±0.6	57-64
Height at sacrum	62.8±0.1	53-72	62.8±0.8	59-66
Diagonal body length	62.0±0.1	50-72	60.4±0.9	54-65
Chest width	18.9±0.1	15-29	19.2±0.4	16-22
Chest depth	28.5±0.04	24-33	28.1±0.4	26-31
Chest girth	86.7±0.1	73-102	87.1±1.2	80-95
Metacarpus girth	7.5±0.02	6-9	7.3±0.2	6-8
Head length	20.0±0.03	16-23	20.1±0.3	19-23
Head width	11.1±0.02	8-15	9.9±0.3	8-11
Pelvis width	17.2±0.03	13-22	17.1±0.4	15-20

Note: SE: Standard error.

Body weights

Bozakh sheep exhibit the lowest body weights of any of the sheep breeds which originate in the Caucasus. The average body weight of Bozakh ewes has been calculated to be 44.2 kg while that of rams has been calculated to be 59.8 kg (Tamamshev 1930) (Table 9).

Reproductive performance and milk production

The data obtained by Tamamshev (1930) suggest that Bozakh sheep display a high level of fertility, with only 5.7% of ewes being barren. However, the prolificacy of the breed stands at only 107%, the lowest of the breeds kept in Armenia. No other information is available on the reproductive traits of this breed.

The Bozakh is a poor milk producer, yielding only 30-35 kg of milk when milked over the 120 to 135 days which make up the breed's lactation period (Tamamshev 1930) (Table 12).

Wool production

Bozakh sheep yield 1.5-1.6 kg of coarse wool during the spring shearing, and 0.8-1.0 kg when sheared during the autumn. The wool produced on the central section of the side of the body has a down content of 32.4%. The down produced by this breed has an average fiber diameter of 30.0±0.2 µm (Rukhkyan 1948) (Table 15).

Estimates of the genetic parameters of this breed are not available and no Bozakh breeding program exists in the country.

The Karabakh Sheep

Karabakh sheep are raised mainly in the southeastern areas of the Armenia and in the Karabakh area, which lies between Azerbaijan and Armenia (Table 7). The breed consisted of only 20,000 animals in 2003, making it the Armenian sheep breed with the smallest population (Table 3). Most purebred Karabakh sheep are found in the territories which formerly made up the Giri and Kapansliy districts.

Appearance

Karabakh ewes, and most rams, are polled, though horned rams do occur occasionally (Table 7). Most animals are either light brown or dark brown, though gray and black individuals also occur the legs are usually darker than the body. Many purebred Karabakh sheep are short-eared, which may reflect a degree of inbreeding.

The fat tail of this breed is similar in shape to that of the Bozakh sheep; however, unlike the fat tail produced by Bozakh sheep, the fat tail of Karabakh sheep is longer than it is wide. The fat tail is shaped like a partially open pair of scissors, with a short tip. The covering of wool in the belly area is relatively poor.

Karabakh ram

Karabakh ewe

Body measurements

Karabakh sheep are taller than Bozakh sheep, but shorter than Balbass and Mazekh sheep. The animals have long legs and a fine frame. Recent data on the physical characteristics of the breed (obtained from animals kept on a farm in the Siunik region) are compared with older data in Table 21.

Table 21. Body measurements of Karabakh sheep.

	Tamamshev (1930) (n=337)		Marmaryan (2000, unpublished) (n=14)	
Trait (cm)	Mean±SE	Range	Mean±SE	Range
Height at ridge	64.6±0.1	53-74	64.9±0.9	59-69
Height at sacrum	66.0±0.2	54-76	65.5±1.1	59-71
Diagonal body length	63.1±0.1	55-70	63.3±0.9	58-68
Chest width	19.0±0.1	14-26	19.6±0.5	16-23
Chest depth	29.1±0.1	18-34	29.4±0.5	26-32
Chest girth	86.3±0.3	69-99	88.2±1.2	81-97
Metacarpus girth	7.2±0.01	6-9	7.4±0.2	6-9
Head length	23.7±0.1	18-27	20.5±0.3	19-22
Head width	12.0±0.03	9-14	10.1±0.2	9-12
Pelvis width	17.6±0.1	15-20	17.5±0.3	15-19

Note: SE: Standard error.

Body weights and growth

Body weights average 48.0 kg (range 31-61 kg) in Karabakh ewes and 56.1 kg (range 50-58 kg) in Karabakh rams (Table 9). The meat of this breed has an excellent taste, and ranks first among that of native breeds in terms of quality and consumer preference (Table 5).

Lambs develop quickly during the suckling period. According to Rukhkyan (1948), at birth, male lambs average 3.6 kg and female lambs 3.4 kg. By the end of the suckling period, male lambs attain an average weight of 24.7 kg and female lambs an average weight of 23.2 kg; daily weight gains range from 210 to 220 g.

Reproductive performance and milk production

Tamamshev (1930) stated that Karabakh sheep display a high level of fertility, with only 5.7% of the ewes being barren. The same researchers stated that, in this breed, prolificacy ranges from 105-110%. However, no other reports are available regarding the reproductive traits of Karabakh sheep.

As is the case with Bozakh sheep, milk production is poor in this breed (Table 7). On average, the lactation period lasts 155 days (range 105-192 days), during which 77.2±5.5 kg of milk are produced. In this breed, milking yields 40-45 kg, slightly more milk than is yielded by Bozakh sheep as a result of milking (Table 12). The milk produced by Karabakh sheep has a higher fat content (6.7%) than that produced by the country's other indigenous breeds (Table 14) and a dry matter content of 17.2% (Rukhkyan 1948).

Wool production

Due to the poor quality of the wool produced, this breed has been subjected to more intensive crossbreeding than any of the other breeds indigenous to the Caucasus. In total, two annual shearings yield only 2.0-2.2 kg of wool. The wool produced by the breed commands a very low price, as it contains a lot of dead hairs and short top hairs.

No estimates of the genetic parameters of this breed are available, and no Karabakh breeding program has been established in the country.

The Armenian Medium-Coarse-Wool (MCW) Synthetic Sheep

After 1936, mass crossbreeding efforts were implemented throughout Armenia in order to increase the quality of the wool produced, though in some districts flocks of pure Balbass sheep were retained. These efforts mainly crossed native ewes with fine-wool rams.

Efforts to upgrade native breeds using fine-wool breeds continued until 1960 when, due to changes in breeding targets, the crossbred ewes already produced were crossed with rams representing semi-fine wool breeds (Rukhkyan 1961; Rukhkyan *et al.* 1989). Artificial insemination was used during these crossbreeding programs because, in most cases, the fine-wool and semi-fine wool rams used were unable to mate with the indigenous fat-tailed ewes with which they were being crossed.

As a result of these breeding efforts, two medium-coarse wool (MCW) breeds were developed (the Aragat and the Martunin) during two clearly distinguishable phases of development.

In the first phase of the breeding program (1931-1952) a flock of Aragat Semi-Fine-Wool pedigree sheep was developed, at the Alagez State Sheep Breeding Farm, by crossing native coarse-wool Balbass ewes with American Ramboulliet and Lincoln sires. After 1952, sires of this pedigree flock were kept on farms in the Martunin district where they were used to develop the MCW Martunin sheep, which was released in 1984.

During the second phase (1970-1984), the MCW Aragat sheep was developed by backcrossing ewes from the Aragat Medium-Coarse-Wool pedigree flock with fat-tailed Balbass rams. This constituted a change of direction in the breeding process, motivated by high demand for medium-coarse white and light-gray carpet wool from the processing industry. Domestic production could meet only 8.5-13% of demand, the rest being met through imports from other republics (Rukhkyan *et al.* 1989). The revised breeding program was intended to address this, and the MCW Aragat breed was registered in 1984.

MCW Aragat sheep

The MCW Aragat sheep, which is also sometimes referred to as a meat–wool–milk sheep, is raised mainly in the western and southwestern areas of the Republic (Table 7). In 2003, there were approximately 40,000 head of MCW Aragat sheep in the country (Table 3).

Appearance

The MCW Aragat breed is distinguished by its endurance and its good adaptation to mountain rangeland management systems. Both ewes and rams are hornless. The wool is always white, though some animals have dark spots around their eyes, on their faces and on the lower parts of their legs. This is a characteristic typical of the Balbass breed, which was used in the crossing program that produced the MCW Aragat. Both males and females are polled. The fat tail produced by this breed consists of two pillows which are the same shape as those produced by Balbass sheep, though they are comparatively smaller and shorter. The chest is wide and deep, and the frame is well developed. The Aragat is a fat-tailed sheep.

Medium-Coarse-Wool Aragat ram

Medium-Coarse-Wool Aragat ewe

Body measurements

Medium-Coarse-Wool Aragat sheep are large. Ewes average 68-69 cm in height at the ridge, and have a comparatively long body. Estimates of different linear body measurements are presented in Table 22.

Table 22. Body measurements of MCW Aragat sheep (Mean±Standard error).

	Sex–age group				
Trait (cm)	Rams†§ (n=26)	Ewes†§ (n=324)	Rams†¶ (n=75)	Ewes†¶ (n=75)	Ewes‡†† (n=25)
Height at ridge	74.3±0.5	65.1±0.2	69.3±0.6	62.4±0.3	68.4±0.5
Height at sacrum	75.5±0.6	65.8±0.2	70.8±0.6	64.3±0.3	70.0±0.6
Diagonal body length	77.8±0.8	66.9±0.2	68.3±0.6	61.6±0.4	69.4±0.7
Chest depth	35.0±0.5	31.0±0.1	30.0±0.4	27.5±0.1	31.2±0.3
Chest width	24.4±0.2	20.8±0.1	19.1±0.3	16.6±0.1	20.8±0.3
Chest girth	108.0±0.7	90.8±0.2	90.2±0.9	78.4±0.3	93.4±0.8
Pelvis width	21.2±0.2	18.3±0.1	17.9±0.3	14.9±0.1	18.2±0.2
Metacarpus girth	10.0±0.1	8.5±0.0	9.6±0.1	8.2±0.1	9.4±0.1

Sources: †Rukhkyan *et al.* (1989); ‡Marmaryan (2000, unpublished).
Notes: § 2-5 year old; ¶1.5 year old; ††3-5 year old.

Body weights and growth

The meat traits displayed by MCW Aragat sheep are more pronounced than those displayed by Balbass sheep. In the autumn of 1982, researchers recorded average live body weights of 92.1±1.7 kg and 57.5±0.3 kg for MCW Aragat rams and ewes respectively (Rukhkyan *et al.* 1989). Ewe lambs weighed 32.2 kg at 6.5 months of age and 49.5 kg at 18 months of age (Rukhkyan *et al.* 1989). A later study recorded a birth weight of 4.20±0.14 kg for male lambs (n=12) and 3.84±0.12 kg for female lambs (n=15) (Marmaryan *et al.* 2000). On average, at 2.5 months of age, male lambs had attained a body weight of 16.7±0.5 kg (n=37), while female lambs weighed 14.8±0.4 kg (n=41) (Marmaryan *et al.* 2000).

Reproductive performance and milk production

Rukhkyan *et al.* (1989) reported that MCW Aragat sheep exhibit a low average level of prolificacy (115-120%). The same authors also noted that lamb survival rates until weaning stand at 95.3-97.0%. The breed produces a desirable amount of milk, yielding 65.3 kg of milk on average as a result of being milked (n=397 ewes). The milk produced has a fat content of 5.9% (Tables 12 and 14) (Rukhkyan *et al.* 1989).

Wool production

The fleeces produced by this breed range in weight from 3.0 to 3.5 kg, in the case of adult ewes, and from 5.0 to 5.5 kg, in the case of adult rams. At the Alagez State Sheep Breeding Farm, Rukhkyan *et al.* (1989) observed wool yields of 5.56±0.69 kg, 4.20±0.38 kg, 3.27±0.04 kg, and 2.85±0.03 kg in the case of rams (n=27), replacement rams (n=50), first class ewes (n=325) and first class ewe lambs (n=270), respectively. The clean fleece yields of the breed range from 60% to 65%. The wool itself has a staple length of between 14 and 15 cm. The top hairs produced by the breed are thin, and most lack a medulla. The fleeces of this type of sheep do not contain dead hairs (Rukhkyan *et al.* 1989).

Genetic parameter estimates and breeding programs

Based on 156 observations, rather low phenotypic correlation estimates were found between body weight and fleece weight, body weight and fiber diameter, fleece weight and wool length, and fleece weight and wool density (0.31, 0.22, -0.06, 0.43 and 0.18, respectively) (Rukhkyan *et al.* 1989).

Using a full random model, estimated heritabilities within individual lines for body weight, fleece weight and wool length ranged 0.13-0.30, 0.18-0.29, and 0.08-0.24, respectively (Rukhkyan *et al.* 1989).

Within the sire line (four sires), repeatability, estimated as the correlation between measurements taken at 1 and 2 years of age, was 0.6, 0.58, 0.69 and 0.83, for body weight, fleece weight, wool length and fiber diameter, respectively (Rukhkyan *et al.* 1989). The corresponding values of correlation between measurements at 1 and 3 years were 0.53, 0.55, 0.6, 0.7 (Rukhkyan *et al.* 1989).

No breeding programs have been established for this breed in Armenia.

MCW Martunin sheep

The MCW Martunin sheep is mainly reared in central and southwestern areas of the Republic, on farms in the Gegarkunik, Ararat and Vayots Dzor regions. These areas are major Balbass sheep keeping regions (Table 7). This type of sheep is also sometimes referred to as a mutton–wool–milk sheep. In 2003, there were 101,000 MCW Martunin sheep in the country (Table 3).

Appearance

Medium-Coarse-Wool Martunin sheep are similar to Balbass sheep in appearance and color, as they are white and have dark spots on their heads. However, they differ from the Balbass sheep because of higher wool quality and yield. Both rams and ewes are polled, though individuals with short horns do occur occasionally. The MCW Martunin is a fat-tailed breed.

MCW Martunin ram

MCW Martunin ewe

Body measurements

Individual MCW sheep are large, and have a strong constitution and a well-developed frame (Table 23).

Table 23. Body measurements of MCW Martunin sheep kept on the Tsakkar pedigree breeding farm.

	Sires (n=23)		Ewes (n=77)	
Trait (cm)	Mean±SE	Range	Mean±SE	Range
Height at ridge	74.1±0.6	66-78	68.5±0.3	62-75
Height at sacrum	74.7±0.5	68-78	68.8±0.3	64-75
Diagonal body length	70.5±0.6	62-75	64.9±0.3	60-70
Chest depth	35.7±0.4	33-39	32.2±0.2	28-35
Chest width	23.2±0.4	20-28	20.2±0.2	17-25
Pelvis width	19.8±0.3	17-22	19.0±0.2	16-23
Chest girth	99.3±1.0	89-109	90.2±0.4	80-97
Metacarpus girth	9.8±0.2	9-13	8.0±0.5	7-10

Source: Rukhkyan *et al.* (1989).

Note: SE: Standard error.

Body weight and growth

In the autumn, MCW Martunin ewes attain a body weight of 55-58 kg, and rams a body weight of 75-80 kg. The average weight of animals kept on pedigree breeding farms are higher, in fact average weights of rams, ewes, ram hoggets and ewe hoggets have been recorded as 92.0, 57.8, 50.6 and 45.9 kg, respectively, during the autumn (Rukhkyan *et al.* 1989). Average birth weights were also studied using lambs from various farms. The birth weights of male MCW Martunin lambs ranged from 3.64 to 4.34 kg while those of female lambs ranged from 3.5 to 4.2 kg. At weaning, male and female lambs were found to weigh 26.0 kg and 23.6 kg, respectively. During the pre-weaning period, lambs were found to gain from 142.8 to 162.2 g per day (Rukhkyan *et al.* 1989).

Reproductive performance and milk production

No reports are available on the reproductive performance of this breed. Over a period of several years, however, Rukhkyan *et al.* (1989) found that the prolificacy rates of ewes kept on farms in the Martunin and Ararat districts ranged from 100% to 102.3%, while in the best flocks they ranged from 101 to 117%. Lamb survival until weaning ranged from 89% to 100% (Rukhkyan *et al.* 1989).

According to Rukhkyan *et al.* (1989), like MCW Aragat sheep, MCW Martunin sheep produce desirable amounts of milk. Within the lactation period, a single ewe can yield 55-60 kg of milk as a result of being milked. Based on data produced through controlled milking, (Rukhkyan *et al.* 1989) found that 27.4% of the 105 experimental ewes studied displayed high levels of milk productivity (81-130 kg); a further 47.6% displayed a medium level of milk productivity (56-80 kg), while the final 25.5% produced only small amounts of milk (i.e. 55 kg or less of milk).

Wool production

Unlike that produced by Balbass sheep, the wool produced by MCW Martunin sheep does not contain dead hairs. It also contains less top hairs than the wool of Balbass sheep. The wool produced by MCW Martunin sheep is medium coarse and bright. Ewes yield 2.0-2.5 kg of wool per shearing and rams 3.5-4.5 kg per shearing. Rukhkyan *et al.* (1989) reported the fleece weights of adult rams, adult ewes and 7- to 8-month-old lambs as 4.4, 2.3 and 0.75 kg, respectively. The same author reported that the average clean wool yield of the breed stands at 68%. The wool produced by MCW Martunin rams consists of 26-31% fur hair and 69-74% intermediate and top hair; in ewes these percentages range from 26% to 29% and from 71% to 74%, respectively (Rukhkyan *et al.* 1989).

The genetic parameters of this breed have not been estimated, and no breeding programs have been established for this breed.

The Armenian Crossbred Sheep

Armenian Crossbred sheep, a group which does not consists of a single defined breed, are the result of selection among the F1 progeny obtained after crossing fine-wool´coarse-wool ewes with pedigree sires representing fast-growing meat–wool breeds such as the North Caucasus meat–wool, the Lincoln, the Russian long-fleece and the mountain Corriedale. Armenian Crossbred sheep have a well-developed and strong frame and grow quickly. They exhibit the optimum combination of meat, wool and milk productivity, and are well adapted to mountain and foothill management. The grouping consisted of a population of approximately 50,000 Corriedale crossbreeds and 226,200 medium-coarse wool crossbreds in 2003 (Table 3), making it the largest of Armenia's sheep groups. This type of sheep is mainly raised in the Kotaik, Gegharkunik, Shirak and Aragatsotn provinces.

In the past, the group was widely distributed throughout Armenia. However, this changed after privatization, as farmers began to concentrate mainly on native breeds because of the collapse of the textile industry and the fact that there was almost no demand for wool.

Appearance

Crossbred sheep have a thin tail which may reach 25-30 cm or more in length. They are similar in appearance to the meat–wool sheep breeds kept in the country. No spots occur on the body of this type of sheep, though black spots do occur on the ears. The fleece produced is white. Rams and ewes are polled.

Body measurements

The body measurements of crossbred ewes kept on farms in the Kotaik region are given in Table 24.

Corriedale crossbred ram

Corriedale crossbred ewe

Body weights and growth

The live body weights of adult (≥2.5 years) crossbred rams range from 90 to 105 kg, while those of adult (≥2.5 years) ewes range from 55 to 56 kg. Crossbred lambs weigh between 28 and 32 kg at weaning. Data on the growth characteristics of this type of sheep are presented in Table 25.

Table 24. Body measurements of 2- to 2.5 year-old Armenian Crossbred ewes (n=50).

Trait	Mean±SE (cm)
Height at ridge	69.1±0.4
Height at sacrum	70.9±0.4
Diagonal body length	71.4±0.4
Chest depth	32.7±0.2
Chest width	23.6±0.2
Chest girth	99.2±0.6
Metacarpus girth	9.3±0.1
Pelvis width	18.9±0.2
Head length	23.8±0.2
Head width	14.1±0.1

Source: Marmaryan (1996).
Note: SE: Standard error.

Table 25. Growth of Armenian Crossbred sheep.

	Rams			Ewes		
Age	Mean±SE (kg)	Range (kg)	CV (%)	Mean±SE (kg)	Range (kg)	CV (%)
At birth	4.4±0.1	2.5-6.0	15.5	4.0±0.1	2.2-6.0	4.2
2.5 months	16.7±0.5	12.0-22.5	20.5	15.2±0.4	10.5-19.0	14.7
5.5 months	30.7±0.9	24.0-36.5	19.4	28.1±0.7	22.5-33.0	13.1
8 months	31.0±0.9	23.5-37.0	19.9	28.2±0.8	22.5-34.5	19.4
14 months	34.5±0.7	25.0-39.0	11.0	32.0±0.9	24.5-37.0	14.9
18 months	54.7±1.0	46.0-63.0	8.6	44.5±0.7	36.0-49.0	8.0

Source: Marmaryan (1996).
Notes: SE: Standard error; CV: Coefficient of variation.

At 18 months of age, male crossbred lambs weigh 12.4 times more than they do at birth. While, at the same age, females lambs weigh 11.2 times more than they did at birth. It was found that maximum average daily weight gain occurred from birth until the age of 5.5 months, with an average daily gain of 155.3-164 g for ram lambs and 143.5-148.8 g for ewe lambs (Marmaryan 1996).

Reproductive performance and milk production

In crossbred sheep, gestation lasts for between 140 and 158 days (148.6 days on average). Female lambs gestate for a shorter period of time than male lambs (Marmaryan 1996).

Crossbred ewes exhibit a high rate of prolificacy: 120-125 lambs per 100 lambed ewes (Karamyan and Minasyan 1973; Marmaryan 1996; Pambukhchyan 1981). No other data is available concerning the breed's reproductive performance.

Per lactation period, crossbred ewes produce 121 kg of milk on average, the fat content of which is 6.5%. Within the milking period, such ewes can yield 40-50 kg of milk as result of milking. The milk produced is used to make various types of cheese (Karamyan *et al.* 1975).

Wool production

The fleece of crossbred sheep consists of long fibers. It is homogenous, and has large lustrous curls. According to the Soviet standards applied to sheep, cross-breeds producing this type of wool are defined as crossbred Corriedales.

Crossbred sheep produce wool which has an average fiber diameter of 26-30 μm and a staple length of 12-15 cm. The fleeces produced by adult rams (≥2.5 years) weigh 6-7 kg, while those produced by adult ewes (≥2.5 years) weigh 3.8-5.0 kg; the clean wool yield of this type of sheep ranges from 58 to 65% (Pambukhchyan 1981). In villages of Kotaik province, the average weight of the fleeces produced by rams was found to be 5.13±0.19 kg (range 3.0-6.9 kg); the average clean fleece yield was found to be 62.8% (range 56.4-69.8%) (Pambukhchyan 1981).

Genetic parameter estimates and breeding programs

Heritability of body weight estimated as twice the daughter–mother regression at the Kotaik sheep farm was 0.58, and that of fleece weight 0.45 (Marmaryan 1996). Phenotypic correlations between body weight and fleece weight were 0.15 in ewes, 0.11 in ram lambs, and 0.43 in ewe lambs. Correlations between body weight and wool length were 0.05, 0.04 and 0.05, for ewes, ram lambs and ewe lambs, respectively; between wool length and wool yield they were 0.24, 0.19 and 0.33, respectively (Pambukhchyan 1981).

