Perspectives

Camel breeding in Kazakhstan and future perspectives

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Implications

- In Kazakhstan, the two species of domestic large camelids (*Camelus dromedarius* and *Camelus bactrianus*) are cohabiting, even sometimes on the same farm.
- There is an increasing importance in the existence of large camelids in the country in relation to the desertification of steppic areas.
- There is a growing demand for camel milk and meat which are contributing to the tradition and ethnical identity of the Kazakh population (formerly nomads).
- There is a necessity to preserve camel population diversity and to identify high-producing animals.

Key words: biodiversity, camel meat, camel milk, camel population, Kazakhstan

Introduction

The two species of domestic large camelids (dromedary and Bactrian) are occupying two different arid ecosystems in the world (hot and cold deserts, respectively). However, their respective geographical distribution is overlapping in some areas. The most important overlapping place is in Kazakhstan where the two species are cohabiting, even sometimes on the same farm (Faye and Konuspayeva, 2012; Imamura et al., 2017). For this reason, a clear description of the current situation of camel breeding in this country can be informative.

For centuries, traditional skills of nomadic animal husbandry are being passed from generation to generation, including camels' hybridization between the two species with the aim of improving milk, meat, and wool productivity. Studying the phenotype and genotype of pure breed Bactrian and dromedary camels and their hybrids by the latest methods will give an opportunity to develop each "breed standards" and detect genotypes with high productivity qualities. Furthermore, Kazakhstan, which is located in the heart of Central Asia possessing a rich history of traditional camel breeding, can become a country exporting camels belonging to all species of domestic large camelids.

The global climate changes, and as a result, the increase of desertification in the large territories of Central Asia, lead to the growing demand for sustainable meat and milk production. Camels with high productive qualities seem to be a perfect answer to these challenges as they are resilient to harsh climatic conditions and sufficiently efficient in their production (Faye and Konuspayeva 2012; Burger al., 2019; Yihang et al., 2020).

Place of Camels in the Lives of the Kazakh People

The crucial camels' role in the life of the Central Asia nomads was cited by many authors (Imamura et al., 2017; Nurtazi et al., 2017; Haruda, 2018; Sala and Kartaeva, 2018; Dioli, 2020; Yihang et al., 2020; Orazov et al., 2021). Traditionally, nomads used camels as a working force and as a milk-, meat-, and wool-producing animal in the camel breeding regions by replacing other agricultural animals (Nurtazin et al., 2017). Camels were used as the main vehicle to transport entire household goods and traditional yurts during transhumance. Looking for good pastures, Kazakh nomads moved from a winter camp (*kystau*) to a spring camp (*kokteu*), and then to a summer camp (*zhailau*) and an autumn camp (*kuzeu*). Kazakhs, migrating for long distances and roaming on sandy terrains, were carrying loads on camels. Carts, pulled by horses or bulls, were practical only for short-distance migrations (Konuspayeva et al., 2003). Therefore, these animals were used for the cultivation of land and the extraction of water. Different types of trading business were carried out with the help of camel caravans. Thus, these animals have capacity to resist to few amount of water and well adapted. The Importance of camels was described in different traditions, folk knowledge, and beliefs (Sala and Kartaeva, 2018).

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Nomadic people used a wide variety of products made from camel's wool, skin, and bones in everyday life. For example, *Tuye moinak* is a leather bottle made only of camel's neck skin, from the throat to the ears. Since only camels provide *moinak*, camels themselves are called *moinaks*. The neck skin is treated and kept longtime with salt to obtain material for making *taspa* (laces) necessary for assembling the *kerege* (the yurt's wooden lattice sections).

In ancient times, camel's shoulder blade had a function of a writing board in yurt schools, and even students and mullah teachers wrote on such shoulder blades. The cleaned camel stomach was used as a glass on the window frames of earthen houses.

Historically, the Kazakh society used the camel to value exchange of goods (one camel was equated to 2 horses or 20 sheep), as the principal part of the *kalyn mal* (dowry animals) given for a bride (Sala and Kartaeva, 2018).

Camel Populations in Kazakhstan

The wide variability of the climate of the Republic of Kazakhstan and its wide-open spaces, mainly semi-arid, are suitable for camel breeding (Sala and Kartaeva, 2018; Orazov et al., 2021). Kazakhstan has a flat land of about 190 million hectares, which is considered a potential area for camel breeding (Nadtochii et al., 2018).

