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Review on Population Status and Conservation Activity of Indigenous Cattle Breeds of Ethiopia

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Abstract: Ethiopia has the home to at least 27 cattle breeds and an estimated 59.5 million head of cattle due to its diversified agroecology and topography and directly serves as for millions of people. Indigenous cattle breed has many important traits compared with exotic cattle breeds. Bos indicus breeds can effectively regulate their body temperature against thermal stress and are better adapted to hot weather than Bos taurus breeds. In addition, several breeds of Zebu and Zenga are able to withstand very harsh environmental conditions, and those characteristics have arisen through evolutionary adaptation. For examples, Begait cattle (Large East African Zebu) found in North-Western Ethiopia are well adapted to very dry climates and they can survive if they are able to drink only once every two days. However, despite the potential of the indigenous livestock currently, the genetic resources are becoming seriously endangered due to high genetic erosion resulting from biotic and abiotic factors. The objective of this review was to highlight threats, conservation methods and improvement activities currently done for indigenous cattle genetic resources in Ethiopia. Based on the review, among the world 1458 breeds all domestic mammalian and avian species, 17% are classified as being at risk and 58% are classified as unknown risk status. The major threats of livestock genetic resources are genetic dilution through the use of exotic germ plasma, feed shortage, illegal trafficking, inbreeding and interbreeding, and trypanosomiasis disease. This situation demands immediate action to save deteriorating genetic resources in the country. Some of endangered indigenous cattle breeds were conserved in ex-situ method at different state ranches, the Borana cattle breed as Did Tuyura Ranch, Horro cattle breed at Horro Ranch, Fogera cattle breed at Metekel Ranch and Andassa Agricultural Research Centre, and Menz sheep breed at Amed Guya Research Centre but, the results were not enough. Therefore, phenotypic and genotypic categorization of breeds will be further characterized, monitor the current population statistics, conservation of breeds under natural niche, and improvement programs will be implemented for all breeds and also improve the productivity of grazing land.

Keywords: Breed, Cattle, Conservation, Indigenous, Threat

1. Introduction

Ethiopia can be considered as a center of livestock diversity and excessive population because of indigenous cattle breeds are spread out diverse ecology, communities and production systems [1]. It appears that the country has served as a gateway to genetic getaway from Asia to Africa and its various ecologies gave rise to further diversification and consequently contributed to creating the vast genotypes and host to current population [2]. Ethiopia has a domestic to at least 27 cattle breeds and an estimated 59.5 million heads of cattle population due to its diverse agroecology, topography and its nearness to Asia, the country is basis to African animal domestication [3-5]. The existence of both Bos taurus and Bos indicus cattle in Ethiopia is evidence of cattle diversity in the country. The cattle sector contributes12-15% of total GDP, 12% of agricultural gross domestic product (GDP) and 33% of total export revenue of country, respectively [6]. Generally, cattle make a contribution a lot to improve the well-being of the farm family via the food supply, balancing nutrition, family income, savings, insurance, ritual, transport, traction and different social purposes [7]. Consequently, these cattle genetic assets are necessary to the economic improvement of the country.

Currently, indigenous cattle genetic assets becoming critically endangered owing to excessive genetic erosion ensuing from biotic and abiotic factors [8]. Among the world,

all domestic mammalian and avian species 1458 breeds, 17 percent of all species all breed are categorized as being at hazard and 58% are labeled as unknown threat status [9]. In Ethiopia, indiscriminate breeding, disease, feed shortage, and agro-chemicals are some reasons for threats of animal genetic diversity http://www.ibc.gov.et/biodiveristy/conservation. Feed shortage and sickness burden exacerbated by way of climate change. Livestock fitness problems such as the high incidence of Trypanosomiasis in the lowlands are amongst the challenges that affect livestock fertility. Sheko cattle breed is extensively recognized to have economically vital qualities such as Trypan tolerance and suitable dairy personality for use in the Trypanosomiasis infested components of the us of a but, the solely taurine breed in East Africa seems to be tremendously threatened as an end result of inbreeding depression due to the small populace size of cattle breeds [10, 11]. According to [11, 12] http://www.ibc.gov.et/biodiveristy/conservation study on Fogera, Begait, Irob, Ogaden, Afar, and Borena cattle breeds, Sinnar donkey breed, and Afar sheep breed is dealing with a range of degrees of threat.