The only existing research flock of crossbred sheep is that raised at the Armenian Agriculture Academy Research Station. Population trends indicate that this group is declining in number; this is an issue that gives cause for concern and that needs to be addressed. No breeding program has been established for this group.

Goat Breed Characterization

Unlike sheep production, goat production has always been a minor livestock production sector in Armenia, accounting for, at most, only 1-7% of livestock production in the country. Goat production is mainly confined to farms of the Vayots Dzor, Siunik and Tavush regions. However, possibly in response to a project promoted by the USDA, producers are showing more interest in raising goats. In fact, the number of goats kept in the country has raised from 14,000 head in 1991 to 46,920 head in 2003 (Table 3).

The Armenian Native Goat

Appearance

Very few studies are available which characterize the goats kept in Armenia; the most detailed is that of Tamamshev (1930), which provides a general characterization. Most Armenian goats are black (53.3% of animals), though white and spotted animals do occur, accounting for 11.3% and 10.9% of the goat population, respectively (Tamamshev 1930). Armenians goats have a short head (18.6 cm) which is usually straight in profile (57.3% of the animals). The forehead of most animals (58.3%) is straight. However, a nearly equal proportion of the population (40.7%) consists of animals with a dome-shaped forehead. Most animals (90%) have a straight nose (Tamamshev 1930). On average, the ears of these animals are 14.8 cm in length. The majority of Armenian goats have wide ears. In most cases (60%) the ears are semi-erect; in the remainder (35%) they hang down. A small proportion (9.3%) of the goats kept in Armenia are hornless (Tamamshev 1930).

Armenian Native buck

Armenian Native doe

Production traits

The body of the Armenian goat is relatively short (64.4 cm) and the spine is straight. Individuals average 64.5 cm in height at the ridge; chest depth and chest girth average 29.5 cm and 81.4 cm respectively. The body is cylindrical and the legs are long. The udders and teats of does are well developed (in 59.3% of the animals); the teats are widely spaced and are cone-shaped.

Tamamshev (1930) records the average live body weight of 2- to 5-year-old does as 33.1 kg (range 25-44 kg, n=33). In a more recent study, however, Marmaryan *et al.* (2000) reported that does have an average body weight of 35.5 kg, ranging between 25 and 45 kg (n=33 does with an average age of 3.36 years).

An average of 89.6 kg of milk is collected through milking (Tamamshev 1930). According to Marmaryan *et al.* (2000), the lactation period ranges from 8-10 months, during which time 150-400 kg of milk may be produced.

The coat of the Armenian goat consists of long, thick, straight, fibers and contains little down.

The genetic parameters of the Armenian goat have not been estimated. Only one program, based on a USDA-funded initiative, supports the development of Armenia's dairy goat sector. The program began in 1999, when the semen of certain milk breeds (Saanen, Alpine, Nubian and Toggenburg) was imported so that breeding efforts could be made which would improve the milk yield of goats kept in Ehidnadzor, in the Vayots Dzor province. A center created in this area now maintains the nucleus breeding herd. To promote the breeding program, cooperatives of goat producers were also established.

In 1999, only 198 does were artificially inseminated at four farms. By 2004, however, this figure had risen to 2500 does kept on 15 farms. In total, 25 farmers are involved in the work being undertaken by the program. The results are encouraging, as crossbred goats are already producing from 280-400 kg milk, considerably more than the 120-140 kg produced by native goats. The live body weights of the crossbred animals are also 10-12 kg higher than those of the native animals.

One important feature of this program is the work being done to improve the marketing of the milk produced. The program has now created 15 subsidiary milk-collecting points, seven of which produce different types of cheese for which the markets in Armenia, Russia and the USA exert a reasonably high level of demand. The results of this initiative suggest that the program will benefit both Armenia and the surrounding region.

The project, which aims to improve both the dairy goat and cattle production sectors, involves the integrated management of breeding, production, and marketing. It has established three dedicated cheese-making plants, one in Aragatsotn province and two in Shirak province, which produce cheese from both goat's milk and cow's milk. To test the marketing prospects of the products produced by these plants, the USDA successfully facilitated the export of both types of cheeses to the USA. As a result of these steps, exports have grown from 33 tonnes in 2001 to 200 tonnes in 2004. In addition, since 2002, 800 tonnes of low-fat cheese spread have been exported to Russia.

Prospects for Small Ruminant Production in Armenia

Per capita consumption rates of milk and meat products are still low in Armenia (Misik 2003; Ministry of Agriculture of Armenia 2002; Marmaryan 2003). However, it is hoped that future increases in people's purchasing power will result in an increase in the demand for small ruminant products, thus creating the conditions necessary for farmers to increase their incomes. However, demand will always be limited by the size of the market available. Because Armenia's internal market is small, opportunities should be sought which would allow goods to be exported, particularly to Russia and, if possible, to the Gulf countries. This would require Armenia to have a competitive production sector that made use of modern technologies and that exploited the potential for production offered by the country's natural resources.

Currently, production conditions within the Armenian livestock sector are far below those required if it is to be healthy and competitive. Meat and milk are the products most likely to be in demand in the years to come. However, Armenia's farmers lack training, and do not have access to the technologies necessary to produce either product competitively. As a result, they do not adequately attend to the health of their livestock, through appropriate veterinary and sanitary control measures. In addition, measures are not implemented to control the quality of the meat and milk produced.

The situation is made worse by the fact that Armenia's farmers are unable to access improved animals, and adequate breeding systems have not been implemented to help them do so. They are also unable to gain access to market information. In addition, research services have not attempted to manage such information and so reorient production.

In short, Armenian farmers lack the organization necessary to efficiently produce, process and market their goods, which remain poorly advertised. Modernizing the small ruminant sector to ensure that it is competitive will obviously be a difficult process which will require both international aid and a high level of commitment on the part of the country's government.

An interesting case that deserves mention here is that of a research–development project, supported by USDA, which involves dairy goats (see preceding section). This integrates goat breeding and production issues, as well as the marketing of products. Goat's cheese is being exported to the USA, although currently on a small scale.

An important issue in this context is the need to revitalize and modernize the country's research and extension services. Especially important is the ability of these services to develop and deliver measures that are appropriate for small-scale and resource-poor farmers, and that will improve their living standards. An efficient research service is needed and research should be strongly linked to development. This would ensure the full exploitation of new technologies and the formulation of the best possible options for taking advantage of existing market opportunities—on which development efforts should focus.

Because no systems are currently in place to regulate the management of small ruminant genetic resources, this could lead to the disappearance of some adapted breeds or their displacement by uncontrolled crossbreeding. The cost of maintaining breeds on research stations is high. Therefore, realistic ways should be sought of establishing nucleus breeding herds in farming communities or, better still, under the control of farmer associations. These steps should be coupled with efforts to improve the marketing of the products of a given breed for which there is a demand. However, though this could save some breeds, it will not save all. For breeds faced with a serious risk of erosion, a regional plan should be devised for the Caucasus; those breeds which only occur in Armenia could then be conserved using modest, but effective, measures.

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Azerbaijan

Chapter Eight

Small Ruminant Breeds of Azerbaijan

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Introduction

The collapse of the Soviet Union has caused profound production changes in Azerbaijan. The rates of development seen in the industrial, agricultural and oil-extraction sectors have, for example, changed dramatically. The agricultural sector suffered seriously during the transition to a new market arrangement, as a result of privatization which shifted the ownership of land and livestock to individuals and fragmented large production units into smaller ones. As a result, production levels declined seriously and organized breeding practically disappeared. The information reported here gathers together the available knowledge on small ruminant production in Azerbaijan.

Importance of Small Ruminants

Azerbaijan has a population of 8,265,700 people, 49% of whom live in rural areas. This part of the population largely depends on agricultural production, a dependency which has become more pronounced since the breakdown of the Soviet Union, after which sources of employment diminished noticeably.

Sheep and goat production are among the most important components of livestock production in Azerbaijan. Sheep provide food (mutton and dairy products) and raw materials for the processing industry (wool and skins) while goats produce milk and meat. It is estimated that approximately 1.5 million people in the country benefit from sheep and goat production.

Small Ruminant Populations and Tenure

Azerbaijan's sheep population in 2003 amounted to 6.78 million head, and is increasing after an initial decline immediately after the breakdown of the Soviet Union. The country's goat population in 2003 was estimated to stand at 0.5 million head. After the disintegration of the Soviet Union, all the assets held by collective farms and State Farms were privatized. The sheep and goats kept by them were therefore distributed among farmers, and only 1% of farm animals were retained within the state sector. Currently farmers' flock sizes vary in size from 10-15 to 500-1000 animals.

This process resulted in the formation of new farming types, including cooperative, small-scale and individual farming units dedicated to the production of cattle, small ruminants, buffaloes, horses and other farm animals. All the country's rangelands have now been divided up and rented to farmers, using different lease terms (from 10 to 15 years). Table 1 gives data on the distribution of small ruminants in the private sector.

The data in Table 1 shows that small ruminant ownership is concentrated in small farming units, each of which owns a handful of animals. These units have no access to production technologies and operate at low levels of productivity.

Breeds: Geographical Distribution and Breed Population Trends

The FAO (2003) reported that there were 593,979 goats and 6,392,462 sheep in Azerbaijan. Slightly different values are reported by the State Statistical Committee of Azerbaijan (2004) (Table 2). There are six breeds of sheep in the country and several different types of goats, which have not been well characterized. Table 2 gives the population numbers of the country's sheep and goat breeds.

Table 1. Distribution of production systems and the tenure of small ruminants in Azerbaijan.

Type of production systems	Numbers of farm units	Total population (in thousands)	Ownership of small ruminant population (%)
Cooperatives	6	239.9	3.3
Small-scale farmers	50,000	2,548.0	35.0
Individual farming units	1,467,000	4,492.2	61.7
Total	1,517,006	7,280.1	100.0

Source: Compiled by the authors based on data provided by the State Statistical Committee of Azerbaijan (2004).

Table 2. Population (number of head) and distribution of sheep and goat breeds in Azerbaijan.

Breed	1992†	1995†	1999†	2003‡	Geographic region
Sheep					
Balbass	250,300	287,700	385,331	474,898	Nakhichevan
Karabakh	171,778	354,650	558,465	781,174	Milsk Karabakh (42.5%) and Karabakh (57.5%)
Gala-Apsheron§	53,135	150,500	500,000	540,000	Apsheron
Lezgin	10,000	24,000	54,400	57,000	Sheki-Zakatal
Bozakh	25,000	51,000	105,000	112,000	Gyanja-Gazah
Merino	900,000	351,780	60,350	52,124	Gyanja-Gazah (Kadabek district)
Crossbreds	na	na	na	4,762,950	Throughout the Republic
Total sheep	1,410,213	1,219,630	1,663,546	6,780,146	
Goats	na	na	na	500,000	Throughout the Republic

Sources: †Compiled by the authors; ‡State Statistical Committee of Azerbaijan (2004); § A variety of the Shirvan breed.
Note: na: not available.

Table 2 shows a decline from 1992 to 1995, and an increase in the sheep population thereafter. No information was available for goat populations during this period. The Karabakh, Gala-Apsheron (variety of the Shirvan), Lezgin and Balbass populations grew during the period 1992-1999 while the Merino population decreased, reflecting difficulties in the wool market and the preference for meat–milk breeds.

Table 2 also shows the main geographical areas in which sheep are kept. In general, the breeds occupy specific ecological areas. An attempt was made to depict maps containing the distribution of sheep breeds in the country in Figures 1-2, while goats are usually distributed throughout the country.

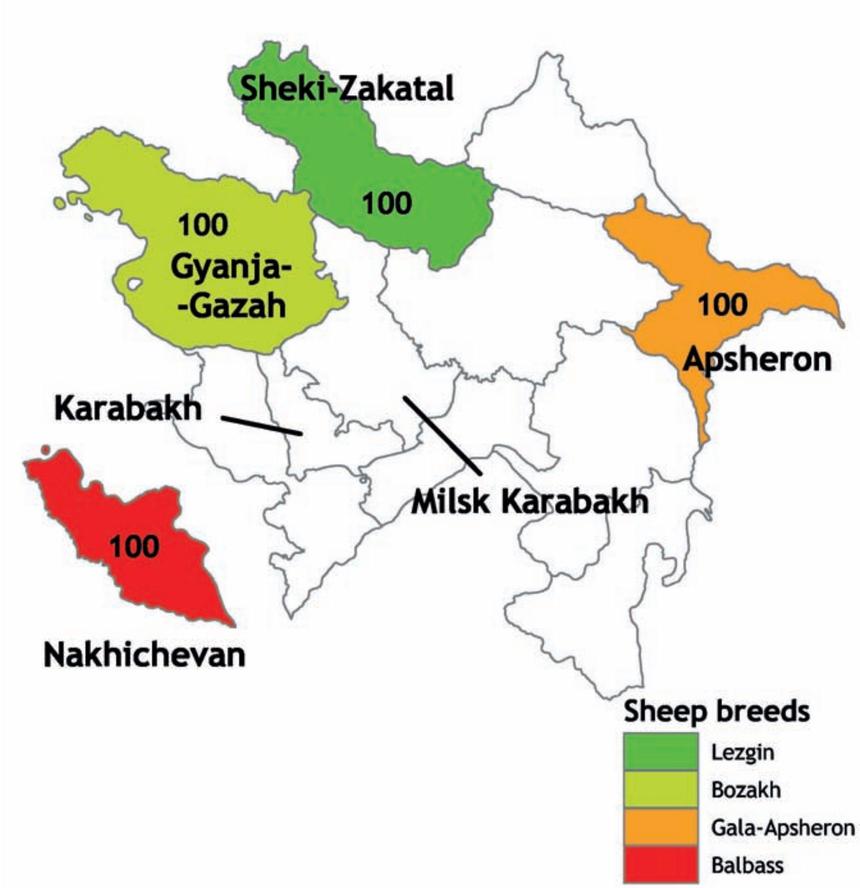

Figure 1. Geographical distribution of Balbass, Gala-Apsheron, Lezgin and Bozakh sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different regions of Azerbaijan. Note that these breeds occur mainly in specific geographical regions.

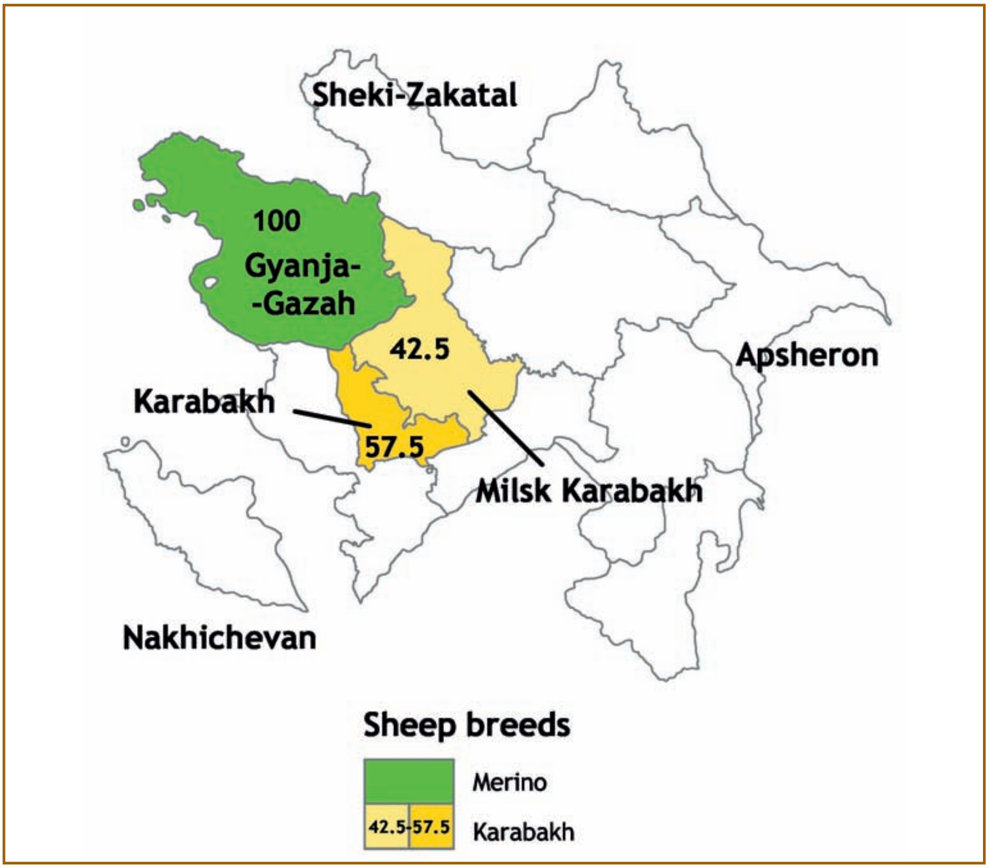

Figure 2. Geographical distribution of Karabakh and Azerbaijan Mountain Merino sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors.
Numbers represent percent distribution of the breeds in the different regions of Azerbaijan. Note that all Mountain Merino are located in Gyanja-Gazah.

Characteristics of Azerbaijan's Sheep- and Goat-Producing Areas

The Nakhichevan region

The Nakhichevan Autonomous Republic, is the home of the Balbass sheep; the area contains adequate summer grazing. The zone is mountainous and accounts for 7% of the total area of Azerbaijan. The region is located in the center of the Araks River basin, at an altitude of 700-4000 m a.s.l. Its summer ranges are mainly located in high mountainous zones, particularly the alpine zone (at 2800-3200 m a.s.l.). These summer ranges provide rich vegetation containing those drought-tolerant grasses characteristic of semi-desert and steppe areas. The basic feed resource consists of *tipchak* (*Festuca sulcata*) plants which grow either alone or in mixed stands.

All of the summer ranges are heavily overburdened. The actual grazing load (16.9 head/ha) exceeds the optimal load (3 head/ha), damaging range productivity. Annual rainfall is 1000-1800 mm. Winters are cold, snowy and windless. Winter temperatures fall to as low as -30°C. By contrast, summers in the area are very hot and dry, with temperatures rising as high as 43°C. There are almost no forests in this area.

The Milsk-Karabakh steppe

The steppe of the Milsk-Karabakh region is suitable for winter grazing because snow is practically absent. The area also provides summer grazing ranges, which are located between the Kura and Araks Rivers. The steppe is dry and hot in the summer (4-5 months). In July temperatures can reach 42°C. January is the coldest month of the year, with an average of 0°C and occasional frosts. Snow seldom falls and melts fast when it does. Annual rainfall in the area is 300 mm. The flora is diverse. In years with wet winters and springs, annual ephemeral grasses form a thick and rich herbage suitable for haymaking.

The Mulgano-Salyan steppe

The steppe of the Mulgano-Salyan region is the main home of the Shirvan breed and is suitable for both autumn–winter and early-spring grazing. This area is located in the east Caucasus. The climate is sub-tropical and semi-desert. Humidity is high in winter and lower (though still considerable) in summer. The foothills of this zone are overgrazed, displaying obvious degradation and the erosion of valuable vegetation. Notably, the winter rangelands have been irrigated as a means of producing more biomass. This is still practiced using channels which capture the waters of the Araks River. Sheep in this region are managed on the basis of year-round grazing on the ranges next to villages. The availability of vast range areas and irrigation mean that this area has promise with regard to the development of sheep breeding under permanent grazing management.

The Sheki-Zakatal zone

This zone is home to the Lezgin sheep. The area accounts for 12% of the total territory of the country, and includes the Belakan, Zakatal, Gakh, Shekin, Oguz and Kabalin regions. The zone contains both highland and lowland areas. The southern steppes serve as winter rangelands for farms in the Zakatal, Kakh and Shekin regions. The lowest temperatures occur in January. From February the temperature are higher; July and August are the hottest months of the year. In this area, precipitation averages 500 mm per year.

The Gyanja-Gazah zone

This zone is home to the Bozakh and Merino breeds. It is located on the northern Shagdag and Mrovdag mountain ranges, where elevations vary from 200-300 m a.s.l. in the Kura River valley to 3,722 m a.s.l. in the southern part of the district.

In the lowlands annual rainfall amounts to 300-400 mm, most of which falls in the autumn and winter. Summers are hot, and temperatures can be as high as 40°C. In winter, cold winds and snow can lower temperatures to as low as -15°C. Snow remains on the ground for 5-10 days. The coldest period of the year lasts from December to February. The vegetation in the area is diverse. In the plains and on the Djairanchelia desert steppe, it includes *Artemisia* and stands containing a combination of Gramineae and *Artemisia* species.

The highlands in the area are used as summer ranges, and contain a combination of Gramineae and *Artemisia* species. These highland areas can produce 8500-9500 kg/ha green matter per year, a figure which can fall to 300-600 kg/ha/year in dry years. From April to the beginning of May the steppe is covered with a rich green biomass that animals can use to restore the weight they lost over the winter. The winter ranges in this area do not provide sufficient feed for the animals kept on them, so feed concentrates need to be provided.

The Kadabek and Shemkir regions

These regions are home to the Azerbaijan Mountain Merino sheep, a breed which is kept on the plateau of the Small Caucasian Range at altitudes of 1500-2200 m a.s.l., though the animals could also be moved to Prikura a lowland area only 300-400 m a.s.l. The average annual temperature in the highlands is 7.9°C, while the average annual rainfall is 559 mm (varying from 359 to 720 mm). These regions provide summer and winter ranges for grazing year-round; however, there are insufficient winter ranges to meet demand, which leads to range overgrazing and degradation.

Table 3 attempts to summarize the use made of the ranges during the year, and includes the periods during which small ruminants need to be provided with feed supplements in winter and the conditions of the resource base for livestock production.

Table 3. Availability of small ruminant grazing ranges and feed potential per zone.

Region	Spring ranges	Summer ranges	Fall ranges	Winter ranges	Months extra feed is required	Potential for small ruminant raising (rank)†	Degraded range degree (rank)‡
Nakhichevan	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb	1	8	5
Milsk-Karabakh	Feb-Jun	Jun-Aug	Sep-Nov	Dec-Feb	1.5	6	5
Apsheron Kura-Araks	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb	1	7	3
Sheki-Zakatal	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb	1	8	2
Gyanja-Gazah	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb	1.5	6	4
Kadabek and Shemkir	Apr-Jun	Jul-Oct	Nov-Dec	Jan-Mar	2	7	3

Source: Compiled by authors.

Notes: †1 the lowest potential and 10 the highest;

‡1 the lowest level of degradation and 7 the highest.

For more details the reader is referred to Figurovskiy (1919), who described Azerbaijan's ecological zones, and Grasscheim (1939), who described Azerbaijan's flora.

The Current Demand for Small Ruminant Products

As is the case in all Caucasian countries, Azerbaijan has a tradition of consuming processed meat and milk products derived from sheep and goats. Reflecting these traditions, despite the people's limited purchasing power, mutton and goat meat are in high demand on the domestic market. The same is true for the milk of these species. By contrast, however, wool and sheepskins are in very low demand due to disrupted markets and the upheavals that have affected Russia's processing enterprises, a problem which is compounded by a lack of processing facilities in the Republic. Table 4 provides data from a qualitative assessment of the importance of meat and milk products produced from the different breeds.

