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The status of conservation and management of indigenous sheep breeds in South Africa – A review

Thabang Godfrey Motaung[1,*] – Joab Malanda Osotsi[1,2] – Malam Abulbashar Mujitaba[1,2] – George Wanjala[1,2] – Gabriella Novotni-Dankó[1,2]

[1]University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Animal Science, Biotechnology and Natural Conservation, Department of Animal Science, Böszörményi Street 138, 4032 Debrecen, Hungary
[2]Doctoral School of Animal Science, University of Debrecen, Böszörményi Street 138, H-4032 Debrecen, Hungary
*Correspondence: Godfreycizza|@gmail.com

SUMMARY

Indigenous sheep breeds in South Africa play an important role in local food security and they are adapted to local conditions. Their genetic and cultural values have to be recognised for national importance. The conservation of these breeds is very critical as most of them are already classified as endangered. The South African government has the initiative to attempt the conservation of these animals; however, it comes with several challenges. In addition to funding, breed conservation demands farmers to understand and recognise the role of such breeds in society. This is especially crucial in the rural communal lands where breeds are kept. Farmers that raise indigenous breeds should be taught the necessity of maintaining the purity of these breeds. Indigenous sheep breeds in South Africa are not favored by the commercial farmers and thus they are more vulnerable. This review outlines the nature of sheep farming and the conservation status of four indigenous sheep breeds in South Africa. The effort and challenges that are met in current conservation arrangements are discussed. Moreover, we emphasise on the conservation techniques that are employed in South Africa.

Keywords: *genetic resource; population trend; challenges; management*

INTRODUCTION

The livestock industry in the developing world is crucial to food security, underlying numerous livelihood objectives in many rural cultures across the globe. Traditional livestock systems based on indigenous animals greatly assist the world's rural poor (Hoffmann, 2011). It provides commodities and services that support a variety of tasks, including adequate nutrition, savings, a source of income, company diversification, transportation, and social events (Herrero et al., 2013). The demand for animal-derived protein is quickly expanding in the global South.

Animal products are necessary for human health and nourishment and, hence, provide a mechanism to strengthen human capital (Adekunmi et al., 2017). This rising demand would be accompanied by a larger human population, higher wealth, and a shift in animal product consumption (Meissner et al., 2014). As a result, ensuring the sustained development of livestock in low-income nations will be critical to ensuring that demand is satisfied.

Indigenous animals comprise a sizable proportion of overall livestock populations in many societies, and their relevance to food security needs recognition (Mwai et al., 2015). Indigenous sheep are valuable genetic resources with significant genetic variety because they have acquired resilient features to thrive in harsh environments (Peters et al., 2010). Domestication, breed development, population structure, and selection impacts have long been studied using genetic diversity (Kijas et al., 2012).

Genetic variety serves as a foundation for optimal livestock production and reproduction and the possibility for genetic improvement (Molotsi et al., 2017). Globally, there is worry about the declining populations of indigenous breeds. As a member of the European Union, Hungary is also highly involved in genetic resource research on indigenous breeds. Klein et al. (2022) documented the lineage information of three traditional Hungarian horses to preserve indigenous horses. Zsolnai et al. (2020), on the other hand, reported the genetic status of the Hungarian grey cattle breed in comparison to other cattle breeds, while Mujitaba et al. (2023) compared the motility and cryo-tolerance of Hungarian Black Racka to German Mutton Merino ram epididymal spermatozoa to enhance the *in vitro* gene conservation of the native sheep breeds. It is, therefore, critical to characterize indigenous breeds for conservation purposes. The characteristics of indigenous farm animals in Hungary have been well-reported (Ilie et al., 2018; Seregi et al., 2015).

Moreover, it is also critical to document existing genetic resources, especially genetic diversity, for the conservation of breeds and populations (Soma et al., 2012). Continuous utilization of inter and intra-breed genetic variation is required for the sustainability of livestock genetic resources (Hoffmann, 2011). Indigenous breeds are in danger of extinction due to the proliferation of exotic and crossbreeds (Ngcobo et al., 2022; Wickefood Earth, 2024).