If cattle, sheep, and horse breeding occupies the most favorable areas, camels occupy the most remote places. Camels are one of the few animals that survive in extreme climatic conditions including steppe areas. The camel population is concentrated in the southern and western part of Kazakhstan. Habitants of these regions use camels as one of the basic sources of nutrients for many centuries (Akindykova et al., 2019).

Those areas are corresponding to the more desertic or semi-desertic places (Shoman et al., 2018). Southern regions are characterized by mild cold winters in January (up to –1.8 °C) and a hot summer in July (up to 28.4 °C) (Nadtochii et al., 2018). In the western part of Kazakhstan, the climate is sharply continental with large temperature differences throughout the year and day. The temperature in the winter is on average, −6 to −10 °C, and in summer +31 °C to +45 °C in July compared with the southern regions of the country.

Regarding the genetic variability, Bactrian camels (Figure 1A) are represented by three different phenotypes obtained as the result of traditional local selection: *Oral bokeilik* (the tallest one, wool and milk production), *Kyzylorda* (meat production), and *Ongtüstik-Kazakhstan* (milk production). Bactrian camels are mainly present in the southern and western regions of Kazakhstan. The dromedary population is represented by only one breed called *Arvana*, of Turkmenistan origin (Figure 1B). They are distributed in the southern part of the country

