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Pastoral livestock breeding strategies for resilience and sustainable development

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Abstract

Pastoralists are involved in extensive communal systems of livestock farming. Pastoralism not only yields meat, milk, and hides but also provides social, economic, and environmental advantages. In India, 20 million individuals partake in pastoralism, with 73 out of the 202 registered livestock breeds being raised and looked after by pastoralists. In pastoral livestock system, breeding management includes sorting livestock and identifying potentially productive animals through practical record-keeping methods. Pastoral communities rely heavily on indigenous knowledge, remembering the performance of individual animals and their ancestors by memorizing events and activities sequentially. Animals are given collective names based on their maternal lineage and unique names based on their coat color and horn patterns. Traditionally, breeding in pastoralism prioritized meeting local needs and emphasizing traits such as strength, maternal instincts, social behavior, loyalty, endurance, and cultural significance over maximizing meat and milk production. Males were chosen based on ancestry and performance, with a focus on adaptability features, while females were selected based on milk production and adaptability traits. Breeding methods in pastoralism aim to enhance livestock genetic diversity, adaptability, and resilience through selective breeding, line breeding, and inbreeding. Pastoralists relied on their indigenous knowledge to maintain mental records of the animals. To improve pastoralists' livelihoods, it is crucial to enhance access to veterinary services, offer training programs, improve market access, provide healthcare and financial resources, ensure access to rangelands and watering stations, involve pastoral communities in wildlife conservation, include pastoralist representatives in policy-making, and promote the preservation and advancement of indigenous knowledge.

Keywords: Pastoralists, communal livestock farming, meat, milk, hides

Introduction

Pastoralism refers to a livestock production system where herders travel to grazing regions with their animals on a seasonal basis in search of food and water. The three main forms of pastoralism are Nomadic pastoralism, which moves constantly without a set base, Transhumant pastoralism, which migrates seasonally between stable bases, and Agro-pastoralism, which combines crop growing and livestock rearing (Sharma *et al.*, 2003) ^[19]. Pastoralists engage in extensive community systems of livestock farming and primarily rely on livestock products for a substantial portion of their livelihood. Livestock under pastoral systems are primarily fed from natural pastures. It provides a vital source of income where other types of agriculture are unfeasible. Pastoralism offers social (jobs), economic (savings), and environmental (manure, energy, etc.) benefits in addition to the production of meat, milk, and hides (Rural, 2017) ^[16]. Therefore, pastoral livestock production constitutes a significant source of revenue for rural households.

Pastoral Production System

Pastoralism is the only viable production method in arid and semi-arid regions, hilly areas, non-arable terrain, and natural rangelands practiced by over 200 million people around the world. If not grazed by animals, these lands, which make up about half of the planet's land surface, cannot be exploited

for human consumption in any other way (Scoones, 2023) ^[17]. Because of their mobility, pastoralists play a crucial role in optimizing the vast potential for carbon sequestration found in rangelands. Important environmental services and co-benefits for humans are also provided by well-managed pastoralism, including preserving soil fertility, controlling fires, and managing pests and illnesses (Mancilla-Leytón *et al.*, 2022) ^[10]. Pastoralism allows for the diversification of climate change adaptation options through the movement of animals. Additionally, pastoralists efficiently manage natural resources, contributing to the preservation of biodiversity in a variety of settings. Despite delivering many benefits from helping combat climate change to maintaining heritage and biodiversity, pastoralism faces dangers from rural exodus and, in some locations, prejudice, wars, and insecurity. Over the past two decades, the traditional way of life for pastoral communities has grown increasingly complex, driven by factors such as sedentarisation, urban extension, and enhanced educational opportunities. Supporting pastoralists in their efforts to address these issues and promote the growth and preservation of pastoralism across the globe requires collaboration between local governments, research facilities, and pastoral organizations (Jenet *et al.*, 2016) ^[8].

Pastoralism in India

India is home to a substantial pastoralist population.

Although official figures are unavailable, community-based organizations estimate that approximately 20 million pastoralists graze the nation's grasslands and forests. Of the 202 livestock breeds registered by the National Bureau of Animal Genetic Resources in Karnal, Haryana, 73 are raised and maintained by pastoralists in India (Shagun, 2022) ^[18]. Native animal breeds, such as camels, cattle, Neeli Ravi and Toda buffalo, and Katchaikatty black sheep, are protected by India's indigenous pastoral communities, such as the Raika and Gujjar in Rajasthan, the Maldhari in Gujarat, the Gaddi in Himachal Pradesh, the Van Gujjar in Uttarakhand Pradesh, and the Konar in Tamil Nadu. While the Raikar Rabari clan in Rajasthan breeds Nari cattle, which are only raised in the Aravalli hill region, the Lambada group in Telangana raises Poda Thurupu cattle, which can tolerate high temperatures. They have developed these breeds over many generations to be disease-resistant, durable to extreme environmental conditions, and able to reproduce vigorously—qualities that are no longer present in exotic or high-performance kinds. These tribes have embraced a seasonal and spatial grazing system that is holistic, complimentary to forest ecology, and symbiotic with agro-ecosystems. They also use traditional knowledge for animal breeding. They assist farmers by providing organic manure (by penning), plough bullocks, and transport agricultural products locally. Pastoralists cultivate animals with certain qualities, such as the capacity to walk great distances or endure drought-like circumstances, and are the custodians of various livestock kinds. In recent times, there has been a constructive change in the discourse around pastoralism in India, as both the central and state governments have shown a greater willingness to accommodate these demands (Sharma and Ilse, 2003) ^[19].

