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Original Article

Preliminary Major Health Problems and Associated Risk Factors of Calves' Mortality in Selected Districts of Ilubabor and Jimma Zones, Ethiopia

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Abstract *- Introduction: Even though there have been good beginnings of initiatives on calves to improve the blood level of local breeds in Ethiopia through artificial insemination, health problems and calf mortality are becoming a bottleneck in livestock production and the livelihood of poor farmers. The study aimed to know the preliminary major health problems and associated risk factors of calves' mortality. A cross-sectional study was conducted on calves from February to June 2023. Binary outcome Logistic Regression data analysis was used to summarize using Stata software version 13. A cluster random sampling technique was used to accomplish the study. Result: A total of 218 farmers and farm owners were interviewed, and feacal samples, ectoparasites and skin lesions were collected from 389 calves. The gastrointestinal parasite infection was significantly related to body condition, age and breeds of calves (P<0.05). The ectoparasites infestation was significantly related to districts, body condition, age and breeds of calves (p<0.05). The variation of ringworm prevalence among risk factors ages, breeds and farms was statistically significant (p<0.05). There was a significant difference in morbidity rate and crude mortality rate between zones, breeds, weaning ages and farm production systems (p<0.05). Conclusion: In study areas, gastrointestinal parasites, ectoparasites and ringworms were major health problems of calves and responsible for high morbidity rate and crude mortality rate. Therefore, awareness of disease prevention and husbandry practices should be made. Also, the Agricultural Bureau and all stakeholders should work cooperatively to reduce the morbidity and mortality of calves.*

Keywords *- Calves, Cross-sectional, Ethiopia, Health problems, Mortality.*

1. Introduction

Ethiopia is first by livestock population from Africa, with an estimated 70.3 million cattle, 9.12% of which are calves under the age of six months [1]. Dairy and beef farming in urban and peri-urban regions is growing swiftly across the country as a result of rising urbanization and increased demand for meat, milk and milk products, even though the extensive production system is still the country's leading method of livestock husbandry [2]. Urban and peri-urban dairies are semi-intensive to intensive production systems that maintain exotic and crossbred cows with comparatively better management practices [3]. Although the dairy industry has grown significantly in recent years, it reportedly suffers from inefficient reproduction, a low rate of calf survival, high calf morbidity and mortality, and a high incidence of diseases [4]. Inadequate quality feed, poor husbandry practices, and reduced attention to young stock management as a result of diverse responsibilities in small-scale mixed farming systems increase calf morbidity and mortality in tropical regions [5].

Parasitic infection of cattle is the major factor responsible for economic losses through reduction in productivity and increased mortality in heavily parasitized animals [6]. Gastrointestinal parasites are the most important agents causing disease in calves [7]. Calves are most vulnerable to gastrointestinal parasites in their first grazing season, although yearlings and, less often, adults are sometimes affected [8]. Gastrointestinal parasitic infections, nematode and Eimeria species play a key role in the economic losses in that they cause low productivity, delayed growth, declined weight gain and death of the animal, and significant expenses of treatment [7]. Ectoparasites, commonly ticks, mites, flee, and lice, affect the host by inflammation and through the damage they inflict on the skin and the host physiology. They are also very important in different disease transmissions, such as parasitic, bacterial,

rickettsial, and viral diseases to man and animals [9]. The damages inflicted by ectoparasites are annoyance, stress, or blood loss. Lice and tick worry are recognized conditions that reduce feed efficiency and weight gains in livestock [9]. In Ethiopia, ectoparasites in ruminants cause a serious economic loss to smallholder farmers, the tanning industry and the country as a whole through mortality of the animals, decreased production, downgrading and rejection of skin and hide [10].