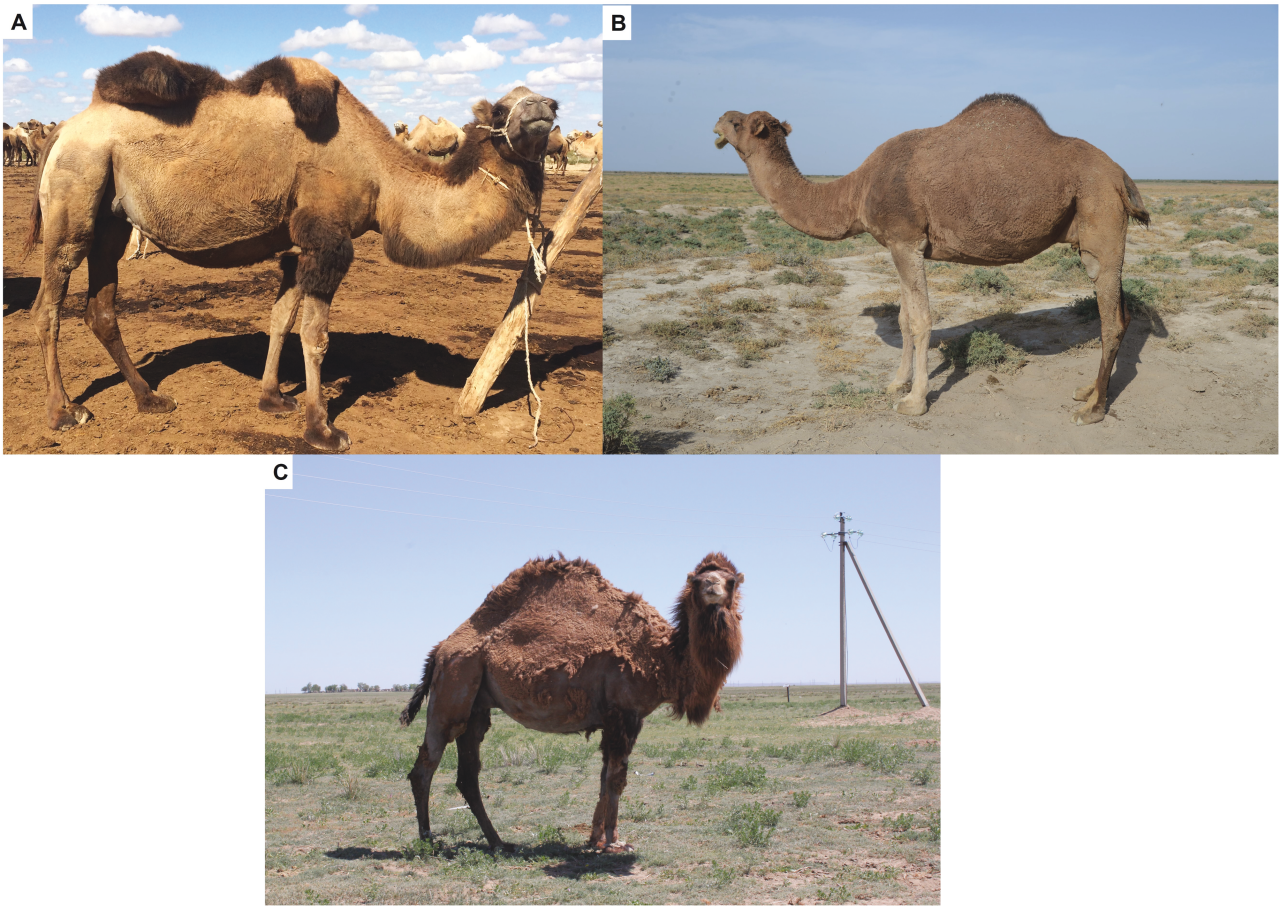

Figure 1. Photos of *Camelus bactrianus* (A), *Camelus dromedarius* (B), and hybrid F1 (C) in Kazakhstan.

where they can be considered the northernmost part of the dromedary's range in the world. Arvana camels are regarded as high-yield milk-producing animals. It is the only dromedary breed used in Kazakhstan for hybridization with Bactrian camels (Faye and Konuspayeva, 2012; Dioli, 2020).

Hybridization has long been common in the Kazakh steppe (Figure 1C). Nowadays, Kazakhstan is a rare country where hybridization is practiced for centuries up to now. The aim of hybridization was to obtain a better pack camel for trade caravans along "silk road" and for military interventions, but nowadays to obtain high milk-, meat-, and wool-producing camels (Faye and Konuspayeva, 2012; Dioli, 2020). Several authors mentioned that wool productivity of hybrids increased by 192% compared with the pure dromedary breed, and the milk production was 69% higher than the Bactrian and even slightly higher (2%) than the dromedary. A difference in the milk composition was observed between the two species, the hybrids being intermediate: Bactrian milk had a higher concentration of vitamin C and minerals and a higher fat content, but lower long-chain fatty acids (Faye et al., 2008; Konuspayeva et al. 2006).

Camel Demography in Kazakhstan

There was a dramatic decrease in the camel population after the collectivization of agriculture. The civil war, then the forced settlement of the nomads and the collectivization of agriculture, carried a blow that could have been fatal to the camel breeding, which lost 90% of its population during this period. The total number of camels decreased from 1.69 million in 1927 to less than 120,000 in 1940.

In 1990, just before the independence, the camel population in Kazakhstan was 143 thousand heads. From 1991 to 1993, the number of camels increased up to 154.8 thousand heads, but later this number decreased up to 95.8 thousand heads in 1998 due to the private restructuration of the agricultural sector (Figure 2). The annual growth since the independence of the country in 1991 is +1.66% on average before Tajikistan (+1%) and Azerbaijan (+0.75%) but far away from Turkmenistan (8%), whereas other countries in Central Asia (Kyrgyzstan, Uzbekistan, and Mongolia) have a negative growth (Faye, 2020). In 2022, the camel population in Kazakhstan reached 272 thousand heads (www.stat.kz).

Orazov et al. (2021) mentioned a tendency of stable growth in the number of camels over the last 5 years. However, the number of camels in the country is still at a low level, and Kazakhstan is at the 20th rank in the list of the camel countries behind Tunisia (FAOstat, 2022). However, at the country level, the percentage of Total Livestock Units due to camels (i.e., the ratio of total camel weight/total herbivorous weight including cattle, sheep, and horse) was doubled since the independence passing from 0.95% in 1992 to 1.79% of the total herbivorous weight in 2020 (Figure 3).

It is difficult to have statistics specific to the Bactrian or dromedary camels, as official data from the FAO (Food and Agriculture Organization) and official governmental statistical data do not allow distinguishing species of large camelids (Faye, 2020).

Bactrians present approximately 90% of the total camel population in Kazakhstan (Imamura et al., 2017), but the dromedary population is increasing in the southern part of the country due to the increased demand for camel milk and products on its basis.