The characteristics of *motal* cheese are summarized in Box 1.

Table 4. Main products obtained from sheep and goats and their market demand.

Breed	Major products	Present market demand	Milk products
Sheep			
Balbass	Mutton	High	Fresh cheese,
	Milk	High	*motal* cheese
	Wool	Low	and other milk products
Karabakh	Mutton	High	Fresh cheese,
	Milk	High	*motal* cheese
	Wool	Low	and other milk products
Shirvan†	Mutton	High	Fresh cheese,
	Milk	High	*motal* cheese
	Wool	Low	and other milk products
Lezgin	Mutton	High	
	Milk	High	Fresh cheese
	Wool	Low	and other milk products
Bozakh	Mutton	High	
	Milk	High	Fresh cheese
	Wool	Medium to high	and *motal* cheese
Merino	Wool	Medium to high	Fresh cheese
	Mutton	High	and *motal* cheese
Goats	Meat	High	Fresh milk for babies,
	Milk	High	and making butter, yogurt,
	Fiber	Low	sour clotted milk and other products

Source: Compiled by the authors.
Note: † also known as Gala-Apsheron.

Box 1. Motal cheese

Motal cheese is produced mainly from goat and sheep milk particularly when flocks are kept on the mountain ranges. *Motal* cheese making is a very delicate process which involves a number of steps. Undamaged healthy ram skins with a covering of wool 2 cm in length are needed for its production. A gauze bag is placed on the skin along with 5-8 cm pieces of matured cottage cheese (*brynza*), and some fat. Salt is also added (accounting for 3-4% of the mixture). Moisture levels are kept at not less than 50-52%, to keep the product clean. The skin is tied up tightly from all sides except the tail end, through which fresh cheese is introduced into the gauze bag through a tube. The skin should be placed in a cool place and allowed to mature; the product should be turned over every 3-4 days. It is then unpacked after 3 months.

High quality *motal* is yellowish and has a pleasant smell and a light consistency. This type of cheese is recommended for consumption only during the winter, due to its high fat content. The product rots easily under the warm conditions that occur in spring, when it turns a greenish color and gives off a distinctive bad odor. Different types of *motal* include *Karabakh*, *Gyangin,* and *Lezgin*.

Salient Characteristics of the Breeds

The most salient characteristics of Azerbaijan's sheep and goat breeds, and the various ecosystems in which those breeds are raised, are given in Table 5.

Table 6 shows that the Balbass, Karabakh and Shirvan (Gala-Apsheron) sheep are the largest breeds and that they yield the most milk. The prolificacy of the indigenous breeds is low, and is similar in all cases. By contrast, the Merino sheep kept have a slightly higher prolificacy rate. The goats kept exhibit high levels of prolificacy and produce more milk than do the country's sheep breeds.

The breeds rank from the best to the poorest producers as follows: Merino>Lezgin>Balbass>Shirvan (Gala-Apsheron)>Bozakh>Karabakh. Karabakh wool contains a high percentage of dead hair and top hair fibers. There is almost no demand for coarse wool, including that produced by the Karabakh.

Management

Mating takes place between September and October and lambing occurs between February and March. Lambs are raised by their mothers until they reach 4-5 months of age. Five- to seven-year-old ewes and rams and 8- to 18-month-old ram lambs are used for mutton production. Shearing is undertaken once a year (during May and June), except in the case of coarse-wool animals, which are shorn twice a year. The milking of ewes (from May to August) is a regular practice in the country.

Sheep flocks are managed under grazing conditions, though additional feed is provided during the winter and early spring for periods which range from 40 to 100 days in length, depending on range productivity. This feed is provided at the rate of 0.3-0.6 feed units per head per day. The additional feed provided consists of stockpiled rough fodder and concentrates. Such management can change according to the severity of the climate. Except in some areas of the Nakhichevan and Gyanja-Gazah regions, winters in Azerbaijan are usually mild and so, during this season, all animals are driven to the winter ranges, which are located in the lowland and plain areas.

Table 7 provides a calendar of the management practices used with Azerbaijan's sheep and goat breeds.

Table 5. Salient breed characteristics of the sheep and goats of Azerbaijan.

Breed	Tail	Coat color	Horns	Distribution	Adaptation to
Sheep					
Balbass	Fat-tailed	White	Only rams	Mountain and lowland ranges	Continental climate
Karabakh	Fat-tailed	Gray, black and chestnut	All polled	Ranges on the plains	Intensive management
Shirvan†	Fat-tailed	White	All polled	Ranges on the plains and steppes	Intensive management
Lezgin	Fat-tailed	White	Only rams	Steep mountains and forests	Remote range management
Bozakh	Fat-tailed	Gray and other colors	Most rams and few ewes	Remote mountain ranges in summer, and winter ranges	Remote range management
Merino	Thin-tailed	White	Only rams	Remote mountain ranges in summer, and winter ranges	Grazing on mountain slopes
Goats	Normal, erect	Many colors	All horned	Steep mountains and plains	Grazing on stony ranges which are difficult to access

Source: Organized by authors.
Note: †also known as Gala-Apsheron.

Table 6. Salient production characteristics of Azerbaijan sheep and goats.

	Live weight (kg)						
Breed	Adult females	Adult males	Weight rank‡	Milk yield (kg)	Lactation period (days)	Milk rank§	Prolificacy (%)
Sheep							
Balbass	50-60	75-88	1	125-130	180	1	125-130
Karabakh	45-55	75-85	2	105-110	180	2	115-120
Shirvan†	50-60	65-85	3	110-115	180	2	110-115
Lezgin	33-36	45-50	4	70-80	180	3	105-108
Bozakh	33-38	58-65	4	75-80	180	3	100-110
Merino	36-40	55-70	4	75-85	180	3	115-120
Goats	30-35	40-45	na	100-150	180	na	150-200

Source: Compiled by the authors.
Notes: na: not applicable; †also known as the Gala-Apsheron.
Ranks: ‡Weight ranks: 1 heaviest to 4 lightest;
§ milk production ranks: 1 best producers to 3 poorest producers.

Table 7. Sheep and goat management features.

	Months											
Events and seasons	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Grazing winter ranges†												
Grazing summer ranges‡												
Supplementary feeding												
Mating												
Lambing												
Milking												
Shearing (sheep)												
Seasons	Winter			Spring			Summer			Autumn		

Source: Compiled by the authors.
Notes: †Goats and Balbass, Karabakh, and Merino sheep graze on the winter ranges during the fall. However, Shirvan (Gala-Apsheron), Lezgin and Bozakh sheep return to the villages and graze on the village ranges during the fall; ‡grazing in the mountains.

Risks Affecting Genetic Diversity

Table 8 summarizes the changes that occurred in the country's sheep and goat populations between 1992 and 2003. The only breed under threat of extinction is the Merino, which declined quite sharply during this period to nearly 50,000 animals, that is, barely 6% the population size of this breed in 1999 (Table 2). The Merino population has declined so sharply mainly because (1) there is no market for wool, and (2) the wool of the Azeri Merino contains a large percentage of dead hair and top hair fiber.

Other breeds have increased in numbers (Table 8). However the fact that the country's breeding programs have been disrupted has resulted in uncontrolled crossbreeding among the breeds. As a result, there are now approximately 4.763 million crossbreds in the country (Table 2).

Table 8. Changes in population size during the period 1992-1999 and risk to genetic diversity.

Breed	Change 1992-2003 (%)	Diversity risks	Reasons for these risks
Sheep			
Balbass	89.7	None	na
Karabakh	354.8	None	na
Shirvan†	916.3	None	na
Lezgin	470.0	None	na
Bozakh	348.0	None	na
Merino	-94.2	High	Wool is not marketable
Goats	Unknown	None	na

Source: Compiled by the authors.
Notes: na: not applicable; †also known as the Gala-Apsheron.

As will be seen from the descriptions of each breed, practically all the indigenous breeds of Azerbaijan were subject to crossing with wool breeds during the Soviet era. In fact only the Balbass and the Shirvan (Gala-Apsheron) were really kept as purebreds, though the same is true to some extent of the Karabakh, Lezgin, and Bozakh. This said, however, most of the indigenous traits have been maintained in the new breeds. The Azerbaijan Merino was the breed most influenced as a result of crossing with fine-wool breeds.

Ownership has also changed, shifting from ownership by large holdings to ownership in small unproductive units after the transition from the Soviet system. Farmers are now responding directly to local market demands for meat and milk (see Table 4). Wool has a very low value and shearing costs may not be covered during production. It is expected that the population numbers of the traditional breeds will increase, because the breeds are adapted to the prevailing environments in which they are raised and are suited to local market preferences and the demand for a large carcass and a sufficient supply of milk.

Current Breeding Program

Following the dissolution of the Soviet Union, there were no breeding programs in Azerbaijan except maintaining some purebred flocks under national research institutions. This is still the case, and the country's farmers are drifting and operating at very low levels of productivity because they lack support. Table 9 lists Azerbaijan's breeds and the institution responsible for each.

Table 9. Breeds and institutes conducting work at some level in Azerbaijan.

Breed	Institutes
Balbass	Nakhichevan State Breeding Farm
Karabakh	ALRI†, Apsheron Experimental Livestock Station
Gala-Apsheron	ALRI, Apsheron Experimental Livestock Station
Lezgin	ALRI, Azerbaijan Academy of Agriculture
Bozakh	ALRI, Azerbaijan Academy of Agriculture
Merino	ALRI, Azerbaijan Academy of Agriculture

Source: Compiled by the authors.
Note: †Azerbaijani Livestock Research Institute.

Sheep Breed Characterization

The Balbass Sheep

Brief account of the development and improvement of the breed

The fat-tailed sheep of the Caucasus, including the Balbass, are thought to be derived from sheep from Anatolia (Kalugin 1930). The Balbass is the most valuable of all the mutton–wool–milk fat-tailed breeds managed in Azerbaijan. It combines the most important traits of mountain-adapted breeds, with the production of wool that has good carpet-making properties, a high meat and milk output, and adaptation to conditions encountered during year-round range grazing. During the Soviet era this breed was kept uncrossed in pure flocks. Currently it is the main breed used by farmers to upgrade sheep production in the Nakhichevan Autonomous Republic. There are nearly 0.475 million head of this breed in Azerbaijan (Table 2).

Appearance

Balbass sheep are fat-tailed. The tail is "S"-shaped, of medium length, and contains 16-18 vertebrae. The fat tail is divided into two parts, and ends in an appendage which is 15-21 cm long. Typically the Balbass is white with black spots around the eyes, under the nostrils, at the end of the ears, on the metacarpal joints, on the hocks, and next to the hooves on all legs. However, the placement of these spots does vary.

Balbass ram

The shape of the ears varies greatly. On average they are 14.7±0.3 cm in length, but can range from 9 cm to 18 cm in length. The ears of the breed are wide and drooping. Both the ewes and the rams can have horns. The ewes have sickle-shaped horns, while the rams have long spiraling horns. The head has a slightly roman profile.

Balbass ewe

Body measurements

Balbass sheep have a strong skeleton. The head is of medium length and rather wide, while the neck is medium to long in ewes and shorter and fatter in males. The animals are tall, rams being taller and longer than ewes (Table 10). Rams and ewes are characterized by a deep chest.

Body weights, growth and carcass traits

Table 11 gives the weights of Balbass sheep at different ages and thus provides information on their growth ability. At 9 months of age, males weigh about 40 kg. However, under improved feeding conditions, males of that age can reach 50-55 kg.

Considering Azerbaijan's market requirements and consumption tradition, the cheapest and best quality mutton can be produced when ram-lambs are slaughtered at the age of 9-10 months. Keeping animals until they are older places a serious burden upon the producers because of the additional expenditures required, making this impossible under present conditions.

Carcass measurements are presented in Table 12. A 9-month- old male weighing about 40 kg would have a clean carcass weight of about 19.4 kg. Soft and juicy meat with adequate amounts of fat, as preferred by consumers, can be obtained from uncastrated lambs during their first year of life.

Table 10. Body measurements of Balbass sheep (cm) at the age of 3-4 years.

	Kalugin (1930)		Unpublished data, State Pedigree Plant (1984)		Unpublished data, Nakhichivan State Breeding Farm (1984)	
Trait	Ewes n=50	Rams n=50	Ewes n=50	Rams n=50	Ewes n=50	Rams n=50
Height at withers	70.1	76.9	70.7	76.8	70.8	76.0
Height at sacrum	72.0	77.2	71.6	77.0	71.0	77.5
Diagonal body length	63.5	70.9	63.9	70.2	63.5	71.0
Chest girth	90.7	99.1	90.3	99.5	90.0	101.0
Chest depth	31.2	33.4	31.8	33.1	31.4	33.0
Chest width	19.7	20.9	19.5	20.6	19.2	20.5
Metacarpus girth	8.4	9.4	8.4	9.4	8.3	9.5
Fat tail girth	52.3	76.9	53.0	76.2	52.5	78.0

Table 11. Body weight of Balbass sheep.

	Live weight (Mean±SE, kg)	
Age	Males (n=50)	Females (n=50)
At birth	3.9±0.1	3.6±0.1
1 month	10.0±0.2	9.4±0.2
4 months	24.2±0.2	23.0±0.2
7 months	34.0±0.2	31.0±0.3
9 months	40.0±0.3	37.0±0.4
12 months	40.0±0.3	38.0±0.2
16 months	46.5±0.3	39.6±0.3
18 months	53.2±0.5	48.5±0.5
2.5-3 years	85.0±0.5	55.0±0.2

Source: Abdullaev (1984).
Note: SE: Standard error.

Table 12. Carcass performance of Balbass sheep (n=10).

Age	Pre-slaughter weight, kg	Carcass weight, kg (%)	Dressed carcass weight without tail, kg (%)	Viscera and tail weight, kg (%)
9 months	40.0	19.4 (49)	16.7 (41)	2.7 (7)
12 months	40.2	18.8 (47)	16.1 (40)	2.7 (7)
15 months	46.0	22.7 (49)	19.6 (43)	3.1 (7)
18 months	50.2	25.7 (51)	21.7 (43)	4.0 (8)
24 months	49.5	24.3 (49)	20.9 (42)	3.4 (6)

Source: Abdullaev (1984).
Note: Percentages, in parenthesis, refer to pre-slaughter weights.

Reproductive performance and milk production

A complete reproductive profile for Balbass sheep, obtained during the Soviet era, is provided in Table 13. This shows that high fertility rates were observed over all the years in which the study was conducted, resulting in an overall fertility rate of 97% and a high lamb survival rate. However, these levels have fallen under the present on-farm conditions, because of critical constraints to production, particularly the shortage of feed.

About 60-85% of Balbass ewes are characterized by well-developed udders that support an average level of milk production of 94.2 kg per lactation (Table 14). Considering that an estimated 30% of the milk produced is retained by the ewes for their lambs, the total amount of milk yielded by a Balbass ewe would be in the range of 125-130 kg.

Table 13. Reproductive performance of Balbass sheep at the age of 2.5-3 years.

Year	Number of ewes mated	Number of ewes lambed (fertility)	Number of lambs born (prolificacy)	Number of lambs surviving (survival)	Reproductive rate to weaning
1966	300	292 (97%)	325 (111%)	320 (98%)	107%
1970	400	390 (98%)	439 (113%)	431 (98%)	108%
1976	400	386 (97%)	430 (111%)	424 (99%)	106%
Total	1100	1068 (97%)	1194 (112%)	1175 (98%)	107%

Source: Abdullaev (1984).

Table 14. Milk production performance of 2.5- to 3-year-old Balbass ewes (n=10).

Lactation month	Average daily milk yield (kg)	Milk yield per month (kg)	Fat (%)
First	0.66	19.8	5.1
Second	0.61	18.3	5.3
Third	0.54	16.2	5.7
Fourth	0.51	15.3	6.2
Fifth	0.46	13.8	6.8
Sixth	0.30	9.0	7.1
Seventh	0.18	1.8	1.4
Average/total	0.49	94.2	5.4

Source: Abdullaev (1983).
Note: For the first 2 months after lambing, milk production was calculated by weighing lambs before and after suckling. Thereafter and until the end of the lactation period, milk production was obtained by control milking (3 times a month).

Wool and skin production

Average wool yield varies as follows: from 3.0 to 3.5 kg in the case of rams, from 2.0 to 2.7 kg in the case of ewes, from 1.3 to 1.85 kg in the case of yearling rams and from 1.0 to 1.7 kg in the case of yearling ewes. The clean wool yield is 61.3% in the case of sires, 59.0% in the case of ewes, and 59.4% in the case of yearling rams and yearling ewes. Balbass wool has a tipped structure and is notable for the length of its fibers. These average 20 cm in length, though this measurement can vary from 10 to 28 cm. The average fiber diameter in the case of first class wool produced by sires shorn in spring is 41.1 microns (μm), while that of the wool produced by yearling rams and yearling ewes is 34.6-36.2 μm and that of the wool produced by ewes is 32.8 μm.

Balbass wool has a high value due to its high down content (Table 15). In comparison to other meat, wool, and milk sheep in the country, there is a high demand for the wool of this breed for use in carpet making. The wool produced by the Balbass is white, long, lustrous, and hard. If carpet making develops into an industry, opening up opportunities for value addition, improvement of this breed would be justified in this regard.

Table 15. Types of fiber found in the Balbass sheep fleece.

	Percentages of fibers of different types		
Age and sex	Fur hair	Short-medium hair	Top hair
4- to 5-year-old sires (n=50)	80.5	18.2	1.3
3- to 5-year-old ewes (n=50)	81.5	17.5	1.0
1-year-old rams (n=50)	82.0	17.0	1.0
1-year-old ewes (n=50)	83.1	16.1	0.8

Source: Abdullaev (1984).

Estimates of genetic variation

No studies have been conducted to estimate genetic variation in Balbass sheep in terms of the breed's production traits.

Present breeding structure

Fewer flocks are under the control of research organizations; in particular pure flocks of Balbass are available at the Nakhichevan State Breeding Farm. However, there is a need to organize a structured breeding program and breeding plans for this important breed.

The Karabakh Sheep (Including the Garadolag Type)

Brief account of the development and improvement of the breed

The Karabakh sheep is mainly found in the Milsk-Karabakh region. The breed is native to Azerbaijan, and in 2003 its population was estimated to stand at about 0.781 million head (Table 2).

This breed is kept under range management conditions for 9 months of the year, and receives concentrates over the winter period (3 months). The breed is exploited for milk and meat production. The products of this breed are in high demand locally.

A distinctive type, known as the Garadolag, was developed by selection during the period 1960 to 1999 in the southeast of Agdam. The best examples of this type are found in the Agjabedi and Imishli districts of the Milsk-Karabakh zone.

Appearance

The Karabakh breed is a meat–wool–milk sheep and is fat-tailed. The body of this breed is short with a deep, wide chest. Most animals are hornless or have under-developed horns; they are either completely earless or have short vestigial ears. The head has a roman profile. The frame of this animal is thin but strong, and the breed is well adapted to forms of management that involve grazing the animals at a distance from the village. The coats of Karabakh sheep are mainly white with yellowish and grayish tones. The neck, belly, and legs have almost no wool. The wool produced is coarse and contains a high proportion of coarse top hair and short dead hair, which reduces its value and makes the breed the poorest wool producer in the country.

The Garadolag is similar to the Karabakh breed, except that it is taller, has a stronger frame, and deposits more fat in its tail. It also has a shorter and wider head than the common Karabakh. Very often the fat tail of the Garadolag reaches the hock, a feature rarely found in Karabakh animals.

Karabakh ram

Karabakh ewe

Karabakh Garadolag ram

Karabakh Garadolag ewe

Body measurements

The body measurements of Garadolag sheep are given in Table 16.

Body weights, growth and carcass traits

Table 17 includes data drawn from two reports on the live weights and carcass performances of Karabakh sheep. In the 40-year period which separates the reports, the live weights of rams increased by 12.9%, while those of ewes increased by 4.3%. Milk production per ewe in the same period also increased (by 15.6%) while wool yield decreased (by about 6%). One should note that Kalugin (1930) studied animals during the period before collectivization took place in the country and that Mekhtiev (1970) studied animals managed on State Farms.

More recent live weight data on the Garadolag type of Karabakh sheep are given in Table 18.

In the Karabakh lowlands, where the Garadolag type sheep is found, winter lambing (November-December) is the rule. These lambs develop well until the age of 10-11 months under optimal conditions of feeding and management. Following this, growth and development up to the age of 15-16 months occurs under less favorable winter conditions, a fact that is reflected by a decline in live weights. For this reason, it is advisable to slaughter surplus lambs at the age of 10-11 months.

Table 19 displays data on carcass performance for the Garadolag type.

Table 16. Body measurements in Karabakh Garadolag 3.5- to 4-year-old rams.

	Livestock Research Institute of Azerbaijan (n=100)		Milsk-Karabakh zone (n=100)	
Trait	Mean	Range	Mean	Range
Live weight in spring (kg)	68.6	62-76	67.0	61-75
Live weight in autumn (kg)	81.8	70-91	80.4	72-91
Height at withers (cm)	68.1	64-80	69.1	63-82
Height at sacrum (cm)	67.1	64-73	68.1	63-76
Diagonal body length (cm)	65.2	60-75	66.8	61-75
Chest girth (cm)	101.6	90-109	102.5	91-111
Chest depth (cm)	34.6	30-36	33.2	30-35
Chest width (cm)	22.0	18-25	23.4	18-25
Metacarpus girth (cm)	9.6	9-10	9.7	9-10
Fat tail girth (cm)	82.4	75-95	86.0	73-94

Source: Abdullaev (1983).

Table 17. Body weights and carcass productivity of Karabakh sheep.

Sex	Age (years)	n	Live weight, kg	Carcass production, %	Source
Rams	2.5	12	59.5	57.4	Kalugin (1930)
Ewes	2.5	12	46.6	54.7	
Rams	4	10	67.2	54.5	Mekhtiev (1970)
Ewes	4	10	48.6	52.8	

Table 18. Live weight of Garadolag sheep at different ages (Mean±Standard error).

	Live weight, kg	
Age	Males (n=100)	Females (n=100)
At birth	4.0±0.09	3.6±0.05
4 months	23.4±0.31	22.4±0.35
7 months	33.1±0.31	30.4±0.43
9 months	37.8±0.28	34.9±0.28
12 months	40.5±0.28	38.5±0.30
16 months	43.7±0.30	39.0±0.28
18 months	49.4±0.54	45.1±0.30

Source: Abdullaev (1984).

Table 19. Mutton productivity of Garadolag ram lambs at different ages.

Age	Pre-slaughter weight, kg	Carcass weight, kg (%)	Dressed carcass weight, kg (%)	Viscera and tail weight, kg (%)
9 months	39.8	19.5 (49)	17.1 (43)	2.4 (6)
12 months	42.0	19.9 (47)	17.4 (41)	2.5 (6)
15 months	42.7	19.3 (45)	16.8 (39)	2.5 (6)
18 months	46.5	21.8 (47)	19.0 (41)	2.8 (6)
24 months	51.2	26.2 (51)	22.8 (45)	3.4 (7)

Source: Abdullaev (1984).
Notes: Percentages refer to pre-slaughter weights; information on sample size was not available.