Dermatophytosis in domestic animals is an infection of keratinized tissues by one of the two genera of fungi, Microsporum and Trichophyton [11]. Although information is lacking in Ethiopia, it is believed to pose the greatest economic and human health consequences in most developed countries [12]. Tartor [13] described that 84.91% of calves showed ringworm lesions were positive for fungal elements in direct microscopy, and 79.72% were positive in culture. The detection rates were 84.91% by direct microscopy and 79.72% by fungal culture. As researchers described, terbinafine and miconazole were effective antifungal drugs for dermatophytes, followed by itraconazole and griseofulvin [14]. Calf morbidity and mortality are the two most important constraints for improving peri-urban and urban dairy production in Ethiopia. Annual calf mortality in urban and peri-urban dairy production systems is reported to be in the range of 15.3%–25% [15]. Similarly, 62% morbidity and 22% mortality are reported in market-oriented smallholder dairy farms in central Ethiopia [16]. However, in the current study areas, there has been no information on calves' health problems. Therefore, the aim of this study was to provide the following objectives.

- To identify preliminary major health problems of calves.
- To know the magnitude of calf morbidity and mortality.
- To identify associated risk factors of calves' morbidity and mortality.

2. Materials and Methods

2.1. Description of Study Area

This study was conducted in purposively selected districts of the Ilubabor and Jimma zones (Figure 1). Ilubabor Zone is located in the south-western part of Oromia, Ethiopia. In the Ilubabor zone, the study was done in three purposively selected districts of Metu, Ale and Yayo, with cattle populations of 146635, 70553 and 63769, respectively (Zone Agriculture office, 2023). In the Jimma zone the study was done in two purposively selected Jimma city, Dedo and Gomma districts with cattle populations of 67808, 435281 and 271332, respectively (Zone Agriculture office, 2023).

2.2. Study Population

The study population consisted of local and crossbreeds of calves. The target population was calves up to 12 months of age in purposively selected districts and Jimma City.

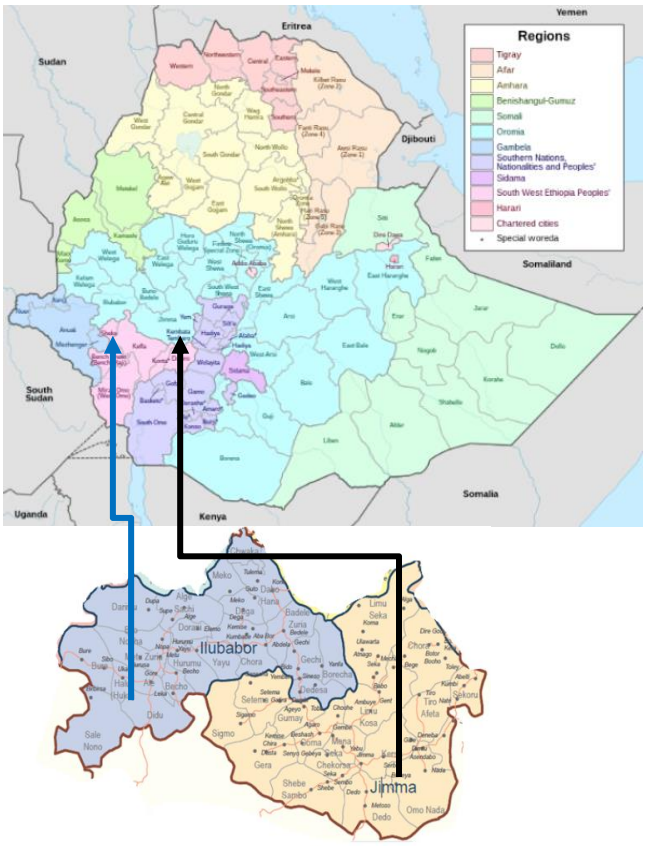

Fig. 1 Map of the study area

The study population was all calves of 12 months in randomly selected kebele and households. Calves were categorized by weaning age (< 6 months, 6-12 months), sex (Male, Female), body condition (good, poor), breed (cross, local), mixing different age groups (yes, no), cleaning activity (regular, irregular), farm type (extensive, intensive, semi-intensive), the floor of the house (soil, concrete, made from the local tree), source of drinking water(tap, hand dung well, river) and colostrum feeding (suckling, hand feeding). Semi-structured questionnaire survey of selected household owners was used to assess factors associated with calf morbidity and mortality.

