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Prevalence of Lameness in Dairy Cattle Reared in Wolaita Soddo and the nearby Kebeles of Bossa Kacha and Offa Sere

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Abstract: *A cross-sectional study was conducted on the prevalence of lameness from October 2010 to March 2011 in Wolaita Soddo and the nearby Bossa Kacha and Offa Sere kebeles, Southern Ethiopia. The minimum sample size was determined to be 384 animals and the study was conducted on 399 animals. The study revealed that the prevalence of lameness was 4% (16/399) in the study area. From the considered risk factors that included milking status, pregnancy, feeding, floor type, frequency of floor cleaning, breeds, age and sex, none was found to be statistically significantly associated with lameness at 95% confidence level. From the 16 lame animals, five were milking. Daily milk yield was significantly reduced after the onset of lameness (p=0.002). The average economic loss due to reduced milk yield and cost of treatment per affected lame cow was found to be 7.33 USD (125.30 ETB). The mean length of time taken for recovery in days in the treated group (10.88) is statistically significantly lower than untreated group (14.62). The study showed significant reduction in daily milk yield during lameness in milking cows. Therefore, dairy farmers should attempt to prevent or detect lameness in lactating cows as early as possible to minimize the economic loss due to reduced milk yield and cost of treatment.*

Keywords: *Dairy farms, lameness, risk factors and Wolaita Soddo,*

1. INTRODUCTION

Lameness is any abnormality that causes the cow to change the way it walks The importance of lameness in dairy cattle has been increasingly recognized in the last two decades (Kelton *et al.*, 1998; Rushen, 2001) and is now considered one of the most urgent health and welfare problems of dairy cattle as well as one of the most significant economic issues for the dairy industry Lesions of the bovine hoof causes milk production loss, reduced fertility, and increased risk of culling (Whitaker *et al.*, 2000).

Hoof disease is also extremely painful, making lameness in dairy cattle a serious animal welfare issue. Pain associated with lameness clearly decreases the welfare of cows (Whay *et al.*, 2002). It likely influences both individual and social behavior of affected animals. For example, lame cows have reduced daily activity levels (O'Callaghan *et al*., 2003), spending more time lying and less time feeding. Moreover, lame cows are less likely to start social interactions with other cows, although they are as likely to be subjected to aggressive behavior by other animals, as sound cows (Galindo and Broom 2002).

Most cases of lameness are due to claw lesions, the remainder being associated with upper limb problems (Hedges, 2001). Risk factors to claw health and cow mobility can be multifarious. Housing of dairy cattle can have unfavorable influence on claw health, but the negative influence of confined dairy systems may be reduced if they are well designed. Studies found that cattle housed in free stalls have more claw lesions than cattle in tie stalls (Whitaker *et al*., 2000). Incidence and prevalence of lameness may also vary greatly in herds within and between the countries (Clarkson *et al.*, 1996; Cook, 2003). In addition to geographical variability, seasonal differences in incidence and prevalence of lameness are also evident (Wells *et al*., 1993). On average, approximately 80% of lame cows are lame in the hind limbs (Hedges, 2001).

Regassa et al., (2009) has conducted a survey on major clinical disease syndromes of cows in small holder dairy farms of Hawassa and reported an incidence of 3.9 lameness in a prospective study and 7% in a retrospective study. The study didn't consider any risk factor and the impact of lameness on production. Identification of specific farm risk factors associated with lameness may allow farms to reduce lameness levels. Despite the importance of lameness to the productivity and welfare of the cow, the extent of lameness in Ethiopian population of dairy cattle especially in Wolaita Soddo and its surrounding area has not been documented. Therefore, the present study was initiated to generate information on:

- The prevalence of lameness,
- To identify risk factors and their relationship with lameness
- To asses losses and economic importance of lameness in the study area.

2. MATERIALS AND METHODS

2.1. Study Area

The study was carried out in Wolaita Soddo and the nearby Bossa Kacha and Offa Sere kebeles dairy farms which are found in Southern Ethiopia situated 325 km South of Addis Ababa (the capital of Ethiopia). The area has a latitude of 7°1'N and a longitude of 38°0'E on the escarpment of the Great Rift Valley. The altitude ranges from 1900 to 2000m above sea level. The mean annual rainfall and temperature are 1300 mm and 19°C, respectively. Rainfall of the area have bimodal season, the long rain season starts from end of June to beginning of September and short rain season stays from December to May. Agro climatically, the area is divided into two; highland ('Dega') (1950-2000m) which accounts for 60% and mid-highland ('Weynadega') (1900-1950m) which covers 40% of the area. Mixed crop and livestock farming system is the mode of agriculture in the area. The major crops that are grown in the area include maize, wheat, teff and root food crops like taro (godere) and Tania (boye) are also common. Livestock are main components for the livelihood of the community to undertake agricultural activities. The total livestock population of the study area includes 21,155 cattle, 4678 sheep, 3821 goats, 823 horses, 916 donkeys, mules 206 and 11,120 poultry (FEDDWZ, 2008).