This review discussed the status, population trend, and management of indigenous South African sheep breeds.

SHEEP PRODUCTION IN SOUTH AFRICA

According to Muiga and Hanotte (2013), the earliest sheep in South Africa originated in Southern and Central Asia and then travelled to Egypt before getting introduced to the Cape. Visitors to the Cape

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reported seeing giant sheep with huge tails comparable to those found in Syria, and delicious meat. (Muiga and Hanotte, 2013). South Africa has around 20 sheep breeds, with the Merino, Dohne Merino, Dormer, Ile de France, Afrino, Letelle Merino and South African Mutton Merino (SAMM) being the most popular among commercial farmers (Molotsi et al., 2017a; Schoeman et al., 2010). On the other hand, the indigenous breeds (Namaqua Afrikaner, Zulu, Pedi, and Damara) are farmed mainly by smallholder farmers who lack infrastructure, management skills, and production resources (Molotsi, 2017).

Sheep farming occurs in all nine provinces of South Africa, but it has historically been centered in the country's arid regions. According to the Department of Agriculture, Land Reform, and Rural Development (2021), the country has roughly eight thousand commercial sheep farms and five thousand communal farmers. South Africa is estimated to have 22.4 million sheep (Merino, Karakul, other wooled sheep, and non-wooled sheep) in 2020, with a downward tendency in the country's sheep population (DALRRD, 2021). Although sheep farming generates a moderate revenue compared to other livestock like poultry, the sheep business is essential in South Africa's rural and arid landscapes (Mthi & Nyangiwe, 2018).

Some of the world's most renowned South African breeds include the evolved composite breeds like the Doper and SA Mutton Merino (Molotsi et al., 2017b). Depending on the breed, sheep may be bred for fibre, wool, and hair, as well as meat production, and occasionally for dairy products (Ntsiapane et al., 2023). Meat production is primarily domestic, with a small portion exported to nearby countries.

PHENOTYPIC CHARACTERISATION OF FOUR SOUTH AFRICAN INDIGENOUS SHEEP BREEDS

Damara Sheep

Large and robust, the Damara sheep originated in Namibia. It has a woolly fleece that sheds in the summer, short hair and a long, narrow, tail (Almeida, 2011). Colors might be multicolored, white, brown, or black (*Figure 1*). It is typical for both rams and ewes to have spiraled horns (Ngcobo et al., 2022). In contrast to other south African sheep breeds, the Damara is immune to external as well as internal parasites, sheep disease, and it is a good browser consuming both shrubland and leaves (Joy et al., 2020). The first lambing takes place between the ages of twelve and fifteen months, and the subsequent ones happen every six to eight months (Kandiwa et al., 2020). Lambs are tiny; fewer birthing problems are frequently related with bigger lambs, and Damara ewes are great mothers (Kilminster & Greeff, 2011).

Figure 1. **A picture of Damara ewe and the ram**

Photo by LGL Damara Sheep

In addition, the meat from Damara is lean, finely textured, and has higher levels of the omega-3 fatty acids (van Harten et al., 2016). According to Simasiku et al. (2019) an adult ram usually weighs between 80 and 95 kg, while an average ewe weighs between 50 and 65 kg. The lambs weigh between 21 and 26 kg after 100 days, and 33 kg is the average weight after six months. The fat accumulation on the carcass is just 0.5 to 2 mm thick (Mupfiga et al., 2022). The Damara sheep's leather proved superior strength and exceptionally fine texture in a study comparing the leather qualities of nine sheep breeds (Van der Merwe et al., 2021).