2.3. Study Design and Sampling Method

A cross-sectional study was conducted from February 2023 to June 2023 to know the status of calf morbidity and mortality and also to assess risk factors as well.

All calves of farmers or farms of one year of age were observed for any health problems, and feacal samples and skin scraping for skin lesions were collected and submitted to the regional laboratory to know the prevalence and major gastrointestinal parasites of calves. Also, all calves of owners were assessed for ectoparasites and submitted to a regional laboratory to identify the genera of those ectoparasites.

2.4. Sample Size Determination and Sampling Technique

The sample size was determined according to [17] for cluster random sampling using an expected animal level prevalence of 50% and a desired absolute precision of 5% with 95% CI since there was no previously expected prevalence in the study area.

$$n = \left[\frac{t^2 * p * q}{d^2} \right] * DEFF$$

Where n = sample size, t = linked to 95% confidence interval for cluster sampling (2.045), p =expected prevalence (fraction of 1), q = 1-p (expected non-prevalence), d = relative desired precision, DEFF = Design Effect =1. Accordingly, 389 local and cross breeds of calves were sampled and assessed for ectoparasites and scraped if any skin lesion was found. First, districts were purposively selected based on calf morbidity and mortality problem reports. In Metu, Ale, Yayo, Gomma, Jimma City and Dedo districts, kebele and households or farms were randomly selected. In the 2nd stage household of each kebele was randomly selected. Finally, all caves of one year of age were examined for ectoparasite and fecal samples were collected except those that did not start feeding the grass.

2.5. Sample Collection and Transportation

2.5.1 Sedimentation Method

A total of 389 fresh fecal samples were collected from the rectum of the animals by wearing plastic hand gloves. The fecal samples were placed in screw-capped universal bottles, preserved with 10% of formalin and transported to Bedelle Regional Veterinary Laboratory. The fecal samples were examined by using standard sedimentation techniques. The presence of at least one parasite egg in either of the tests indicates that the result is positive. The egg morphology, appearance, size, color and presence of blastomeres were used to identify the parasites.

2.5.2. Tick Collection and Preservation

Firstly, the selected calves were properly restrained and checked for any tick infestation. Ticks were removed from different body regions of the host skin for identification using hand manually [18]. The collected ticks were preserved in separate pre-filled universal bottles with 70% alcohol before transportation to the Bedelle regional veterinary laboratory for identification of their genera. The collected ticks were identified into different general levels by using a stereomicroscope, according to standard identification keys given by Walker [19]. Accordingly the most prevalent tick genera was Boophilus, which was followed by Ambyleyoma.

2.5.3. Lice Collection and Identification

Those detected lice that were unidentified during the clinical examination were collected by forceps/hand picking, with hairs from their attachment site, put into a clean, separate container (universal bottles), labeled and kept preserved with 70% ethyl alcohol before transportation to Asella regional veterinary laboratory for detailed laboratory examination as described by Urquhart [20]. Then, the collected ectoparasites were examined by stereomicroscope, and identification was performed according to the identification key given by Wall and Shearer [21]. Linognathus vituli and Damalina bovis were among the major lice species identified in different studies.

2.5.4. Skin Scraping Lesions

The samples of skin scraping were collected from the periphery of the lesion after cleaning with 70% ethyl alcohol in sterile falcons. Samples were collected from infected animals suffering from lesions suggesting ringworm infections (Circumscribed areas of hair loss filled with raised white scales on the head, neck or all over the body). One or two drops of 20% KOH (potassium hydroxide) were placed on a microscopic slide, and a small amount of the specimen was added; then, the slide was gently passed through a low flame and covered by a cover slip. After 2 h, the specimen was examined for the presence of hyphae under a light microscope (40 x objectives) according to [22].

2.6. Data Management and Analysis

All data obtained from the field was recorded in the record sheet format and later entered into a Microsoft Excel worksheet. Binary outcome Logistic Regression data analysis was used to summarize using Stata software version 13. The overall prevalence was calculated by dividing positive samples by the total number of examined samples and multiplied by a hundred. The Odds Ratio was used to assess the association between the dependent and independent variables. P-value of less than 0.05 ($P < 0.05$) was set for the significance of statistical associations [23].