2.2. Study Design and Animals

The study was a repeated cross-sectional study type where 20 randomly selected farms were visited once to diagnose the prevalence of lameness with repeated visit as necessary to record new cases and time taken for recovery by old cases. All animals owned by the sampled farms were included in the study.

2.3. Sample Size Determination

The sample size for the study was determined based on the description of Thrust field (1995) and taking the expected prevalence of 50%, the confidence interval of 95% and 5% required absolute precision. Then the minimum required sample size was calculated using the following formula:

$$N = \frac{1.96^2 x Pexp\ (1-Pexp)}{d^2}$$

Where, N=sample size, Pexp=expected prevalence and d=required precision. By substituting the values in the formula and taking d=0.05;

$$N = \frac{(1.96)^2 x 0.5\ (1-0.5)}{(0.05)^2} = 384$$

But the study was conducted in a total of 399 animals to increase the accuracy.

2.4. Data Collection and Management

A questionnaire format (annex I) was developed on which data pertaining to history, physical examination findings and all other information about the farms was collected and recorded. The variables

considered to be potential risk factors and on which information was gathered and registered include: production status, pregnancy status, feeding, floor surfaces, frequency of cleaning, cow tracks, breed, sex, age, limbs of animals and seasons (months). Animals were examined for any abnormal gaits and posture indicative of lameness and physically examined for lesions causing lameness.

The questions used to collect history data were framed in such away that farmers could give information that are recent and easy to recall. A formal discussion has been held for a length of about an hour with each of the twenty key respondents and owners of the selected farms to generate relevant information from the farmers regarding lameness and the considered risk factors.

2.5. Data Analysis

The data collected on the paper format was then transferred to and stored in Microsoft Excel database program. Descriptive statistics was employed to summarize and analyze the data.

3. RESULTS

3.1. Prevalence of Lameness

From a total of 399 bovines examined in 20 farms for lameness, an overall prevalence of 4% was recorded. From the 20 observed farms, lameness has occurred in 11 (55%). There is no statistically significant association between the prevalence of lameness and the examined farms ($p>0.05$).

Table1. *The prevalence of lameness in the individual farms examined*

Farms examined	Number of animals examined	Number (%) positive animals
Farm 1	38	1(2.6%)
Farm 2	11	1(9.1%)
Farm 3	11	0(0.0%)
Farm 4	16	1(6.2%)
Farm 5	12	0(0.0%)
Farm 6	13	1(7.7%)
Farm 7	150	6(4.0%)
Farm 8	15	0(0.0%)
Farm 9	14	1(7.1%)
Farm 10	15	0(0.0%)
Farm 11	13	0(0.0%)
Farm 12	16	1(6.2%)
Farm 13	10	1(10.0%)
Farm 14	10	0(0.0%)
Farm 15	10	1(10.0%)
Farm 16	10	0(0.0%)
Farm 17	10	0(0.0%)
Farm 18	10	1(10.0%)
Farm 19	8	1(12.5%)
Farm 20	7	0(0.0%)
Total	399	16(4%)

$X^2 = 10.755$, $p= 0.932$

3.2. Prevalence of Lameness and the Risk Factors

From a total of 75 milking and 324 non-milking animals examined for lameness occurrence in this study, prevalence of 6.7% and 3.4% were recorded, respectively. There was no statistically significant association between the prevalence of lameness and milking status (Table 2).

Table2. *Prevalence of lameness in milking vs. non-milking cows*

Milking status	Number of animals examined	Number (%) positive animals
Milking	75	5(6.7%)
Non-milking	324	11(3.4%)
Total	399	16 (4%)

$X^2 = 1.693$, $p= 0.193$

Among 62 pregnant and 337 non-pregnant animals examined for lameness, a prevalence of 3.2% and 4.2% was recorded; respectively. There was no any significant association between prevalence of lameness and pregnancy status (Table 3).

