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Cattle farming practices, trait preferences and breeding failures in smallholder cattle farming in Hambantota, Sri Lanka

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Abstract

Cattle productivity can be significantly enhanced through breed improvement, but farmers' trait preferences must be considered when improving the genetic make-up of local cattle breeds. This study investigated the breeding practices, trait preferences, and factors contributing to breeding failures among cattle farmers in the Hambantota district, Sri Lanka. Data were collected using a pre-tested, semi-structured questionnaire administered to 200 randomly selected smallholder cattle farmers from all the veterinary regions in the Hambantota district. The analysis revealed that 52 %, 34 % and 14 % of the farmers had an extensive, semi-intensive or an intensive farming system, respectively. All the famers (99.5 %) practised crossbreeding system while natural service was the predominant breeding method. Traits i.e., milk yield, body size, calf survival, heat tolerance, disease and tick resistance, and calving interval affected ($p<0.001$) the selection of a cattle breed with the highest mean ranking value for milk yield. Feed shortage, harsh environmental conditions, improper application of artificial insemination, inadequate housing, predator attacks, poor veterinary services, limited knowledge in breeding and heat sign detection contributed to breeding failures ($p<0.001$). In the extensive and semi-intensive systems, feed scarcity, harsh environmental conditions, and predator attacks contributing to breeding failures are inherent in rural smallholder cattle production in Hambantota district. The study recommends that future cattle breeding programmes need to prioritise milk yield without compromising body size, calf survival, heat tolerance, disease and tick resistance, and calving interval. Regular and expanded veterinary services also need to be prioritised.

Keywords: cross breeding, extensive farming system, feed scarcity, milk yield, natural service

1 Introduction

Livestock perform many functions, primarily producing milk and meat, which are essential sources of high-quality protein, as well as by-products such as hides, skins, manure and various others. Further, livestock acts as a 'living bank' for smallholder farmers, reducing the risks associated with crop farming and readily meeting financial needs in times of economic hardship (Perera & Jayasuriya, 2008). Apart from these benefits, the productivity and the ultimate economic benefits of cattle at the smallholder level are receiving serious attention due to the increasing demand for animal protein as a result of rising populations and living standards. Previous studies found that the costs of rearing dairy cattle, including health care, nutrition, and reproduction management, appear to be higher than the income and do not match the livelihood needs of the rural dairy farmers (Yakubu *et al.*, 2019; Bekuma *et al.*, 2020; Haile & Tesfahun, 2022). This is thought to be due to poor reproductive and production performance of animals caused by multiple factors such as low genetic potential of the livestock and poor management, seasonal availability of feed, the prevalence of diseases, inadequate nutrition, and difficulty in detecting of oestrus and improper breeding systems (Bekuma & Ketema 2018; Azage *et al.*, 2010). Together, these factors reduce reproductive efficiency, shorten the expected length of productive life and reduce milk production, which in turn

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increases the gap between demand and supply of milk and milk products (Bekuma *et al*., 2020).

The income of smallholder farmers can be increased by increasing the productivity or milk production of cattle which can be achieved e.g. through genetic improvement of dairy cattle (Haile & Tesfahun 2022). Genetic improvements of livestock are permanent, cumulative and usually highly cost effective (Bekuma *et al*., 2020). Farmers usually practice cross breeding for breed improvement using exotic sire or semen (Hailu & Abate, 2016). Further, Bekuma *et al*. (2020) emphasised that improving the genetic make-up of the local breeds through crossbreeding with high-yielding dairy cattle using AI and correct oestrus detection is essential to improve the performance of local breeds. Haile & Tesfahun (2022) recommended that for the genetic improvement of local breeds, if there is bull shortage, a village-level mating program can be established. However, there are concerns on conserving the indigenous genetic resources while genetically improving local breeds. Therefore, livestock breeders or implementing agencies and policy makers need to pay attention for the genetic conservation of local cattle breeds while improving the genetics of local breeds (Alilo, 2019).

Though the breed selection and proper breeding practices are necessary to improve the performance of local cattle breeds, respective farmer preferences become a critical factor in the particular region (Yakubu *et al*., 2019) and the traits preferences are influenced by socio-economic (Yakubu *et al*., 2019) and cultural factors. Farmers' trait preferences also vary through communities, farming systems, and agro-ecological zones (Chawala *et al*., 2019). Previous studies identified the farmers prefer several traits in cattle such as milk yield, appearance, genotype, fast growth rate, adaptability to local feed conditions, disease resistance, reproductive performance, traction, butter fat yield, calving interval, body size, and survival in selecting breeding stock (Haile & Tesfahun 2022; Godadaw *et al*., 2014; Yakubu *et al*., 2019).