Therefore, integral to be characterized, conserved and properly utilize the indigenous animal genetic assets under low levels of input in the country. Conservation techniques can be broadly classified into two approaches in-situ and ex-situ. In-situ (on-site) conservation is the conservation of genetic sources within the natural ecosystem in which they occur, whilst ex-situ (off-site) conservation is the conservation of genetic resources outside the natural ecosystem in which they happen [13]. Therefore, the objective of this review is to focus threats, the repute of conservation methods and improvement activities presently carried out to preserve and sustainable use of indigenous cattle genetic sources in the country.

2. Cattle Genetic Diversity in Ethiopia

The existence of both *Bos-taurus* and *Bos-indicus* cattle in Ethiopia is evidence of cattle diversity in the country. Sheko cattle breed is the uniquely remaining descendants of indigenous African taurine cattle trypanosome tolerant in Ethiopia. West African breeds (e.g., N'Dama and Baoule), the Kuri and the Sheko breed from Ethiopia are some of the breed's trypanosome tolerant in Africa. Almost (98.2%) of the breeds are indigenous to the country [14] evolved over centuries, managed by using smallholder farmers in notable numerous ecosystems (highland, dry mountain, lowlands, arid and forest) and they are frequently said to possess special genetic traits. All these populations are now being intensively crossbred with Zebu cattle (Bos indicus) and their unique genetic make-up is disappearing via unbalanced genetic admixture [15]. The livestock population is primarily of local origin and not characterized as belonging to specific breeds. However, the local breeds are usually named after the region they occupy. Even amongst these identifiable types, there has been massive intermixing, resulting in a dilution of livestock breed characteristics. Even though, several attempts had been made to introduce 'improved' breeds but, their success was once poor in terms of achieving genetic potential. The fertility and longevity of introduced breeds are so poor that regularly occurring importation of exotic breeds is necessary. Some breeds are frequently crossed with 'exotic improved breeds due to small population, dilution of breed characters and for creation of new gene pool. Recently, the problem of identifying status of local breeds and lack of conservation system this makes use of favorable local breeds genetic characteristics are also the main threats to animal genetic resources in Ethiopia [16].

2.1. Description and Distribution of the Cattle Breeds

Ethiopian indigenous cattle breeds have distinctive morphological features which differentiate them from other cattle. And also have important non-visible qualities such as disorder resistance, climatic stress resistance and productiveness traits additionally differ among breeds. These characteristics are usually the end result of natural and human selection. Some breeds are already recognized for their unique adaptive qualities (e.g. Sheko) or appropriate economic performances (e.g. Ethiopian Boran). One of the everyday first-rate features of Ethiopian cattle is trypanosomiasis resistance. Trypanosomiasis is a tsetse-transmitted disease in vertebrates. In cattle, the important pathogenic trypanosomes are Trypanosome Congolese and T. vivax. Temperate cattle breeds are outstandingly susceptible to trypanosomes infection. Monitoring the population information for each breed and regularly reporting about the population currently at threat of extinction.

2.1.1. Abigar Cattle Breed

Abigar cattle breeds are originated around the White Nile in Sudan and adjoining lowlands of the southwest of Ethiopia where they are usually kept by the Nuer people in the Akobo vicinity of the Gambella location [17]. They are comparable to the adjacent Aliab Dinka in Sudan, and each have retained the giant body size, longhorns and small humps of the authentic Sanga. They have straight profile heads and the horns range in length and structure but in general, are very lengthy and project outward and upward or are oval. Distinctive coat colors are light in shade, white with pink and gray coat shades are additionally discovered [18]. Their population size is estimated to be 548, 600 [19] and nowadays are not at risk.

2.1.2. Arsi Cattle Breed

Arsi cattle are mostly originated in the central high- lands of Ethiopia mainly in Arsi, Shewa and Bale administrative regions. Their quantity is estimated over 2,012,000 [19]. It is descended from the latest introductions of zebu into Africa from West Asia, and probably developed from a cluster of small shorthorn Abyssinian Zebu by means of the highland Oromo human beings [17]. They are small, short and compact; red with a black muzzle color is the predominant color though many animals are black, light grey, or white with black spots. It is categorized into zebu cattle kinds [18, 20].