Table3. *Prevalence of lameness in pregnant vs. non-pregnant cows*

Pregnancy status	Number of animals examined	Number (%) positive animals
Pregnant	62	2(3.2%)
Non pregnant	337	14(4.2%)
Total	399	16 (4%)

$X^2 = 0.117$, $p = 0.732$

From 230 animals fed roughage plus concentrate and 169 animals fed roughage alone and examined for lameness, a prevalence of 3.2% and 4.2% was recorded, respectively. The statistical analysis revealed no statistically significant association between lameness and feeding (Table 4).

Table4. *The prevalence of lameness in animals fed different types of feed*

Feeding	Number of animals examined	Number (%) positive animals
Roughage plus concentrate	230	9(3.9%)
Roughage	169	7(4.1%)
Total	399	16 (4%)

$X^2 = 0.13$, $p = 0.908$

From a total of 188, 119 and 92 animals kept in concrete, soil and stone laid floor surfaces, lameness prevalence of (3.7%), (5.0%) and (3.3%) were recorded, respectively. The occurrence of lameness is higher in animals kept in soil floor surfaces as compared to concrete and stone laid surfaces but not statistically significant (Table 5).

Table5. *The prevalence rate of lameness in different types of floor surfaces*

Floor surfaces	Number of animals examined	Number (%) positive animals
Concrete	188	7(3.7%)
Soil	119	6(5.0%)
Layered stones	92	3(3.3%)
Total	399	16 (4%)

$X^2 = 0.504$, $p = 0.777$

Among 27, 112 and 260 animals examined for lameness with rough cow tracks lengths of zero meter, 1-3 meter and greater than 3 meter, the recorded prevalence rates were 3.7%, 5.4% and 3.5%, respectively. The prevalence of lameness was not statistically significantly associated with the length of rough cow tracks (Table 6).

Table6. *The prevalence rate of lameness in animals moving along different lengths of rough tracks*

Length of cow track in meter	Number of animals examined	Number (%) positive animals
None	27	1(3.7%)
1-3	112	6(5.4%)
>3	260	9(3.5%)
Total	399	16 (4%)

$X^2 = 0.738$, $p = 0.691$

From 188, 60, 90 and 61 animals examined for lameness with the frequency of cleaning of their sheds with once in a day, once in 2 days, once in 3 days and once in 4 or more days, the prevalence of 3.7%, 5.0%, 4.4% and 3.3% were recorded, respectively. There was no any statistically significant association between the occurrences of lameness frequencies of cleaning of animal sheds (Table 7).

Table7. *The prevalence of lameness vs. frequency of cleaning of sheds*

Frequency of cleaning	Number of animal examined	Number (%) positive animals
Once in a day	188	7(3.7%)
Once in 2 days	60	3(5.0%)
Once in 3 days	90	4(4.4%)
Once in 4 and above days	61	2(3.3%)
Total	399	16 (4%)

$X^2 = 0.322$, $p = 0.956$

From a total of 12 crosses, 199 locals and 188 exotic breeds of animals examined for lameness, the prevalence rates recorded were 0.0%, 4.5% and 3.7% respectively. There was no statistically significant association between breed and prevalence of lameness (Table 8).

Table8. *The prevalence of lameness in different breeds of cattle*

Breeds	Number of animals examined	Number (%) positive animals
Cross	12	0(0.0%)
Local	199	9(4.5%)
Exotic	188	7(3.7%)
Total	399	16 (4%)

$X^2 = 0.677$, $p = 0.713$

Among 65, 74, 84 and 176 animals of less than 6 months, 6 month-2 years, 2 to 4 years and above 4 years age groups examined for lameness, the prevalence recorded were 3.1%, 1.4%, 4.8% and 5.1%, respectively. Age determination of bovine is mentioned in (annex II). From this study, lameness was most prevalent in older animals and it may be due to the environment, aging and cumulative damages to claw tissue but there was no statistically significant association between lameness and different age groups of animals (Table 9).

Table9. *The prevalence rate of lameness and the age of animals*

Age	Number of animals examined	Number (%) positive animals
<6 months	65	2(3.1%)
6 month to 2 years	74	1(1.4%)
2 to 4 years	84	4(4.8%)
>4years	176	9(5.1%)
Total	399	16 (4%)

$X^2 = 2.186$, $p = 0.535$

For 359 female and 40 male animals examined for lameness, a prevalence of 3.9% and 5.0% was recorded; respectively. There was no any significant association between lameness and sex of animals (table10).

Table10. *The prevalence of lameness and sex of animals*

Sex	Number of animals examined	Number (%) positive animals
Female	359	14(3.9%)
Male	40	2(5.0%)
Total	399	16 (4%)

$X^2 = 0.113$, $p = 0.737$

From the total of 16 animals found positive for lameness, one animal was diagnosed with right forelimb lameness, whereas two were with left forelimb lameness, eight with right hind limb lameness and five with left hind limb lameness. The occurrence of lameness and the limb affected are statistically significantly associated where lameness was most common in hind limbs than in forelimbs (Table 11).