In Sri Lanka, the livestock sector contributes about 1 % to the total GDP. Though Hambantota is a crop growing district in Sri Lanka, it has a considerable cattle population. According to the Department of Animal Production and Health (DAPH) (2022), there were 35,543 heads of cattle in Hambantota district out of which around 11,000 were milking cows with a milk production of about 6.98 million litres in 2022 (DAPH, 2022). According to DAPH (2021), the average milk production was 1.8 litres per cow per day in Hambantota district while it was 5.7 litres per cow per day in Puttalam district, both districts being classified as low country dry zone according to the agro-climatic zones of Sri Lanka (Punyawardena, 2020). In Hambantota district, the percentage of European cross, Indian cross and local breeds was 2.0 %, 36.7 % and 61.3 %, respectively, whereas in Puttalam district it was 22.1 %, 22.7 % and 55.2 %, respectively, as estimated using data from DAPH (2008). Accordingly, the higher percentage of local breeds and lower percentage of European crossbreeds is considered to be the main reason for the low milk production in the Hambantota district. Although the productivity of cattle can be improved through the breed improvement, the farmer's preference for different traits needs to be considered in improving the genetic make-up of the local cattle breed. Hence, the present study was undertaken to investigate the breeding practices, trait preferences and reasons for breeding failures among cattle farmers in the Hambantota district.

2 Materials and methods

The study was approved by the Ethics Review Committee (ERC) of the faculty of Technology, South Eastern University of Sri Lanka under the ERC reference ERC/FT/2022/12.

2.1 Study area

The Hambantota District is a coastal region located in the southern part of Sri Lanka and categorised under the low-country dry zone according to the agro-ecological zones (AEZ) of Sri Lanka. Southern Province is influenced by two monsoons, the southwest and northeast monsoons. The part of the Hambantota district influenced by the southwest monsoon experiences heavy rainfall from May to September and the part of the Hambantota influenced by the northeast monsoon receives rainfall from December to February. The period from May to September is generally dry in that part of the district which receives rainfall from the northeast monsoon. Total rainfall is <1750 mm per annum and during the dry period farming is rather vulnerable to drought conditions (Premalal *et al*., 2013). Livestock such as cattle, buffalo, and poultry are popular agricultural activities in the Hambantota district and there are twelve veterinary regions in the district.

2.2 Data collection and sample size

Data were collected through face-to-face interviews with 200 randomly selected smallholder cattle farmers from all the veterinary regions in the Hambantota district using a pre-tested questionnaire. There were registered and unregistered farmers, the registered farmers were selected using the random number and the unregistered farmers were selected with the assistance of veterinary office from each region. The questionnaire consisted of questions on socio-economic characteristics of farmers, cattle breed types, purpose and

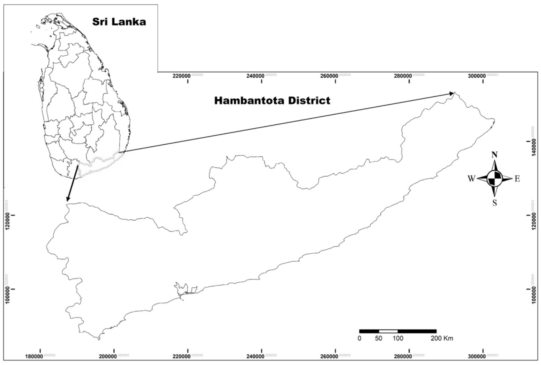

Fig. 1: *Hambantota district shown in Sri Lanka country map.*

reason for rearing cattle, farming management system, cattle breeding system, cattle trait preferences, and factors affecting breeding failure. Table 1 shows the number of farmers selected from each veterinary region.

Table 1: *Number of respondents from each veterinary region in Hambantota district.*

Veterinary region	*No of livestock farmers*
Ambalantota	21
Tissa	16
Hambantota	18
Beliatta	19
Walasmulla	14
Okewela	18
Katuwana	16
Sooriyawawa	11
Tangalle	15
Weerakatiya	15
Agunakolapelassa	17
Lunugamwehera	20
Total	200

2.3 *Data analysis*

The data collected from the questionnaire survey were thoroughly checked and entered into an excel sheet. Then the data were analysed using excel and SPSS. For the analysis in the SPSS, the data was imported from Microsoft Excel 2013 to SPSS version 26.