Namaqua Afrikaner and Ronderib Afrikaner

The Namaqua Afrikaner sheep is a distinctive sheep with a huge fat-tail (*Figure 2*). The tail can form more than 30% of its weight as fat (Van Marle-Koster and Snyman, 2013). The Hottentot people of pre-colonial South Africa are thought to be the ancestors of the first people to keep the hardy Namaqua Afrikaner sheep breed (Epstein, 1960; Qwabe et al., 2013). The Namaqua Afrikaner is tiny in stature and has long legs

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(Ramsey et al., 2000). Its white-haired coat is silky and perfect for light leather goods, such as winter gloves (Van der Merwe et al., 2021). Red or black heads are possible for animals (Ngcobo et al., 2022). The presence of horns is a characteristic feature of the rams and ewes (*Figure 2*). With its first lambing occurring at 16 months and following lambing cycles lasting 9 to 10 months, the Namaqua Afrikaner is a late-maturing breed (Letsoalo, 2017). It is one of the most vulnerable and critically endangered sheep breeds in South Africa (Ngcobo et al., 2022). The Carnarvon Experimental Station of the Northern Cape Department of Agriculture is involved in conservation efforts to prevent the extinction of this breed (Molotsi et al., 2013). Animal surpluses from conservation breeding initiatives are offered to be purchased by farmers.

Figure 2. **Namaqua Afrikaner ram and the ewe**

Photo by Greta Sayman

The Ronderib Afrikaner breed has a distinct line known as the Steekhaar Ronderib Afrikaner, with the hair that is coarse, and the Blinkhaar Ronderib Afrikaner, with a hair is fine, soft, and shiny. The former was believed to be extinct until a flock of twenty was found in 1995 on a property close to Upington. (*Figure 3*). The term 'Ronderib' relates to the oval-shaped ribs that are unique to these breeds (Buduram, 2004). South Africa, it has acclimatized to the harsh arid environments of the Northern Cape province (Horsburgh et al., 2022).

In addition, Ronderib Afrikaners have long, slender legs that enable them to travel great distances in pursuit of water and grazing areas (*Figure 3*). The huge, spherical tail can retain up to three kilograms of fat for energy to be utilized during dry spells (Ramsey et al., 2000). Blankets made from the breed's light cream wool and lustrous, silky hair are unique (Van der Merwe et al., 2021). Moreover, Van der Merwe et al. (2021) indicate that the skin is highly prized for high-quality leather goods. According to Campbell (1995), lambing can start as early as eight months, and mature slowly between ten and twelve months before being sold. 'Ronderib' sheep are seldom used as the only breed in the farm because of their small and lean carcasses (Van der Merwe et al., 2020). Furthermore, to prepare ewes for mating, Ronderib rams are sometimes used as teaser rams (Ngcobo et al., 2023).

Figure 3. **Ronderib Afrikaner Ram and the ewes with a lamb**

Photo by Op Vakansie Boerdery

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Zulu sheep

The native Zulu sheep are small-eared, Nguni-type sheep that do well in humid climates (*Figure 4*). The wither height of males is 65 cm and females 62 cm (DAD-IS, 2022). The average body weight is 39.1 kg for males, and females weigh 33.4 kg (DAD-IS, 2022). Due to its varied ancestral gene pool, the Nguni-type is well adapted to the harsh climate seen in some areas of South Africa's KwaZulu-Natal region (Mavule et al., 2013). It is resistant to tick-borne illness, tolerates drought and heat, and thrives in marginal community grazing circumstances (Xulu et al., 2022).

Figure 4. **Zulu sheep flock**

Photo by Michael Hickman

According to Kunene et al. (2011), communal farmers raise and market these multicolored, fat-tailed sheep extensively in rural areas. Mavule et al. (2013) observed that sheep with small ears are common in the breed. Some sheep even have short ears, often known as "rat ears" or "swelamadlebe" – One without ears. This condition results from a recessive trait, so it is seldom observed in flocks. A 1995 study (unpublished data) estimated that there were only three thousand pure Nguni sheep left in South Africa. Recently, Ngcobo et al. (2022) reported a downward trend in the breed population in South Africa. Moreover, crossbreeding with exotic breeds to increase carcass quality and mutton output is considered a primary threat to these breeds' genetic integrity (Nxumalo et al., 2022).