Table11. *The prevalence of lameness and limbs affected*

Limb affected	Number of animals examined	Number (%) positive animals
None (normal)	383	0(0.0%)
Right forelimb	1	1(100.0%)
Left forelimb	2	2(100.0%)
Right hind limb	8	8(100.0%)
Left hind limb	5	5(100.0%)
Total	399	16 (4%)

$X^2 = 3.990E2^a$, $p = 0.000$

A total of 60 animals in October, 41 in November, 179 in December, 44 in January, 30 February and 45 in March were examined for lameness and the prevalence of 2(3.3%), 2(4.9%), 7(3.9%), 1(2.3%), 2(6.7%) and2(4.4%) were recorded, respectively. Lameness prevalence was higher in February but the occurrence of lameness and the study months were not statistically significantly associated (Table 12).

Table12. *The prevalence of lameness in different months of examination*

Months	Number of animals examined	Number (%) positive animals
October	60	2(3.3%)
November	41	2(4.9%)
December	179	7(3.9%)
January	44	1(2.3%)
February	30	2(6.7%)
March	45	2(4.4%)
Total	399	16 (4%)

$X^2 = 1.073$, $p = 0.956$

3.3. Lesions Identified in Lame Animals

The lesions that were found causing lameness were 6 (37.5%) mechanical trauma, 4 (25%) tick infestation, 3 (18.75%) inter-digital space and hoof crack and hoof overgrowth each (Table 11).

Table16. *Lameness causing lesions observed during the study and treatments given*

Cause	Number (%) positive	Treatment
Tick infestation	4 (25%)	Diaznon (15%) spray
Mechanical trauma	6 (37.5%)	Wound management
Inter-digital space and hoof crack	3 (18.75%)	Debriding, topical antiseptic and IM oxytetracycline adminstration
Hoof overgrowth	3 (18.75%)	Hoof trimming
Total	16 (4%)	-

3.4. Effect of Treatment on Recovery Period

From all animals that had shown signs of clinical lameness, only eight of them had received treatment. The treatment has statistically significantly reduced the mean length of time taken for recovery in days in the treatment group (Table 13).

Table13. *Mean number of days taken to recover from lameness in treated and untreated group*

Treatment status	Number of animals	Mean number of days taken to recover from lameness	t (p value)
Treated	8	10.88	6 (0.001)
Untreated	8	14.62	
Total	16	12.75	

3.5. Effect of Lameness on Milk Yield

From 16 lameness positives animals, five were milking cows in which the daily milk yield was significantly reduced after the onset of lameness (p=0.002) (Table 13). The average economic loss due to reduced milk yield and cost of treatment per affected lame cow was found to be 7.33 USD (125.30 ETB) (Table 14)

Table13. *Mean daily milk yield reduction due to lameness*

Lameness status	Number of milking cows with lameness	Mean daily milk yield per cow	Mean (95% CI) of the Difference	t (p) value
Before	5	7.7	2.2 (1.16-3.24)	5.88 (0.002)
After	5	5.5		

Table14. *Economic loss due to reduced milk yield and cost of treatment*

Cow	Daily mean milk yield before lameness in liter	Daily mean milk yield before lameness in liter	Difference	Length of recovery time in days	Mean cost of milk per liter	Economic loss due to reduced milk yield in birr	Treatment expense in birr	Total economic loss in birr
1	4.5	2.5	2	22	4	176.00	2.50	178.50
2	4	3	1	21	4	84.00	3.00	87.00
3	9	7	2	7	3.5	56.00	0.00	56.00
4	10	7	3	15	3.5	180.00	0.00	180.00
5	11	8	3	10	3.5	120.00	5.00	125.00
Total (Mean)	38.5 (7.7)	27.5 (5.5)	11 (2.2)	75 (15)	4 4	616 (123.2)	10.5 (2.1)	626.5 (125.3)