3 Results

3.1 *Socioeconomic characteristics of the farmers*

Table 2 provides the results on the socioeconomic characteristics of cattle farmers in Hambantota district.

Table 2: *Socioeconomic characteristics of the cattle farmers in Hambantota district (n=200).*

Characteristics	*Percentage*
Gender	
Male	92.5
Female	7.5
Age of the head of household	
< 40 years	19.5
40 – 50 years	40.5
51 – 60 years	30.5
> 60 years	9.5
Education level	
No schooling	33.5
Primary	45.0
Secondary	18.5
Tertiary	3.0
Main occupational status of farmers	
Crop farming	66.5
Fishing	1.0
Cattle rearing only	14.5
Trading	0.0
Government servant	2.0
Private worker	3.0
Labourer	13.0
Cattle farming experience	
< 1 year	4.0
1–5 years	8.5
5–10 years	23.5
> 10 years	64.0
Monthly income (SLR)*	
Below 30,000.00	37.5
31,000.00 – 50,000.00	58.0
51,000.00 – 70,000.00	4.5
Credit facilities for livestock rearing	
Received	8.0
Not received	92.0
Types of land holding	
Own land (inherited and transferred)	100.0

I SLR = 0.0034 $ or 0.0033€

According to Table 2, 92.5 % of males and 7.5 % of females are involved in cattle farming in the Hambantota district. Regarding the educational status of farmers, 33.5 % of the respondents did not attend schools and another 45 % of farmers obtained primary level of education. Further, most of the farmers (60 %) were below 50 years old. The study found that 14.5 % of the farmers are rearing cattle only. The rest of the farmers carried out other work also to earn money in addition to cattle rearing. The present study also found that most of the farmers (64 %) had more than 10 years of experience in cattle rearing. Further, majority of the farmers (58 %) earned monthly income of SLRs. 31,000.00 to 50, 000.00 from cattle rearing. It was found that 92 % of the farmers did not receive any credit facilities for cattle rearing and all of the farmers used their own land for the construction of cattle shed.

3.2 Breeds, production systems and breeding systems

The results obtained in relation to breed types, herd composition, purpose of cattle rearing, production systems, housing systems, and breeding systems are presented in Table 3.

The predominant breeds in Hambantota district are identified as Jersey cross breed (32.3 %), Jersey Sahiwal cross (24.2 %), local breeds (19.3 %), Sahiwal (12.3 %) and Friesian cross (10.4 %) (Table 3). According to the results (Table 3), the percentage of milking cows and non-milking cows were 19.2 % and 15.8 %, respectively. Total male cattle percentage (male calves – 8 %, young male – 5.3 %, bull – 8.3 %) was 21.6 % and the total percentage of female cattle was 78.4 %. Most of the farmers (73 %) raised cattle "only for milk purpose", another 3 % of the farmers kept cows for "meat and milk" and 24 % of the farmers raised bull and bull calf "only for meat". The results showed that the percentage of male calves were less than the percentage of female calves. With regard to the farming systems, majority of the farmers (52 %) adopted extensive farming system, another 34 % of the farmers practiced semi-intensive system and 14 % of them practiced intensive farming system. With regard to the breeding systems, 99.5 % of the farmers adopted cross breeding system while only 0.5 % of the farmers practiced pure breeding.

Table 3: *Farming related information of cattle farmers in Hambantota district.*

Breed types	*Percentage*
Jersey cross breed*	32.3
Jersey Sahiwal cross	24.2
Jersey Red Sindhi cross	1.1
Local breed (Sri Lankan breed)	19.3
Red Sindhi	0.4
Sahiwal	12.3
Friesian cross	10.4
Herd composition	*TLU mean*
Male calves	20.80
Female calves	43.84
Male (6 months – 1 year)	21.15
Female (6 months – 1 year)	27.72
Male (1 – 2 years)	26.65
Female (1 – 2 years)	73.80
Pregnant cow	119.54
Lactating cow	180.00
Bull	56.00
Purpose of cattle rearing	*Percentage*
Cow for milk only	73.0
Cow for meat and milk	3.0
Bull & bull calf for meat only	24.0
Production systems	*Percentage*
Intensive	14.0
Semi-intensive	34.0
Extensive	52.0
Breeding system	*Percentage*
Cross breeding	99.5
Pure breeding	0.5

* Jersey crossed with local breed.