3. Results

During the study period, 164 smallholder farmers, 31 semi-intensive dairy farm owners and 23 intensive dairy farm owners with a total of 561 calves up to 12 months of age they owned were interviewed. A total of 389 caves were observed for any ectoparasite infestation, and feacal samples and skin lesion samples were collected for up to one year.

3.1. Prevalence of Gastrointestinal Parasites

Out of 389 fecal samples collected, 148 (38%) were positive for eggs of different species of gastrointestinal parasites in both Jimma and Ilubabor zones. The prevalence was 43.8% and 31.9% in Ilubabor and Jimma zones, respectively. The gastrointestinal parasite infection was significantly related to zone, body condition, age and breeds of calves. The odds of gastrointestinal parasite infection were 3.4, 2.6 and 2.75 in good body condition, 6-12 months ages and local calf breeds, respectively ($p<0.05$) (Table 1). However, there was no significant association among districts and sex ($P> 0.05$) (Table 1).

3.2. Prevalence of Ectoparasites

Out of 389 calves observed, 280 (71.98%) were positive for either one or more ectoparasites in both the Jimma and Ilubabor zones. The prevalence was 89.55% and 53.20% in the Ilubabor and Jimma zones, respectively (Table 3). Ticks, fleas and lice were known calves' ectoparasite infestation with 54.5% (212/389), 32.4% (126/389) and 3.3% (13/389) prevalence, respectively (Table 2).

The ectoparasites infestation was significantly related to the study area, body condition, age and breeds of calves ($p<0.05$). The odds of ectoparasites infestation were 2.8, 2.2 and 3.5 in good body condition, 6-12 months of age and local calf breeds, respectively ($p<0.05$) (Table 3). However, there was no significant association between sex ($P> 0.05$) (Table 3).

During surveillance, two tick genera were identified, namely Boophilus and Ambyleyoma. Boophilus was the most tick genera that infested calves. Biting lice (*Damalinia bovis*) and sucking lice (*Linognathus vituli*) were identified during surveillance.

3.3. Prevalence of Ring Worm

According to the results of this study, among 389 calves, 16 of them (4.10%) were clinically positive for skin ringworm lesions (Figure 2). After microscopic examination, 11 calves (2.83%) were positive for dermatophyte infections. However, skin lesions were negative for mangemitis and Dermathophilosis. The variation of ringworm prevalence among risk factors ages, breeds and farms was statistically significant ($p<0.05$) (Table 4).

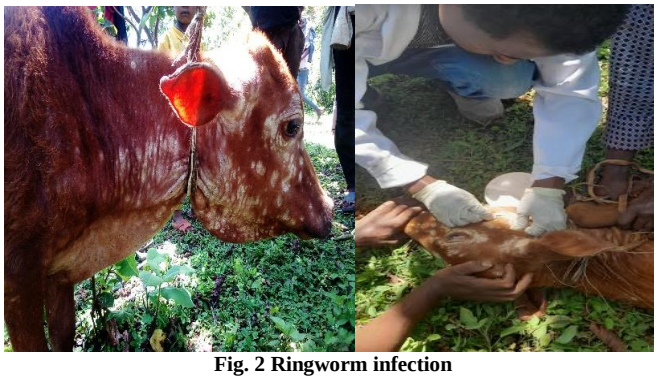

Fig. 2 Ringworm infection

3.4. Morbidity and Mortality of Calves

Generally, the morbidity rate and crude mortality rate were 34.90% (196/561) and 12.30% (69/561) respectively (Table 5). There was a significant difference in crude mortality rate between the Jimma zone (13.75%) and the Ilubabor zone (10.96%), with an Odds ratio of 1.8 higher mortality risks in the Jimma zone.