2.1.3. Begait Cattle Breed

Begait cattle breed, referred to as Barka, is believed to be originated from Sudan and the low lands of Eritrea [21]. They are currently, observed in the Humera area of Ethiopia. Begait cattle is phenotypically somewhat huge with a well-developed udder, small and stumpy horns in both male and females, lengthy teats, a higher milk yielder and aggressive nature (Ibid). The common coat colors are grey, brown, and black and white. In phrases of susceptibility, they are very vulnerable to food shortages.

2.1.4. Boran Cattle Breed

According to Nigatu et al. [22] report, Boran cattle are being raised via both the Boran and Somali ethnic group in Ethiopia. They were further dispersed via the nomads of southern Ethiopia and Somalia who migrated to Kenya and in the late Nineteen Twenties whereby European ranchers in Kenya bought these cattle and developed the extended Boran or Kenya Boran through selective breeding. It was then delivered to Zambia in 1947 and South Africa in the Sixties [23]. Concerning the phenotypic characteristics of the breed [24] described that ordinary Boran cattle have white coat coloration and large dewlap and hump. But mainly they have light grey or fawn with black or dark brown shading on the neck, head, shoulders and hindquarter and shorter, greater pendulous sheath, well-developed hump, well-developed udder, lengthy legs, extensive ear and massive dewlap and erect horn orientation with dominantly thick base [25, 22, 26]. However, based on the survey report of [22] it was once published that the Ethiopian Boran cattle recognized via the community 50 years ago were not same with the modern Ethiopian Boran types, especially in terms of their body size and coat color. These phenotypic characteristics are a result of the adaptation mechanisms of the breed to harsh environments. For instance, white color is beneficial in thermo-regulation ability; lengthy legs to trek lengthy (60 km per day) and vast ear and giant dewlap assist to extend the floor place for metabolic warmth dissipation. Those Somali Boran cattle have white with black patches coat color [22].

2.1.5. Fogera Cattle Breed

Fogera cattle breed are regarded as a particular breed that lives the Fogera plains around Lake Tana, Ethiopia having its personal described phenotypic and genetic characteristics. Regarding its origin, there are two schools of concept as cited by specific scholars. According to the assumption of [27], the nomads from the south moved northwards and settled with their cattle in the areas of west and south of Lake Tana where the cattle grew to be recognized as Tana land Boran. According to [28, 21] it is believed that it is a Zebu x Sanga (called Zenga) breed. Despite the low bootstrap estimates that indicate the sampling bias, the protein polymorphism, as properly as nuclear DNA reports, located the shut relationships between Fogera cattle (the breed currently observed around Lake Tana) with Boran or Ogden cattle breeds [29]. The coat color of Fogera cattle breeds varies, black and white or black and gray coat [21]. Most of their traits are (small horns, very massive dew-lap, pendulous naval flap and perpetual sheath, docile) point out the attribute of zebu cattle [28, 22]. Only the hump, which in most of the instances is rather small and cervical or cervicothoracic in the position [19] represents the Sanga genetic influence. These cattle, therefore, have been categorized by using breeders as intermediate zebu-Sanga type. This breed was developed through the interbreeding of quite a number breeds.

2.1.6. Horro Cattle Breed

Abyssinian Highland Zebu and Nilotic Sanga breed particularly the Abigar. The breeds that emerged from these crosses have been labeled in a separate crew of "Zenga" cattle [17]. According to [18, 20] additionally grouped into the Horro into Sanga-Zebu (Zenga) type. They are very good-looking animals being uniform in color and physical conformation. They are of medium to giant size, with small and finely formed heads, a straight profile and medium to massive horns. The hump is small to medium in size. The Horro cattle have a uniform brown color which is slightly lighter round the muzzle and on the flank. Although the complete variety of populations is no longer yet recorded, [17] suggested that the breed is no longer at risk of genetic erosion.