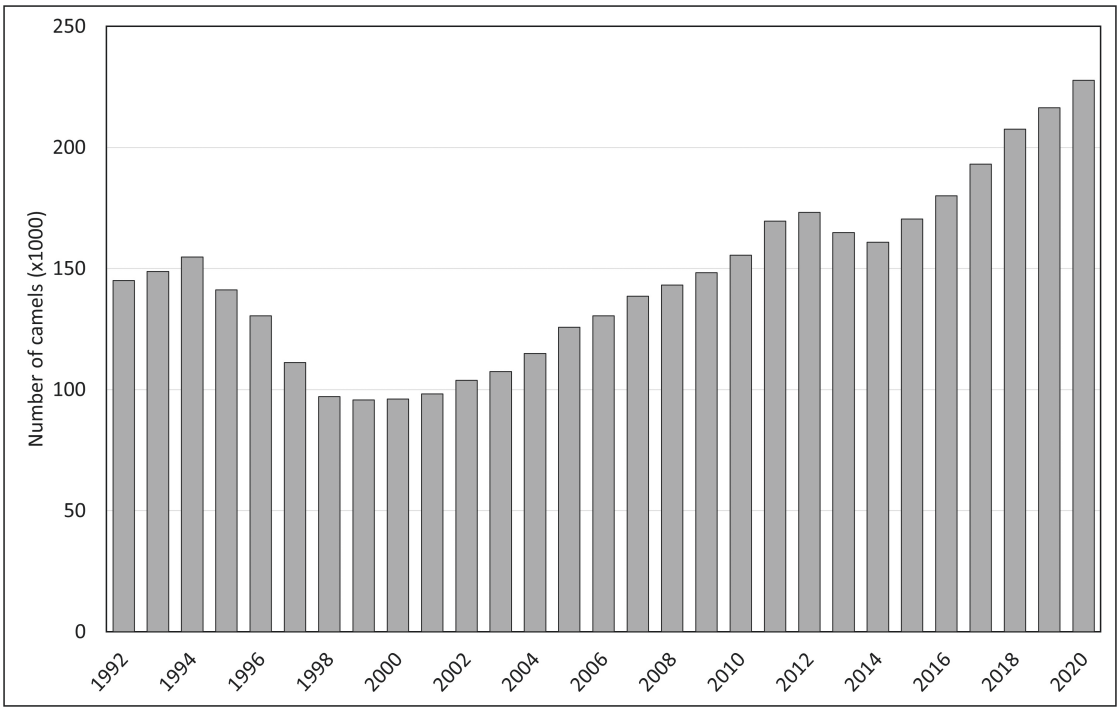

Figure 2. Change in the whole camel population in Kazakhstan since the independence (Source: FAOstat, 2022).

