Post-Natal Calf Management Practices of Selected Small-Scale Dairy Farms in Four Regions of Ethiopia

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Abstract
Calf management during the postnatal period is of paramount importance for sustainable livestock production. A well-informed and evidence-based approach is crucial for the improvement of postnatal calf management practices. A cross-sectional investigation was conducted to assess the post-natal calf management, calf health problems, and associated risk factors among small-scale dairy farmers from four regions in Ethiopia (Amhara, Oromia, SNNPR, and Tigray) between September 2017 and November 2021. The study included 199 urban, 290 peri-urban, and 180 rural farmers, with 202 (30.3%) having intensive farms, 255 (38.1%) semi-intensive, and 212 (31.6%) extensive farms. Data on birth history, colostrum feeding management, vaccination practices, and previous disease history of selected calves were collected using a semi-structured questionnaire. Descriptive statistics and multinomial logistic regression models were employed to analyze the data with SPSS and SAS statistical software. The prevalence of dystocia was found to be notably higher in this survey compared to previous reports conducted different parts of the country. This observation might be attributed to crossbreeding between local cows. Among all birth difficulties, 90 cases (76.9%) were recorded when cows attempted to deliver crossbreed calves, suggesting a significant association between crossbreed calves and delivery complications, with an odds ratio (OR) of 2.59 and a confidence interval (CI) of 1.626-4.151. Majority of the farmers (94.9%) practiced colostrum feeding, and 64% vaccinated their calves for at least one type of vaccine. The overall calf morbidity was 40.9%, with regional prevalence as follows: Amhara region (78.6%), Oromia region (41.2%), SNNPR (31.4%), and Tigray region (23.9%). The most frequently observed disease syndrome was diarrhea (30.7%), followed by external parasites (21.8%), wound and other skin problems (21.8%), septicemic unknown infections (21.8%), coccidiosis (6.8%), poisoning and feed intoxication (4.7%), mixed infection (4.1%), and anemia (2.7%). Among the risk factors analyzed, only the sex of the farm owner, herd size, amount of colostrum fed and breed of calves showed a significant (P<0.05) effect on calf health problems. Based on the findings, appropriate calf housing, strict hygiene and sanitation, and proper feeding management were recommended.
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1. Introduction

The postnatal period is a critical phase that lays the groundwork for future productivity and overall herd performance, making proper care for calves essential not only for the sustainability of the dairy industry but also for preserving and maintaining high-quality livestock genetics (Ameha et al., 2021). However, calf mortality rates have become a significant obstacle to the expansion and genetic enhancement of dairy herds (Ameha et al., 2021). Reports suggest that calf morbidity and mortality are prevalent issues in countries where cattle are raised, with estimated rates ranging from 0.9% to 37%, and a pooled prevalence of 14.79% based on a systematic review (Tora et al., 2021). Observational studies show a similar prevalence estimate, ranging from 0.9% to 37.3% (Desta et al., 2012).

Calf health during the rearing period has been linked to housing conditions, with studies indicating a significant relationship between the two (Wudu et al., 2008). Unclean environments have been found to increase the risk of disease in calves compared to clean barns (Wudu et al., 2007). In Ethiopia, there are traditional feeding practices like calf sharing, which hinder optimal calf growth (Tegegne et al., 2019). Williams and Anderson (2019) highlighted the importance of improving calf housing and hygiene practices to enhance overall livestock productivity. However, in many rural areas of Ethiopia, calf-housing structures lack adequate sanitation and ventilation, leading to an increased risk of disease.

The livestock sector in Ethiopia faces significant disease challenges that affect calf health and survival (Abate and Gebre, 2018). Disease management strategies have been reviewed, emphasizing the importance of effective disease control measures (Abate and Gebre, 2018). Nevertheless, limited access to veterinary services and resources poses obstacles to appropriate disease management in many regions. Genetic improvement strategies for calves in Ethiopian livestock production have been discussed, with an emphasis on using improved indigenous breeds and crossbreeding to enhance calf performance and overall productivity (Tsegaye and Assefa,

2021). The Ministry of Agriculture, Ethiopia (MOA, 2023) has stressed the significance of strengthening extension services to provide livestock keepers with the necessary information and skills to enhance calf health and productivity. However, limited resources and training challenges hinder effective knowledge transfer.