Calves in Jimma zone 1.8 are more likely at higher risk of morbidity and mortality. The odds of calf morbidity and mortality were 2.02 times more likely in crossbreeds in comparison to local breeds, which was statistically significant. The odds of calf morbidity and mortality were 2.67 times more likely in calves weaned at an age of less than six months. The odds of calf morbidity and mortality were 2.2 and 1.66 times more likely in calves in intensive production and semi-intensive production systems, respectively. The odds of calf morbidity and mortality were 2.04 times more likely in calves fed colostrums by hand (Table 5). While risk factors like districts, body condition, sex, mixing different age groups, cleaning activities, the floor of the house, and source of water were statistically not significant ($P> 0.05$, Table 5)

4. Discussion

The current study showed that calves from the study area were infected with gastrointestinal parasites and ringworms and infested by ectoparasites. The overall prevalence of gastrointestinal parasites in calves was 38% in dairy farms in towns and rural areas of smallholder dairy farms, which agreed with Tigist [24], who reported 41.30% in the Amhara regional state. The gastrointestinal garasite infection was significantly related to the age of calves ($p<0.05$), which agrees with Cheru [25], who noted that the incidence of gastrointestinal garasite rises with age.

In this study, the prevalence of gastrointestinal parasites was found to be significant ($p<0.05$) higher in local breed calves (41%) than crossbreed calves (32.6%), which is in agreement with the report of Tigist [24] and around Gonder town and Gudeta [26] in East Wollega Ethiopia. This may be due to the fact that farmers who own crossbreeds or farmers who live in urban areas tend to follow an intensive management system. In contrast, those farmers who have our indigenous breed tend to follow a free grazing system means an extensive management system. Thus, the chance of exposure to infective parasitic eggs or larvae of the local-breed calf is higher than that crossbreed calf. In this study, the prevalence of gastrointestinal parasites was found to be significant ($p<0.05$) higher in calves with good body condition (50%) than in calves with poor body condition (29.5%), which is in agreement with the report of Hailu [27]. In the present study, overall ectoparasite prevalence was 71.89%, which was agreed with Singh and Rath [28], who reported 72.59% in India. The odds of ectoparasite infestation were 3.5 times more likely in local calf breeds in comparison to crossbreed calves, which was statistically significant ($P.V< 0.05$) that was in agreement with Assefa [29] showed a significant difference between breeds on prevalence of ectoparasite infestation and recorded higher significant ectoparasite infestation in local calf breed than exotic breeds. In this study, the prevalence of ectoparasite infestation was found to be significant ($p<0.05$). In this study, the prevalence of ectoparasite infestation was found to be significant ($p<0.05$) higher in calves 6 to 12 months of age (74.40%) than in calves less than six months of age

(68.97%). The odds of ectoparasite infestation were 2.2 times more likely in calves 6 to 12 months of age in comparison to calves less than six months of age. The difference might be due to adult calves being more move from one grazing area to another, from one herd to other herds, from one home to another in comparison to younger calves.

In the current study, the prevalence of ringworm was 4.10% and 2.83% by clinical lesions and direct microscopic examination, respectively. That was in agreement with Zekarias and Berhanu [30], who described the clinical case prevalence of ringworm as 6.2% in Ethiopia. The ringworm infection was significantly related to age and 3. 6 more likely to occur in calves less than 6 months (6.9%) in comparison to calves 6-12 months (1.9%) age that agrees with previous Tartor [13], which young animals are particularly susceptible to infection by ringworm fungi especially calves with poor husbandry practice. The odds of ringworm infection were 4.3 times more likely in local calf breeds in comparison to calves in cross breeds, was statistically significant (P.V< 0.05), was in agreement with Hameed [31] those showed a significant difference between breeds on the prevalence of ringworm infection. The odds of ringworm infection were 6.3 times more likely to occur in calves of the extensive production system in comparison to calves of intensive and semi-intensive calves production systems, which was statistically significant (P.V< 0.05) and agreed with Tartor [13] that showed significant ringworm infection among production system.