Reproductive performance and milk production

In general, Azerbaijan's meat-wool-milk sheep are characterized by rather low levels of prolificacy. Lambing rates and lamb survival rates of Karabakh sheep are given in Table 20.

In 1976 milk production in this breed was observed at two sites in Azerbaijan where the same management system is used (Table 21).

Experiments showed that, under improved feeding conditions, Garadolag ewes could be milked safely in the third month of lactation without affecting the normal growth and development of lambs. This allowed the production of 35-40 kg of commercial milk rich in fat. Under current conditions, this ability could help farmers to increase their low incomes.

Table 20. Lambing rates and survival in flocks of Karabakh sheep.

Location	Year	No. of ewes mated	No. of lambs born	Lambing rate, %	Lamb survival, %
LRIA	1968	250	275	110	98.5
Karabakh zone	1976	250	272	109	98.9
LRIA	1976	250	276	110	98.9
Karabakh zone	1984	300	335	112	99.4
Total/average		1050	1158	110	99.0

Source: Abdullaev (1983).
Note: LRIA: Livestock Research Institute of Azerbaijan, which is located in western Azerbaijan, 10 km from the town of Gyanja and 3 km from the Khanlar district.

Table 21. Milk production performance of 2.5- to 3-year-old Garadolag ewes at two sites in 1976.

	Breeding farm Azril (n=10)			Karabakh zone (n=10)		
Lactation month	Per day (kg)	Per month (kg)	Fat (%)	Per day (kg)	Per month (kg)	Fat (%)
First	0.60	18.0	5.2	0.50	15.0	5.1
Second	0.45	13.5	5.5	0.45	13.5	5.4
Third	0.40	12.0	5.9	0.45	13.5	5.8
Fourth	0.36	10.8	6.4	0.35	10.5	6.2
Fifth	0.46	13.8	7.0	0.42	12.6	7.0
Sixth	0.32	9.6	7.2	0.33	9.9	7.1
Seventh (10 days)	0.25	2.5	7.6	0.26	2.6	7.5
Total lactation		80.2			77.6	

Source: Damirov (1989).
Note: For the first 2 months after lambing, milk production was calculated by weighing lambs before and after suckling. Thereafter and until the end of the lactation period, milk production was obtained by control milking (3 times a month).

Wool production

Karabakh sheep are sheared twice a year. The wool is coarse and not uniform, and contains coarse top hair (19-24%) of diameter of 50-60 µm, short- to medium-length hair (12-23%) of diameter 37-48 µm, and down fibers (51-55%) of diameter 25-27 µm (Rzaeva 1954, Melikov 1958). In addition, the Karabakh fleece contains a large proportion of dead hair (3-13%) which reduces the value of the wool significantly. The annual wool yield of ewes after two shearings averages 2.4 kg of greasy wool. On average, adult rams (3.5-4 years) produce 2.2 kg at the spring shearing and about 1.0 kg of wool at the fall shearing, totaling 3.2 kg per year with an average wool diameter of 63 µm (Abdullaev 1984).

Like that of the ordinary Karabakh, the wool of Garadolag sheep is also coarse, not uniform, tipped, and high in wool grease. Fleece weights and clean yields are shown in Table 22.

Table 22. Wool production in Garadolag sheep (Mean±Standard error).

			Fleece weight (kg)		
Sex	Age	n	Greasy wool	Clean wool	Clean yield (%)
Rams	3.5-4 yr	20	3.20±0.16	2.23±0.16	69.7
Ewes	2.5-3 yr	35	2.20±0.03	1.50±0.02	68.2
Ram-lambs	14-15 m	124	1.42±0.02	0.95±0.01	68.3
Ewe-lambs	14-15 m	168	1.31±0.01	0.91±0.01	69.5

Source: Abdullaev (1983).

Melikov (1958) considered the Garadolag the poorest wool producer among Azerbaijan's sheep breeds, in terms of both quality and quantity of wool. The average spring wool yield of ewes (3-4.5 years of age) is 1.7 kg, while in the autumn they yield 0.8 kg; annual production is 2.5 kg. However, Abdullaev (1984) showed that that Garadolag wool is better than Karabakh wool because it contains 3.8% more down, 11% more short-medium hair, 5.6% less top hair, and most importantly, 9.2% less dead hair. Garadolag wool, with average fiber diameter of 22.2 µm, is 10.3% finer than Karabakh. It is believed that this difference is due to a selection for fleece characteristics in the Garadolag sheep. There is little demand for the wool of this breed in Azerbaijan.

Estimates of genetic variation
No studies have been conducted to estimate genetic variation in the production traits of this breed.

Present breeding structure
No formal breeding plans are available for this breed. Some purebred flocks do exist in the Imishli and Agjabedi districts.

The Shirvan Sheep - Including the Gala (Gala-Apsheron) Type

Brief account of the development and improvement of the breed
The Shirvan is the main breed managed in the Shirvan, Mulgano-Salyan, and Apsheron zones. It is well adapted to the high temperatures which occur in these areas in the summer. In the Apsheron peninsula, people produce the Gala (Gala-Apsheron) sheep, which is named after a local village. This is a variety of Shirvan sheep that has practically replaced the original Shirvan. During the breed's development period, Gala sheep were crossed with various fine-wool breeds. In 1960 all remaining Gala sheep were concentrated and managed on the Zira and Gobi farms in the Apsheron region. Today the Gala population is 540,000 head (Table 2); studies of the breed type are continuing.

Appearance
Gala sheep are large and have a large fat tail; they are managed under extensive conditions. The head is medium-sized and has a slightly roman profile. The ears are long. The neck is long and muscular and the body is relatively short. Gala rams are usually polled: only 3-4% of them have rudimentary horns. Wool coverage is poor. The fleece's dominant color is white.

Body measurements
The body measurements of the Gala are presented in Table 23.

Body weights, growth and carcass traits
A short body characterizes Shirvan sheep. The lambs are rather heavier at birth than the lambs of other breeds. Up to the age of 6 months, they rapidly gain weight; however after weaning, due to poor grazing conditions, they grow slowly. The average live weight of a 2.5-year-old ram is 71 kg (Table 24).

The wool produced by this breed is valuable, as it is in high demand. The

Shirvan ram

Shirvan ewe

Gala-Apsheron ram

Gala-Apsheron ewe

breed shows great potential for this type of production, and could be improved.

The demand for mutton–wool–milk fat-tailed sheep includes a demand for the Gala. These animals mature early and display good weight-gain rates, particularly under good conditions of feeding and management. Table 25 reports the breed's carcass performance.

Table 23. Body measurements of 3- to 4-year-old Gala sheep.

	Rams		Ewes	
Trait (cm)	Mean±SE	Range	Mean±SE	Range
Height at withers	78.8±0.9	66-85	67.7±0.4	59-71
Diagonal body length	68.8±0.4	62-78	62.4±0.4	57-66
Chest width	25.6±0.3	22-30	20.5±0.3	16-21
Chest depth	32.8±0.2	29-37	28.1±0.4	23-32
Chest girth	100.6±0.8	96-117	90.4±0.6	77-99
Metacarpus girth	9.8±0.02	7-12	8.5±0.01	6-11
Tail length	29.8±0.3	25-33	25.0±0.5	19-27
Fat tail girth	84.1±0.1	68-91	75.0±0.2	68-82

Source: Mekhtiev (1970).
Notes: SE: Standard error; number of observations was not provided.

Table 24. Body weights of Gala sheep at different ages.

	Live weight (kg)			
	Males (n=50)		Females (n=50)	
Age	Mean±SE	Range	Mean±SE	Range
At birth	4.2±0.04	3.0-5.5	3.9±0.04	2.6-5.2
1 month	10.5±0.5	7.6-14	9.8±0.1	7.0-13
6 months	37.0±0.3	28-45	33.7±0.3	26-41
12 months	46.0±0.9	32-60	39.1±0.6	30-48
16 months	59.9±0.9	41-76	50.1±0.6	38-66
30 months	71.0±1.2	61-80	55.4±0.8	46-68

Source: Nadjafov (1978).
Note: SE: Standard error.

Table 25. Mutton productivity of Gala sheep at different ages (n=5 head per group).

Group and age	Pre-slaughter weight, kg	Carcass weight, kg (%)	Dressed carcass wt. with no tail, kg (%)	Viscera and tail wt., kg (%)
Ewes (3-4 years old)	35.0	13.9 (40)	12.0 (34)	1.9 (5)
Wether rams (3-4 years old)	35.5	14.6 (41)	13.0 (34)	1.6 (5)
Yearling rams	30.0	11.4 (38)	10.8 (36)	0.6 (2)
Yearling ewes	29.0	11.7 (40)	10.0 (34)	1.7 (6)

Source: Abdullaev (1967).
Note: Percentages refer to pre-slaughter weights.

Reproductive performance and milk production

The prolificacy and the survival rates of Shirvan and Gala-type sheep are quite similar, as can be seen in Table 26. The survival rates of this breed are extremely high.

Abdullaev (1973) considered the milk produced in the first two months of lactation to be the main source of feed for lambs, and the milk collected in the following months to be that used for commercial purposes. Table 27 shows that about 30 kg of milk are used by the lamb and about 40-45 kg are used as commercial milk.

Wool production

The average greasy wool yield of this breed is 2 kg in the case of ewes (3-3.5 years), and 2.4 kg in the case of rams (3-3.5 years) (Nadjafov 1978). Up to 58% of the wool produced consists of down, while 18-20% consists of short to medium-length hair and 20-22% of it consists of top hair. Dead hair accounts for one-fifth of the fleece on average. The wool has a tipped structure.

Estimates of genetic variation

No studies have been conducted to estimate genetic variation in this breed in terms of its production traits.

Table 26. Reproductive performance of Shirvan and Gala sheep genotypes.

Genotype	Year	Number of ewes lambed	Number of lambs born (prolificacy)
Shirvan	1964	626	666 (106%)
Gala-type	1978	705	744 (106%)

Source: Abdullaev (1983).

Table 27. Milk production performance of 3- to 3.5-year-old ewes.

	Milk production (n=16)		
Lactation month	Per day (kg)	Total (kg)	Fat (%)
First	0.50	15.5	5.3
Second	0.48	14.4	5.5
Third	0.49	15.2	5.7
Fourth	0.44	13.2	6.4
Fifth	0.38	11.4	6.8
Sixth	0.15	4.5	7.6
Total lactation	0.41	74.4	6.0

Source: Nadjafov (1977).
Note: For the first 2 months after lambing, milk yield production was calculated by weighing lambs before and after suckling. Thereafter and until the end of the lactation period, milk yield was obtained by control milking (3 times a month).

Present breeding structure

Pure flocks of Gala are available in Azerbaijan, some of which are under the control of the Livestock Research Institute of Azerbaijan. However, no formal breeding plans are available for this breed.

The Lezgin Breed

Brief account of the development and improvement of the breed

The Lezgin breed is considered to be a meat–wool–milk sheep. It is found in Azerbaijan's Sheki-Zakatal zone, and is also found across the border in the Republic of Dagestan.

The Caucasian Tushin, Karabakh, and Balbass breeds might have influenced the development of this breed, which was subject to improvement during the Soviet era. There are 57,000 head of this breed in the country and its numbers are increasing.

Appearance

The Lezgin breed is the smallest of all Azerbaijan's sheep breeds, something which may explain its low level of popularity. The animals are fat-tailed with a strong constitution and have a compact frame and a sizable belly. They are well adapted to range grazing. White is the dominant color in the fleece, but the head and legs are brown. The fleece of the Lezgin breed is also characterized by its high down content. The head is of medium length, and rams usually have horns. Lezgin ewes have well-developed udders.

No information is available on the body measurements of this breed.

Lezgin ram

Lezgin ewe

Body weights, growth and carcass traits

Table 28 shows the growth pattern of Lezgin sheep. Flocks leave the summer ranges and move to winter ranges when they are 8 months of age. During this period growth slows down. At this time, those animals exceeding the need to replenish the flocks are slaughtered for mutton.

Data on the carcass performance of these animals is provided in Table 29. Carcass percentages are relatively low and are typical of smaller animals.

Table 28. Body weight and growth of Lezgin sheep (Mean±Standard error).

	Males (n=50)		Females (n=50)	
Age	Live weight (kg)	Daily weight gain (g/d)	Live weight (kg)	Daily weight gain (g/d)
At birth	3.2±0.1	na	3.0±0.1	na
4 months	22.8±0.4	164	21.0±0.3	150
8 months	30.8±0.4	67	21.1±0.5	51
12 months	35.2±0.5	37	32.8±0.5	48
15 months	36.3±0.5	12	34.0±0.6	13
18 months	42.6±0.6	70	37.8±0.6	42

Source: Abdullaev (1984).
Note: na: not applicable.

Table 29. Mutton production performance of Lezgin ram lambs (n=150).

Age	Pre-slaughter weight, kg	Carcass weight, kg (%)	Dressed carcass weight, kg (%)	Viscera and fat weight, kg (%)
8 months	29.6±0.6	13.6±0.5 (46)	13.0±0.5 (44)	0.6±0.1 (2)
18 months	42.6±0.5	20.4±0.4 (48)	19.8±0.4 (46)	0.6±0.1 (1)

Source: Abdullaev (1984).
Notes: Weights are given as the mean ± standard error; percentages refer to pre-slaughter weights.

Reproductive performance and milk production

Abdullaev (1984) noted high levels of fertility and high survival rates in addition to a low prolificacy rate: characteristics typical of the sheep of the Caucasus

(Table 30). The high survival rate observed up to the age of 9 months reflects the fact that this breed is well adapted to the conditions in which lambs are raised.

Lezgin ewes are poor milk producers, being among the poorest milk-producing ewes in Azerbaijan. Milk production at the fifth month does not justify further milking, as the average yielded per ewe is barely one-quarter of a kilogram. The total amount of milk produced during a lactation period of 180 days does not exceed 60 kg (Table 31).

Wool production

Lezgin sheep are shorn in spring (April-May) and in the fall (September). Melikov (1947) found that the down fibers of the breed had an average fiber diameter of 16.0-29.7 µm. Short to medium-length hair had a diameter of 30.0-57.8 µm, while top hair had a diameter of 76.7 µm. Lezgin wool is very long: in rams, staple length reaches 19 cm in spring and 16.3 cm in autumn; in ewes, the corresponding values are 18.8 cm in spring and 14.5 cm in autumn. There is a great demand for this product, and considerable potential exists for improving this trait.

Estimates of genetic variation

No estimates have been made of genetic variation or repeatability for this breed.

Table 30. Reproductive performance of 2- to 2.5-year-old Lezgin ewes under natural mating regimes.

Indicators	Number of head	%
Inseminated ewes	940	100.0
Lambed ewes (fertility)	890	94.7
Barren ewes (100-fertility)	50	5.3
Lambs born alive (prolificacy)	964	108.3
Lambs surviving to weaning (survival)	924	95.9
Lambs surviving to the age of 9 months	906	94.0

Source: Abdullaev (1984).

Table 31. Milk production of 2.5- to 3-year-old ewes Lezgin ewes (n=16) in villages in the Sheki-Zakatal zone.

	Azizbekov Village			G. Nasibov Village		
Lactation month	Yield per day (kg)	Yield per month (kg)	Fat (%)	Yield per day (kg)	Yield per month (kg)	Fat (%)
First	0.45	13.5	4.8	0.44	13.2	4.7
Second	0.38	11.4	5.0	0.40	12.0	4.9
Third	0.36	10.8	5.3	0.38	11.4	5.6
Fourth	0.28	8.4	6.3	0.30	9.0	6.5
Fifth	0.25	7.5	6.6	0.76	7.8	6.9
Sixth	0.18	5.4	6.9	0.20	6.0	7.1
Total lactation	0.32	57.3	5.3	0.33	50.2	5.6

Source: Abdullaev (1993).

Note: For the first 2 months after lambing, milk yield was calculated by weighing lambs before and after suckling. Thereafter and until the end of the lactation period, milk yield was obtained by control milking (3 times a month).

Present breeding structure

Pure flocks of Lezgin sheep can be found in the Sheki-Zakatal zone, some of which are under the control of the Livestock Research Institute of Azerbaijan. No formal breeding plans involving this breed are available in the country.

The Bozakh Sheep

Brief account of the development and improvement of the breed

The Bozakh breed corresponds to the local mutton–wool–milk sheep distributed over vast areas of Azerbaijan and Georgia. There are about 112,000 animals of this breed in the country (Table 2).

Kalugin (1930) noted that the Bozakh breed is very similar to the Karabakh breed, differing only in the growth and character of its wool. The breed stands between the Karabakh and Tushin breeds in terms of its appearance and production and is actually believed to have resulted from the intercrossing of these breeds, because the Bozakh's dispersion area is precisely located between the breeding territories of these two breeds.

During the development period, which started in 1930 in the Gyanja-Gazah area, Bozakh sheep were crossed with fine-wool and mutton–wool breeds. At that time the area was dedicated to the production of sheep orientated towards wool and meat production. In the eastern regions of Gyanja-Gazah, the Bozakh was used to produce the Azerbaijani Mountain Merino, while in the western regions it was used to produce a new type of mutton–wool sheep. By 1970 no purebred state- or cooperative-owned flocks of Bozakh sheep remained: pure examples of the breed were only found in small numbers raised by households.

Selection in Bozakh began in 1984 on farms in the Tauzsk region. Several crossbred flocks of semi-fine and fine fleece sheep were amalgamated to form a basic flock for this purpose. These animals were crossed and selection was applied to improve body weight and wool traits, with more emphasis being placed on the former than on the latter. Animals of the desired type were then used for pure breeding. This led to what is now known as the New Bozakh. This type is well adapted to year-round range management. In 1992, the population of Bozakh sheep on the farms in the Tauzsk region amounted to 25,000 animals, including 5000 ewes of the desirable type.

Appearance

Bozakh sheep have short, wide heads. Most (70%) have ears which are 11 to 15 cm long. On average, more than 80% of rams have horns, as do up to 10% of ewes.

Bozakh sheep have a thin, medium-length neck; the ram's neck is shorter and fatter than that of the ewes. Rams are 4-5 cm taller than ewes. Both ewes and rams have short, reasonably round and compact bodies. The chest of the breed is deep and wide. This type of sheep has a fat tail, which may contain up to 15

Bozakh ram

Bozakh ewe

vertebrae. The girth of the tail's fat deposits varies from 54.8±1.2 to 64.2±2.0 cm (mean±standard error; Abdullaev 1993). The dominant color in the fleece is white, with grayish tones, but the head and feet are dark grey.

Body measurements

Table 32 summarizes the linear measurements of New Bozakh sheep aged from 4 to 18 months.

Table 32. Body measurements of Bozakh sheep of different ages (Mean±SE).

	Males, age in months (n=50)				Females, age in months (n=50)			
Trait (cm)	4	8	12	18	4	8	12	18
Height at withers	53.8±0.2	57.0±0.2	58.8±0.3	61.2±0.3	51.8±0.3	55.2±0.3	57.2±0.3	60.0±0.4
Height at sacrum	54.0±0.3	57.5±0.3	59.6±0.3	62.0±0.3	52.5±0.2	56.0±0.3	58.2±0.3	60.0±0.4
Diagonal body length	54.5±0.4	56.0±0.4	58.5±0.4	62.0±0.4	52.0±0.2	56.0±0.2	57.5±0.3	61.0±0.3
Chest depth	24.0±0.3	25.1±0.3	26.0±0.3	29.3±0.3	23.1±0.2	25.0±0.2	26.0±0.3	28.8±0.3
Chest width	15.1±0.2	16.5±0.2	18.4±0.3	20.5±0.3	14.0±0.2	15.0±0.2	17.8±0.2	19.8±0.2
Chest girth	70.8±0.3	82.0±0.3	87.0±0.4	91.0±0.4	68.5±0.4	72.0±0.4	85.0±0.1	89.5±0.5
Metacarpus girth	7.2±0.1	7.5±0.1	8.3±0.2	8.7±0.2	7.1±0.1	7.4±0.1	8.0±0.1	8.5±0.1
Fat tail girth	30.5±0.4	38.4±0.4	43.5±0.4	54.6±0.5	31.0±0.3	38.5±0.3	43.0±0.4	55.0±0.4

Source: Abdullaev (1993).
Note: SE: Standard error.

Body weights, growth and carcass traits

Weight data for this breed, which allows growth rates to be assessed, is provided in Table 33. The daily weight gain between birth and 4 months of age averaged 162-173 g/d. After this, the growth rate of the animals decreases. Young animals quickly react to the decline in feeding and management conditions that occurs with the onset of winter. It is therefore recommended that surplus lambs should be slaughtered at 10-11 months of age.

Using five ram-lambs recently returned from alpine rangelands, aged 8 and 18 months, Abdullaev (1993) obtained the mutton production results shown in Table

34. Animals were slaughtered after a short period of fasting; mean pre-fasting weight was 34.6 kg in 8-month-old lambs, and 45.5 kg in 18-month-old lambs.

Reproductive performance and milk production

Bozakh ewes display a high level of fertility and, like other Caucasian breeds, exhibit a low level of prolificacy. Survival rates at weaning and at 9 months of age are also high. Results obtained during the period during which the New Bozakh breed was created are given in Table 35.

The breed does not produce large amounts of milk (Table 36). Taking into account the fact that, during milking, ewes retain about 30% of their milk for their lambs, the total amount of milk yielded for commercial production would stand at approximately 46-48 kg.

Table 33. Body weight and growth of New Bozakh sheep (Mean±Standard error).

	Males (n=50)		Females (n=50)	
Age	Live weight (kg)	Daily weight gain (g/d)	Live weight (kg)	Daily weight gain (g/d)
At birth	3.2±0.04	np	3.0±0.04	np
4 months	23.9±0.3	173	22.4±0.2	162
8 months	33.9±0.3	83	31.0±0.4	72
12 months	37.8±0.3	33	34.8±0.4	32
15 months	38.5±0.4	8	35.8±0.4	11
18 months	45.7±0.4	80	42.2±0.5	71
Adult (3.5-4 yr)†	58.5±0.6	na	35.9±0.4	na
Adult (3.5-4 yr)‡	63.1±0.7	na	38.8±0.5	na

Source: Abdullaev (1993).
Notes: †spring; ‡fall; na: not available; np: not pertinent.

Table 34. Mutton production performance of Bozakh ram-lambs (n=5; Mean±Standard error).

Age	Pre-slaughter weight, kg	Carcass weight, kg (%)	Dressed carcass weight, kg (%)	Viscera and kidney fat weight, kg (%)
8 months	33.4±0.5	16.3±0.5 (49)	15.7±0.4 (47)	0.6±0.2 (2)
18 months	44.6±0.6	21.9±0.4 (49)	21.3±0.4 (48)	0.6±0.2 (1)

Source: Abdullaev (1993).
Note: Percentages refer to pre-slaughter weights.

Table 35. Reproductive performance of 3.5- to 4-year-old New Bozakh ewes, under natural mating regimes.