Considering the challenges faced in calf health and management in Ethiopian small-scale dairy farms, the objectives of this study are to evaluate existing calf health and management issues in different regions and to assess post-natal calf management and health practices of dairy farmers. The study aims to provide valuable insights into improving calf care, thus enhancing the productivity and sustainability of the dairy sector in the country.

2. Methodology

2.1 Study Design and Sampling Method:

A cross-sectional investigation was conducted to assess calf management, health problems, and associated risk factors. Purposive sampling was used to select farmers with at least one cow and calf up to 6 months of age (weaning age) and up to 9 months (post-weaning age) during the study period. Four regions were purposively selected based on dairy potential and ease of access. A total of 11 representative zones and 26 districts were chosen from the selected regions. Data collection took place through interviews with individual farmers between September 2020 and November 2021.

2.2 Study Area

The study was conducted in four regions in Ethiopia: Oromia, Amhara, Southern Nations, Nationalities, and Peoples' Region (SNNPR), and Tigray. Within these regions, twelve zones were purposively selected based on their dairy potential and accessibility. From Oromia region, the selected zones were West Arsi, East Wollega, East Shewa, and West Shewa. In Amhara region, the chosen zones included Bahir Dar, Bahir Dar Special Zone, and West Gojam. From the SNNPR region, Sidama and Gedio zones were selected, and from Tigray region, the chosen zones were South East Tigray, East Tigray, and Mekelle. In total, 26 districts were selected from all regions, and within these districts, kebeles and households were purposively chosen for the study. Households or small-scale farms selected based on the presence of calves. Farms which do not have calves less than 9 month was intentionally omitted.

2.3 Selection of calves

Households were selected for the study based on the criterion of having calves aged less than 9 months. In cases where multiple calves were present on the farm, priority was given to the youngest calf and those with exotic bloodlines. The birth history of each calf was meticulously recorded for later analysis. Detailed data regarding the calf's birth, including the date of birth, birth weight, and any notable events or conditions surrounding the birthing process, was collected. Additionally, information about the dam, such as the age, health status, and any specific management practices during pregnancy, was recorded.

The birth history data served as a valuable foundation for further analysis and evaluation of calf management practices. With access to this information, various aspects related to calf health and rearing could be assessed. For example, any associations between specific birth conditions and subsequent calf health outcomes could be investigated. Moreover, the impacts of management practices during the early stages of the calf's life on its growth and overall well-being could be considered.

2.4 Clinical examination

Selected calves were tagged and clinically examined. Table 1 show the proportion of local breed and crossbreed calves selected and examined in each region.

Table 1: The total number of calves examined within each region

Region	Local Breed Calves (%)	Crossbreed Calves (%)	Total Calves Examined
Amhara	23 (41.07%)	33 (58.93%)	56
Oromia	149 (37.4%)	249 (62.6%)	398
SNNPR	83 (54.2%)	70 (45.8%)	153
Tigray	13 (28.26%)	33 (71.74%)	46
Total (N=669)	273 (40.79%)	388 (57.91%)	653

2.5. Statistical Analysis

The collected survey data underwent coding and was then entered into Excel for organization. To analyze the data, two statistical software packages, SPSS and SAS, were utilized. Statistical significance was considered at a level of $P<0.05$, indicating that results with a p-value less than 0.05 were deemed statistically significant. Binary logistic regression was used to assess associations between variables and diseases occurrence, while multinomial logistic regression was employed for multivariate analysis.

3. Results

3.1 Demography characteristics

The majority of farmers (73%) were between 31 and 60 years old, with a minimum age of 18 and a maximum of 90 years. The overall mean age was 43 years. Further demographic information is provided in the following table (Table 2).

Table 2: General demographic characteristics of respondents

Demographic characteristics	Categories	Number	Percent (%)
Sex	Male	431	64.5%
	Female	237	35.5%
	Total	668	100.0%
Age	18-30	119	17.8%
	31-40	215	32.1%
	41-50	177	26.5%
	51-60	92	13.7%
	Above 60 years	66	9.9%
	Total	669	100%
Education level	Illiterate	154	23.0%
	Primary	300	44.8%
	Secondary	153	22.9%
	College/university	62	9.3%
	Total	669	100.0%
Farming system	Intensive	202	30.3%
	Semi intensive	255	38.1%
	Extensive	212	31.6%
	Total	669	100.0%
Farm location	Urban	199	29.8%
	Peri urban	290	43.4%
	Rural	180	26.8%
	Total	669	100.0%

3.2 Livestock ownership

The majority of farmers predominantly keep local breed cattle, except for dairy cows. The mean average value of local breed cows is 1.33, with a range (R) of 0-15 and a standard deviation (SD) of 1.946. On the other hand, the mean average value of crossbreed cows is 2.216, with a range (R) of 0-16 and a standard deviation (SD) of 2.216. The average livestock for farmers is 7.27, ranging from 0 to 77, with a standard deviation (SD) of 6.087 (Table 3).

