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**ADDIS ABABA UNIVERSITY
COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE**



**INCIDENCE OF LAMENESS, ASSOCIATED RISK FACTORS, TREATMENT
RESPONSE AND MILK YIELD LOSS REDUCTION IN BISHOFTU DAIRY
FARMS, OROMIA, ETHIOPIA**

MSc RESEARCH THESIS

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CLINICAL MEDICINE**

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DEPARTMENT OF CLINICAL STUDIES

MSc Thesis

**A Thesis submitted to Addis Ababa University College of Veterinary Medicine and
Agriculture in partial fulfillment of Masters of Veterinary science in Veterinary
Clinical Medicine**

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ADDIS ABABA UNIVERSITY

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As member of the examining board of the final MSc thesis open defense, we certify that we have read and evaluated the thesis prepared by Ayana Bane **“Incidence of lameness, associated risk factors, treatment response and milk yield loss reduction in Bishoftu dairy farms ”** and recommend it to be accepted fulfilling the thesis requirement for the degree of Masters of Science in Veterinary Clinical Medicine.

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Finally, approval and acceptance of the thesis dissertation is contingent upon the submission of its final copy to the CGS/FGC through the departmental graduate committee (DGC) of the candidate’s major department.

DECLARATION

I hereby declare that this thesis entitled “**Incidence of lameness, Associated risk factors, Treatment response and Milk yield loss Reduction in Bishoftu dairy farms**” is my original work and has not been submitted for a degree in any other university or institution. All sources used in writing the materials for this thesis have been acknowledged. This thesis is submitted in partial fulfillment of the requirements for the degree of Master of Science in Veterinary Clinical Medicine at Addis Ababa University, College of Veterinary Science and Agriculture, and is submitted in line with the rule and regulations of the university regarding graduate research work submission. Therefore, I recommend that it be accepted as fulfilling the research thesis requirements.

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STATEMENT OF THE AUTHOR

I **Ayana Bane** hereby declare and affirm that the thesis entitled “**Incidence of lameness, associated risk factors, Treatment response and Milk yield loss Reduction in Bishoftu dairy farms** “is my own work conducted under Associate Professor Fekadu Regassa's guidance. I have followed all the ethical standards of research while preparing, conducting data analysis and finalizing this thesis. All academic content included in the thesis has been given recognition through citation. I have correctly cited and referenced all the original sources. I also guarantee that I have abided by all academic rule and norms of honesty and integrity and I have not misrepresented or fabricated or forged any idea/data/fact/source in my submission. This thesis is being submitted as partial fulfillment of the requirement for an award of the degree of the Post Graduate Studies of Addis Ababa University, College of Veterinary Medicine and Agriculture. I also declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

I understand that any violation of the above will attract disciplinary action from the University and is also bound to initiate penal action by the sources which have thus not been properly referenced or from whose proper permission has not been taken when needed.

Name: Ayana Bane Signature_____

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Submission date_____

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LIST OF ABBREVIATIONS

ABWMs	Animal-Based Welfare Measures
BCS	Body Condition Score
CSA	Central Statically Agency
DD	Digital Dermatitis
HOG	Hoof over Growth
ID	Interdigital Dermatitis
IRR	Incidence Rate Ratio
LF	Left Front
LH	Left Hind
NSAIDs	None Steroidal Anti-inflammatory Drugs
QGIS	Quantum Geographic Information System
RF	Right Forelimbs
RH	Right Hind limbs
SARA	Sub- Acute Ruminant Acidosis
SU	Sole Ulcer
VLS	Visual Locomotion Scoring
WLD	White Line Diseases

ABSTRACT

Lameness is one of the most serious global health issues in dairy cows, negatively affecting animal welfare, milk production, reproductive health and farm economics. Although several studies have investigated the prevalence of lameness in Ethiopia, there is a scarcity of research on its incidence and treatment response in Bishoftu town. Therefore, a seven- month longitudinal study was conducted on dairy farms in Bishoftu from November 2024 to April 2025 to assess the incidence of lameness, identify associated risk factors, evaluate treatment response, and determine its impact on milk yield. A total of 574 cows from 30 purposively selected dairy farms were included, representing small, medium and large scale operation through proportional sampling method. Lameness was diagnosed and scored through visual observation and clinical examination during weekly farm visits. Lameness positive cows were treated according to its cases and the recovery time was recorded. The result showed that, out of 574 cows followed for seven months from 30 farms, the overall incidence rate at cow level and herd level were 5.23 cases per 100 cow months at risk and 63.33% respectively. A poisson regression analysis showed that the herd size, breed, age, milking status, and BCS were significantly associated with lameness ($P < 0.05$). As study showed, hind limbs was more affected (60%) than forelimbs (40%) and hoof overgrowth (26.67%) was the major cause of lameness in the current study followed by laminitis (20%). Locomotion score 3 was the major lameness score (40%) followed by score 2 (26.7%). The study showed that, 100% of treated cows (30/30) fully responded to treatment with different recovery time. Most cows recovered within 14 days after treatment, while a few took up to 28 days. In lactating cows, there was a significant improvement in milk production after treatment, with ($p < 0.05$). The study concludes that lameness significantly affects dairy farm economics and animal health. Therefore, early detection, timely treatment, farmers' awareness and automated diagnosis should be recommended as key essential strategy for preventing and diagnosis of lameness in dairy herd.