3.3 Breeds, production systems and breeding systems

Figure 2 shows the breeding methods employed by farmers for different breeds. The study found that farmers did not stick to just one method and they employed either natural service, AI or both natural service and AI. The application of breeding method depends on the availability of resources to perform AI.

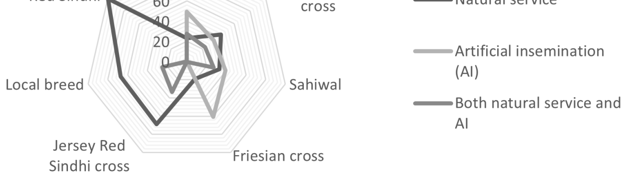

Fig. 2: *Breeding methods employed by farmers for different breeds.*

The results (Fig. 2) showed that natural service was the main breeding method practiced by farmers for breeding of Red Sindhi (100 %), local breed (67.3 %) and Jersey Red Sindhi cross (67.7 %). AI was the main method used for the breeding of Jersey cross breed (49.4 %), Sahiwal (39.4 %) and Friesian cross (60.7 %). For the breeding of Jersey cross breed, 23 % of farmers employed natural service, 49.4 % employed AI and 27.6 % of the farmers employed both natural service and AI.

3.4 Trait preferences by cattle farmers

Table 4 shows the various traits preferred by farmers with their mean rank values. The higher the mean rank value for trait the higher the preference by farmers.

Table 4: *Trait preferred by farmers in cattle breeding.*

	Values		
Preferred traits	*Mean*	*T*	*P*
Body size	4.49	12.3	0.00
Milk yield	4.93	13.7	0.00
Survival of the calves	4.18	12.6	0.00
Tolerance to heat	4.14	12.3	0.00
Disease and tick resistance	4.04	12.1	0.00
Calving interval	3.73	10.7	0.00

The results showed that traits i.e., body size, milk yield, survival of the calves, tolerance to heat, disease and tick resistance and calving interval are preferred by farmers ($p<0.001$) for cattle breeding. The milk yield was the most preferred trait (Table 4).

3.5 Factors affecting the breeding failures

Table 5 shows the factors causing for breeding failures in dairy cattle in the study area. The higher the mean rank value of the factor, the higher the effect for breeding failure. According to Table 5, the scarcity of the feed (shortage of feed) was the highest ranking factor with mean rank value of 4.42 affecting the breeding failures in cattle followed by harsh environmental factors (higher temperature and relative humidity) (4.36), improper application of AI (without following the recommended procedure for application of Artificial Insemination) (4.33), improper housing system (cattle shed without wall, with sand flour and roof either with thatching or metal)(3.80), predator attack (attack by Fox, Leopard and Stray dogs) (3.80), poor veterinary services (veterinary services are not available adequately and timely) (3.6), lack of knowledge in breeding (farmers don't have sufficient knowledge in cattle breeding) (3.20), other factors (3.02), and difficult and poor knowledge in heat sign detection (2.19).

Table 5: *Factors affecting for breeding failures.*

Factors	*Mean*	*T value*	*P value*
Lack of knowledge in breeding	3.20	2.6	0.009
Poor veterinary services	3.60	8.6	0.00
Harsh environmental factors	4.36	12.3	0.00
Difficult and poor knowledge in heat sign detection	2.19	-8.8	0.00
Feed scarcity (Lack of forage and concentrated feeds)	4.42	12.7	0.00
Improper housing system	3.80	10.0	0.00
Predator attack	3.80	11.1	0.00
Improper application of AI	4.33	12.6	0.00
Other factors	3.02	2.0	0.046

4 Discussion

4.1 Socioeconomic characteristics of the farmers

Smallholder cattle farming in Hambantota district is mostly male led, with limited education and diversified incomes due to low revenue from livestock. Farmers practice subsistence production, relying on available resources without significant investments or credit. This highlights their sustainable yet constrained system, which should be considered for future livestock development programs.

4.2 Breeds, production systems and breeding systems

The study revealed that 68 % of farmers in Hambantota district now raise crossbreeds, a significant shift from 2008 (DAPH) when local breeds dominated (61.3 %) and European crossbreeds were rare (2 %). This change stems from Sri Lanka's National Livestock Breeding Policy (2010). Currently, European crossbreeds dominate, with cows (pregnant/lactating) being the most common in herd composition. Previous studies found herd structures vary globally based on farming systems (Yakubu *et al.*, 2019; Sharma *et al.*, 2019; Lesnoff *et al.*, 2002).