BaPedi sheep

This ancient sheep breed known as the BaPedi is said to have migrated into the province of Limpopo from the south a few centuries ago (Ramsay et al., 1998). Recent survey indicate that the breed is mostly found in the Limpopo province of South Africa (Ngcobo et al., 2022). Like Zulu sheep, it is another Nguni-type sheep. The common coat colors are red, white, and brown and it has a thick tail, small frame, and long legs (*Figure 5*). This breed is reported to be immune to viral diseases, blue tongue, redwater, and heartwater due to its tick resistance (Maqhashu, 2019).

The BaPedi is an early breeder and matures early. (Maqhasu, 2019). The first lambing occurs at 9 to11 months. It reproduces prolifically, with three lambing's in two years (Maqhasu, 2019). BaPedi ewes can maintain high reproduction rate at up to eight years of age (Ngcobo et al., 2022). The ideal slaughter weight of 25 kg to 30 kg. It takes ram lambs up to 12 months and the ewes up to 14 months to attain the desired weight (Nedambale et al., 2020).

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Figure 5. **BaPedi sheep ram and the ewe with lamb**

Photo by Wickedfood Earth

SOCIO-ECONOMIC AND CULTURAL VALUES OF INDIGENOUS SHEEP BREEDS IN SOUTH AFRICA

The literature on the cultural usage of sheep in South Africa is limited. However, Coertze (1986) observed that sheep in many rural areas of South Africa, are related to traditional practices. Some people would sacrifice a sheep during the rite to placate their ancestors (Prs.obs, 2020). Sheep are also commonly used in the initiation ceremony of young boys into manhood. In the Sotho tradition, a sheep is slaughtered to notify the ancestors when a family member gets married (Hoag, 2018).

South Africa has a high per capita consumption of mutton; however, local mutton consumption by rural communities is difficult to quantify. Because of the great predilection for mutton meat, most of the mutton produced in South Africa is consumed domestically (Cornelius, 2023). Religion and tribal customs influence preferences for hide colors, prioritizing color over other criteria like milk production and conformation (Hugo, 1968). Indigenous breeds are preferable in this aspect since they are multi-colored. In many rural South African communities, livestock is an essential source of social currency (Fraser and Badenhorst, 2014).

THE PRESENT STATUS AND THREAT FOR EXTINCTION OF FOUR INDIGENOUS BREEDS IN SOUTH AFRICA

Several scholars have raised concerns about the dwindling numbers of indigenous livestock in many parts of the world (Taberlet et al., 2008; Ramljak et al., 2011; Peretti et al., 2013; Abu, 2021; Ovaska et al., 2021; Davidescu et al., 2023; Trzcińska et al., 2023). The threats to indigenous sheep breeds in South Africa are also alarming. Numerous indigenous breeds in South Africa are threatened despite having genetic resources that rank better than those of other breeds (Molotsi et al., 2019b; Qwabe et al., 2013). Some of the effective population sizes are known, while others are unknown (*Table 1*). This demonstrates how conservation efforts for these breeds are hampered by poor reporting to FAO or DAD-IS in developing nations (Molotsi et al., 2019a). The International Union for the Conservation of Nature and Natural Resources (IUCN) categorized species with an effective population size below 50, 250, or 1000 as Critically Endangered, Endangered, or Vulnerable, respectively (IUCN, 2012). On this note, except for the Damara sheep breed, all the three South African native sheep breeds are on a declining trend and are either critically endangered or vulnerable to extinction. Therefore, relevant authorities must stage-manage and double up efforts towards conserving these valuable genetic resources.

Table 1. **The overall risk level of native breeds in South Africa (DAD-IS, 2022)**

Population Parameters	Zulu seep	Bapedi sheep	Namaqua Afrikaner sheep	Damara sheep
Year	2022	2022	2022	2022
Trend	Declining	Declining	Declining	Increasing
Population size	289	49	87	1003
Matured ewes	259	24	75	655
Matured rams	41	26	15	348
Stud ewes	96	24	Not known	655

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To preserve endangered indigenous breeds effectively, a thorough understanding of the breed's characteristics must be described (Mathew and Mathew, 2023). Kunene and Fossey (2006) indicated that Zulu sheep are facing extinction. Qwabe et al. (2013) discovered a significant decline in the Namaqua Afrikaner sheep population. According to Sandenbergh et al. (2018), uncontrolled crossbreeding contributes to the extinction of native livestock species and the depletion of regional genetic resources. Furthermore, they endanger the survival of these distinct genes and adaptive features like resistance to native illnesses and parasites. As a result, unless immediate action is taken, many breeds will go extinct sooner or later.