Table 3: livestock size

Cattle type	Minimum	Maximum		Mean	SD
Local cows	0	15	15	1.33	1.946
Cross cows	0	16	16	1.65	2.216
Total Cows	0	20	20	2.98	2.663
Oxen	0	14	14	1.32	1.782
no. of cross bulls	0	14	14	0.21	.756
Total l bulls	0	18	18	0.48	1.125
cross heifers	0	25	25	0.59	1.451
Total heifers	0	28	28	1.10	1.754
Total local calves	0	9	9	0.74	1.222
Total cross calves	0	12	12	.64	1.301
Total no. of calves	0	12	12	1.38	1.680
Total cattle herd	0	77	77	7.24	6.087

3.3. Birth conditions of calves in different regions

Out of the total selected and examined calves (669), 127 (18.2%) calves were born from cows that experienced difficulty during delivery (dystocia). The highest prevalence of dystocia was registered in Oromia region was 13.3% (89/669). Based on the respondents' observations at the time of delivery, it was found that 27.8% of the delivery problems were attributed to various factors.
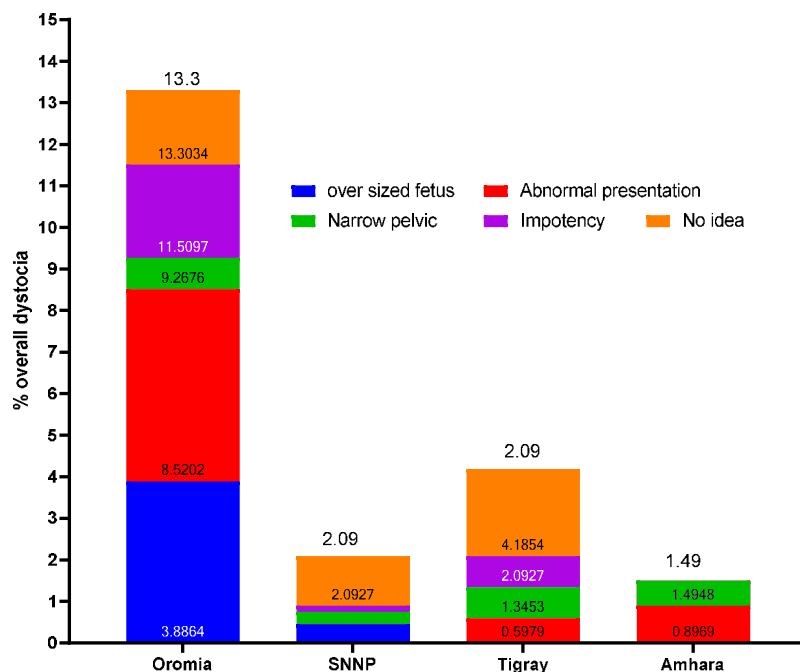

Figure 1: Proportion of predisposing factors for dystocia according to the respondents

These factors include abnormal presentation of the fetus, physiological and anatomical conditions of the dam, such as undeveloped pelvic cavity (8.6%), and insufficient labor (12.6%). Another significant factor contributing to delivery problems was an oversized fetus, accounting for 22.8% of the cases. These observations highlight the importance of monitoring and addressing these issues to reduce the occurrence of delivery complications and ensure the successful birth of healthy calves. Interestingly, most of the delivery problems (68.37%) were attended to by non-professionals like the owner or other family members, while only about 37 cases (31.6%) were attended by veterinary professionals.