Herd structure is influenced by animal species (depending on whether it is cattle or goats or sheep), socio-economic factors, and cultural beliefs. For example, in the study area, farmers are Buddhist, and they avoid selling (even though in smallholder livestock production systems, farmers sell animals to generate immediate cash for urgent financial needs) cattle for meat due to religious and ethical reasons, keeping them primarily for milk. Even unproductive cows are rarely culled, as slaughter is considered unethical after years of milk production. Male calves are managed in three ways: sold early, given away freely (due to rearing costs and meat-selling reluctance), or raised for meat at commercial weight.

In terms of farming systems, in Hambantota district, farmers mainly practice semi-intensive livestock rearing system due to sufficient grazing land and feed availability, including grass along canals, and roadside vegetation. Nevertheless, limited feed resources during dry season remain a persistent concern for smallholders which compel farmers to increase in-house feeding.

Sri Lanka has promoted crossbreeding since the 1930s to enhance cattle productivity (Silva *et al.*, 2008). The National Livestock Breeding Policy (2010) advocates crossing local breeds with up to 50 % taurine genetics for better milk yields. Implemented by DAPH through local veterinary offices, the breeding program provides semen of improved breeds, in addition, most of the bulls available and used for mating at the local levels are crossbred, driving farmer adoption of the crossbreeding system. However, future breed improvement initiatives must align with Hambantota's extensive and semi-intensive smallholder systems while maintaining current self-sufficiency levels.

4.3 Breeding methods adopted by farmers

Farmers' use of AI for breeding depended entirely on timely service availability during heat detection. When AI was inaccessible (even after reporting heat signs), they resorted to natural service. This aligns with studies in Kenya (Lukuyu *et al.*, 2019) and Ethiopia (Bekuma *et al.*, 2020), where natural mating dominated (68-89 %) due to availability, reliability and cost, despite AI being preferred where available. Bekuma *et al.* (2020) found that merely 3 % of surveyed farmers in Ethiopia utilized AI for breeding, with most perceiving little benefit from the technology. However, Haile & Tesfahun (2022) found that 96.1 % of the farmers preferred AI over natural services in the southern part of Ethiopia. DAPH (2022) reports Sri Lanka's Southern Province (including Hambantota) achieved only 59 % of its 15,230-cattle AI target, reflecting service deficiencies. AI remains underprioritized in the dry zone compared to other regions, with historical data showing only 10-15 % of the breedable cows received AI services, yielding just 2-5 % AI-originated calves (Perera & Jayasuriya, 2008). In extensive farming system, farmers rely mainly on communal bulls for natural mating, leading to limited AI use (Leroy *et al.*, 2016). In that case, farmers often lack knowledge of bull breeds and sometimes AI-inseminated cows are unknowingly exposed to natural mating in pastures, creating uncertainty about conception sources. Haile & Tesfahun (2022) found 30 % of farmers depended entirely on pasture bulls for breeding.

This study reveals strong interdependence between farming systems (extensive/semi-intensive), and breeding practices in the rural smallholder livestock production which is a challenge for government sponsored crossbreeding programs in Hambantota. Uncontrolled breeding persists due to inadequate AI availability and poor post-insemination management. Effective implementation requires timely, accessible AI services, as success depends critically on proper timing.

4.4 Trait preferences by cattle farmers

The study found that milk yield is the most preferred trait in dairy cattle, alongside other traits like body size, calf survival, heat tolerance, disease resistance, and calving interval. In Ethiopia, milk yield was also the top priority, followed by appearance and genotype (Haile & Tesfahun, 2022). In Sri Lanka's Southern province, Hambantota district had the lowest average milk yield (1.75L/cow/day), compared to Matara (2.8L) and Galle (3.1L) as per our estimate having the data from DAPH (2023). This justifies the farmers' emphasis in Hambantota on milk production. Despite the low yield, 73 % of Hambantota farmers reared cattle for milk, likely hindered by poor management in semi-intensive and extensive production systems. Although most farmers kept crossbreeds, low yields persisted, possibly due to inadequate practices in extensive and semi-intensive systems (Alilo, 2019).