2.1.7. Sheko Cattle Breed

Sheko cattle are discovered uniquely in the remote niche of southwestern Ethiopia especially at the humid Sheko and Bench districts owned by smallholder farmers who breed them for millennia of years for their herbal resistance to disease, in particular tsetse-transmitted trypanosomiasis [30]. This breed represents the closing remnants of Africa s unique Bos-taurus (humpless Shorthorn) cattle which were likely the first to be domesticated in eastern Africa [30]. The phylogenetic, genetic distance-based, evaluation of the breed indicated that Sheko cattle are distantly related to Sanga cattle breeds of Ethiopia [29]. They are smaller in physical size, with narrower belly and hindquarters, and shorter or no horns which made them much less complicated to manage [31]. Sheko cattle have higher feed conversion efficiency, toughness and fertility appropriate mothering ability compared to different cattle breeds in adjoining areas. However, these days some of the Sheko cattle show up small humps that they inherited from zebu introgression [32]. On the different hand, their occasional aggressive temperament and voracious feeding habits, particularly during the dry season, were mentioned as undesirable traits which set off its keepers to intentionally reinstate with smaller breeds of decrease feed consumption [31].

2.2. Threats to Livestock Genetic Resources

According to the [15] report from 7600 breeds about (20%) worldwide, belonging to 18 mammalian species and 16 avian species are at risk and 62 breeds became extinct within the first 6 years of this century. The African continent is the home to 145 cattle breeds/strains and 22% of the original breeds have become extinct in the last 100 years and 27% of the remainder is at varying degrees of risk [33]. Today 70%

of the livestock breeds existed in developing countries where the risk of loss is highest. The major threats of indigenous cattle genetic resource turn down are feed shortage as a result of degradation of rangelands/grazing areas, overgrazing and overstocking; sporadic invasion of rangelands by weeds and shrubs, expansion of crop cultivation, illegal trafficking, poorly designed and managed introduction of exotic genetic materials, weak development interventions, inbreeding and interbreeding and Trypanosomiasis. Various ongoing development interventions like Artificial insemination and introduction of genotypes into new environments that are aggravates the threat of the breeds should be avoided by revising and designing sound approaches for cattle conservation and improvement programs [34, 35]. Without breeding strategic scheme extensive importation of exotic germ plasma is one of the major causes for genetic dilution or eradication of indigenous cattle breeds in the country. An example is the global impact of the North American Holstein-/Friesian cattle on other dairy breeds, in some case entire breeds have effectively been replaced by this breed. The application of artificial insemination in indigenous cattle using semen from exotic cattle breeds are resulting in the unpredicted substitution of indigenous genes by exotic genes [36, 37]. The application of these technologies for germplasm propagation and dissemination may contribute to the erosion of diversity.

Ethiopian indigenous breed like Abergelle, Anuak, Adwa, Afar, Arado, Begaria, Gofa, Gurghe, Gojjam Highland Zebu, Hammer, Harar, Jemjem, Kereyu, Jijiga, Medense, Raya, and Smada cattle was conventionally conserved by farmers. In line with this Borana, Bageit, Fogera, Horro, Irob, Ogaden Zebu, Sheko cattle were in-situ conservation and selection with ranch and ex-situ conservation with cryopreservation activity implemented but Ambo cattle breed was improved by crossing with exotics. In general, the risk factor of most indigenous cattle breeds is not further studied shown in Table 1. The population of Fogera breed had declined due to the dominancy of small-sized zebu breeds through crossbreeding and flock change due to lack of animal feed [38]. The shift from livestock dominant mixed crop-livestock production system to crop dominant mixed crop-livestock system has also affected the indigenous Fogera and Begait cattle breeds. In this regard, the expansion of dominantly rice, sesame, and other crop farming at the expense of productive communal lands is interfering with the production and productivity potential of the breeds [39].

The population of pure Fogera cattle is not viable and the population growth is at decreasing trends as a result of feed shortage, cross-breeding with other indigenous breeds, disease, and parasites [40]. The mean time required for the counts to decline from the existing population size to 300 individual animal extinction thresholds is 162.7 years unless faced by stochastic and deterministic disturbances [40]. According to [40] study 86, 87 & 78% of sample respondents from Bahir Dar Zuria, Fogera and Dera district reported that the populations of Fogera breed decrease from time to time.

In other words, Sheko is now considered endangered by gradual interbreeding with the local zebu [41]. With this respect, the molecular genetic evidence also showed that about 90% of the sampled Sheko bulls have had their specific taurine allele replaced by indicine allele confirming an alarming introgression of Zebu genes [42]. This, calls for an immediate conservation and improvement program to reverse or at least halt further decline of the breed. On the other hand, pastoralists identified scarcity of pasture in Borana rangeland due to the increasing recurrence of droughts as the main cause shrinkage of the grazing land [43]. The study of [3] has shown that the gradual decreasing trend of the Abigar cattle population in the region due to frequent drought, prevalence of disease, and feed shortage.