Table 4: personnel assist the delivery process

Delivery assistance	Amhara	Oromia	SNNPR	Tigray	Total
Owner	5 (3.9)	53 (41.7%)	13 (10.2%)	6 (4.7%)	77 (61.6%)
Other persons		4 (3.1%)	0	4 (3.1%)	8 (6.2%)
Veterinary professionals	5 (3.9)	32 (25.2%)	1 (0.8%)	4 (3.1)	42 (33.1%)
Total	10 (7.8)	89 (70.1%)	14 (11%)	14 (11%)	127 (100%)

3.4. Colostrum feeding practice

The vast majority of farmers (94.9%, n = 669) provided colostrum to their newborn calves, indicating widespread acceptance of the importance of colostrum feeding. In general, the direct suckling method was the preferred choice for rearing calves, as indicated by 408 respondents, accounting for 64.3% of the participants. An alternative feeding method known as the bucket feeding method was used by 198 farmers, representing 31.2% of the respondents. Interestingly, only a small number of farmers, specifically 3 respondents (0.5%), used both feeding techniques simultaneously.

Regarding the amount of colostrum provided to calves, approximately 115 calves (18.1%) were fed up to one liter of colostrum per day. A larger proportion 216 (34%) and 229 (36.1%) of calves, received 1-2 and more than 2 liters of colostrum per day, respectively. The calves that were fed less than one liter of colostrum were found to be more affected by diseases compared to those that received more than two liters. This suggests that providing an adequate amount of colostrum, specifically more than two liters, may have a protective effect against diseases in calves. About 87 farmers did not recall the amount of colostrum provided. Regarding the time of colostrum feeding, it was observed that 446 calves (70.2%) consumed their first colostrum within six hours of

delivery. A smaller number of calves, 50 of them (7.9%), consumed colostrum between 6 to 24 hours after delivery. The remaining 116 calves (18.3%) consumed colostrum after 24 hours of delivery.
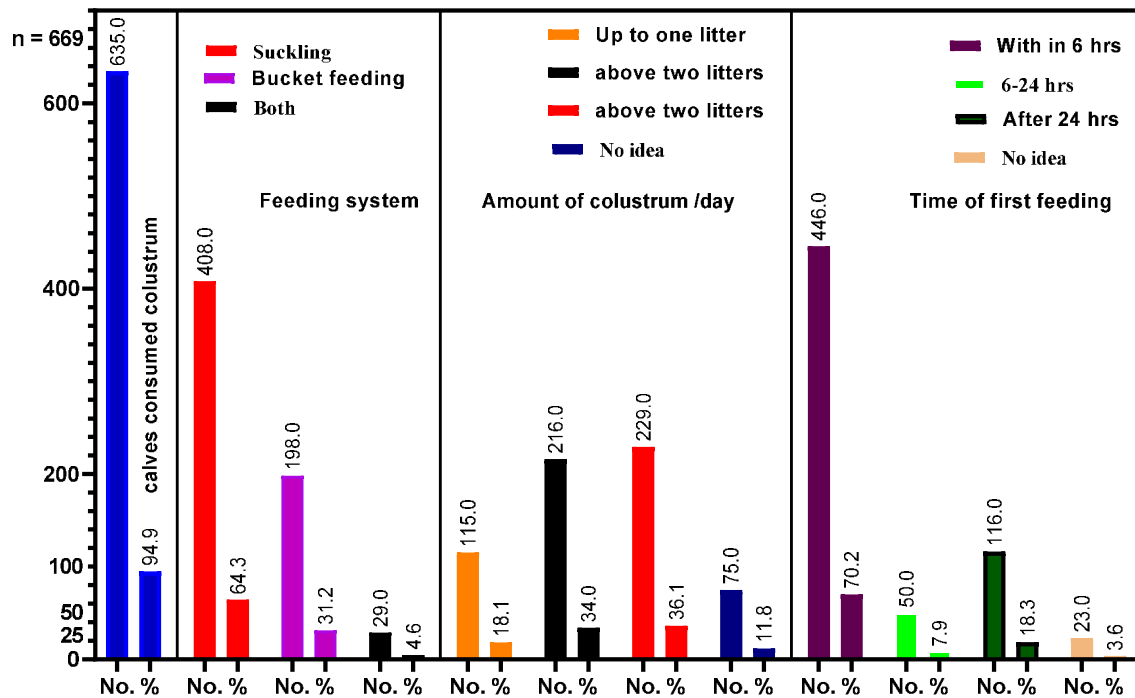