Livestock Breeding: Key to Sustainable Livestock

Animal breeding involves the selection and mating of domestic animals to enhance desirable traits, leveraging natural genetic variation. This controlled process yields permanent and progressive improvements over generations. By targeting inheritable characteristics, breeders aim to optimize the genetic potential of offspring, which, combined with factors like nutrition, health, and management, determines an animal's overall performance. Livestock are bred by farmers to have higher yields, disease tolerance, effective reproduction, and resilience to environmental stresses being the most common ones. Through targeted breeding programs and conservation of genetic variation, animal populations can be substantially improved, leading to better outcomes for agriculture, food quality, and environmental sustainability (Brito, 2021) ^[1].

Pastoralists possess a wealth of information and expertise pertaining to livestock and have even devised customary approaches for specific characteristics. For example, one of the strategies employed in the case of reproduction is selective breeding. However, because of the different varieties of pastoralism that occur, strategies for breeding in pastoral herds vary and mostly depend on economic context, indigenous knowledge, and geographical area (FAO, 2021) ^[4].

Efficient Breeding Practices for Pastoral Farming

Globally, pastoral societies employ a wide range of

techniques to regulate the breeding of their animals. The environment, pastoralists, and livestock are all closely dependent on one another, which accounts for the diversity of indigenous livestock breeds. With thousands of years of breeding history, pastoral herds and flocks have some of the highest levels of genetic variety and resilience of any breeding population. Herders always work to enhance their animals through genetic selection and local ecological expertise, which enables the animals to adapt for market demands, diseases, and environmental changes (FAO, 2009) ^[3].

Livestock breeding involves strategic selection and mating processes to alter the genetic characteristics of a population. Selection identifies superior individuals as parents for producing the next generation, while mating systems determine ideal pairings between males and females. The combination of selection and mating strategies forms a comprehensive breeding plan.

Identification of animals

In pastoral systems, breeding management entails classifying livestock and identifying animals that may be productive by employing practical method of recording information. In pastoral systems, written records do not exist. Pastoral groups remember the performance of individual animals and their ancestors by memorizing events and activities in a sequential manner, a process that heavily relies on indigenous knowledge. In general, animals are ranked as good or poor to facilitate selection. In pastoral systems, based on the ancestry, livestock were given both collective and individual names. Animals were given collective names derived from the mother lineage from which they were descended. Also, animals were given unique names based on the color of their coats and the patterns on their horns. Such knowledge was mentally recorded. It was challenging for pastoralists to recall the identities of individual animals because of their enormous herds. The quantity of the herds involved causes pastoralists to lose sight of the lineage, which leads to a lot of mistakes in the recording system (Mgongo, 2014) ^[13].

Selection of animals

Pastoralists dedicate their lives to maintaining and improving the native animal breeds. These animals support local communities' means of subsistence by adapting to the climate or locality. The traditional pastoral communities' selective breeding methods and hundreds of years of natural selection have produced these regional breeds (Vivekanandan, 2002) ^[20]. Traditionally, breeding focused on meeting local requirements, prioritizing traits like strength, maternal instincts, social behaviour, loyalty, endurance, and cultural appeal over maximizing meat and milk production. In pastoral breeding, males were selected based on ancestry and performance, with emphasis on adaptability features such as: Hump size, Body structure, Coat color and Fertility (Marshall, 2018) ^[12]. Unsuitable males were castrated for alternative uses. For females, selection criteria included: Milk production and Adaptability traits such as conformation, coat color, fertility, and longevity (Marshall, 2016) ^[11].

Better body conformation in both males and females may indicate that farmers recognize the value of choosing

animals that can develop the most muscle in a feed-scarce environment. Strong, large-framed animals that can adapt to their surroundings, disease tolerance is preferred by agropastoralists. The females are also selected for ceremonial slaughter and gift during marriage. Coat color and hump size were the other significant selection criteria, and they may have been related to the breed's adaptable nature. The hump is a way to store fat against unforeseen feed resources and to improve heat transfer, while the white or grey coat may be an adaptation to the arid region to reflect sunlight (Mohammedamin Ismael and Birhanu Tesema, 2024) ^[14]. Pastoral societies have traditionally used adaptive trait selection, which is regarded as a novel strategy in the current breeding program.