2.3. Livestock Genetic Resources Conservation Approach

Conservation of livestock diversity has been defined as the total sum of all operations involved in the management of animal genetic resources so that the pool of genetic diversity is maintained [44, 45]. It encompasses the management of human activities in such a way that animal genetic resources are best utilized and developed to meet immediate and long-term human needs for future generations. Loss of genetic diversity will likely decrease the ability of animals breed to respond to environmental change and will result in a loss of genetic information potentially useful for breeding improvement [46]. Most attention in the conservation of animal diversity has been intended for rare breeds. According to [47] strategies identified for effective management of domestic animal diversity at the global level for each species are: Identifying and listing all breeds and describing and characterizing breeds to understand their unique qualities and potential contributions to the future. Sorting adequate samples at the same time as many breeds as possible, generally in the form of frozen semen, ova, and embryos, to enable the future regeneration of lost populations of animals. There are two major approaches of conservation for livestock genetic resources are available.

2.3.1. In-Situ Consrveation

In-situ conservation, also called ‘on-farm conservation', can be defined as the continuous husbandry of populations by farmers in the agro-ecosystems where those populations have evolved [48]. Thus, in-situ conservation encompasses entire ecosystems, including immediately useful species of animals that form part of the system. The disadvantages are that selection and genetic drift may result in unfavorable genetic changes if the population is small. There is a risk of increasing inbreeding and hence homozygosity, which is associated with reduced fitness. The animals are at risk from disease and other natural disasters. Also, they are likely to be less productive and so more coasty to maintain. In Ethiopia, institutions involved in-situ conservation of biodiversity includes the IBC, the Ethiopian Institute of Agricultural Research, Regional Agricultural departments, Higher Learning Institutions, etc. However, the impact of their work on the conservation of biological resources in practical terms is very limited [49]. So, identifying the status of the livestock

genetic resources and designing conservation strategies based on the priorities is crucial.

Table 1. *Some of Indigenous Cattle Breed, Location, Population Status, Improvement and Conservation Activity.*

Breed Type	Location Breed Found	Current Population& Status	Improvement Action
Abergele cattle	Amhara & Tigray region	Unknown	Normally practiced by farmers
Anuak/Abigar cattle	Gambella region	Unknown but limited due to trypanosomes & drought	Normally practiced by farmers
Arsi cattle breed	Central highland part of Ethiopia	Diluted with the exotic breed	Unknown
Bagiat cattle	Northwest part of Ethiopia	Decrease due to feed shortage	Improvement in ranch & ex-situ conservation
Begaria cattle	Benishangul Gumuz Region	Unknown	Community-based conservation
Bale cattle	The high plateau of Bale	Unknown	Normally practiced by farmers
Boran cattle	Southern rangeland of Ethiopia	High risk of destocking and Critically endangered	In-situ & ex-situ conservation implemented
Fogera cattle	Around lake Tana Amhara Region	Dilution risk with small indigenous breeds	Selection in ranch, in-situ & ex-situ conservation practiced
Gojjam high land zebu cattle	Distributed in Awi, East & West Gojjam area	Uncontrolled breeding with other indigenous breeds	Normally practiced by farmers
Horro cattle breed	Eastern welega, Shewa, Illibabur area	Unknown	Ranches & community breeding activity practiced
Irob cattle breed	Found in Tigray region	Unknown & threatened due to lack of awareness	Ex-situ conservation applied
RayaAzabo cattle breed	Found in Tigray & Wollo area	Unknown but, dilution with other local breeds	Normally practiced by farmers
Sheko cattle breed	The southern part of the country	Population 2400 & critically endangered due to dilution,	In-situ & ex-situ methods of conservation undertaken

Source: [3, 5]

2.3.2. Ex-Situ Conservation

Ex-situ approaches to conservation include maintaining breeds in the farm, creating a conservation herd (gene pool) and cryo-preservation (of semen and embryos) and keeping of live animals in designated localities, e.g. government farms or ranches. In marked contrast to the situation in plants, cryo-preservation is technically feasible for very few livestock species. In the context of conservation of domestic animal diversity in Ethiopia, there are three ex-situ conservation methods [8]. Maintaining breeds in the farm it involves the breeding animal's sample of a breed outside its normal production habitat. Many of the pros and cons of this approach are similar to the in-situ conservation method. However, there is potentially more control over the management of the population.