Figure 2: Colostrum feeding practice of farmers

3.5. Vaccination practice

Regarding vaccination practices, out of the selected farmers, around 67.6% reported practicing vaccination once their calves reached the appropriate age for vaccination. The most commonly used vaccines were Anthrax vaccine (used by 194 farmers) and Blackleg vaccine (used by 243 farmers). These choices might be due to the widespread occurrence and severe impact of Anthrax and Blackleg diseases. Contagious Bovine Pleuropneumonia (CBPP) vaccine was rarely mentioned by the farmers.
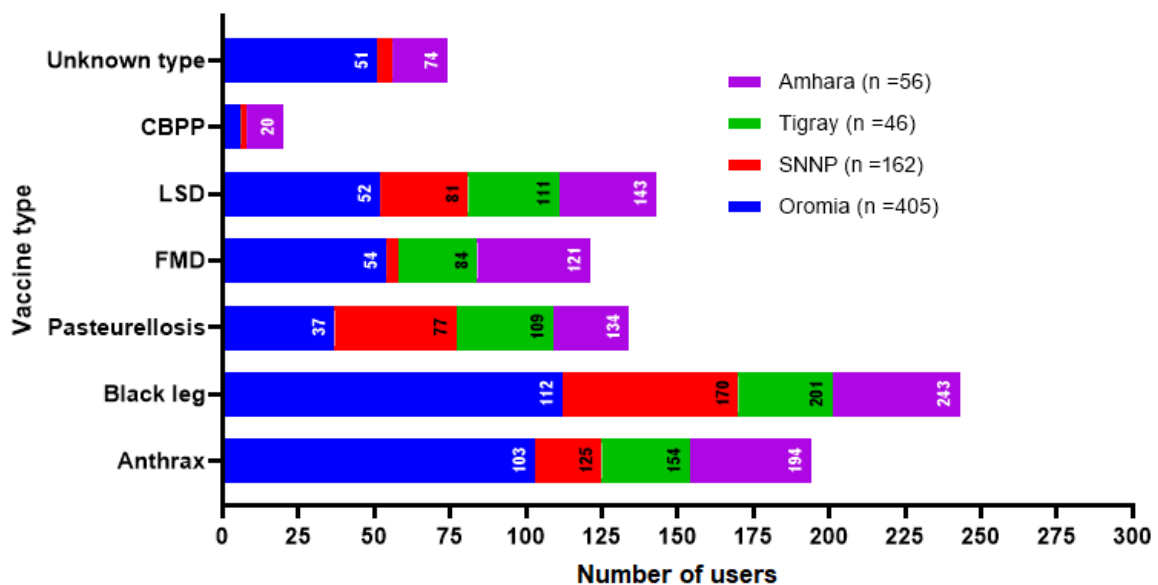

Figure 3: veterinary vaccine types used by farmers

3.6. Disease prevalence in selected farms

A total of 653 calves were clinically examined for diseases symptoms upon data collection, among which 40.8% (267/653) show signs of morbidity. The prevalence of calf morbidity was 26.8% in farms located in non-urban areas and 11.1% in urban farms.

Table 5: The prevalence of disease on selected calves based on region and farm location (n=653)

Region	Urban	Non-Urban	Health calves	Total calves Examined*
Amhara	7 (12.50%)	37 (66.07%)	12 (21.43%)	56
Oromia	57 (14.32%)	102 (25.56%)	236 (59.30%)	398
SNNP	20 (13.07%)	28 (18.30%)	125 (81.70%)	153
Tigray	3 (6.52%)	8 (17.39%)	35 (76.09%)	46
Total	87 (13.32%)	175 (26.80%)	408 (62.42%)	653