Trait	Number of head	%
Inseminated ewes	990	100
Lambed ewes (fertility)	969	98
Barren ewes (100-fertility)	31	3
Lambs born (prolificacy)	988	103
Lambs surviving to weaning (survival)	965	98
Lambs surviving to the age of 9 months	940	95

Source: Abdullaev (1983).

Table 36. Milk production of 3.5- to 4-year-old Bozakh ewes.

	Bozalgandy Village (n=50)			Garakhandy Village (n=50)		
Lactation month	Per day (kg)	Per month (kg)	Fat (%)	Per day (kg)	Per month (kg)	Fat (%)
First	0.58	15.3	4.8	0.50	15.0	5.0
Second	0.47	14.1	5.2	0.48	14.4	5.3
Third	0.44	13.2	5.4	0.42	12.6	5.6
Fourth	0.40	12.0	5.9	0.38	10.4	6.1
Fifth	0.25	7.5	6.2	0.26	7.8	6.4
Sixth	0.20	6.0	7.0	0.18	5.4	7.2
Total lactation		68.1			65.6	

Source: Abdullaev (1993).
Note: For the first 2 months after lambing, milk production was calculated by weighing lambs before and after suckling. Thereafter and until the end of the lactation period, milk production was obtained by control milking (3 times a month).

Wool production

The wool produced by Bozakh sheep is not uniform, and is semi coarse and tipped. It consists of 66% short to medium-length hair, 10% top hair and 24% down. Shearing takes place twice a year (during the spring and the fall). The average annual wool yield is 3.0 kg (range 2.8-3.5 kg) in the case of adult rams (3.5-4 years) and 2.2 kg (range 1.7-2.6 kg) in the case of adult ewes (2.5-3 years) (Abdullaev 1993). The average annual wool yield of ewe-lambs is 2.3 kg (range 1.8-2.7 kg). The clean yield after the spring shearing amounts to 60-65% and after the fall shearing 70% in rams and ewes.

The wool is classified as semi coarse wool of the first grade. The medium-length wool produced (10.0±1.3-13.6±0.6 cm) meets the requirements of wool combing, and is a valuable product with market demand; moreover, this aspect of the breed has the potential to be improved.

Estimates of genetic variation

No studies have been conducted to estimate genetic variation in the production traits of this breed.

Present breeding structure

Pure Bozakh flocks are available in Azerbaijan, some of which are under the control of research organizations. No formal breeding plans are currently available for this breed.

The Azerbaijan Mountain Merino

Brief account of the development and improvement of the breed

Merino sheep were first introduced into Azerbaijan in the 1940s, when Russian migrants from the Tavriya, Kherson, and Ekaterinoslav provinces moved to the Kedabek region of Azerbaijan and brought with them several hundred head of

Merino sheep. Later on Merino rams of the Mazaev type were repeatedly imported into Azerbaijan from the northern Caucasus.

The Azerbaijan Mountain Merino breed was developed by crossing local Kedabek Merino with Askania rams and, to a minor extent, with Caucasian rams. This process also crossed local coarse-wool Bozakh sheep with Merino rams; this was followed by selection (Sadykov 1949). In 1945 the population of pure and crossbred Merino sheep in Azerbaijan had increased to 106,000 animals, or 90% of the total sheep population. About 35,000 animals were pure-bred Merino, while the rest were crossbreds.

To further improve wool density and quality, in 1946 sires of the Grozniy type were introduced into the crossing process. The resulting sheep were characterized by a heavier fleece, a high clean yield, a heavier body weight, a strong constitution, and the preservation of traits which are valuable in the Bozakh (such as a good level of adaptation to distant grazing). In 1947, on the Kedabek State Pedigree Farm, the breed was renamed the Azerbaijan Mountain Merino.

Due to the collapse of the markets and a decline in the demand for wool, the population of this breed declined sharply, falling from 900,000 head in 1999 to just over 52,000 head in 2003 (Table 2). It is thought that this breed could disappear in the near future.

Appearance

Sheep of this breed are of medium size and have a strong constitution. The head is large. Rams can be horned, but ewes are polled. The horns produced by rams are spiral-shaped and long. The fleece is white and the skin is without folds.

Mountain Merino ram

Mountain Merino ewe

Body weights, growth and carcass traits

Azerbaijan Merinos are medium-sized. The highest live weight is reached 4-4.5 years of age (Table 37).

Reproductive performance and milk production

The Azerbaijan Mountain Merino displays excellent reproductive rates; prolificacy is slightly higher than that of the other breeds in the country, but is still low (Tables 6 and 38).

The Azerbaijan Mountain Merino produces about 65-75 kg milk per lactation. This allows lambs to be fed normally until weaning and still yields 40-45 kg of milk for commercial purposes. The milk produced has a desirable fat content (5.5-6.0%). Table 39 displays the milk production performance of adult Azerbaijan Mountain Merino ewes (3-4 years old).

Table 37. Body weight and growth of Azerbaijan Merinos.

	Live weight (kg)			
	Males (n=50)		Females (n=50)	
Age	Mean±SE	Range	Mean±SE	Range
At birth	3.4±0.1	2.7-4.5	3.1±0.1	2.4-3.9
1 month	8.1±0.1	7.0-9.5	7.6±0.1	6.5-8.5
2 months	13.3±0.2	11.0-15.0	12.5±0.2	10.5-14.0
3 months	18.7±0.2	16.5-21.0	17.2±0.2	15.0-18.0
6 months	28.0±0.2	25.0-30.0	25.8±0.2	25.0-29.0
9 months	31.6±0.4	28.0-35.0	30.0±0.4	26.0-34.0
12 months	36.1±0.3	34.0-40.0	34.0±0.4	32.0-39.0
16 months	35.9±0.3	35.0-46.0	34.3±0.3	31.0-38.0
18 months	45.3±0.4	41.0-49.0	42.0±0.4	38.0-46.0
4-4.5 years	85.0±0.5	75.0-95.0	70.0±0.6	67.0-78.0

Source: Smaragdov (1972).
Note: SE: Standard error.

Table 38. Reproduction in Azerbaijan Mountain Merino ewes.

Year	Number of ewes mated	Number of ewes lambed	Fertility (%)	Number of lambs born	Prolificacy (%)	Lamb survival (%)
1972	147	145	98.6	172	119	99
1980	300	296	98.7	354	120	98
1985	250	247	98.8	290	117	99

Source: Abdullaev (1984).

Table 39. Milk production in 3- to 4-year-old Azerbaijan Mountain Merino ewes (n=16).

Lactation month	Average milk yield per day (kg)	Average milk yield per month (kg)	Milk fat (%)
First	0.56	16.8	5.3
Second	0.55	16.5	5.5
Third	0.50	15.0	5.6
Fourth	0.42	12.6	6.0
Fifth	0.30	9.0	6.5
Sixth	0.18	5.4	7.2
Total		74.8	

Source: Odjahkuliev (1976).
Note: For the first 2 months after lambing, milk yield was calculated by weighing lambs before and after suckling. Thereafter and until the end of the lactation period, milk yield was obtained by control milking (3 times a month).

Wool production

A long fiber length is a major characteristic of the Azerbaijan Mountain Merino breed, a feature which is not common in Merino sheep.

Average fleece weights for males and females of different categories are provided in Table 40.

Table 40. Average fleece weights of Azerbaijan Mountain Merino sheep (n=100).

Sex	Age (years)	Fleece weight (kg)	Range (kg)	Reference
Rams	3-4	6.3	5.6-7.0	Unpublished data, State Breeding Plant (1935)
Ewes	3.5-4	3.4	3.0-3.8	
Rams	3-3.5	8.2	7.4-9.0	Unpublished data, State Breeding Plant (1940)
Ewes	3-3.5	4.2	3.5-4.9	
Rams	3-3.5	9.3	8.2-10.4	Unpublished data, State Breeding Plant (1946)
Ewes	3-3.5	4.1	3.5-4.7	
Ram-lambs	1.4-1.6	5.3	4.2-6.4	Bagirov *et al.* (1976)
Ewe-lambs	1.4-1.6	3.5	3.3-3.7	
Rams	4-4.5	7.0	5.9-8.1	Odjahkuliev (1976)
Ewes	3.5-4	3.4	3.1-3.7	
Ram-lambs	1.4-1.5	4.1	3.8-4.3	
Ewe-lambs	1.4-1.5	3.2	3.0-3.4	

On average, ram hoggets produce fibers with a diameter of 19.9-22.0 μm. The wool produced is strong, with a high clean yield (48-52%). The wool is a valuable product, as there is a market demand for it. This is something which should be considered for breeding purposes.

Estimates of genetic variation

No estimates of genetic variation in the production traits of this breed are available.

Present breeding structure

Pure flocks of this breed can be found in Azerbaijan, some under the control of research organizations. However, no formal breeding programs exist for this breed in the country.

Goat Breed Characterization

The Azerbaijan Native Goats

Brief account of the development and improvement of goats

During the period 1912-1917, Angora goats were introduced to Azerbaijan in order to cross them with indigenous goats and so further improve them. Kalugin (1930) indicated that by 1926 the State Committee on Land Resources of Azerbaijan had also acquired Angora goats with the same purpose in mind. Melikov (1941) noted that Angora breeding on the State farms of Azerbaijan yielded good results with regard to acclimatization, fleece yields, and fleece quality. However, in 1948, the Council of Ministers of the USSR adopted a resolution to ban goats from all farms in Azerbaijan, to allow for the better management of the forest and ranges. This terminated Angora pedigree goat breeding in the country.

At present, the Republic's goat population stands at more than 0.5 million animals (Table 2).

Goat production cannot compete with cattle, buffalo, and sheep production in lowland areas, where goats have been completely displaced. However, goats are economically important in mountainous areas and in both the Nakhichevan Autonomous Republic and Nagorniy Karabakh, where the goat population is even larger than the sheep population.

Sheep breeders keep goats as flock leaders, and do not consider them to be commodity producers. As they are kept as part of producers' sheep flocks, goats are managed in the same way as sheep. They drift together to the winter ranges and return to the mountains together in summer. The Azerbaijani goats are not productive; however, they can easily withstand severe conditions by accepting any kind of feed offered and by grazing on the scanty ranges for the majority of the year. However, their productivity is low.

Azerbaijan's goats have been poorly characterized and little information is available on them within the country.

Appearance

The goats indigenous to Azerbaijan are usually black and black-red (45.5%), white (13.4%), gray (12.9%), red and dark-red (12.2%), and motley (9.6%), though other colors do occur.

These goats have medium-length head, and in the case of does, a short muzzle (bucks have a long muzzle). They have a straight nose, and a thin, medium-length neck. Their horns grow upwards, then backwards and to the side. They have a narrow, medium-length chest, a sizable belly, and medium-sized udders.

Azerbaijan Native buck

Azerbaijan Native doe

More differences occur in the size and form of the ears, according to which animals are categorized into three types: short-eared, medium-eared, and long-eared. Goats of the first type are practically earless, while individuals of the second type have ears which are 9-16 cm in length. The third type has drooping ears which are 16 to 23 cm in length.

Body measurements

Table 41 provides the body measurements of goats indigenous to Azerbaijan.

Height data was obtained by measuring animals at three points: the withers, the back, and the loins. Bucks are taller than does: the average height at withers is 65.4±1.0 (range 49-80 cm) for bucks and 63.9±0.1 (range 49-73 cm) for females.

Table 41. Body measurements of 3.5- to 4-year-old native goats of Azerbaijan.

	Females (n=39)		Males (n=47)	
Trait (cm)	Mean±SE	Range	Mean±SE	Range
Height at withers	63.9±0.1	49-73	65.4±1.0	49-80
Height at loins	65.2±0.1	50-75	66.3±1.0	49-74
Diagonal body length	62.9±0.1	48-76	65.0±0.8	49-76
Chest depth	28.9±0.1	22-36	29.4±0.4	22-35
Chest width	15.4±0.1	10-29	15.4±0.3	10-22
Chest girth	77.3±0.2	61-95	79.6±1.2	66-94
Metacarpus girth	8.2±0.02	7-10	8.8±0.2	7-11
Head length	10.7±0.02	5-25	19.5±0.9	10-22
Head depth	12.3±0.02	11-16	13.5±0.3	11-16
Horn length	29.4±0.2	12-52	31.0±1.4	7-45
Horn girth	10.3±0.1	7-15	15.4±0.4	7-22
Ear length	14.4±0.1	2-23	13.1±0.4	6-19

Source: Kalugin (1930).
Note: SE: Standard error.

Body weights, growth and carcass traits

At birth kids weigh 2.0-2.5 kg, while at the age of 4-5 months they weigh 18-22 kg. Adult goats (3.5-4 years old), both bucks and does, weigh from 40 to 50 kg. The meat of bucks has a somewhat unpleasant smell. To reduce its strong odor, male kids are castrated at the age of 1.5-2 months, and the skin of slaughtered bucks is removed with the minimum of contact possible between it and the meat. The carcass yield of medium size goats ranges from 40% to 45% (Levi 1951).

Reproductive performance and milk production

The milk of Azerbaijani goats consists of 3.7% dry matter and 4.37% fat. People process the milk to produce cheese, butter, yogurt, clabber (soured, thick milk) and other dairy products.

Lactation in Azerbaijan's goats lasts for 5-6 months. The total amount of milk yielded is in the range of 100-150 liters, and milk has a fat content of 3.8-4.6%. The milking of goats starts at the same time as the milking of sheep, usually from the time a sufficient amount of grazing becomes available. An average daily milk yield is 1.0-1.5 liters, declining to 0.05-0.10 liters at the end of the lactation period.

Goats should be milked one hour after they are fed, in order to ensure that they stand quietly when they are being milked. After kidding, does can be milked 4-5 times a day, reducing gradually to 2 or 3 times a day. Milking should be done quickly and should take place regularly (i.e. at the same time each day).

Fiber and skin production

The combed hair of Azerbaijan goats is suitable for use in handicrafts (i.e. the making of shawls, gloves and hats).

Goatskins are suitable for the production of leather and fur. Goatskin leather is the best raw material for the production of footwear.

Present breeding structure

No formal breeding plans and no experimental herds are available for goats in Azerbaijan.

Prospects for Small Ruminant Production in Azerbaijan

At present in Azerbaijan the demand for sheep and goat products, mainly meat and milk, is extremely high; however, the amount the country can supply is insufficient to meet its requirements. This offers small ruminant producers in rural areas an opportunity for income generation. However farmers are not able to take full advantage of this opportunity, as they have to access the markets via intermediaries who treat them unfairly. Clearly there is an important work to do in this regard, to effectively link farmers to markets in a manner that means they will receive fair prices as an incentive to produce more. Clearly the support of the government is urgently needed. Examples of such support include the provision of adequate policies, the control of unfair intermediation, and efforts to encourage farmers to sell directly through local outlets. All of this should be based on sustainable technical recommendations. Development programs should consider these aspects, through the provision of credit and efforts to organize farmers into entrepreneurial institutions which will help them with production and marketing.

There is also a clear demand for technological improvements, which should be economically feasible and socially acceptable under the new farming conditions found in the country. This demand will further increase as farmers benefit more from their improved access to markets. To this end, research and extension should generate and disseminate appropriate technologies to improve productivity in all the different areas of production (i.e. nutrition, management, health, and breeding). Research organizations are insufficiently funded and understaffed. It is critical that efforts are made both to address this and ensure institutional capacity building. Young scientists should be attracted to research and extension work and then duly trained in the use of modern technologies.

New forms of tenure have dramatically changed the patterns in which the ranges are utilized. As a consequence, some ranges are being overgrazed. Priority needs to be given to finding ways to exploit this resource without causing it to degrade. In addition, the provision of fodder obtained from cultivated forages and haylands has been disrupted. This is causing a severe lack of feed during the winter periods, when supplemental feeding is needed for a period of about 2 months. Addressing this will require important work to be undertaken in the fields of range management, forage production and forage conservation, in accordance with the new production scales seen in the country.

The important role played by Azerbaijan's genetic resources is unquestionable. All the indigenous breeds are available to serve the needs of farmers and their families by providing food and by acting as a source of cash. The products produced are in high demand and the breeds' genetic integrity is not under threat, save in the case of Merino sheep (a non-indigenous breed). However, there is an urgent need to reorganize the genetic structure of the breeds and to formulate long-term breeding plans which could be used to better manage these valuable resources.

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Georgia

Chapter Nine

Small Ruminant Breeds of Georgia

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Introduction

Small ruminant production plays an important role in the livelihoods of the rural poor in Georgia through the production of mutton and milk, which are consumed and sold to provide a source of income. The proportion of mutton produced relative to the total amount of meat produced in the country has fallen since the 1950s, when it was at its highest (30%), decreasing to around 11-18% during the period 1960-1990. After the dissolution of the Soviet Union, from 1990 onwards, the sheep state enterprises and sheep production cooperatives were privatized and ownership of the sheep was transferred to individual farmers who, at the time, were unfortunately not prepared for such a change. The state was not able to support the new farmers and those with no other means to sustain their livelihoods resorted to slaughtering their animals to provide food and cash. As a consequence the sheep population in Georgia decreased significantly, falling from 1,955,000 head in 1985 to 659,200 head in 2002.

Mutton production in Georgia increased from 7400 tons in 1981 to 8400 tons in 2003, while the production of sheep milk increased from 7200 tons in 1991 to 21,800 tons in 2003.

While sheep milk production is not necessarily significant at the national level, both milk and mutton could provide important food sources in specific rural areas. For instance, during the period 1960-1990, in the Kazbegi and Dusheti regions mutton accounted for 49% (on average) of all the meat produced, while during the same period, sheep milk accounted for 79% of all the milk produced in these regions. During that period sheep rearing activities were undertaken in most of these regions.

Georgia's alpine areas contain approximately 200,000 ha of pastures; these can only be exploited by sheep. The elimination of sheep in these areas, or a sharp drop in their numbers, would have a pronounced negative economic impact in the rural population and would trigger large-scale out-migration.

Main Agro-ecological Regions and Areas of Fodder Production

Agladze and Zotov (1987) characterized the following different regions of Georgia that have the potential for livestock production.

Southern region containing winter pastures

Georgia's winter pastures are located in the southern basins and watersheds of the Kuri, Iori, and Alazani rivers, in semi-arid, semi-dry, and dry areas, at 90 to 600 m a.s.l. The mean annual temperature in these areas is 14.2°C, the minimum temperature in January and February ranges from –3.4°C to 1.8°C. There are 252 frost-free days on average per year. Annual rainfall in the area is 265-350 mm, most of which falls in spring and autumn. Watering places are satisfactory in terms of availability and quality.

The vegetation includes the following genera: *Artemisia*, *Salsola* (*S. nobulosa, S. ericoides, S. dendroides*), *Andropogon*, *Festuca*, and *Stipa*. Approximately 85-95% of the fodder used by the small ruminants kept in these winter pastures derives from the natural pastures themselves. The remainder includes concentrated fodders and roughage obtained from natural haylands and arable lands. These winter pastures are characterized by the fact that they are subject to erosion.

Eastern region containing summer pastures

The summer ranges of eastern Georgia are located in different zones: 15% are in semi-mountainous zones at low elevations (700-1800 m a.s.l.), 52% are in subalpine zones (1800-2600 m a.s.l.) and 33% are in alpine zones (2600-3200 m a.s.l.). The annual temperatures in these pastures range from 5.3 to 8.1°C. In January, the coldest month, temperatures range from 2.5 to 7.5°C. In July and August, the hottest months, temperatures range from 15.8 to 18.8°C. Rainfall ranges from 542 to 657 mm per year, 304-400 mm of which falls in the period July-October, the warmer months. The most commonly occurring plants on the south Georgian uplands are motley grass (*Artemisia* spp.), brome grass (*Bromopsis variegata*), bent grasses (*Agrostis* spp.), fescue (*Festuca ovina*) and matgrass (*Nardus stricta*).

Some of Georgia's summer rangelands are located in the forest areas of the Major Caucasus Ridge. The Ridge's northern slopes, Kazbegi and an insignificant part of the Dusheti region contain only natural haylands, grasslands and pastures. The territory is characterized by a very rocky, steep and eroded landscape. Plains and gently sloping areas are located in the valleys. The natural fodder-producing lands are concentrated on mountainsides with slopes of 30-40°. The mean annual temperature varies from 0.3 to 5.8°C, while the temperatures in July and August, the warmest months, vary from 7.7 to 8.8°C. Rainfall ranges from 652 to 1,444 mm per year, 529-1,104 mm of which fall between April and October, the warmer months. The flora of these pastures and haylands consists of bent grass (*Agrostis planifolia*), smallreeds (*Calamagrostis* spp.), brome grass (*Bromopsis variegata*), fescue (*Festuca varia*), lady's mantle (*Alchemilla vulgaris*) and *Sibbaldia* spp.

As in most summer pastures, the animals kept in these areas are well provided with sources of water. The pastures satisfy 100% of the fodder demand of the small ruminants kept there. Additional forage is needed only for rams during the mating season.

Western subtropical Georgia

Western subtropical Georgia consists of two zones: (1) a humid zone which has mild winters and hot summers, and (2) a humid zone which has moderately cold winters and hot and dry summers. Throughout western subtropical Georgia, annual temperatures range from 12 to 14°C. The coldest month is January, when temperatures range from 2 to 5°C. At elevations above 900-1000 m a.s.l., temperatures fall to –3°C. There are 20-30 days of frost per year in the region. In August the mean temperature varies between 17 and 22°C. Maximum temperatures in the period July-August reach 32-38°C. Annual rainfall in the Imereti region ranges between 908 and 1,514 mm, while in the humid Kolkhida lowlands 1,325 mm of rain fall per year on average. The region contains natural fodder grasslands and haylands in the plains, and also contains foothills and forests.

The natural ranges of Georgia offer possibilities for seasonal grazing. Winter ranges located in semi-desert and semi-arid steppe regions are notable for the composition of their flora and the distinctive dynamics of the vegetative growth that occurs there. The vegetation grows and spreads only in spring, autumn and (in some years) in winter. This provides high-quality fodder for winter grazing. In the summer the vegetation in these ranges is at its least productive, and dries out due to the intense heat and droughts that occur. These ranges can be used after the winter frosts end, and during spring.

Summer range use complements the use of winter ranges. Such summer ranges include those in the alpine and sub-alpine zones located on the southern foothills of the Major Caucasus Ridge, as well as those in the south Georgian uplands. These ranges are distinguished by the diversity of flora they contain. In summer, vegetation growth is excellent, though this decreases gradually in autumn; from late autumn to spring the ranges and pastures are covered by snow.

Fodder availability determines the three types of production systems used in the country: the migratory, semi-sedentary and sedentary systems. Currently, the migratory system is the most convenient system, in that it utilizes natural fodder resources, the cheapest form of feed, to the maximum. In this system, animals graze on summer pastures from May to September. Then, from the end of September until the middle of April, they graze on the winter pastures. Other systems are severely constrained by the availability of fodder that needs to be cropped or harvested from rangelands. Since the breakup of the Soviet Union, forage cultivation has been hampered by a lack of resources and machinery.