In the present study, the estimated morbidity rate and crude mortality rate across all rural areas of districts and towns were 34.94% and 12.30%, respectively. That is in agreement with Rahmeto [32], with 39.8% and 13.5% morbidity rates and crude mortality rates, respectively. There was a significant difference in mortality rate between the Jimma zone and the Ilubabor zone, with an Odds ratio of 1.8 higher mortality risks in Jimma. The difference in environment or production system can explain the mortality variation. The difference may be due to the larger number of crossbreed calves in the Jimma zone, those difficult to resist poor husbandry practices and endemic diseases. This finding is consistent with results from previous studies [33]. The odds of calf mortality were 2.2 and 1.66 times more likely in calves in intensive production (20.51%) and semi-intensive production systems (16.70%), respectively, in comparison to calves in extensive production systems (10.67%), which was statistically significant. That, in agreement with Fentie [33] reported calf crude mortality in the range of 9.4%–14% in mixed crop-livestock production, 15%–25% in urban and peri-urban dairy production.

The odds of calf morbidity and mortality were 2.04 times more likely exposed to the risk of death in calves fed colostrums by hand (12,8%) in comparison to calves fed colostrums by suckling(10%), which was statistically significant and agreed with Rahmeto [32] and Amold [34] those described importance of colostrum on calf morbidity and mortality. In the current study weaning age of the calves was associated with calf mortality, with rates of 17.13% and 8.40% in weaning ages less than six months and six to twelve months, respectively.

The odds of calf morbidity and mortality were 2.02 times more likely exposed to the risk of death in crossbreed calves (20.25%) compared to local breed calves (9.18%). The breed had having a significant effect on calf mortality in the current study, and crossbreds recorded significantly higher mortality than local calve breeds in agreement with Tadesse [35]. Crossbred calves are not well adapted to the tropical environment and are often subjected to environmental stress which leads them to high risks of health problems.

5. Conclusion and Recommendations

The overall high prevalence of gastrointestinal parasites in the current study shows that parasites can be considered as one of the production constraints of calves in the study areas. Zones study area, body condition, age and breeds of calves showed a statistically significant variation with the occurrence of gastrointestinal parasites.

Ectoparasite infestation in calves has significant economic importance due to direct and indirect loss of production, reduced weight gain, retard growth, skin damage, immunosuppression, nuisance and biological vectors of different bacteria, viruses and protozoa. The present study showed a high prevalence of ectoparasites on calves in the study area. The problem of external parasites seems to be crucial as they are widely distributed inrelation to breed and management systems. Ticks, Fleas and Lice were important ectoparasite investigated study areas. Risk factors: study area, body condition, age and breed were significantly associated with ectoparasite infestation.

Even though there is a low ringworm infection in this study, it causes adverse effects on calf production, tanning industry and the health of the public and concomitantly poses a huge economic loss. Age, production system and breeds of calves showed a statistically significant variation with ringworm infection.

In the present study, the estimated morbidity rate and crude mortality rate across all rural areas of districts and towns were high. Study area, breeds of calves, weaning age, farm production system and colostrum feeding showed a statistically significant association with Calf morbidity and mortality.

Based above conclusions, the following recommendations are forwarded;

- Awareness should be created for farmers to manage their calves intensively(zero-grazing), improve feeding and watering of calves, regular cleaning of calf floor, separate their pen from adults, make appropriate floor, avoid grazing in marshy areas, improve management of crossbreeds.
- Anti-parasitic drugs are still an important part of parasite control in grazing livestock. As study area climatic conditions, the grazing animals must be dosed by broad spectrum anthelmintic at least twice in year at the onset of rain (March and April) and offset of rain (September and October).
- Awareness should be created for owners of intensive and semi-intensive production systems to rear in appropriate places with enough land, store feeds in appropriate places, avoid feeding fresh green grass, manage their calves intensively and keep environmental sanitation in addition to strategic deworming of cattle with effective broad spectrum anthelmintic.
- It is better to encourage and adapt deworming supported by laboratorical investigation.
- There should be close attention by all stakeholders, farmers, veterinarians and the government on control and prevention measures for losses caused by ectoparasite infestation and transmission of pathogens to domestic animals.
- Further detailed study should be conducted to have appropriate information on the seasonal occurrence, species of ectoparasite, burden and the effect of these ectoparasites on calves and economic losses caused by them in the study area.
- For effective control of ringworm, proper cleaning and disinfection of the house and environment is mandatory.
- Reducing the density of animals and direct contact with infected calves.
- Isolation and treatment of ring worm-infected calves by antifungal drugs like terbinafine and miconazole.
- Awareness creation of an extension production system to provide supplementary feed, enough water, forage and grass, improve their house, bedding house floor, calves receive colostrum within one hour of life, avoid early winning, separate from adults, early treatment of sick calves, proper disposal of died calves or animals(burring).