Genetic diversity of sheep in South Africa

According to Soma et al. (2012), indigenous fat-ramped breeds (Persian sheep breeds) have little genetic diversity as compared to indigenous fat-tailed breeds (Nguni breeds, Karakul, Damara). Literature also reveals that the Karakul breed has the largest genetic diversity, which might hint at its Central Asian roots (Meadows et al., 2005). The genetic diversity of three populations of Namaqua Afrikaner sheep in South Africa was assessed by Qwabe et al. (2013). According to the researchers' findings, the three populations under study may be distinguished as separate groupings, and the Namaqua Afrikaner sheep breed has a moderate level of genetic variation. Moreover, Qwabe et al. (2013) found minimal crossbreeding between the Namaqua Afrikaner sheep and both kinds compared to South African Mutton Merino and BaPedi sheep.

Soma et al. (2012) found significant levels of genetic variety in Zulu sheep, which are comparable to the findings of Selepe et al. (2018) and Kunene et al. (2014). However, Zulu sheep numbers are declining due to interbreeding with the Dorper breed (Selepe et al., 2018). Because of their considerable genetic variety, fat-tailed sheep breeds are noted for their resilience to severe settings (Almeida et al., 2011).

CONSERVATION OF ANIMAL GENETIC RESOURCES

Animal genetic diversity conservation encompasses all processes in managing animal genetic resources so that these resources are optimally utilized and developed to meet short-term needs in food and agriculture, as well as ensuring the sustainability of genetic diversity to meet potential future needs (Chagunda and Wollny, 2003). Because the demand for animal-derived goods is likely to rise in the future, livestock systems must boost both productivity and efficiency (Boettcher et al., 2014). Climate change is projected to have a disastrous impact on the animal genetic resources of vulnerable agricultural communities with livestock production systems in arid locations (Naskar et al., 2012). Given South Africa's very arid environment, increasing production and efficiency will be especially difficult for smallholder sheep producers. As a result, it is critical to retain adequate genetic variety in livestock genetic resources to ensure adaptability capacity in a turbulent environment with an unpredictable future.

Chagunda and Wollny (2003) make a compelling case for the preservation of animal genetic resources:

- Economic: Since genetic variety is the basic material for every livestock development plan, conservation will preserve and enhance genetic variance, opening new opportunities for livestock management in the future.
- Scientific: The entire potential of DNA sequences responsible for the development of specialized physiological and adaptive activities has yet to be realized. Conservation provides for the expression of these characteristics.
- Cultural and Social: Livestock husbandry is a component of civilization and human culture, and as a complex social-ecological system, it is profoundly rooted in society.
- Development and Sustainability: The sustainable utilization of animal genetic resources underpins the sustainable growth of livestock husbandry. Smallholder farmers in developing nations should be provided with assistance, resources, and knowledge of locally accessible animal genetic resources to expand their livestock operations.

Conservation management strategies and progress

There are two methods for conserving farm animal genetic resources (FAnGR): *in situ* and *ex-situ* (Srivastava et al., 2019). In contrast, *ex-situ* conservation includes both *in vitro* and *in vivo* procedures, *in situ* conservation takes place in the natural environment of the animal (Burger et al., 2021). One way to describe conservation that takes place in a controlled environment is "in vivo conservation" (*Figure 6*). Moreover, *in vitro* conservation involves the storage of gametes as well as the use of the latest reproductive biotechnologies.

The *ex-situ in vitro* conservation provides an excellent opportunity to conserve genetic resources indefinitely at subzero temperatures (-196 ºC) using liquid nitrogen (Maxted, 2013). It permits the collection and cryo-preserving of gametes of both sexes from living or post-mortem elite, endangered, or threatened breeds (*Figure 7*).