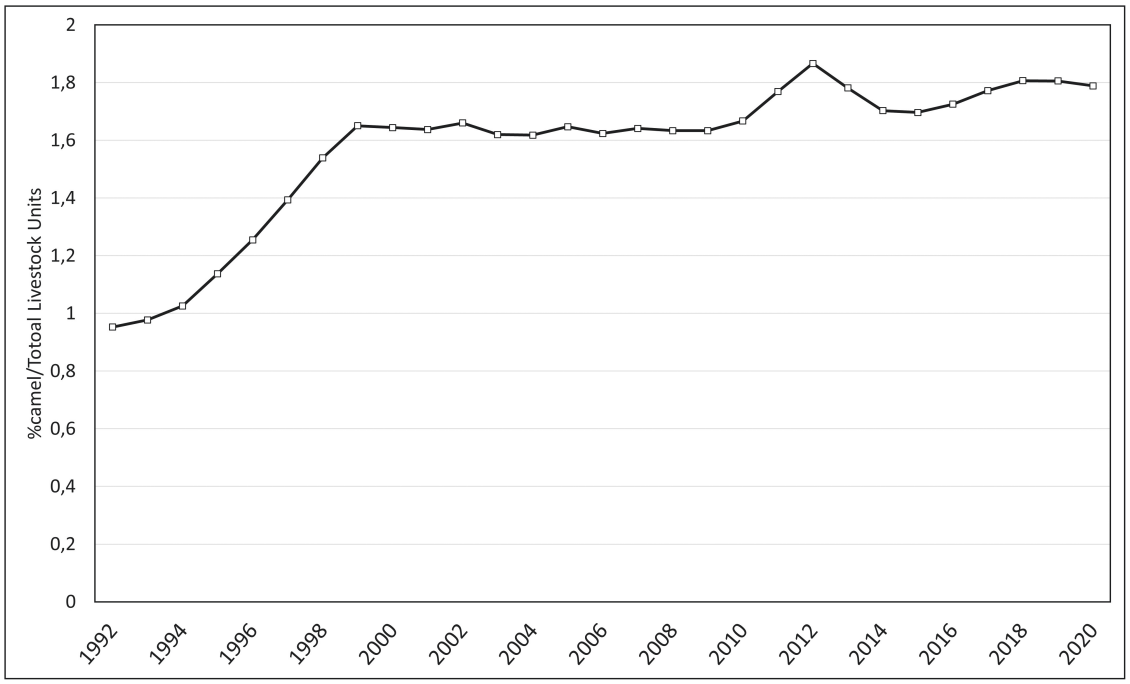

Figure 3. Change in percentage of camel in the Total Livestock Units (total weight of the herbivorous) from 1992 to 2020 (Source: FAOstat, 2022).

Camel Milk Production

The milk is the most consumed product of livestock resources in Kazakhstan, followed by meat and eggs (Liang et al., 2020). Currently, interest in camel breeding products is increasing all over the world (Faye, 2018). Camel breeding has been successfully developing in the country over the past 10 yr. In the period from 2010 to 2016 in Kazakhstan, the production of camel products increased 3.4 times up to 34 million USD (Baimukhanov, 2020; Orazov et al., 2021).

Nowadays, camel milk is in high demand both in domestic and foreign markets. There is an upward trend in prices for dairy products from camel milk, and these factors create an attractiveness for breeding camels with high dairy productivity in the southwestern region of Kazakhstan (Nadtochii et al., 2018; Baimukhanov, 2020). The potential value of camel milk is on average 3.6% of the total national milk production (Faye and Konuspayeva, 2008), and this proportion increased by 30% since its independence.

Without any possibilities to conserve fresh milk for the long period, Kazakh people traditionally made various fermented camel milk products, such as fermented camel milk named *shubat*, dehydrated cheese named *kurt* (*qurt*), and caramelized dessert named *balkaimak*. Nowadays, most volume of these "terroir products" are produced in the small-scale manufacturing sites organized by farmers or by cooperatives (Faye and Konuspayeva, 2012). In the modern milk markets production of ice creams, and lyophilized camel milk powder start be appeared. Therefore, in three regions, the production of lyophilized camel milk powder at an industrial scale was launched (Figure 4). The most part of this product, approximately 20 thousand tons, is exported to Russia, China, and European countries each year. Raw camel milk is purchased from local camel farms for two USD per liter, while it is less than 20 cents for cow milk. All mentioned products are available in supermarkets, markets, and restaurants. Kazakhstan is one of the rare countries, where standards for different camel milk products are developed.

Figure 4. Powder camel milk sold in Almaty Sydyk shop.

Any official data concerning produced camel milk volume are absent in the FAO database and on the website of the government statistical agency of Kazakhstan. However, with 23% of lactating camels in the national camel herd (estimation based on the international statistics from the FAOstat website) and a mean daily production of 5 liters, the camel milk production could reach 100,000 tons in 2020, while it was 65,000 tons only during the independence. For milk production, dromedary Arvana breed was preferred as it can produce up to 6,000 liters over 12-mo lactation, while production potential for Bactrians is between 650 and 2,000 liters over the same period (Faye and Konuspayeva, 2012). Such production is comparable to that of Turkmenistan (100,200 tons in 2020).

According to the published data on the camel milk volume produced only by large camel farms, in 2020, 2,454,920 liters were produced in the Almaty region, 244,204 liters in Atyraou region, 137,960 liters in Kyzylorda region, and 1,268,178 liters in Turkestan region (https://eldala.kz/rating/4495-top-24-proizvoditeley-verblyuzhego-moloka-v-2020-godu).

The high milk productivity of the local Arvana breed could be because of the high milk-yielding potential of camels (Al-Hadrami and Faye, 2022). In the future, the local Arvana breed could be exported to other countries as a genetic resource for increasing milk yield of the camel population worldwide.

If the self-sufficiency in meat products (117.6%) is reported in the population of the Republic of Kazakhstan, self-sufficiency regarding dairy products is at an extremely low level (0.1%). Thus, increasing the production volume of camel milk could partly contribute to satisfying the local demand. Camel milk is an important source of macronutrients, vitamins, and amino acids, and its daily consumption partially facilitates the problem of food security in Kazakhstan and other countries (Orazov et al., 2021). Moreover, the consumption of camel milk being under the fermented form, its probiotic quality contributing to its health effect widely documented, is an important commercial argument (Manaer et al., 2015).