Farmers associate larger body size in cattle with higher productivity, as local breeds are smaller and yield less milk, linking body size preference to milk production needs. They also believe calf survival is crucial, thinking that suckling before milking boosts milk yield—a practice supported by Combellas & Tesorero (2003), who found calf presence during milking enhances production, common in tropical regions. In addition, farmers value calf survival to sustain their future herds. Farmers in Hambantota district prioritize heat tolerance and resistance to ticks and diseases due to the region's hot, dry climate, where ticks thrive (Namgyal *et al.*, 2021). Smallholder farmers in tropical regions similarly value disease resistance (Yakubu *et al.*, 2019; Chawala *et al.*, 2019). Although calving interval was the least preferred trait in this study, Yakubu *et al.* (2019) ranked it highest, and prolonged intervals reduce herd productivity (Belay *et al.*, 2012).

Farmers' focus on milk yield suggests a need for genetic improvement, as recommended by Sri Lanka's National Livestock Breeding Policy (2010), which advocates crossbreeding with AFS (Australian Friesian Sahiwal), Jersey, or Sahiwal breeds for semi-intensive systems and Sahiwal for extensive systems—while preserving heat tolerance and disease resistance. The DAPH oversees this crossbreeding, and these findings guide its implementation. However, it is important to note here that along with genetic improvement, feeding and nutrition should be further improved to enhance the milk yield.

4.5 *Factors affecting the breeding failures*

In Hambantota district, dairy farming relies on extensive and semi-intensive systems, where cattle primarily graze for feed. Semi-intensive systems include evening shelter and feed supplements, while extensive systems lack both. However, grazing lands are shrinking due to development (Seresinhe & Marapana, 2011), and dry-season forage shortages worsen feed scarcity, leading to nutrient deficiencies—especially in extensive systems. Poor nutrition negatively impacts reproductive performance, as seen in Kenyan smallholder farms (Lanyasunya *et al*., 2005), and adequate nutrition is crucial for successful reproduction (Bisinotto *et al*., 2012). Thus, feed scarcity in Hambantota likely contributes to breeding failures and poor reproductive performance.

Harsh environmental conditions significantly contributed to breeding failures in Hambantota, a dry-zone district with prolonged high temperatures and humidity. These climatic stressors severely impair dairy cow reproduction, as heat stress – exacerbated by humidity – disrupts ovarian function, oocyte quality, and embryonic development (Salem *et al*., 2006; Sartori *et al*., 2002). Elevated temperatures increase early embryonic mortality and hinder growth (Wolfenson *et al*., 2000), while heat stress broadly reduces reproductive efficiency through multiple mechanisms (Jordan, 2003). These findings align with previous studies confirming that extreme heat negatively impacts dairy cattle fertility.

The study revealed that farmers' lack of breeding knowledge and inadequate veterinary services significantly contributed to cattle breeding failures. Proper breeding management – including record-keeping and heat detection – is essential for success. In Sri Lanka, the DAPH's veterinary offices are responsible for AI and extension services, thus the lack of knowledge and the subsequent breeding failures may be attributed to poor services of the Government Veterinary Offices. Mugisha *et al*. (2016) similarly found that effective extension services are crucial for successful cattle breeding programs. Our results align with Khan *et al*. (2016), confirming that housing systems impact dairy cattle reproductive performance in extensive and semi-intensive farming systems.

The study revealed an unexpected factor in breeding failures: predator attacks (foxes, leopards, and stray dogs) in grazing areas, particularly affecting pregnant cows in extensive/semi-intensive systems. These vulnerable animals often cannot escape, leading to abortions even if they survive attacks. Additionally, village dogs chasing cattle during grazing movements further increased abortion risks, contributing significantly to breeding failures. The study identified breeding failure factors like feed scarcity, harsh climate, and predator attacks as inherent to Hambantota's production systems, making short-term solutions challenging. While shifting to intensive farming could mitigate these issues in long-term especially due to shrinking grazing lands and government policy. Immediate improvements require addressing veterinary and educational gaps. Strengthening veterinary services and farmer training in breeding management can effectively reduce preventable breeding failures.

5 Conclusion

This study offers crucial insights for rural dairy cattle breeding programs in Hambantota, where farmers maintain diversified livelihoods and predominantly keep Jersey-cross cows. The breeding system relies heavily on natural service due to limited AI availability during heat detection, making crossbreeding inevitable in this smallholder context. Milk yield emerged as the most prioritized trait, while feed scarcity ranked as the primary cause of breeding failures. Systemic challenges like feed shortages, harsh climate, and predator attacks are inherent to the production system, potentially addressable through long-term intensification. More immediately, improving veterinary services and farmer training could significantly reduce breeding failures. The DAPH should enhance veterinary regional capacity with trained staff and resources to deliver effective extension services and breeding support.

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Conflict of interest

The authors declare no conflict of interests.

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