4. DISCUSSION

The present study, conducted from October 2010 to march 2011 had shown that the prevalence rate of lameness in and around Wolaita Soddo dairy farms was 4.0% which was very less compared to the reported prevalence of 15% by FAWC, (1997), 22% by Whay, (2002) and 20.4% in dairy cows and 8.1% in bred heifers by NAHMS, (2003) in from UK. Clarkson et al., (1996) reported the prevalence of lameness across 37 dairy farms in five regions of Great Britain to be 54.3% with a mean prevalence of 20.6%. In the United States, it was reported that15% of dairy cattle sent to slaughter was due to lameness (NAHMS, 1996). Esslemont and Kossaibati (1996) reported 24 % prevalence of lameness in a survey of 90 herds during 1992-1993 while in another survey conducted on 50 farms during 1995-1996 in three regions of Britain by Kossaibati and Esslemont, (1999) a prevalence of 38 % was reported. The variation in the prevalence of lameness between the various studies conducted in different countries may be ascribed to the differences in management system, climate, study period, productivity of the cows and methods employed in lameness detection. Geographical variability and seasonal differences in incidence and prevalence of lameness are also evident (Wells et al., 1993).

Even though, this study does not include most of the predisposing factors within its analysis model, it has tried to test considered risk factors that included milking status, pregnancy, feeding, floor type, length of rough track, frequency of floor cleaning, breed, age and sex. None of these factors were found to be statistically significantly associated with lameness at 5% significance level. In this study, highest prevalence of lameness (5.1%) was recorded in the oldest group (>4years) than in 6 month to 2 years group (1.4%). More lameness with increasing age was recorded in several studies (Wells et al.. 1993; Ward, 1999; Offer et al., 2000, Manske et al. 2002). This study was carried out in less rainy months of Ethiopia, and as a result there was no significant difference in the occurrence of lameness between the studied months. However several studies have shown the existence of variation in the prevalence of lameness among different seasons (Cook, 2003; Wells et al., 1993; Clarkson et al. 1996). For example, a study performed in Wisconsin, USA reported seasonal differences in the prevalence of clinical lameness at 21.1% in the summer and 23.9% in the winter (Cook, 2003). Wells et al. (1993) also studied the mid-western region of the US and reported a prevalence of 13.7% in winter and 16.7% in spring. Clarkson et al. *(*1996) had also reported that the incidence of lameness and the prevalence of claw lesions were higher in winter (25. %) than in summer (8.6%).

In this study, occurrence of lameness and the limb affected are statistically significantly associated where lameness was most common in hind limbs than in forelimbs. Hedges, (2001) also reported that on average, approximately 80% of lame cows are lame in the hind limbs. Singh et al., (1998) also reported similar findings from Punjab where the distribution of lameness in cattle was 28.9% in forefeet, 54.7 in

hind feet and 16.3% in both forefeet and hind feet. The same authors have also reported more frequent foot abnormalities in the hind feet (80%) than in the forefeet (20%) in buffaloes.

In this study lesions that were found causing lameness were 6 (37.5%) mechanical trauma, 4 (25%) tick infestation, 3 (18.75%) inter-digital space and hoof crack and hoof overgrowth each. Singh et al., (1998) have reported the prevalence of various foot lesions that caused abnormal gait and lameness to be 28.3% interdigital wound, 20.1% overgrown hooves, 10.6% cork screw hoof, 9.4% laminitis, 9.4% hoof crack, 8.9% white line disease and 15% miscellaneous causes (coronet swelling, gluteal degeneration and tendon injury. More than 75 % of lameness in New Zealand is of traumatic origin (Chesterton et. al., 1989). It was revealed that lameness had a significant impact on livestock production by causing reduction in daily milk yield. In this study, the mean daily milk yield of five lame cows' was statistically significantly reduced ($P<0.05$) after lameness. The reduction in milk production in lame cows may due to reduced consumption of feed as a result of pain and discomfort, which influences weight gain and milk production. The average economic loss due to reduced milk yield and cost of treatment per affected lame cow was found to be 7.33 USD (125.30 ETB) in this study.

5. CONCLUSION AND RECOMMENDATIONS

The study found that the hind limb of dairy cattle is more prone to foot lesions than the forefeet and that treatment is beneficial in shortening the period in which the animal will be lame. The study also revealed that lameness is an economically important disease of dairy cattle that reduces milk production significantly. However, the production status, pregnancy status, feeding, floor surfaces, cow track length, age, breed, sex and the study months were found unrelated to the prevalence of lameness in dairy farms in Wolaita Soddo.

Based on the above conclusion, the following recommendations

- More information needs to be generated through additional investigation on other possible risk factors and the occurrence of the disease in the wetter months of the country in order to provide evidence based advice to the dairy farmers to decrease the incidence of lameness
- Further studies are also needed to know the impact of lameness on other parameters of production, reproduction and behavior.
- Identification and treatment of lame cows as early as possible is essential to minimize loss of milk production due to the disease.

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