Camel Meat Production in Kazakhstan

Bactrian camels are the main meat and wool producers. Their live weight, which can reach one ton, is on average higher than the dromedary. Some hybrids F1 (first generation) can be also heavier than the parents. Camel meat consumption is not very popular except in rural areas, although it has indisputable intrinsic qualities: low in cholesterol and fat, very high essential amino-acid index, and rich in vitamins (Raiymbek et al., 2015). This marginalization is due to its low valuation in terms of cutting, slaughter age, and finishing, and its consumption is limited to steppe areas. Most part of the camel meat is consumed only in a traditional way (no standard cutting, boiled meat, and rural consumption), but a recent factory was implemented to process meat, notably for preparing canned camel meat for the army (Figure 5). Some enterprises also introduced new meat products such as *Qaz*y (a kind of sausage popular in Kazakhstan, usually made of horse meat). Such introduction to the market is promising for the development of the sector. The total amount of camel meat available on the national market is about 592 tons only, which is 0.1% of the total red meat produced in the country (Faye, 2008). Most part of camel meat is produced in the regions of Bactrian camel breeding (Baimukanov et al., 2020). Camel meat is not available in supermarkets or markets. However, several specialized shops and restaurants are selling camel meat products (Shoman et al., 2018).

Figure 5. Canned camel meat processed at Almaty for the national army.

Camel Wool, an Emerging Sector

Compared with meat sector, the wool sector is not well organized. There are no camel wool processing industrial production sites in the country. However, in the camel breeding regions, the camel wool is widely used in households after traditional processing steps to make *shekpen* (wool raincoats, water-resistant homespun caftan), *kurteshe* (jackets), *keudeshe* (waistcoats), and *shulyk* (socks). The wool itself is used to fill in *körpe* and *körpeshe* (blankets and mats). These products are heat and cold resistant. Camel wool products are considered to have healing properties and can accelerate recovery during various diseases (Hasi et al., 2020). Due to their thermodynamic properties, the underwear equipping the Soviet cosmonauts was in camel wool.

Further Perspectives of Camel Breeding in Kazakhstan

Therefore, increasing of arid zones as a result of the climate change and the deterioration of the global ecological environment has accelerated the degradation of grassland resources, which directly affects the production of livestock resources. In addition, the camel has a better ability to recycle nitrogen and is less demanding for fodder in comparison to ruminant animals, especially under stressful conditions (Zarrin et al., 2020). Meanwhile, the specific energy consumption and costs in terms of 1 kg of protein in camel's milk are more than 26% lower than in cow's milk. (Nadtochii et al., 2018). Specific physiology and adaptive capacity and increased interest for these animals as livestock species worldwide could lead to high productive camels becoming an important protein source for humans.

Modern research works and scientific projects in Kazakhstan are focused on the composition of camel milk and meat at molecular level, camel milk products microbiology by the latest identification methods, probiotic and technological properties of fermented milk, production of probiotics, identification of the contaminants in camel products, phenotype and genotype description according to modern methods reported in the literature data, and identification of the genes responsible for high milk and meat productivity (Konuspayeva et al., 2006, 2011; Faye et al., 2008; Baubekova et al., 2015; Raiymbek et al., 2015). In the future, on the basis of expected and current scientific data, it will be possible to develop "breed standard" for each local camel population, to develop genomic selection domain, and to become a genetic resource center for high milk- and meat-producing genotypes.

Conclusion

Undoubtedly, the camel will remain the iconic animal of the steppes of Central Asia for a long time, but his entry into a certain "modernity" seems to be a foregone conclusion. Updating camel husbandry through large-scale commerce and modern technologies will be important for Kazakhstan. It will help to create more employment in rural areas and increase the number of rural communities soon and to use more rationally the arid and semi-arid territories of the country.

By saving and developing traditional camel breeding, by carrying out scientific works on the studying phenotype and genotype biodiversity, and by determining distinctive qualities of local camel populations, it will be possible to use efficiently the ancestral treasure—camels' gene pool—and save it.

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Conflict of interest statement. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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