Land Use and the Present Status of Fodder Production

Georgia's territory covers 76,400 km^2. Of this 53.6% consists of mountains, 33.4% of foothills, and 13% of valleys and plains. In such a varied territory, large areas of natural pastures, haylands, and fodder-producing arable lands have historically contributed to the development of livestock production, through semi-sedentary and seasonal-grazing-based production systems.

Natural grasslands and hay fields have always played a significant role in Georgian agriculture. According to the data provided by the State Committee of Statistics (2002), by January 1, 2002, almost 60% of Georgia's 3 million ha of agricultural land consisted of rangelands (1.798 million ha; Table 1), while a further 5% consisted of haylands (143,000 ha); only 26% of the country's agricultural land was classified as arable land. After the breakdown of the Soviet Union, a process of privatization and the leasing of the land systematically decreased the amount under state or cooperative ownership (see Table 1).

The cropping of forages decreased dramatically in Georgia between 1985 and 2001 (Table 2), causing a dramatic reduction in both fodder-producing areas and the amount of fodder available to sustain animal production. By 2000 the cropping of some sources of fodder had almost stopped entirely, or had fallen to low production levels. The productivity of natural fodder areas also decreased significantly, particularly that of the haylands: in 1985 natural haylands produced 469,000 tons of hay and in 2001 only 115,000 tons. This fall in productivity was the reflection of dramatic changes in the tenure of production systems leading to land fragmentation, the collapse of the production organization and that of production supporting services, the continued obsolescence of machinery and facilities and elevated cost of fuel.

Table 1. Land use by different types of farms in 1986 and 2002 (in thousand hectares).

	All farms			Private farms			State farms		
Land types	1986	2002	Change (%)	1986	2002	Change (%)	1986	2002	Change (%)
Agricultural land	3268	3005	-8	184	744	304	3084	2261	-27
Arable land	783	796	2	96	437	355	687	359	-48
Permanent plantations	357	268	-25	85	181	113	272	87	-68
Haylands	177	143	-19	3	42	>1000	174	101	-42
Ranges	1951	1798	-8	0	84	>1000	1951	1714	-12

Source: State Committee of Statistics (2002).

Table 2. Changes in fodder production from 1985 to 2001 in all farm categories, in thousand tons.

	Year			
Fodder sources	1985	1990	2000	2001
Grain (total)	622.2	666.3	430.5	713.6
Maize for silage	823.2	536.1	na	4.0
Fodder root crops	95.7	56.2	na	1.2
Perennial grass hay	130.9	128.2	32.4	110.3
Annual grass hay	196.2	185.2	19.1	43.9
Hay from natural haylands	469.8	310.9	85.5	115.0

Source: State Committee of Statistics (2001).
Note: na: not available.

Official data on the productivity of natural pastures are not available. However, our own estimates, made on some registered pastures and experimental data, suggest that in the last 8-10 years productivity has decreased by 30-40% in the case of winter pastures and by 15-20% in the case of summer pastures.

The fall in the production of hay from haylands, and the demand for coarse fodder in mountainous regions during the winter means that more hay needs to be produced. To fulfill this demand, an extra 400,000-450,000 ha of hay-producing land would be needed. Such an increase in area could be achieved simply by converting the best summer pastures into hay fields managed by farmers.

The Sheep and Goats of Georgia

Population and regional distribution

Despite the significant role sheep played in food production in the years after the dissolution of the Soviet Union, Georgia's sheep population decreased sharply. As a consequence of the privatization process, the tenure of all livestock was transferred to small-scale farmers who were, at least initially, not prepared for such change. The state was unable to provide adequate assistance and most farmers, lacking the necessary skills, found it difficult to manage their farms and livestock without support. At the same time, all genetic improvement programs and improved stock sources were almost completely dismantled and discontinued. With no access to improved animals, breed quality deteriorated and indigenous genetic diversity is now threatened. The decrease in sheep and goat populations from 1985 to 2004 is shown in Table 3. Note that the population of sheep is showing a recovery from 2002, whereas the population of goats still show some decrease.

Table 3. Sheep and goat population of Georgia from 1985 to 2002 (in thousands).

	Year							
Species	1985	1992	1995	1999	2000	2001	2002	2004
Sheep	na	na	na	na	591.0	583.7	610.8	780.8
Goats	na	na	na	na	42.4	43.9	48.4	33.2
Sheep and goats	1955.0	1469.6	793.32	586.7	633.4	627.6	659.2	814.0

Source: State Committee of Statistics (2004).
Note: na: data not available.

From 1985 to 1999 Georgia's small ruminant population decreased by about 70%. Only after 1999 did a population recovery seem to begin to occur.

The distribution of sheep and goats by regions, as of 2001, is presented in Table 4. Kakheti is the region with the largest population of small ruminants (36.9%) with 243,000 head, mainly comprised of sheep, and is followed by Kvemo Kartli and Samtskhe-Djavakheti regions. Those two regions' small ruminants account for 23.6% and 13.7% of Georgia's sheep and goats, respectively. An insignificant number of small ruminants are also found in the Racha-Lechkhumi, Zemo Svaneti and Guria regions.

Table 4. Number of sheep and goats, and data on wool, mutton and sheep milk production, according to regions in Georgia, as of 2001.

Region	Sheep and goat population		Wool production, (tons)	Average wool yield (kg)	Mutton production (tons)	Milk production (tons)
	Number	%				
Adjara Autonomic Republic	17,020	2.6	16	2.3	199	605
Imereti	35,868	5.4	70	2.6	465	545
Samegrelo and Zemo Svaneti	19,604	3.0	60	2.4	148	581
Guria	11,439	1.7	4	2.6	36	729
Racha-Lechkhumi and Zemo Svaneti	5382	0.8	15	2.7	39	139
Shida Kartli	20,615	3.1	70	2.8	445	405
Mtskheta-Mtianeti	60,336	9.2	198	2.9	694	990
Kakheti	243,306	36.9	655	2.7	2520	4723
Kvemo Kartli	155,504	23.6	452	2.9	1724	5884
Samtskhe-Djavakheti	90,082	13.7	400	3.0	1338	5022
Total	659,156	100.0	1940	2.9	7608	19,623

Source: State Committee of Statistics (2002).

Kakheti is a wool producing region, while Kvemo Kartli can be considered a dairy producing region. The sheep from the Samtskhe-Djavakheti region are distinguished by their wool yielding capacity of about 3 kg per sheep per year.

Main breeds and their regional distribution

Four main sheep breeds are found in Georgia: the Tushetian, the Imeretian, the New Georgian Semi-Fine-Wool Fat-Tailed, and the Georgian Fine-Wool Fat-Tailed. There is a well-defined goat breed known as the Megrelian, as well as some small populations of indigenous goats throughout the country.

The Tushetian and Imeretian are ancient sheep breeds, the former being more numerous than the latter. Tushetian sheep are found mainly in eastern Georgia, whereas Imeretian sheep are more common in western Georgia.

In his monograph “Sheep Breeding in Georgia”, Rcheulishvili (1957), claimed that the indigenous sheep of ancient Georgia were originally fine-wool and semi coarse-wool types that gradually developed into low-grade coarse-wool sheep. He explained this process in terms of the peculiar economic and political history of Georgia. By the time Georgia was annexed by the Russian Empire (1801) most of the Georgian sheep population consisted of coarse-wool sheep.

As part of the modernization of agriculture in the Soviet Union, a program was established in the 1930s to transform the region’s coarse-wool sheep into fine-wool and semi-coarse wool sheep. This included large-scale crossbreeding operations involving Tushetian sheep. This was driven by demand for homogeneous fine and semi-coarse wool from the textile industry. As a result of interbreeding Tushetian ewes with fine-wool rams (Merino-like, Mazaevsky-type and New Caucasian Rambouillet sheep), two new fat-tailed sheep breeds were developed: the New Georgian Semi-Fine-Wool Fat-Tailed (New Georgian SF), and the Georgian Fine-Wool Fat-Tailed (Georgian F).

In comparison with the Megrelian goat, the native goats of eastern Georgia are smaller, less productive and are kept in small numbers (1-3 goats per family) by smallholder farmers. Their average live bodyweight is 35-36 kg. Tskhinvali goats are the biggest of the group (36-38 kg) while Roki goats (from the Djava region) only weigh 32.9 kg on average. Tskhinvali goats are also the tallest, standing 64.3 cm at the crest, while Eldar goats are the smallest (57.8 cm at the crest). Eastern Georgia goats have oblong figures, poorly developed chests, and overgrown hind parts. All goats are covered by hair which lacks fine fibers. Their coats are white, brown, dark or of mixed colors. They are shorn once a year and the fiber is not used. The milk yield of these goats does not exceed 107 kg on average, except in the case of Akhalkalaki goats which are the most productive and may give up to 121 kg of milk per lactation. The fat content of eastern Georgian goat milk varies from 2.5% to 5.8%.

By contrast Megrelian goats are much larger, give higher yields of milk, and exhibit comparatively high fertility levels — features that make them very popular amongst the people of western Georgia.

The geographical distribution of sheep and goat breeds in Georgia is shown in Table 5 and is depicted in Figures 1-5. Note that the Imeretian and Megrelian breeds are specific to certain regions of the country. The Tushetian occurs in the east and south. The synthetic breeds are mostly confined to the eastern part of the country.

The major concentration of sheep in east Georgia is determined by natural conditions, such as climate, that favor the rearing of sheep. In addition, there is a long tradition of sheep rearing in the area.

Figure 1. Geographical distribution of Tushetian sheep and crosses.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors. Numbers represent percent distribution of Tushetian sheep and crosses in the different regions of Georgia.

Table 5. Geographical distribution of sheep and goat breeds in Georgia: numbers of animals per breed (thousands of animals) per region, and the percentage of the population of each breed throughout regions.

		Regions (%)[†]									
Breed	Total n	Kakheti	Kvemo Kartli	Shida Kartli	Mtskheta-Mtianeti	Samtskhe-Djavakheti	Imereti	Guria	Samegrelo Zemo-Svaneti	Racha-Lechkhumi-Zemo Svaneti	Adjara
Sheep											
Tushetian[‡]	701.9	41.1	32.5	4	9.1	13.3	0.0	0.0	0.0	0.0	0.0
Imeretian	45.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0
New Georgian SF	1.3	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Georgian F	1.2	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crossbreds[§]	31.4	0.0	0.0	0.0	0.0	0.0	0.0	48.3	0.0	14.6	37.1
Total	780.8	37.3	29.2	3.6	8.1	12.0	5.8	1.9	0.0	0.6	1.5
Goats											
Megrelian	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0
Indigenous Georgian[¶]	9.0	20.0	20.0	10.0	10.0	10.0	10.0	10.0	0.0	5.0	5.0
Total	33.2	5.4	5.4	2.7	2.7	2.7	2.7	2.7	72.9	1.4	1.4

Source: State Committee of Statistics (2004).
Notes: [†] values for regions along a row, represent the number of sheep per breed per region expressed as a percentage of the breed's population in Georgia; SF: Semi-Fine-Wool Fat-Tailed; F: Fine-Wool Fat-Tailed.
[‡] including crosses with Tushetian.
[§] crossbreds of different breeds.
[¶] Estimated number of indigenous goats of Georgia, small animals low in productivity that are usually counted as part of sheep counts.

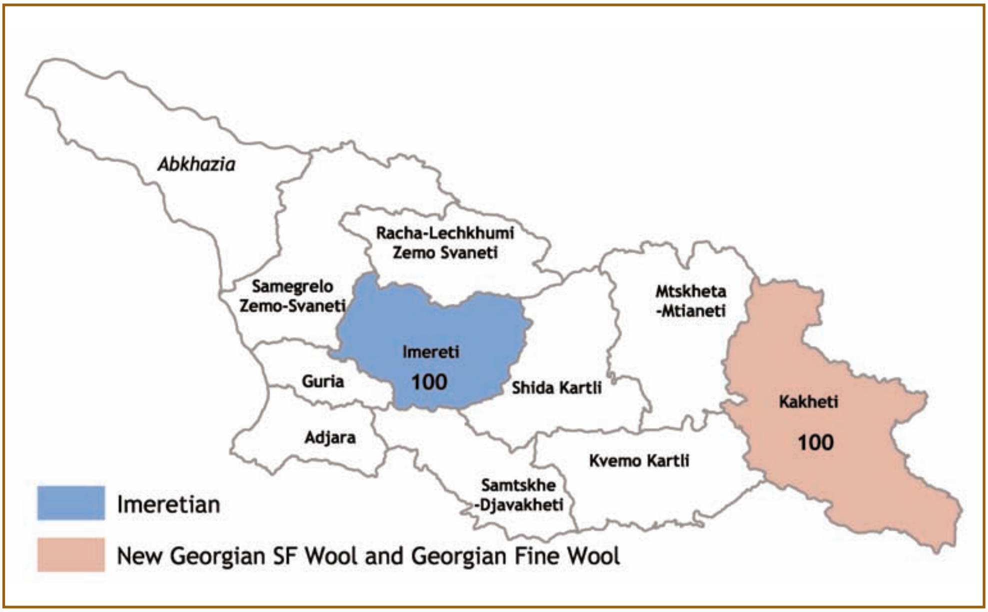

Figure 2. Geographical distribution of Imeretian sheep, New Georgian Semi-Fine-Wool Fat-Tailed sheep and Georgian Fine-Wool Fat-Tailed sheep.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors. Numbers represent percent distribution of the breeds in the different regions of Georgia. Note that the whole populations of New Georgian SF Wool and Georgian Fine-Wool sheep overlap in Kakheti region.

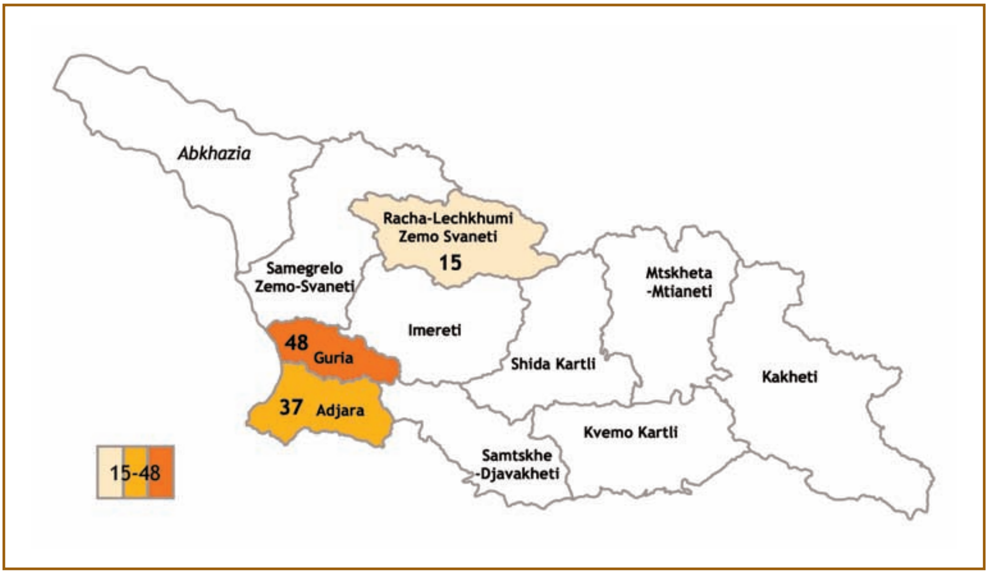

Figure 3. Geographical distribution of crossbreds of different breeds.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors. Numbers represent percent distribution of crossbred sheep in the different regions of Georgia.

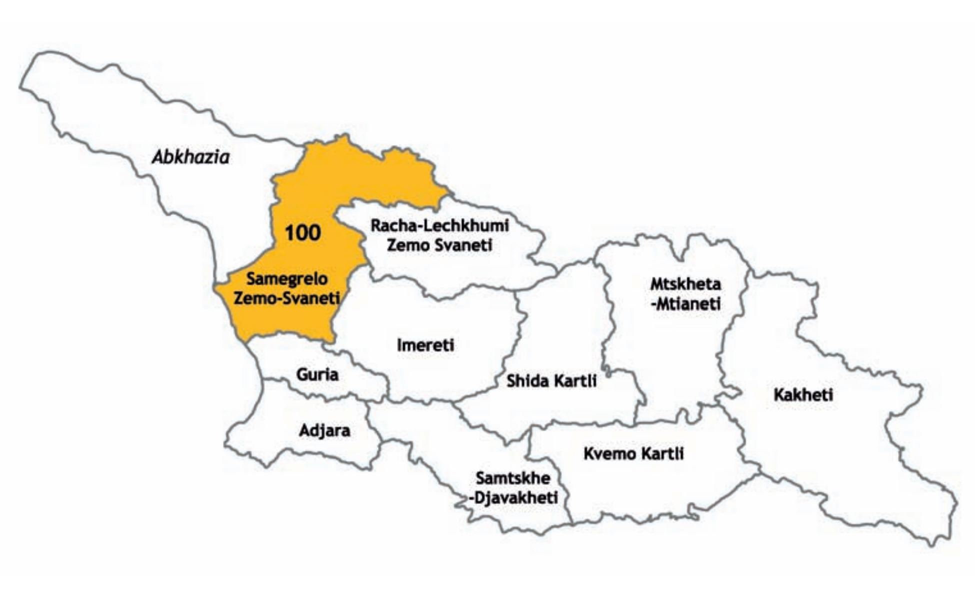

Figure 4. Geographical distribution of Megrelian goats.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors. Number represents percent distribution of Megrelian goats which are found mainly in the Samegrelo Zemo-Svaneti region.

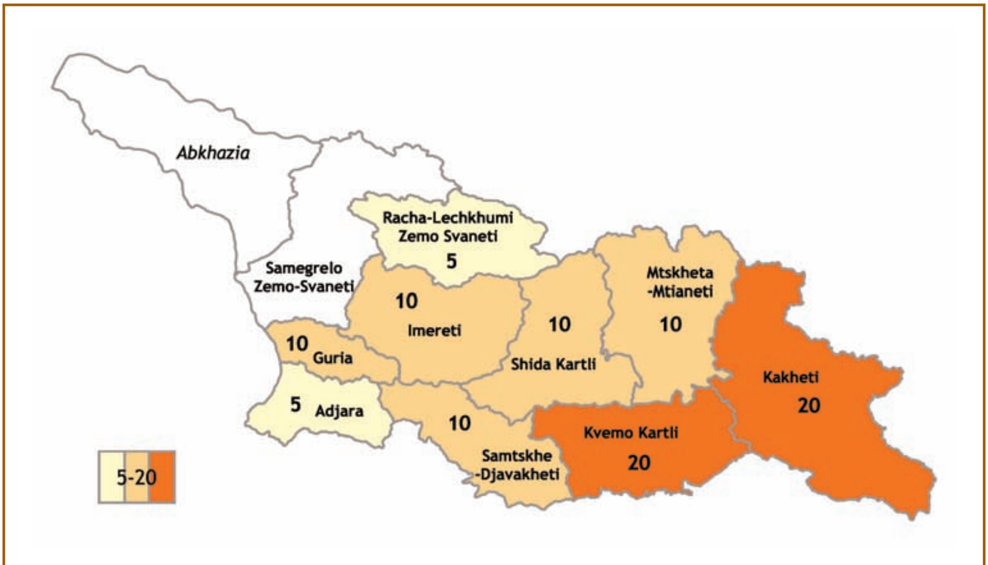

Figure 5. Geographical distribution of Indigenous Georgian goats.
Source: Map was drawn by Piero Daltan—ICARDA (2006), based on information provided by authors. Numbers represent percent distribution of this breed in the different regions of Georgia.

General Distinguishing Features of the Breeds

While the productivity of the breeds will be presented in detail below when they are characterized, in this section the general characteristics of the breeds are presented in Tables 6-7 to allow the reader to rapidly compare size, main products and other salient features.

Notice the light weights of the Imeretian sheep and the Eastern goat in comparison to their other indigenous counterparts.

Table 7 shows the outstanding production values associated with the Megrelian goat and the high prolificacy levels of Imeretian sheep. Milk yield was determined during the suckling period by weighing lambs three times per month, before and after suckling. After weaning, control milking was used during the second 10-day period of each month.

Table 6. Live body weights and appearance of Georgian sheep and goat breeds, and the major products obtained.

	Liveweight (kg)		Horns (%)			
Breed	Ewes	Rams	Ewes	Rams	Color	Main products
Tushetian[†] sheep	41.0	52.0	25-30	100	White	Mutton, wool, cheese
Imeretian[‡] sheep	28.0	35.0	16.5	100	White	Mutton, wool
New Georgian SF sheep[§]	44.5	64.0	0	100	White	Mutton, wool, cheese
Georgian F sheep[¶]	56.7	78.3	0	100	White	Mutton, wool, cheese
Megrelian goat[††]	41.4	52.3	100	100	White	Meat, milk
Eastern goat[‡‡]	35.5	45.5	100	100	Various	Meat, milk

Sources: [†]Roschupkin (1958); [‡]Rcheulishvili (1957); [§]Natroshvili (1947); [¶]Badzoshvili (1954); [††]Gligvashvili (1998); [‡‡]Gligvashvili (1996).
Notes: SF: Semi-Fine-Wool Fat-Tailed; F: Fine-Wool Fat-Tailed.

Table 7. Milk production and fertility of Georgian sheep and goat breeds.

	Lactation		Milking			
Breed	Total milk yield (kg)	Length (days)	Length (days)	Milking yield (kg)	Milk fat (%)	Lambing rate (lambs per 100 ewes)
Sheep						
Tushetian[†]	48.4	165	60-70	16.1	7.7	90-98
Imeretian[‡]	nm	nm	nm	nm	nm	110-230
New Georgian SF[§]	54.0	150-165	60-70	15.5	7.0	108-110
Georgian F[¶]	49.5	150	60	15.0	7.1	109-110
Goats						
Megrelian[††]	208.0	210	90	60	3.8	118-122
Eastern[‡‡]	107.0	180	80	na	2.5-5.8	na

Sources: [†]Roschupkin (1958); [‡]Mushkudiani (1984); [§]Natroshvili (1947); [¶]Badzoshvili (1954); [††]Gligvashvili (1998); [‡‡]Gligvashvili (1996).
Notes: nm: not milked because of its high prolificacy; na: not available; SF: Semi-Fine-Wool Fat-Tailed; F: Fine-Wool Fat-Tailed.

Adult (≥3 years of age) Tushetian and Imeretian females and males produce 2.5 and 3.1 kg of fleece, respectively. This consists of heterogeneous fibers, including guard, intermediate and down fibers. The fiber diameter of the guard hairs is over 70 µm, while that of intermediate fibers is 38-44 µm and that of down 25.6-31.6 µm. These values are representative of a rather coarse fleece. Within the New Georgian SF breed, there are coarse-wool types and finer-wool types. The former have wool fibers similar to those of the indigenous breeds and the latter have homogeneous finer fibers ranging from 22 to 24 µm in diameter.

Threats to Genetic Diversity

As seen in Table 3, unfortunately, the majority of Georgia's small ruminant populations have faced risk of disappearance as a result of a process that started after the dissolution of the Soviet Union. Although the slight recovery in the sheep population after 2002, the synthetic breeds face the major risk; their populations have declined sharply and they may eventually disappear entirely if measures are not taken to avoid extinction. A brief account of the risks to genetic diversity is presented in Table 8.