The technique ensures the regeneration of extinct breeds in a single generation (no back-crossing is needed) when gametes are collected and cryopreserved from the same breed (Bolton et al., 2022; FAO, 2012).

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Figure 6. **Different methods of livestock conservation (Srivastava et al, 2019)**

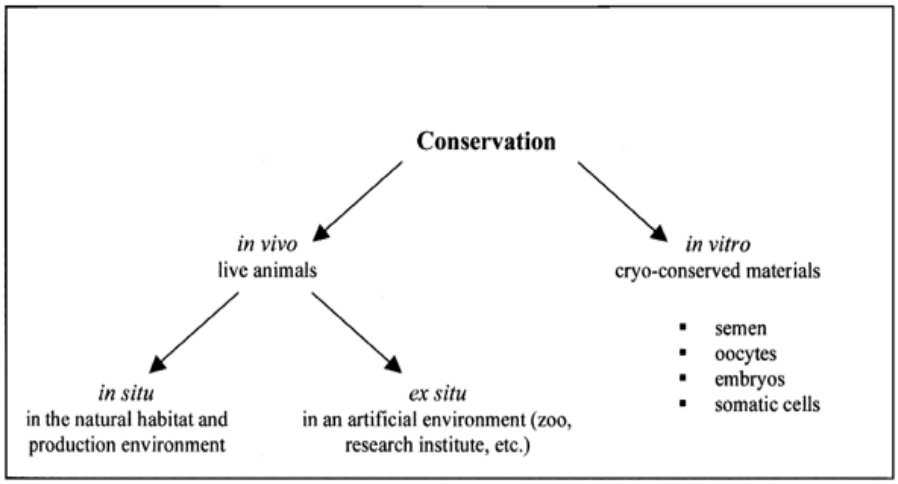
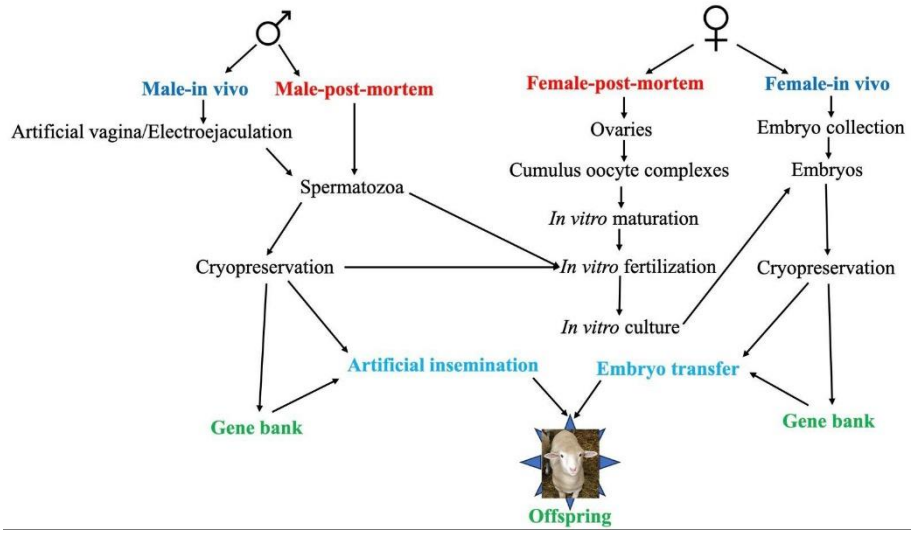


Figure 7. **Flow chart of two gametes sources for *ex-situ in vitro* gene conservation**



Source: edited by the authors: Motaung et al, 2024

However, the Conservation Planning Specialist Group of the IUCN is advocating for combining both the *ex-situ* and *in situ* techniques as *ex-situ-in-situ-continuum* because it holds a more excellent prospect in conserving the genetic resources of threatened or at-risk breeds (Paramio & Izquierdo, 2016).