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Ethics Approval and Consent to Participate

A local ethics committee ruled that no formal ethics approval was required to conduct this research. Before conducting the research, informed consent was obtained from the owners of the lactating cows used in this study.

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Data Availability Statement

All data generated and analysed during this study are included in this published article.

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Appendix

Table 1. Risk factors associated with gastrointestinal parasites

Variables	No. of calves examined	No. infected	Prevalence (%)	OR (95% CI)	P.V
Zone					
Ilubabor	201	88	43.8	2.3(1.45-3.73)	0.013
Jimma	188	60	31.9	RF	RF
Total	389	148	38		
District					
Metu	69	27	39.1	0.74(0.512-1.290)	0.234
Ale	71	33	46.5	1.4(0.83-2.16)	0.062
Yayo	61	26	42.6	0.97(0.47-1.59)	0.187
Goma	62	22	35.5	0.64(0.42-1.15)	0.143
Jimma city	55	18	32.7	1.2(0.65-1.79)	0.057
Dedo	71	19	26.8	RF	RF
Body condition					
Good	162	81	50	3.4(2.13-5.57)	0.029
Poor	227	67	29.5	RF	RF
Age					
6-12 month	215	91	42.3	2.6(1.74-3.78)	0.040
< 6 month	174	57	32.8	RF	RF
Sex					
Female	223	90	40.40	1.33(0.74-2.45)	0.109
Male	166	58	34.90	RF	RF
Breed					
Local	251	103	41	2.75(1.84-3.91)	0.004
Cross	138	45	32.6	RF	RF

Table 2. Ectoparasite prevalence

Zone	District	No. of calves	Ticks	Fleas	Lice
Ilubabor	**Metu**	69	45	36	1
	Ale	71	62	35	1
	Yayo	61	25	39	0
Total		201	132	110	2
Jimma	**Gomma**	62	38	7	2
	Jimma city	55	0	0	0
	Dedo	71	42	9	9
	Total	188	80	16	11
Grand total		389	212	126	13

Table 3. Risk factors associated with ectoparasite infestation

Variables	No. of calves examined	No. calves infested	Prevalence	OR (95% CI)	P.V
Zone					
Ilubabor	201	180	89.55	4(3.10-5.68)	0.000
Jimma	188	100	53.20	RF	RF
Total	389	280	71.98		
District					
Metu	69	58	84.10	3.4(2.32-5.18)	0.013
Ale	71	67	94.40	3.79(2.52-5.65)	0.004
Yayo	61	55	90.20	4.2(2.86-6.29)	0.001
Gomma	62	44	70.97	2.69(1.59-3.81)	0.023
Dedo	71	56	78	3.3(2.29-4.89)	0.019
Jimma city	55	0	0	RF	RF
Body condition					
Good	162	152	93.80	2.8(1.34-3.94)	0.021
Poor	227	128	56.40	RF	RF
Age					
6-12 month	215	160	74.40	2.2(1.13-3.67)	0.039
< 6 month	174	120	68.97	RF	RF
Sex					
Male	166	128	77.11	1.3(0.88-1.95)	0.102
Female	223	152	68.16	RF	RF
Breed					
Local	251	223	88.84	3.5(2.23-5.64)	0.031
Cross	138	57	41.3	RF	RF