Main Management Characteristics

Sheep and goats in Georgia are managed in a similar way. Features of this management are included in Table 9. Currently mating occurs naturally, and the mating season extends from August to October. Sheep milking usually starts 2 months after lambing.

Institutions that Supervise and Conduct Breeding Research

Research into issues related to sheep and goat breeds is mainly conducted by the Georgian Zoo-Veterinary University. There are no research stations for livestock, and due to limited funds and resources, the quality of the research has deteriorated.

Table 8. Breed populations (in thousands) and risks to genetic diversity.

Breed	Population	% of total species population	Risk of disappearance
Sheep			
Tushetian and its hybrids	701.9	89.89	None
Imeretian	45.0	5.76	Low
New Georgian SF	1.3	0.17	Very high
Georgian F	1.2	0.15	Very high
Crossbreds of different breeds	31.4	4.02	nk
Total sheep	780.8	100.00	
Goats			
Megrelian	24.2	72.89	Medium
Indigenous Georgian	9.0	27.11	nk
Total goats	33.2	100.00	

Source: State Committee of Statistics (2004).
Notes: SF: Semi-Fine-Wool Fat-Tailed; F: Fine-Wool Fat-Tailed; nk: not known.

Table 9. Main features of the management of sheep in Georgia.

Events and seasons	Months											
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mating												
Lambing												
Weaning												
Milking												
Shearing												
Winter grazing												
Summer grazing												
Seasons	Winter			Spring			Summer			Autumn		

Source: Organized by authors.

Sheep Breed Characterization

The Tushetian sheep

Brief account of the development and improvement of the breed

The Tushetian breed has the largest population among the sheep breeds of Georgia (96.5%) ad includes about 701.9 thousand animals (Table 8). This breed is the result of centuries of local sheep breeding. Because of its distinctive genetic properties and valuable economic features, the Tushetian sheep is the basic Georgian sheep breed, as it is well adapted to the local environment and therefore widely used as a primary source of germplasm in sheep breeding programs. Tushetian sheep are found throughout eastern Georgia: from the high mountains of the Major Caucasus Ridge to the highland plateau of the Minor Caucasus Ridge and on all inter-mountain plains. The breed is also reared in Russia (the north Caucasus), Azerbaijan and Armenia.

Georgian breeders worked on the Tushetian breed for many years. This mostly involved attempts to improve it and distribute it more widely, so further promoting it as the country's main sheep breed. After the dissolution of the Soviet Union the funding for this work stopped, the work stopped and the breed standards degraded.

Appearance

Tushetian sheep have a compact body, and the legs are long with hard hooves; the fleece is white and has heterogeneous fibers. Strong constitution and high endurance mean that they are suited to the conditions encountered during migratory grazing in rough mountains.

The foreheads are flat and slightly concave. The forehead is 21.5 cm long in ewes and 22.5 cm long in rams, with a width of 10.8 cm in ewes and 9.7 cm in rams (Rcheulishvili 1957). The profile of the nose of most ewes is even, but in some instances it is crooked.

Tushetian ram

Tushetian ewe

Most animals (99.2%) have flat and slightly dropping ears (Rcheulishvili 1957). The average length of the ears is 10.6 cm in ewes and 10.9 cm in rams (Roschupkin 1958).

Most females have rudimentary horns, though 25-30% have relatively developed horns. In rams, horns are well developed. The horns separate at the base and are twisted; in most cases this involves 1.5 twists or more, with the tendency for further twists as the animal grows older.

According to Bogolubsky (1934), Tushetian sheep are semi-fat-tailed sheep, with fat deposits on the sacrum and haunches and around the tail vertebra. The tail fat deposit is well developed in terms of its width. The breed is divided into two types according to the two tail shapes that occur. The Dumeuli type has a long and hanging tail that reaches the hock. The tail of the Kuntuli type is lifted and is placed almost on the same level as the sacrum.

Body measurements

The Tushetian are small animals when compared to many other Caucasian breeds. Tushetian ewes stand 50-60 cm tall at the crest according to Kalantar (1913), 63.5 cm at the crest according to Pridorogin (1949) and 58.5 cm at the crest according to Rcheulishvili (1957). Recent data are shown in Table 10.

A summary of the body measurements of ewes and rams recorded at the Krtsanisi experimental farm, from birth until the age of 2 years, is given in Table 11. With regard to height, the animals seem to develop little from the age of 1 year onwards.

Body weight, growth and carcass traits

Table 12 summarizes reports on body weights in accordance with the season of the year, which greatly affects body weight and is closely associated with the migratory nature of the breed.

Table 10. Body linear measurements of Tushetian sheep.

	Roschupkin (1958)†		E.L. Khachapuridze, G.D. Agladze and L. Iñiguez (unpublished work)‡	
Trait (cm)	Ewes	Rams	Ewes	Rams
Height at crest	60.3	65.7	60.6	66.1
Height at sacrum	61.2	66.3	61.3	60.6
Diagonal body length	57.8	66.1	57.9	66.2
Chest width	16.1	18.9	16.2	19.0
Chest depth	27.2	31.8	27.3	31.9
Chest girth	83.5	87.3	83.6	87.4
Metacarpus girth	7.4	8.5	7.4	8.5
Head length	19.4	21.3	19.4	21.3
Forehead width	10.9	12.2	10.8	12.3

Notes: † Adult animals, with no specific information provided on age and number of records per sex; ‡ Data involving 2.5- to 3.5- years old ewes (n=100) and rams (n= 50), respectively.

Table 11. Body measurements of Tushetian sheep from birth until the age of years (2000-2001).

		Age					
Trait (cm)	Sex	At birth	3.5-4.0 months	5.5-6.5 months	1 year	1.5 years	2 years
Head length	F	10.0	10.4	17.3	19.2	19.2	19.4
	M	10.0	10.7	18.3	20.5	20.6	21.2
Forehead width	F	6.5	7.3	10.2	10.2	10.6	10.6
	M	6.6	7.8	10.4	10.5	11.0	11.1
Height at the crest	F	34.2	44.7	55.1	55.3	59.0	60.2
	M	35.0	46.4	56.5	58.7	60.4	65.6
Diagonal body length	F	26.4	42.4	50.5	52.0	57.0	57.5
	M	27.0	44.3	51.5	53.3	60.2	65.9
Chest width	F	5.6	10.1	14.1	14.4	15.4	16.3
	M	5.8	10.6	14.2	16.5	18.7	18.8
Chest depth	F	11.9	19.6	21.9	24.0	26.0	26.8
	M	12.5	20.5	23.3	25.0	26.5	30.6
Chest girth	F	34.7	59.1	70.8	73.0	79.7	82.1
	M	35.6	61.6	73.1	76.8	80.3	86.5
Metacarpus girth	F	5.1	5.8	6.5	6.9	7.2	7.3
	M	5.2	6.0	7.0	7.6	8.1	8.4

Source: E.L. Khachapuridze and G.D. Agladze (unpublished work).
Notes: 20 animals were examined in each sex; F: Females; M: Males.

Table 12. Live body weight of ≥3.5-year-old Tushetian sheep affected by season.

	Rcheulishvili (1957)	Roschupkin (1958)		E.L. Khachapuridze (unpublished work)	
Sex	Autumn weight (kg)	Spring weight (kg)	Autumn weight (kg)	Spring weight (kg)	Autumn weight (kg)
Ewes	41.5	36.7	40.6	37.8 (100)	41.1 (100)
Rams	58.6	43.3	52.4	45.7 (20)	51.1 (20)

Note: The numbers in parenthesis refer to the numbers of animals weighed.

Tushetian sheep are not necessarily homogeneous with regard to their liveweight, and variations between regions and within regions also occur. This reflects the lack of selection apparent in the breed.

Data on the growth of Tushetian sheep is given in Table 13.

According to observations made by E. L. Khachapuridze (unpublished work), during the suckling period (from lambing to weaning, before the age of 3.5-4 months) intensive growth takes place, especially in the second month (170 g/d). After this, growth rates decrease slightly, particularly after the suckling period. The intensity of the weight increases observed in young ewes and rams decreases even more after they leave the summer pastures, at 9-12 months of age.

Kalantar's reports (1913) record comparatively lower weights than later reports do. Specifically, Kalantar (1913) reported that ewes weighed 20-28 kg and rams 24-40 kg.

The mutton produced by Tushetian sheep is noted for its gastronomic qualities and is among the best quality meat produced by Caucasian sheep (Kalantar and Gaevsky 1985), ranking second after the Imeretian breed. Tushetian mutton has a pleasant aroma, being practically free from the odor usually associated with mutton. The only drawback of the breed as a meat producer is its low live bodyweight, which leads to low carcass weight performances (Table 14).

Table 13. Body weights and growth of Tushetian sheep.

	Roschupkin (1941)				E.L. Khachapuridze (unpublished work)			
	Female		Male		Female		Male	
Age	n	Weight (kg)	n	Weight (kg)	n	Weight (kg)	n	Weight (kg)
Birth	1,382	3.06	1,451	3.15	55	3.09	47	3.15
Weaning (3.5–4 months)	314	17.8	332	19.2	52	17.9	47	18.1
5.5-6.5 months	880	23.9	789	26.5	46	23.7	46	25.5
1 year	1,578	27.2	766	30.0	45	26.8	46	29.4
1.5 years	1,119	33.8	1,045	43.2	20	36.0	20	40.6

Table 14. Meat traits of Tushetian sheep.

Sex and age group	n	Live weight (kg)	Carcass including tail and abdominal fat: kg	Carcass including tail and abdominal fat: %	Fatness
Female (3.5 years and older)	20	40.1	20.2	50.4	Fat
Female (3.5 years and older)	18	37.6	18.6	49.5	Above-average
Female (2.5-3.5 years)	15	35.4	16.8	47.5	Medium
Wethers (1.5-years-old)	11	43.7	20.5	47.1	Fat
Wethers (1.5-years-old)	15	41.9	18.7	44.7	Average
Rams (9-month-old)	18	41.7	26.9	64.7	Fat
Wethers (9-month-old)	nr	34.4	22.5	65.4	Fat
Yearling rams	nr	41.5	24.1	58.4	Fat

Source: Rcheulishvili (1957).
Note: nr: Not reported.

Reproductive performance and milk production

Ewes can be mated at the age of 1-1.5 years. In Tushetian sheep, gestation lasts for 148-150 days (Roschupkin 1958). Fertility rates are below 85%, due to poor feeding. However, the lambs delivered are strong and have a high rate of survival (95%) (Roschupkin 1958).

At Krtsanisi Experimental Farm, for the period 2000-2002, the fertility rate of the ewes did not exceed 88% (E.L. Khachapuridze and G.D. Agladze, unpublished work). By 1 January 2001, 297 out of 340 ewes mated had lambed, giving a fertility rate of 87.4%. By the same token, 314 lambs were actually delivered by the 297 ewes lambed, yielding a prolificacy rate of 105.7%. In 2002, out of 347 mated ewes 291 lambed, giving a fertility rate of 83.9%. In all, 305 lambs were delivered, yielding a prolificacy rate of 104.8%.

Tushetian sheep are milked twice a day: once in the morning and once in the evening. The morning milk yield significantly exceeds the evening's milk yield, by approximately 60-68%. The lactation period lasts for up to 165 days. Milk yield decreases over this period, as shown in Table 15.

Table 15. Tushetian sheep milk production according to the month of lactation.

	Roschupkin (1958) n=98 ewes	E.L. Khachapuridze and G.D. Agladze (unpublished work) n=50 ewes
Month of lactation	Milk yield (kg)	Milk yield (kg)
First	10.9	11.7
Second	10.2	11.3
Third	10.0	10.1
Fourth	8.2	8.6
Fifth	6.3	6.7
Sixth	2.7	3.5
Total	48.4	51.9

Khachapuridze and Agladze, whose work began in 2000, estimated these values for Tushetian sheep using controlled milking at a rate of three times per month (once every ten days) throughout the whole lactation period before and after weaning. The maximum milk yield was recorded in the first two months after weaning. Weaning occurred at 3-4 months of age.

The milk yield of Tushetian sheep increases up to the age of 6 years, after which it decreases gradually. As a result of this feature, Tushetian ewes are culled on Georgian farms after the fifth lambing. Data on the dynamics of Tushetian ewes' milk yields are presented in Table 16 according to age.

The lambs are separated from the ewes in the first days of June, when they are 3.5-4 months old. After weaning, commercial milk production starts. Milking lasts for two months. The milk obtained constitutes approximately one-third of the total amount of milk yielded during lactation. With an average fat content fluctuating between 7.7% to 7.9% (Table 17), the milk is used to produce cheese for which there is a great demand in local markets.

In general, sheep cheese is made from whole milk. This milk is put into a special bag made of sheep skin (*guda*), and then salt is added. The bag is then sealed (almost hermetically) and left for over a month. The cheese produced is called *gudis qweli* (*qweli* is cheese in Georgian).

Wool production

The wool produced by Tushetian sheep consists of the undercoat, and transitional hairs and guard hair. In the past it was in great demand for use in carpet making, a fact which previously provided export opportunities.

The fleece is white and the sheep are shorn twice a year, in spring and in autumn. Average wool yields are shown in Table 18. Adult females produce up to 2.1-2.6 kg of wool per year.

Table 16. Milk production of Tushetian ewes according to their age.

Age	Average milk yield during lactation period (kg)	Production in relation to production of 2-year-old ewes (%)
2 years	45.5	100
3 years	47.9	105
4 years	46.5	102
5 years	62.1	124
6 years	74.2	163
7 years	23.8	52

Source: Roschupkin (1958).
Note: Sample size was not available.

Table 17. Composition of milk from Tushetian sheep (Mean±Standard error).

Milk composition	Roschupkin (1958)	E.L. Khachapuridze and G. D. Agladze (unpublished work)
Milk fat (%)	7.7±0.3	7.9±0.4
Specific gravity	1.04±0.15	1.04±0.20
Dry matter (%)	18.5±0.4	18.6±0.4

Note: Sample size was not available.

Table 18. Wool production of Tushetian sheep (kg).

		Roschupkin (1958)			E.L. Khachapuridze and G. D. Agladze (unpublished work)		
Age	Sex	Spring	Autumn	Annual	Spring	Autumn	Annual
1 year	F	0.86	ns	0.86	0.93	ns	0.93
	M	0.99	ns	0.99	2.09	ns	2.09
1.5 years	F	ns	1.82	2.68	0.93	1.92	2.85
	M	ns	1.78	2.77	1.09	1.89	2.98
Adults (>2 years)	F	1.01	1.38	2.39	1.11	1.50	2.61
	M	1.35	1.68	3.03	1.43	1.75	3.18

Notes: ns: not shorn. Young ewes (1.5 years) are not shorn in the spring because the wool is short at that time.
F: Females; M: Males.
Sample size was not available.

Data on the length of the wool produced by Tushetian sheep is presented in Table 19. These results demonstrate the suitability of this wool for the carpet industry. The percentage elasticity varies: guard hair averages 48.9-57.6%, transitional hair 37.3-50.4%, and undercoat hair 32.5-44.1%.

Genetic and phenotypic parameters

Roschupkin (1958) reported genetic correlations between various wool traits and also between various milk traits; however, no information was provided regarding how these values were obtained nor the number observations involved.

Table 19. Wool fiber length of Tushetian sheep.

		Fiber length (cm)		
Age	Sex	Guard hair	Transitional	Undercoat
5.5-6.5 months	Females	14.3	9.6	5.8
	Males	15.5	9.1	5.3
1.5 years	Females	13.6	8.6	6.1
	Males	14.4	8.9	5.9
Adult (>2 years)	Females	15.5	10.0	7.5
	Males	15.4	8.6	6.9

Source: Roschupkin (1958).
Note: The number of animals studied was 10 in each category.

Current breeding structure

There is no breeding plan for the improvement of Tushetian sheep, though the Department for Mutton and Wool Production of the Georgian Zoo-Veterinary University works on a small scale in this regard and plans to get involved in a larger project for meat and milk production improvement which should start in 2006. The breed is very popular in the private sector of eastern Georgia and is the major sheep breed of Georgia. The breed does not face the threat of extinction.

The Imeretian Sheep

Brief account of the development and improvement of the breed

The Imeretian sheep has the second largest population among the sheep breeds of Georgia; however, the population numbers are small (about 45 thousand head, Table 8). Imeretian sheep are farmed in western Georgia and there is great market demand for the breed. At present this breed is no longer reared on state farms, except in the case of the Terdjola State Pedigree Farm where 35 animals are kept including 15 ewes. This breed was subject to unsystematic and accidental crosses with Tushetian, Tsakel and Karachavsky sheep on the summer pastures of western Georgia (Rcheulishvili 1938, 1957). Nevertheless, the relative isolation of sheep farms in various villages in western Georgia has kept the breed relatively pure. Currently, purebred Imeretian sheep are found in the Sachkhere and Chiatura regions of western Georgia. According to Mushkudiani (1984), 63.1% of the total population of Imeretian sheep is purebred.

Appearance

Imeretian sheep have a strong constitution and are well adapted to the environmental conditions in which they live. They are also known to have a good maternal ability and a high level of prolificacy.

The head is covered with undercoat hair, and is narrow with a crooked nose. Rams are horned with half-curved horns. Most ewes are polled (54.9%), though some have horns or rudimentary horns. Like the head, the ears are covered with undercoat hair. The ears of the breed are either straight (42%), or slightly hanging (58%). The neck is short. In this breed two types of animals can be found: fat-tailed (62%) and ordinary thin-tailed (38%) (Rcheulishvili 1957; Mushkudiani 1984).

Imeretian ram

Imeretian ewe

Body measurements

The Imeretian is the smallest of Georgia's sheep breeds (Table 20).

Table 20. Average body measurements of 3-year-old Imeretian ewes (n=30).

Trait	Mean (cm)
Head length	19.9
Forehead length	10.2
Forehead width	10.2
Height at crest	54.2
Height at sacrum	55.5
Chest girth	72.3
length of front leg	34.3
Length of back	18.1

Source: Mushkudiani (1984).

Body weights, growth and carcass traits

The live body weights included in Table 21 show that ewes reach maturity at an early age, due to their rather low adult weight. Ewes reach their adult (≥3 years) weight of 28 kg at 18 months of age. Adult rams (≥3 years) weigh 35.1±1.2 kg (n=10) (Mushkudiani 1984).

Table 21. Live body weights of Imeretian ewes.

Age	n	Body weight, mean±SE (kg)	Body weight relative to adult body weight (%)
At birth	127	1.9±0.1	7
3 months	98	12.8±0.2	46
6 months	81	19.6±0.2	70
12 months	81	24.8±1.9	89
18 months	81	28.0±0.2	100
Adult ewes	100	28.0±0.4	100

Source: Mushkudiani (1984).
Note: SE: Standard error.

The birth weights of twin lambs vary from 1.3 to 1.8 kg, while those of triplets vary from 0.8 to 0.9 kg.

In comparison to other breeds, the mutton of Imeretian sheep displays the best gastronomic traits and lacks the unpleasant mutton odor associated with the mutton produced by other breeds. The dressing percentages of the breed are 50.3% in the case of rams and 44.3% in the case of ewes (Rcheulishvili 1957; Mushkudiani 1984).

Reproductive performance and milk production

According to the reports produced by Rcheulishvili (1957) and Mushkudiani (1984) Imeretian ewes are prolific, as it is not uncommon to obtain two or three lambs per lambing; in addition, the animals have an extended breeding season. The same authors also indicate that Imeretian ewes are precocious, and may have their first lambs at between 11 and 14 months old. Pregnancy lasts for 137-143 days, and ewes return to heat 21-25 days after lambing. As a result, even under seasonal grazing it is possible for ewes to lamb twice a year. Over three years of observations, Mushkudiani (1984) observed that 72% of ewes lambed twice a year, delivering an average of 2 lambs per lambing (averages ranged between 1.5 and 2.6) and an average of 3.5 lambs per year (averages ranged between 2.5 and 5).

Researchers at the Lomtagora Experimental Farm in the Marneuli region recorded data for 159 ewes. These ewes produced 391 lambs in one year, giving a prolificacy rate of 245.9%. Of this ‘crop’ of lambs, 328 survived until weaning, yielding a survival rate of 84% (Mushkudiani 1984). An outlier ewe, which lambed in the same year, delivered three lambs; the same ewe then delivered a second litter of triplets in the same year.

Rcheulishvili (1957) and Mushkudiani (1984) conducted a comparative analysis of milk production in various breeds. This allowed them to establish that Imeretian sheep give a higher yield than the other breeds kept in Georgia. Despite this, however, the breed is not milked. Imeretian ewes with a single lamb produce 0.437 kg of milk daily, while those with twins give 0.480 kg of milk per day, and those with triplets 0.517 kg of milk per day (Rcheulishvili 1957; Mushkudiani 1984).

Wool production

The wool of Imeretian sheep contains heterogeneous fibers, a significant amount of which consists of undercoat and transitional hair. The fleece is usually pure white, though it can sometimes be black, brown or a mixture of these colors.

The breed's annual wool yield is low, averaging 1.4 kg in young ewes (1-2.5 years), 1.4-1.7 kg in adult ewes (3-4 years) and 2.08 kg in adult rams (3-4 years) (Mushkudiani 1984).

Fiber diameter varies from 20 to 26.3 µm in the case of the undercoat and from 55.5 to 63.4 µm in the case of guard hairs Chirvinsky (1951, cited by Rcheulishvili 1957). In total, the undercoat and guard hairs make up 42.4-57.5% of the weight of the fleece.

Current breeding structure

No breeding programs remain from the efforts initiated by Rcheulishvili (1957) and Mushkudiani (1984). Furthermore, neither Georgia's state farms nor its private farms are attempting to conserve or multiply the breed. Population numbers have been decreasing dramatically each year. Given these circumstances, steps should be taken to preserve this important and adapted breed.

The New Georgian Semi-Fine-Wool Fat-Tailed Sheep

The New Georgian Semi-Fine-Wool Fat-Tailed (SF) sheep is one of the synthetic breeds created during the Soviet Union to produce mutton, fat, wool, and milk. The population of the New Georgian SF does not surpass 1300 animals (Table 8).

Brief account of the development and improvement of the breed

This breed was developed by Natroshvili (1947) at "Udabno" Research Farm (Georgian Scientific Research Institute of Livestock Breeding), by crossing Tushetian ewes with Merino rams of the Novokavkazskaia and Mazaevsky types. Its adaptation to mountain grazing, its mutton quality, and its fat tail were inherited from the Tushetian breed. From the fine-wool breeds, it inherited wool uniformity, high wool and milk yields, a heavier weight, precocity and desirable fertility.

Appearance

The New Georgian SF sheep has good conformation, a frame suited to meat production, a wide, deep chest and round ribs. The head has a straight profile, though some individuals do have a curved nose. Individuals have long legs with hard hooves. Though the fat tail of this breed resembles that of the Tushetian, the fat deposition is greater. The horns produced by males are similar to those of Tushetian males.The ewes are either polled or have small horns. The ears are flat or slightly curved.