In situ conservation of indigenous South African breeds is challenging (Ngcobo et al., 2022) since rural farmers are unaware of the need for conservation. Mavule et al. (2013) also found that rural farmers have minimal understanding of gene conservation. Thus, ex-situ conservation—both in vivo and in vitro—has shown to be a vital strategy for preserving these breeds (Ngobo et al., 2022). For in vivo conservation, Bapedi and Zulu sheep, for instance, are kept in a controlled environment at the Agricultural Research Council. According to Kunene et al. (2011), the Bapedi sheep were also kept at the Mara research station. Mavule et al. (2016) reported that the Zulu sheep population are currently thriving at Makhathini Research Station. Nevertheless, Selepe et al. (2018) observed that genetic material from Zulu sheep and locally developed breeds, mainly Dorper sheep, are mixed in the Makhathini Research Station. When a research station houses many breeds, it begs the question of effectiveness in vivo conservation. In the Northern Cape Province, near Upington, Namaqua Afrikaners are preserved in reserve in the Karakul and Carnarvon experimental stations (Snyman et al., 2011).

Sustainable breeding for indigenous breeds

Many South African smallholder livestock communities lack systematic breeding programs for indigenous breeds (van Marle-Köster and Visser, 2018). Thus, long-term breeding plans are required to adequately adapt to present and future difficulties. Product quality, efficiency, genetic variety, environmental soundness, and animal health and well-

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being should all be considered in sustainable animal breeding (Sejian et al., 2013). Animals in the farming system should essentially optimize the system. For example, if there is a resource restriction, such as land, the goal should be to maximize the animal's productive potential rather than increasing production per given hectare of land.

Smallholder communities require clearly stated holistic breeding goals including the animal's ability to thrive in adverse environmental circumstances (Sejian et al., 2013). As a result, farmer cooperation in designing sustainable breeding programs becomes critical. A comprehensive grasp of farmers' views of robustness features is essential for designing breeding programs for smallholder groups. Designing breeding programs for smallholder communities requires more than just research; it also requires infrastructure and community development to boost livelihoods and alleviate food insecurity (Meissner et al., 2014).

CHALLEGES DURING FARM ANIMAL GENETIC RESOURCE CONSERVATION

There are many stumbling blocks in conserving indigenous sheep in South Africa. Ngcobo et al. (2022) identified the following challenges.

Hybridization

In addition to driving the extinction of native livestock species, random interbreeding destroys unique local genetic resources (Sandenbergh et al., 2018). For example, the Namaqua Afrikaner is on the verge of extinction and may only be seen in conservation flocks in its native South Africa.

Inbreeding

The indigenous breeds of South Africa are considered unsuitable for commercial setups due to their tiny body frames and poor development rates (Kunene et al., 2009). Consequently, to boost these animal's carcass quality and growth rate, smallholder farmers switch to composite breeds, which causes genetic loss (Snyman et al., 2011). On average 10 sheep per flock are maintained by smallholder farmers (Van Der Merwe et al., 2020), which makes it difficult for random mating and reduction of inbreeding (de Boer et al., 2021). Repeated inbreeding over several generations can lead to inbreeding depression (Doekes et al., 2021). Inbreeding depression is defined as a decline in mean phenotypic value with increased inbreeding (Doekes et al., 2021).

Smallholder farmers engage in uncontrolled breeding, in which rams roam with sheep and spend the night in the kraal (Mavule et al., 2013). There is no defined breeding season, and lambing is continuous throughout the year in this agricultural method due to unrestricted breeding resulting in high lamb mortality due to unfavorable weather conditions. Conversely, rams retained mates with their dam and siblings, which results in depression caused by inbreeding. This management approach demonstrates wasteful crossbreeding and a lack of awareness of inbreeding. Allelic variation is reduced, and advantageous alleles are suppressed when closely related sheep are bred with a common ancestor.