Table 4. Prevalence and risk factors associated with ringworm

Variables	No. of calves	No.calves with clinical lesion		No. of positive calves		OR (95% CI)	P.V
			Prev(%)		Prev(%)		
Zone							
Ilubabor	201	7	3.5	4	2	0.86(0.57-248)	0.166
Jimma	188	9	4.8	7	3.7	RF	
Total	389	16	4.10	11	2.83		
District							
Metu	69	5	7.3	3	4.4	1.2(0.87-2.98)	0.118
Ale	71	1	1.4	1	1.4	0.74(0.43-2.31)	0.220
Yayo	61	1	1.6	0	0	0.79(0.65-3.12)	0.451
Goma	62	5	8.1	4	6.5	1.44(0.96-3.22)	0.077
Dedo	71	4	5.6	3	4.2	1.35(1.02-3.04)	0.104
Jimma city	55	0	0	0	0	RF	
Body condition							
Good	162	7	4.3	5	3.1	1.1(0.85-2.86)	0.740
Poor	227	9	4	6	2.64	RF	
Age							
< 6 month	174	12	6.9	8	4.60	3.6(2.42-5.62)	0.027
6-12 month	215	4	1.9	3	1.4	RF	
Sex							
Male	166	7	4.2	4	2.4	0.97(0.71-2.86)	0.316
Female	223	9	4	7	3.1	RF	
Breed							
Local	251	14	5.6	11	4.38	4.3(3.42-7.85)	0.002
Cross	138	2	1.2	0	0	RF	

Farm							
Extensive	287	15	5.22	11	3.8	6.3(3.64-10.52)	0.000
Intensive and semi-intensive	102	1	0.98	0	0	RF	

Table 5. Risk factors associated with calves' morbidity and mortality

Variables	No. of calves	No. of calves diseased	No. calves died	Morbidity rate	Crude mortality rate	OR (95% CI)	P.v
Area							
Jimma	269	89	37	33.10	13.75	1.8(0.16-3.72)	0.044
Ilubabor	292	107	32	36.64	10.96	RF	
Total	561	196	69	34.90	12.30		
District							
Metu	101	51	17	50.50	16.83	0.78(0.57-1.94)	0.650
Ale	89	24	8	26.96	8.99	1.1(0.62-1.71)	0.910
Yayo	93	32	7	34.41	7.53	0.92(0.64-2.32)	0.731
Gomma	94	37	19	39.36	20.21	1.3(0.88-1.93)	0.184
Jimma city	82	29	13	35.37	15.85	0.85(0.52-2.12)	0.609
Dedo	93	23	5	24.73	5.38	RF	
Breed							
Cross	158	68	32	43	20.25	2.02(1.34-3.08)	0.001
Local	403	128	37	31.76	9.18	RF	
Sex							
Female	321	122	47	38	14.6	1.2(0.72-1.86)	0.170
Male	240	74	22	30.80	9.20	RF	
Weaning age							
< 6 month	251	102	43	40.60	17.13	2.67(1.86-3.84)	0.000
6-12 month	310	94	26	30.30	8.40	RF	
Mixing different age groups							
No	437	155	58	35.5	13.30	1.13(0.84-3.45)	0.107
Yes	124	41	11	33.06	8.90	RF	
Cleaning activities							
Regular	462	168	62	36.35	13.40	0.97(0.68-2.52)	0.134
Irregular	99	28	7	28.3	7.8	RF	
Farm							
Intensive	78	35	16	44.87	20.51	2.2(1.35-3.62)	0.002
Semi-intensive	24	9	4	37.5	16.70	1.66(1.19 -3.23)	0.011
Extensive	459	152	49	33.10	10.67	RF	
Floor of house							
Soil	373	134	41	35.92	11	0.94(0.61-2.37)	0.105
Concrete	102	41	19	40.20	18.63	1.3(0.78-3.56)	0.210
Local material	86	21	9	24.41	10.46	RF	
Source of water							
Tap	145	61	25	42	17.24		0.236
Hand dung well	78	29	10	37.18	12.80		0.705
River	338	106	34	31.36	10	RF	
Colostrum feeding							
Hand feeding	129	58	23	44.96	17.83	2.04(1.35-3.09)	0.001
Suckling	432	138	46	32	10.65	RF	