* *14 calves missed farm location data*

Diarrhoea was the most frequently observed disease syndrome, accounting for 30.7% of cases. External parasites and wound/other skin problems were the next most common at 21.76% each, followed by unknown infections in 17.48% of cases, followed by coccidiosis in 6.8%, and cases of poisoning/feed intoxication at 4.7%. A diagnosis of mixed infections was made in 4.1% of cases, and anaemia was found in 2.7% of calves.
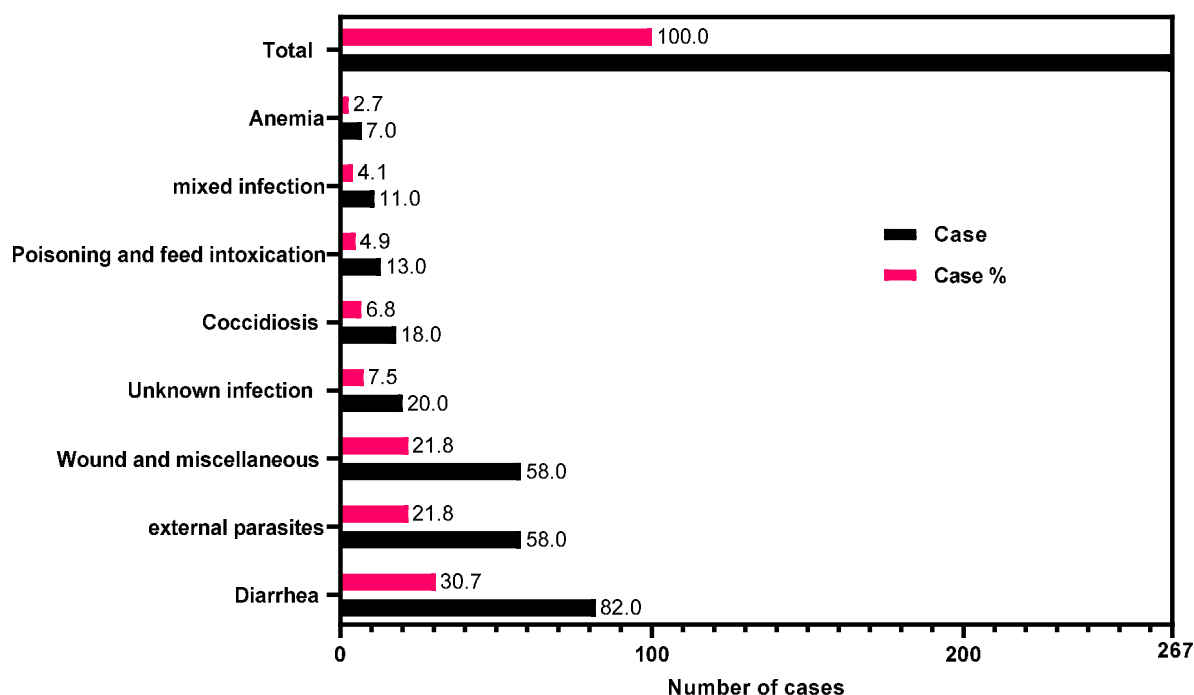

Figure 4: Tentatively diagnosed Major calf health problems observed in selected dairy farm

3.7. Clinical examination of selected calves

The effect of different factors on the prevalence of disease was tested by multiple logistic regressions. More than eight parameters were considered to weigh up their effect. The result shows no significant association between disease occurrences and farmer's education status, calves' sex, vaccination, birth condition and colostrum feeding. Significant relation was observed between disease occurrence and herd size, breed of calves, amount of colostrum fed and sex of farm managers.

Table 7: logistic regression analysis for disease prevalence and associated risk factors

Variables	Category	Wald	Sig.	OR	95% CI	
					Lower	Upper
Total cattle herd	Large	5.182	.023	.562	.342	.923
	Medium	4.986	.026	.582	.362	.936
	Small					
Breed	Cross	5.221	.022	.591	.376	.928
	Local					
Amount of Colostrum	one litter or less	3.96	0.012	1.839	1.143	2.879
	one to two litters					
	above two litters					
Farm managed by	Male	4.795	.0107	.673	.416	1.090
	Female					

4. Discussion

The prevalence of dystocia observed in this survey is notably higher compared to previous reports conducted by Mamo (2004) in Debreziet, Tigrie (2004) around Holetta, and Takele et al. (2005) around Nazareth, who reported prevalence rates of 5.79%, 7.5%, and 6.95%, respectively. This might be due to cross breeding between local cows. Interestingly, the survey found that crossbreed calves experienced more complications during the birth process compared to local breed calves. Among all birth difficulties, 90 cases (76.9%) occurred when cows attempted to deliver crossbreed calves. The findings suggest a significant association between crossbreed calves and delivery complications, with an odds ratio (OR) of 2.59 and a confidence interval (CI) of 1.626-4.151.