Globalization

The process by which global standards influenced businesses is known as globalization (Taberlet et al., 2009). Globalization accelerates animal extinction because farmers crossbreed native breeds to compete with foreign varieties. According to Burger et al. (2013), Namaqua Afrikaners, for example, store fat in their tails, which results in an uneven distribution of fat throughout the carcass. For this reason, the carcass quality of this breed is not up to par with exotic varieties raised for meat. Nonetheless, this breed's reproductive rate and production are comparable to commercial breeds (Schoeman et al., 2010).

Climate Change

Human activities induce changes in climatic temperature and weather (Yang et al., 2022). This latter has a negative impact on animal output due to drought and heat (Nardone et al., 2010). Due to lack of money and resources, smallholder farmers are unable to cope with the effects of climate change (Kamara et al., 2019). According to Maluleke et al. (2020), South Africa is one of the developing nations affected by climate change. Due to their heightened vulnerability to the effects of climate change (Maluleke & Mokwena, 2017), smallholder farmers in South Africa sell their cattle at a discount (Halimani et al., 2021). Most farmers in the two South African areas of Limpopo and Mpumalanga attested to a change in grass availability, and 55.19% of them said that this was the reason for livestock deaths (Nesamvuni et al., 2020).

Lack of Resources

The key difficulty has been noted as lacking basic resources such as machinery, structures, and irrigation equipment (Kamara et al., 2019). In contrast, veterinary services have been a serious issue for smallholder farmers (Mavule et al., 2013).

Lack of Veterinary Service

Diseases account for about 70% of lamb mortality in the South African sheep industry (Mavule et al., 2013). Despite the reported disease resistance of indigenous sheep breeds diseases remain a serious threat (Mavule et al., 2013). Climate change-related extreme temperatures may contribute to the spread of diseases such as tick-borne illnesses, brucellosis, foot and mouth disease, and red-water bacterial infections (Maluleke et al., 2020). Remote farmers have limited access to veterinary care and knowledge, so these diseases kill their livestock and reduce the number of native sheep.

The lack of Information/Schooling

According to Mavule et al. (2013), smallholder farmers in South Africa are still ignorant of the global need to preserve farm animal genetic resources (AnGR). For 10% of smallholder farmers, the

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conservation of AnGR is not important (Mavule et al., 2013). Moreover, some (19%) keep their native sheep but don't think many of them are endangered (Hasani et al., 2018). Many older Africans are illiterate due to apartheid-era lack of access to school (Webb, 2021). For instance, Kunene and Fossey (2006) claimed that sheep ranching in KwaZulu Natal, South Africa, is dominated by older individuals (40–50 years old). Since 40% of these farmers do not hold formal education, it is challenging to disseminate conservation information (Ntuli & Fourie, 2021). Acquiring recently established technologies such as estrous synchronization and artificial insemination might be significantly hampered by illiteracy (Salami et al., 2010). These are essential resources for enhancing the genetic makeup of cattle (Korkmaz & Yaprak, 2022). Moreover, smallholder farmers often lack the knowledge of when to sell their animals (older ewes and unproductive rams, for example), and some sell to satisfy their needs (Van Der Merwe et al., 2020). Therefore, to effectively teach young people to breed indigenous sheep and maintain this better genetic material, the government and stakeholders must support this effort.

CONCLUSIONS

Despite government involvement to preserve these breeds. The indigenous sheep breeds of South Africa particularly Namaqua Afrikaner, Bapedi, and Zulu are still at risk or vulnerable to extinction. Several scholars have raised concerns about the declining numbers of these breeds. It is evident from the literature that immediate and more strategic approaches are needed to facilitate the conservation of these breeds. The main causes of these breeds' declining populations and genetic degradation are inbreeding and a lack of resources. Thankfully, in-situ and ex-situ conservation initiatives are in place to protect these breeds. However, rural farmers' adoption of contemporary reproductive technologies (estrous synchronization and gametes storage) is poor because of the distances between smallholder farmers and research stations. Given that these breeds are largely found in rural areas, the absence of community-based conservation programs remains challenging. Furthermore, most indigenous sheep caretakers in South Africa are adults, making adequate information transmission and knowledge of farm animal genetic conservation and the significance of indigenous breeds difficult.

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