2.3.3. Creating a Conservation Herd (Gene Pool)

This involves crossing several rare breeds together, then breeding them to maintain genetic variability. It is an effective way of conserving genetic variation for two or three breeds. Maintenance of genetic diversity is almost better served by pooling five breeds in a conservation herd [50]. However, there is a greater risk of losing useful genes when more populations are combined. The disadvantage of this approach is that, although useful genes may be conserved, the identity of individual breeds is lost.

2.3.4. Cryo-preservation

This involves frozen storage of rare breeds in the form of living semen, ova, embryos or tissues, which can be used to regenerate animals. Cryopreservation of semen and embryos is a powerful tool for the preservation of genetic diversity. In the situation of a critical threat with a high probability that a breed will become extinct, preservation of genetic material of individual animals in the form of germ cells and embryos is necessary to ensure that an adequate genetic pool is retained for future improvement programs. Breeding technologies as artificial insemination and embryo transfer may provide support for this approach. The use of frozen semen in the conservation program is particularly feasible where traditional use of AI is already strong in Ethiopia. The collection of semen of endangered local breeds should take place as part of the AI program. According to [51] study concluded that developing and using indigenous breeds in government ranches and research centers and establishing Gene Bank for Cryo-preservation of adapted animal germplasm (gametes, embryos.) from endangered breeds (e.g. Sheko and Borena) to backup maintenance of live animals. In this regard, the experiences of countries- Benin, Brazil, China, India, and Kenya [52] can be taken into consideration.

Conservation aims at farm animal genetic resources ranging from avoiding extinction, maintaining genetic diversity and/or the cultural, ecological or socio-economic values of breeds, to provide the right conditions for their evolution within an evolving production system [52, 53]. Although much information is lacking, conservation of farm animal genetic resources (AnGR) in the Ethiopian perspective should be viewed from the rational utilization and protection of existing genotypes from genetic erosion [54]. According to [55] study indicated that comprehensive characterization, conservation, and improvement programs have to be designed to utilize the genetic resource sustainably. Moreover, the future direction for the development of this sector should better be geared towards the selection and improvement of local breeds, while cross-breeding and replacement can be used in the urban and peri-urban areas applying the controlled cross-breeding strategy [54, 55].

In Ethiopia, some activities carry out to maintain pure stocks of three cattle breeds and one sheep breed, but conservation activities of farm AnGR have not so far been

practiced in the country. Some of the ranches was Borana cattle bred as Did Tuyura and Abernossa Ranch, Horro cattle breed at Horro Ranch, Fogera cattle breed at Metekel ranch and Andassa Agricultural Research Centre and Menz sheep breed at Amed Guya Research Centre, Wolaita cattle ranch and Jigjiga ogaden cattle ranch are the only conservation attempts made in Ethiopia [54]. The newly established ranches are Begait cattle ranch at Humera and Horro cattle ranch at Bako [7].

3. Conclusion

From the above review, Ethiopia can be considered as a center of livestock diversity. Indigenous cattle breeds like Abigar, Arsi, Begait, Begaria, Boran, Fogera, Gojjam highland zebu, Irob, Sheko, etc… are threatened gradually. Some of activities were performed to conserve critically endangered indigenous cattle breeds in ex-situ conservation method at different ranches and research centers. Borana cattle breed at Did Tuyura Ranch, Horro cattle breed at Horro Ranch, Fogera cattle breed at Metekel Ranch and Andassa Agricultural Research Centre, and Menz sheep at Amed Guya Research Centre are the only conservation attempts made in Ethiopia and other cattle breeds conventionally conserved by farmers. Generally, I will recommend from review point of view, on-farm and station phenotypic and genotypic characterization activities so far will be carried out those breeds not further characterized and monitored their population statistics. Improving the productivity of grazing land should be done to maintain indigenous cattle breeds in their natural habitat. The government should be by allocating enough budgets to establish new and to maintain existing ranches and research centers to conserve those endangered indigenous cattle breeds.

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