Regarding colostrum feeding practices, over 90% of the respondents practiced colostrum feeding for their calves. However, certain drawbacks related to the amount, time of first colostrum and frequency, and method of colostrum feeding was noted. About 67.3% of the calves received their first colostrum feed within the recommended six-hour timeframe after birth, previous research has emphasized the importance of early colostrum feeding for calf health and immunity (Ameha et al., 2021). Delayed colostrum feeding can increase the risk of calf illnesses, as each one-hour delay has been associated with a 10% increase in illness risk (Temesgen, 2004; Otte and Chilonda, 2002; Moran, 2015).

The prevalence of diarrhea in calves has been a consistent finding across various research studies, including the current survey and previous research conducted by Wudu et al. (2007), Amoki (2001), and Jemberu (2004). These studies have consistently reported diarrhea as the most frequently occurring condition in calves, accounting for a significant proportion of all observed cases, with incidence rates ranging from 39% to 6%. The high incidence of diarrhea underscores the need for effective disease control measures, as highlighted by Abate and Gebre (2018) in their list of reported calf diseases, which also emphasized the importance of addressing respiratory and enteric infections.

Similarly, other studies conducted by Sivula et al. (1996), Terence (2001), and Wudu et al. (2008) also identified diarrhea, septicemia, and pneumonia as the most common diseases in dairy calves. The persistence of these infections over several decades suggests a lack of proper management practices and disease prevention strategies in calf rearing. The continuous presence of these diseases can have serious consequences on calf health and growth, ultimately impacting the overall productivity of the entire herd (Bekele et al., 2009; Ferede et al., 2014).

There is a significant difference in disease prevalence between farms managed by females and males (OR=0.673 (CI=0.416-1.090), p= 0.0107), consistent with various studies worldwide. Farms where the owners themselves rear the calves tend to have lower disease rates compared to those managed by employees, and farms where the farm wife takes care of the calves also tend to have lower disease rates compared to those managed by the farm husband (Moran, 2015). Additionally, the study revealed that calves reared in large herd sizes are more susceptible to diseases than those raised in smaller herd sizes (p<0.005). This observation aligns with findings from other studies conducted by Bekele et al. (2009) and Ferede et al. (2014). Improved management practices, including calf rearing by owners themselves, and appropriate vaccination strategies are essential to protect young calves during their vulnerable stages and enhance calf health and overall livestock productivity in Ethiopia (Bekele et al., 2009; Ferede et al., 2014; Moran, 2015).

Calves that received colostrum early in life showed lower susceptibility to diseases compared to those that did not. Although the difference between the two groups was not statistically significant (p>0.05), the prevalence of diseases among colostrum-fed calves was 39.9%, whereas it was 47.1% among non-colostrum-fed calves. Farmers in the survey opted for the bucket feeding method only when their calves refused direct suckling, indicating that the bucket feeding method served as a backup option in cases where the traditional direct suckling method was not feasible or successful.

The current regional disease prevalence in the survey aligns with previous reports from the same regions. For instance, the findings of Bekele et al. (2009) in Hawassa, SNNPR, reported a calf morbidity prevalence of 29.3% (n=41), which is highly comparable to the present study's finding of 31.4% (N=154) in the same region. Similarly, a study conducted by Ferede et al. (2014) in Bahirdar, Amhara region, indicated a calf morbidity rate of up to 65.3% during the wet season, which is close but slightly lower than the current survey's finding of 78.6% (N=44) in the same region. On the other hand, the current study's results are lower than another study conducted by Wudu et al. (2007) in smallholder dairy farms of Ada'a Liben district, Oromia, where they reported overall incidences of crude morbidity and crude mortality of 62% and 22%, respectively. These findings indicate that diarrhoea is a significant health issue for the surveyed calves, and external parasites and skin problems also pose significant challenges.

Based on the findings, effective extension programs should prioritize several key management interventions to address constraints related to calf health and productivity. Training and awareness creation are essential to ensure proper colostrum feeding management and milk feeding practices, enabling the transfer of passive immunity to newborn calves. Ensuring easy access to veterinarians and animal health specialists will enable effective implementation of animal health programs, including timely vaccinations and disease prevention strategies. Future research should focus on developing vaccines tailored to common calf diseases, with a specific focus on calves younger than six months of age. Finally, breeding programs involving crossbreeding should carefully consider the physiological capability of local breed cows to improve calf health and overall dairy productivity. By addressing these aspects, extension programs can significantly enhance calf management practices and contribute to a healthier and more productive dairy sector.

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