New Georgian Semi-Fine-Wool Fat-Tailed ram

New Georgian Semi-Fine-Wool Fat-Tailed ewe

Body measurements

In comparison to Georgia's indigenous sheep, this breed is larger and has a larger frame (Table 22). At 6.5 to 7.5 months of age, ewe lambs usually have not reached their adult size, particularly with regard to their chest measurements.

Table 22. Body linear measurements of New Georgian SF sheep (Mean±Standard error).

Trait (cm)	6.5-7.5-month-old Males	6.5-7.5-month-old Females	Adult ewes (3-4 years)
Height at crest	57.1±0.6	53.6±0.4	62.2±0.3
Height at sacrum	56.7±0.6	54.7±0.6	62.0±0.5
Diagonal body length	57.6±0.5	57.5±0.8	62.0±0.5
Chest width	19.8±0.4	20.1±0.3	24.4±0.5
Chest depth	26.6±0.3	25.0±0.3	32.8±0.3
Chest girth	87.8±0.7	77.7±0.8	97.9±1.0
Metacarpus girth	8.8±0.2	8.4±0.2	8.6±0.2
Height of front leg up to elbow	41.3±0.5	37.1±0.4	43.5±0.6

Source: Natroshvily (1947).
Note: The number of animals observed is not indicated in the reference.

Body weights, growth and carcass traits

Individuals of this breed weigh more than individuals of the Tushetian breed. At 1.5 years of age, females and males are not fully developed, though they will have attained average weights of 38 kg and 58 kg, respectively (Table 23). At this age, ewes weigh less than 80% of their adult weight (as measured during the autumn). Males of the same age approach 83% of their mature weight of 70 kg. Notice that from 1 to 1.5 years of age, the weight of individuals increases considerably in relation to the weight gains made at other ages. The weights of individuals are strongly influenced by the season; for instance, adult ewes weigh 38 kg in spring and 48.4 kg in autumn.

New Georgian SF lambs grow quickly from lambing until weaning, gaining 157 g per day in the case of females and 170 g per day in males.

The mutton produced by this breed has a similar taste to that produced by Tushetian sheep. The breed's carcass weight averages 21 kg (Table 24) while the Tushetian breed exhibits an average carcass weight of 17.2 kg.

Reproductive performance and milk production

New Georgian SF ewes lamb, on average, five times in their life, and produce 9-10% more twins on average than Tushetian ewes. The prolificacy rate of the breed is 108-110%, and lamb mortality is not higher than 9-10% (Natroshvili 1947). Note, however, that Natroshvili (1947) did not indicate the number of sheep considered when making these estimates.

Milking in New Georgian SF ewes begins on about June 15, once animals are in their summer pastures, and lasts for 45 days, until the beginning of August. During this period, the milk produced is high in fat and thus yields a form of cheese which is in higher demand. The New Georgian SF produces slightly more milk than the Tushetian (Table 25).

Table 23. Growth of New Georgian SF lambs and younger sheep (Mean±Standard error).

Age	Females (kg)	Percentage of adult weight	Males (kg)	Percentage of adult weight
At birth	3.59±0.03	7	3.88±0.03	6
3.5-4.5 months	25.3±0.2	52	26.7±0.3	38
5.5-6.5 months	27.5±0.3	57	30.1±0.3	44
1 year	29.3±0.2	61	32.1±0.3	46
1.5 years	38.0±0.3	79	58.4±0.6	83
Adult (3-4 years)	48.4±0.3*	100	70	100

Source: Natroshvili (1947).
Note: * weight obtained during spring.

Table 24. Carcass measurements of 3-year-old New Georgian SF rams with above average fatness (n=24).

Trait	Weight (kg)	Percentage of liveweight
Liveweight before slaughter	47.9	100
Carcass weight	21.0	44
Fat tail weight	2.2	5
Inner fat weight	0.9	2
Total carcass + fat tail + abdominal fat	24.1	50

Source: Natroshvili (1947).

Table 25. Yield and composition of milk produced by New Georgian SF and Tushetian sheep.

Breed	Mean total yield (kg)	Milk milked (kg)	Dry matter (%)	Fat (%)
New Georgian SF	48.4	15.3	20.6	8.83
Tushetian	54.0	11.7	20.3	9.03

Source: Natroshvili (1947).

Wool production

The wool produced by this breed is semi fine, and the fleece is somewhat shorter than that produced by the Tushetian. This is because its fleece does not contain the long, coarse guard hairs found in Tushetian wool. However, the wool is long enough for the breed to be shorn twice a year, thus making it suitable for use in the worsted wool industry, since in 6 months it reaches 9 cm in length (Natroshvili 1947). Natroshvili (1947) also reported fiber diameters of 26-27 µm. Wool yields and wool length at different ages are shown in Table 26.

Table 26. Wool production in New Georgian SF sheep (Mean±Standard error).

Age	sex (season)	Fleece weight (kg)	Wool length (cm)
1-year-old	Females	3.04±0.02	9.5±0.11
	Males	3.40±0.03	10.3±0.11
1.5-year-old	Females	3.54±0.03	na
	Males	4.40±0.05	na
Adult	Females (spring)	1.43±0.03	9.4±0.14*
	Females (autumn)	1.64±0.03	na
	Males (spring)	2.5†	10.6±0.17*
	Males (autumn)	1.87†	na

Source: Natroshvili (1947).
Notes: *Average of two seasons; New Georgian SF sheep are shorn once a year; na: data not available; number of observations involved was not provided; † no estimation of variation for these figures.

According to the data provided by Natroshvili (1947), which was based on wool samples taken from ewe hoggets, the wool contents of semi-fine wool (26-30 µm), semi-coarse wool (31-35 µm) and coarse wool (>35 µm) were 72.8%, 26.5% and 0.7%, respectively.

Current breeding structure

There are no plans for the improvement of this breed which, with a population of 130,000 head, is on the verge of extinction. Every year the condition of the breed worsens, and it will disappear altogether if urgent measures are not taken.

The Georgian Fine-Wool Fat-Tailed Sheep

Brief account of the development and improvement of the breed

The Georgian Fine-Wool Fat-Tailed sheep (or the Georgian F sheep) was developed in 1954 by I. Badzoshvili at the former Eldar Experimental Farm, in the Tsitelitskaro district. To do this, Badzoshvili crossed Tushetian ewes and Novokavkazsky Merino and Rambouillet Merino rams. In 1952 (when the breed was recognized as such) the Georgian F had a total population of 7969 sheep. At the beginning of the 1980s, however, population numbers had fallen to only 2000, while in 1999 they had declined to approximately 1200. The available information on the characterization and productivity of this breed is very scarce and mostly anecdotal.

Appearance

The head of this breed has a straight profile; the crest is flat and wide, and the chest is deep and wide. The body frame resembles that of the Tushetian. Like the Tushetian, the Georgian F is adapted to seasonal grazing.

The ewes of this breed are either hornless or have small horns. Georgian F rams have well-developed horns. The ears of the breed are flat and droop slightly. The animals are fat-tailed like the Tushetian, but accumulate less fat.

Georgian Fine-Wool Fat-Tailed ram

Georgian Fine-Wool Fat-Tailed ewe

Body measurements

Badzoshvili (1954) recorded the following average body measurement in adult ewes (3 years): height at crest 61.4 cm, height at sacrum 62.1 cm, diagonal body length 64.3 cm, back width 17.2 cm, and metacarpus girth 7.71 cm. These measurements are similar to those of the New Georgian SF (Table 22).

Body weight, growth and carcass quality

While the frame of the Georgian F is similar to that of the New Georgian SF sheep, the breed weighs more than either the New Georgian SF or the Tushetian breeds (Table 27). No carcass studies are available regarding this breed, though the breed's creator indicated that the carcass yields of ewes and rams average 44.2% and 49%, respectively (Badzoshvili 1954).

Table 27. Live body weight of Georgian F sheep.

	Ewe weights (kg)			Ram weights (kg)		
Age	n	Mean	Max	n	Mean	Max
At birth	462	3.9	5.5	450	3.7	5.3
At weaning (3.5-4-months)	608	27.6	41.0	612	30.5	45.0
1 year	100	51.0	56.0	92	61.5	79.0
1.5 years	100	52.9	55.0	94	67.0	79.0
Adults	1609	56.7	74.0	103	78.3	94.0

Source: Badzoshvili (1954).

Reproductive performance and milk production
Reproductive data is available for this breed (Badzoshvili 1954). Ewes are mated for 5-6 lambing seasons. First mating occurs at the age of 18-19 months, and pregnancy lasts for 149-150 days. The breed has a prolificacy rate of 109-110 lambs per 100 ewes, though in some instances this can reach 118%. The survival rate of the lambs is high, and the mortality rate does not exceed 4% before weaning.

No hard data on milk production is available for this breed; however, the breed's creator (Badzoshvili 1954) mentions an average daily milk yield of 0.32-0.34 kg and an average annual milk production of 43.5 kg. Lactation lasts for five months. Details of the chemical composition of the milk are not available.

Wool production
The wool of this breed is homogenous in terms of length and fineness (Table 28).

Most adult ewes produce wool fibers with a diameter of 22 μm, while most adult rams produce wool fibers with a diameter of 24 μm. Hoggets produce wool fibers with a diameter of 21-22 μm (Table 29).

Current breeding structure
Like in the case of the other synthetic breed, there are no plans for the improvement of the Georgian F sheep that is also on the verge of extinction.

Table 28. Wool production in the Georgian F breed.

	Wool yield (kg)		Wool length (cm)	
Sex and age groups	Mean	Max	Mean	Max
Young ewes (1.5-2 yrs)	3.2	6.0	9.6	10.8
Young rams (1.5-2 yrs)	3.5	6.0	9.5	10.5
Adult ewes (over 2 yrs)	3.7	6.2	8.7	12.5
Adult rams (over 2 yrs)	4.5	7.8	9.3	13.5

Source: Badzoshvili (1954).
Note: no record is available of the number of sheep used to obtain these values.

Table 29. Distribution of Georgian F sheep according to fiber diameter of their wool.

		Percentage of sheep in different fiber-diameter classes			
Sex and age groups	n	27 μm	26 μm	24 μm	21-22 μm
Young ewes (1.5-2 yrs)	200	0	0	10	90
Young rams (1.5-2 yrs)	92	0	0	20	80
Adult ewes (over 2 yrs)	1697	1	2	35	62
Adult rams (over 2 yrs)	63	0	18	48	34

Source: Badzoshvili (1954).

Goat Breed Characterization

Goat farming is one of the oldest activities practiced in Georgian agriculture, and seasonal grazing predominates over stationary farming. The main breed Georgia is the Megrelian, raised in a particular region of the country. A minor population of Indigenous goats is also available.

The Megrelian Goat

The Megrelian goat stock in the country is estimated in 24.2 thousand head. This is considered to be the distinctive goat of Georgia.

Brief account of the development and improvement of the breed

Megrelian goats are kept in the western part of the country. Based on a survey in 1935, Japaridze *et al.* (cited in Gligvashvili 1996) distinguished five basic populations: the Megrelian lowland, the highland, the Abkhazian, the Kvemo Svanetian and the Lechkhumian populations. Currently, however, only two Megrelian types are recognized: the highland and the lowland. Highland goats exhibited higher bodyweights while lowland goats were used more for milk production.

Appearance

Most Megrelian goats (89%) have a strong constitution. They have a medium-sized head, a long neck, and straight legs with strong hooves. The udder is oval or pear-shaped with identically developed sides. The teats range from medium-sized to large. The hair of this breed is long, coarse, straight, and elastic. It is mainly white and bright. Body measurements are shown in Table 30.

Body weights, growth and carcass traits

Megrelian does can weigh more than 40 kg (Table 31). Gligvashvili (1996) found that the heaviest weights were attained by 5.5-year-old females; there were large variation within and between age groups.

Megrelian buck

Megrelian doe

Data on the growth of kids from birth to 18 months is included in Table 32. Note that at the age of 18 months female kids have attained only 74% of the weight of 2.5-year-old does. The weights of different types of Megrelian goats, as classified according to ecotype, are included in Table 33. Kvemo Svanetian goats were distinctly heavier than the other Megrelian ecotypes.

Table 30. Average body measurements of Megrelian does (3 years and older).

Trait (cm)	Mean±SE	Range
Height at crest	65.4±0.2	53-79
Height at sacrum	67.4±0.2	52-78
Diagonal length	71.2±0.3	45-90
Chest girth	82.2±0.7	75-99
Chest depth	31.3±0.1	23-39
Chest width	18.6±0.2	14-23
Metacarpus girth	10.5±0.1	na

Source: Japaridze *et al.* (1935; cited in Gligvashvili 1996).
Note: The number of animals observed is not indicated in the reference; na: not available; SE: Standard error.

Table 31. Body weights of Megrelian does at different ages.

Age	n	Mean±SE (kg)	Range (kg)
2.5 years	37	43.0±0.6	42.1-46.5
3.5 years	38	44.0±0.3	41.5-46.3
4.5 years	51	44.5±0.3	42.3-47.4
5.5 years	40	46.7±0.1	42.6-56.2
6.5 years	48	45.2±0.6	41.0-50.1
7.5 years	16	45.0±0.2	41.0-56.2

Source: Gligvashvili (1996).
Note: SE: Standard error.

Table 32. Body weights of Megrelian kids as they grow.

	Females		Males	
Age	Mean±SE (kg)	Range (kg)	Mean±SE (kg)	Range (kg)
At birth	2.15±0.01	2.03-3.30	2.32±0.01	2.10-2.50
3 months	12.2±0.4	7.0-17.1	13.5±0.3	10.5-17.3
6 months	18.6±0.3	15.3-20.7	21.3±0.4	15.2-23.8
9 months	21.8±0.3	19.1-25.6	24.2±0.2	20.6-27.6
12 months	21.6±0.5	14.7-25.3	23.8±0.5	15.0-26.2
18 months	32.0±0.4	28.0-35.0	41.0±0.3	29.0-55.0

Source: Gligvashvili (1996).
Notes: The number of animals observed is not indicated in the reference; SE: Standard error.

Table 33. Body weight of Megrelian does (3.5-4 years) in different regions.

Population	n	Mean±SE (kg)	Range (kg)
Megrelian Lowland	77	37.4±0.8	25.0-53.0
Megrelian Highland	210	42.4±0.4	29.0-55.0
Abkhazian	79	46.2±0.7	29.9-62.5
Kvemo Svanetian	147	48.6±0.5	37.0-66.0
Lechkhumian	66	40.3±0.5	29.0-50.0

Source: Japaridze *et al.* (1935; cited by Gligvashvili 1996).

ICARDA and the Georgian Zoo-Veterinary Academy (now the Georgian Zoo-Veterinary University) started work to describe the Megrelian goat at the beginning of 2002. This work took place on-farm in the village of Nakiani, in Chkhorotskui district. The liveweights of the different age groups given in Table 34 reflect the current production situation, and the fact that the weights now attained are heavier than those measured in earlier studies.

On the farm used in the study, the maximum live bodyweights of female and male Megrelian goats exceeded 55 kg and 72 kg, respectively.

Gligvashvili (1996) studied the carcass characteristics of Megrelian goats of different ages. The results of this study have been summarized in Table 35. The meat of Megrelian goats is characterized by its excellent gastronomic qualities and is in great demand.

Table 34. Body weights (kg) of Megrelian kids and adult goats under on-farm conditions in Georgia.

Age	Females (n=30)	Males (n=8)
At birth	1.9	2.1
3 months	8.1	10.3
6.5 months	17.2	20.4
9 months	20.8	24.6
>3 years in spring	39.0	51.4
>3 years in autumn	43.8	53.2

Source: E. L. Khachapuridze, G. D. Agladze and L. Iñiguez (unpublished work).

Table 35. Carcass traits in Megrelian goats.

	Adult		1.5-year-old		8-month-old	
Trait	Does	Bucks	Bucks	Wether	Wether	Bucks
Pre-slaughter weight (kg)	40.1	60.9	36.3	30.0	18.0	17.9
Carcass and abdominal fat						
Weight (kg)	17.2	26.4	15.6	13.8	7.8	7.3
Percentage	42.3	43.4	43.1	45.8	43.2	42.0
Carcass alone						
Weight (kg)	16.1	25.3	15.1	12.9	7.3	6.9
Percentage	40.3	41.5	41.5	43.1	40.4	40.2
Abdominal fat						
Weight (kg)	1.05	1.11	0.56	0.82	0.51	0.31
Percentage	2.62	1.82	1.54	2.73	2.82	1.73

Source: Gligvashvili (1996).
Note: The number of animals observed is not indicated in the reference.

Reproductive performance and milk production

The reproductive life of does lasts for 6-7 years. E. L. Khachapuridze, G. D. Agladze and L. Iñiguez (unpublished work) recorded kidding percentages of 95% and a prolificacy of 118% when working in the village of Nakiani in 2001. At that time, of 82 does exposed to a buck, 78 kidded, providing a fertility rate of 95%.

Of the kidded does, 14 produced twins. This meant that there were 92 kids in total, yielding a prolificacy rate of 118%.

In the case of these goats, milking starts in June after weaning, when they are still being kept on the summer pastures. In total lactation lasts for seven months. Milk yields increase from the first month of lactation to the fourth month of lactation. At the end of the fourth month (July) the milk yield reaches a maximum and thereafter gradually decreases. According to the data obtained by Gligvashvili (1996) milk production increases with age, as the annual milk yield of does in their first, second, third, fourth and fifth lactation was found to average 139 kg, 149 kg, 179 kg, 193 kg and 208 kg, respectively.

Megrelian goats are high milk yielding, and are comparatively more prolific than other types of Georgian goats. According to Japaridze *et al.* (1935; cited by Gligvashvili 1996), the highest average annual milk yield of the different types of Megrelian goats is provided by the Megrelian Lowland goat, while the lowest milk yields are provided by the Lechkhumian goat populations (Table 36).

The lactation period of Megrelian does lasts for up to 6-7 months.

Table 36. Average annual milk production of Megrelian goat populations.

Populations	Mean±SE (kg)	Range (kg)
Lechkhumian	181.8±16.1	70-730
Megrelian Highland	208.1±5.2	60-500
Kvemo Svanetian	220.8±10.0	319-750
Abkhazian	271.0±8.8	155-441
Megrelian Lowland	296.1±17.8	120-746

Source: Japaridze *et al.* (1935; cited by Gligvashvili 1996).
Notes: The number of animals used when calculating these averages is not indicated in the reference;
SE: Standard error.

Breeding programs

Research on the Megrelian goat has been conducted by the staff of the Georgian Zoo-Veterinary University at different times, and the results were used in the description of this breed. No systematic work to improve the Megrelian goat breed was undertaken during the Soviet Union either. Thus there were no official plans for Megrelian goat breeding.

Other Indigenous Goats from Georgia

Besides the Megrelian, several types of indigenous goats are found throughout Georgia. These animals, about 9000 head, are small, low productive and usually confounded in sheep flocks and sheep counts. Local farmers usually keep several head of such goats (between 2-4 and 10-12 head). No research regarding these goats has been conducted within the past 30 years and they remain uncharacterized. These goats are smaller and less productive than Megrelian goats, though anecdotal information also refers them as to be excellent milk producers. There is a need to characterize these populations and reveal their assumed potentials.

Indigenous Georgian buck

Indigenous Georgian does

Prospects for Small Ruminant Production in Georgia

In the late 1990s and early 2000s, demand for mutton and goat meat, and for sheep and goat milk (mostly for cheese production) steadily increased, despite the fact that people in Georgia had only a low purchasing power as a result of high unemployment rates and low wages. According to the data provided by the State Committee of Statistics (2003), only 80% of the meat and 70% of the milk consumed by the nation in 2003 was produced locally. According to the same data, tper capita consumption levels improved from 22 kg of meat and 137 kg of milk in 1988, to 25 kg of meat and 176 kg of milk in 2003. As economic conditions improve, this demand is expected to further increase if the prices of locally produced goods remain competitive in relation to those of imported products. This seems to be stimulating goat and sheep production in Georgia, a fact which is reflected in the increases seen in the sheep and goat populations, which rose from 583,500 head in 1989 (their lowest level) to 780,800 head in 2004 (Table 3).

Some consideration has also been given to the opportunities available for exporting organic products, mainly to countries in the Middle East and Asia. This could further encourage the production of small ruminants and bring additional benefits to farmers.

The demand for wool is very low at the moment, and will probably remain so unless the rehabilitation plans of the Tbilisi Cloth and Worsted Industrial Complex change the country's 'demand environment'. However, the competitiveness of the wool production industry, and the size of the flocks available, mean that this scenario does not look likely.

Sheep breeding has been a traditional component of rural life and farming in Georgia, allowing people to produce meat and milk using the available, and otherwise unused, vegetation on the country's vast natural rangelands (1.8 million ha of summer and winter rangelands and 143,000 ha of natural haylands).

Potentially, small ruminants could continue to exploit these areas to provide the products demanded by the Georgian population. However, this needs to be carefully managed, and will require considerable improvement on various production fronts. These are outlined in turn below.

The problems and constraints facing emerging sheep production systems should be carefully assessed, taking into account the land tenure reforms currently underway. Recently, Georgia's government has become more interested in agricultural development, especially in relation to the sheep and goat production sectors. A new draft law on taxation has been developed and submitted to the State Parliament which will provide new advantages for farmers and, hopefully, promote the development of the sheep production sector. By 2004, 92,000 ha of haylands (64.2% of the country's 143,200 ha of haylands) had been privatized, as had 684,600 ha of rangelands (38.4% of the country's 1,796,700 ha of natural rangelands). However, problems are emerging in relation to the management of these privatized areas. Urgent action is needed to overcome these management problems. Such action should include the consolidation of sheep farms, the establishment of joint stock and cooperative farms, the leasing of rangelands by these organizations once they are formed, and mechanization.

Market potential and consumption trends should be properly evaluated. Improvements in marketing are urgently needed, as are efforts to reduce intermediaries' exploitation of farmers.

Breeding programs should be re-established in an efficient manner. These should be sustainable and should consider market opportunities and trends. Steps should also be taken to ensure that scientific centers (such as the Georgian Zoo-Veterinary University) and breeding farmers are jointly involved in the management and implementation of such programs.

Attention should be given to production output and quality. The Imeretian sheep's valuable qualities and the remarkable milk production potential of the Megrelian goat should be considered, and Tushetian sheep and Megrelian goats should be used to improve other less competitive breeds.

According to the data provided by the State Committee of Statistics (2003), in 2003 Georgia produced 765.1 thousand tonnes of milk, including 21.8 thousand tonnes of sheep and goat milk. It should be possible, in the future, to increase the share of this milk derived from small ruminants from 2.9% to 5-6%. Sheep and goat breeding demand less investment, so production costs are low. Reorienting and promoting production in this way could help to reduce poverty and slow the out-migration of rural people.

Perhaps most importantly of all, human resources need to be developed. This would involve upgrading and training of animal production technicians, veterinarians, economists, and managers. Farmers, particularly the young, should receive appropriate training. In addition, support should be given to professional young scientists, by providing them with English language courses and allowing them to learn new skills in advanced and recognized research centers in developed countries.

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