Breeding management

In pastoralism, breeding methods focus on improving livestock genetic diversity, adaptability, and resilience (Houessou *et al.*, 2022) ^[6]. The traditional breeding methods are selective breeding, line breeding, and inbreeding. Through selective breeding, herders pick animals that exhibit desired qualities. Breeding within a specific family line is known as line breeding, and breeding within a small group to fix traits is known as inbreeding. In pastoralism, the goal of breeding is not to optimize a trait or combination of qualities toward some stable, ideal animal-object with the "correct" gene combination. The purpose of pastoral breeding populations is to interact with constantly changing landscapes. In general, a community-based breeding program was suggested as an important approach in the genetic improvement programs to produce resilient livestock for the future (Haile *et al.* 2019) ^[5].

Pastoralists raise their animals to thrive in difficult environments with severe temperatures and other environmental factors. Pastoralists are not as good at managing breeding within their own herds as they are at making sure that their herds do not interact with other herds. Pastoralism makes it hard to control which animals breed unless inferior males are kept out. The breeding strategy for pastoral production systems needs to consider technologies that fasten the improvement of traits of adaptation, feed efficiency, milk and meat production, and traits of diseases and parasites resistance already favored by the society in the traditional selection practices. Opportunities available on assisted reproduction technologies need to be integrated with indigenous traditional knowledge so that resilient animals will evolve soon against heat load, feed shortage, diseases, and parasite burden that will be anticipated in the coming climate change scenario. Herders owning a small number of animals are pooled together for the purpose of sharing a common male animal.

Pastoralists frequently use castration of male animals to increase weight and make them easier to handle. However, a drawback is that a herd may end up breeding from low-quality animals if improper decisions are made regarding the genetic characteristics of those that remain intact or if accidents happen to male animals. Using mechanical methods to prevent animals from reproducing is one counter-strategy; genital covers for sheep and goats are extremely common (FAO 2001) ^[2].

Record Keeping: Research on the effects of livestock

ranking and selection in pastoral systems is lacking, as there were no written records kept (Mgongo *et al.*, 2014) ^[13]. Pastoralists relied on indigenous knowledge to help them maintain mental records of the animals they encountered. This indigenous knowledge contains complex elements that show the relationships between societal culture, desired traits, and behavioural patterns that are not always linked to performance. In contemporary production systems, evaluating and selecting livestock is crucial for breeding and has a significant impact on the herd's reproductive ability. A reliable record system is vital to correct errors and drive meaningful improvements in the pastoral system. Data on socioeconomic traits such as age, breed, and sex composition of the herd, standards for selection and culling, production, and reproduction should be recorded (Kugonza *et al.*, 2011) ^[9].

Inbreeding

Inbreeding can occur when related animals are bred together. It can result from incorrect recruitment into breeding groups, especially in large herds where identifying individual animals is challenging. Inbreeding is two types: close inbreeding, mating between first- or second-degree relatives, and linebreeding, mating animals with at least one common ancestor. Pastoralists may encourage inbreeding by keeping animals for extended periods and breeding them from the same ancestor (Ilse Köhler-Rollefson, 2001) ^[7]. By using selective improvement, primarily obtaining superior male animals from external sources, livestock managers can sustain their native stock. Female stock should be graded and removed to reduce the number of unproductive animals. Inbreeding can negatively impact the health and productivity of animals in pastoral herds, leading to genetic disorders, reduced growth rates, and increased mortality rates.

Conclusion

In India, many pastoral communities have a low socioeconomic and political profile, despite their substantial contributions to the national economy through milk, meat, leather, dung, and other products. In the context of sustainable livelihood approaches to development, indigenous livestock is crucial for rural welfare and poverty alleviation. Indigenous breeds possess genes for disease resistance necessary for maintaining viable animal production systems. The breeding strategies of pastoralists result in animals that can survive and reproduce in harsh environments, making them productive under constraints. These animals, with closed gene pools, are distinct and correspond with ethnic groups' distribution ranges. Pastoral breeds are often seen as genetically superior by farmers due to their fitness traits. To enhance pastoralist livelihoods, it is essential to improve access to veterinary services, provide training programs, boost market accessibility, provide health care and financial resources, reduce strain from mining and agriculture on grazing pastures, ensure access to rangelands and watering stations, engage pastoral communities in wildlife preservation, increase livestock insurance accessibility, conduct a national livestock census, involve pastoralist representatives in policy formulation, and promote the preservation and advancement of indigenous knowledge.

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