Key-words: *Dairy Cows, Incidence, Lameness, Longitudinal, Recover time, Risk factor*

1. INTRODUCTION

Ethiopia has Africa's highest livestock population, comprising 70 million cattle, 42 million sheep, 52 million goats, 8 million camels, and 56 million chickens (CSA, 2021), which are used for milk and meat production, agricultural draught power and a source of income for farmers (Ayele *et al.*, 2016). Over the past decades, advancements in dairy farming practices have significantly boosted milk production, leading to higher yields of key milk compositions like fat and protein (Rittweg *et al.*, 2023). Currently, the alarming high growth rate of human population created a parallel high need for livestock product mainly milk and meat which can only be fulfilled by improving level of production per animal through intensification and addressing challenges against productivity (Abunna *et al.*, 2017).

Despite a large population and expanding dairy sector, the country's dairy system is struggling to meet rising demand for milk and its products due to factors such as lameness, mastitis, infertility, metabolic disorder and low milk production (Negash, 2017; Arero, 2020). Lameness is a major health issues in dairy farms globally, impacting animal welfare, fertility, milk production and economic value of the farms (Whay and Shearer, 2017). Thus, lameness affect cow's period of service and calving interval by disrupting their normal physiological features and exposing them to infectious diseases such as mastitis and milk fever (Afonso *et al.*, 2020).

Some research indicates that, after mastitis and infertility, lameness ranks third in terms of the financial losses in dairy farmers (Sulayeman and Fromsa, 2012). Thus, lameness-related economic losses have recently examined and categorized as treatment cost, losses due to reduced milk production, discarded milk during treatment, reduction of reproduction, increased culling rate and reduction of herd costs due to the problem (Dolecheck and Bewley, 2018). Lameness has a huge negative effect on the general welfare of dairy cows in addition to the financial cost since it makes the cows uncomfortable and painful and interferes with their regular feeding, lying, and other behaviors (Whay and Shearer, 2017;Hund *et al.*, 2019).

Noninfectious factors like White line disease (WLD), Sole ulcer (SU), Sole hemorrhage, laminitis, or infectious hoof disorders such as digital dermatitis (DD), Interdigital dermatitis (ID), Heel erosion and (Foot rot) are the most common causes of lameness in dairy farms (VanNuffel *et al.*, 2015). Other potential factors associated with lameness includes environmental, management, nutrition and animal risk factors that cannot be changed including parity, breed, age, stage of lactation, milk yield and BCS plays an important role to causes lameness prevalence in dairy cows (Randall *et al.*, 2018; Mohammed *et al.*, 2024). So, the occurrence of clinical lameness is complex, which is linked to several factors that are mainly related to housing conditions and management practices (Oehm *et al.*, 2019).

Problem of the statement: Farmers usually underestimate the occurrence of lameness, which leads to a negative view of its effects on cow productivity, welfare, and health (Horeman *et al.*, 2014). This misconception leads an increased number of chronically lame animals, a delayed detection of lameness, and higher financial losses in the farm (Laven, 2013). Despite increased awareness of the problem in relation to wellbeing and lost productivity, few studies have shown a decline in the occurrence of lameness over the previous twenty years (Egger-danner *et al.*, 2017). Thus, dairy farmers in many countries did not consider lameness to be a concern, sometimes underestimating it and only presenting severe cases for treatment. So, reducing lameness prevalence and its impact is one of the biggest recent problems in the dairy industry worldwide (Kalyuzhny *et al.*, 2019).

In Ethiopia various cross-sectional study have been reported for addressing the prevalence of lameness at a single point in time with recorded cow level prevalence of 10.2% in Hawasa (Gessese *et al.*, 2024), 17.9% in Yirgalem, 16.7% in Arsi Negele, 9.7% in Wondogenet, 4% in Wolaita Sodo (Shiferaw *et al.*, 2021), 25.6% in Adama (Duba, 2017), 13.9% in Bishoftu (Abunna *et al.*, 2017), 5.77% in Desie and kombolcha (Mekonin *et al.*, 2025) and 2.5% in Jimma (Sulayeman and Fromsa, 2012) with at herd level prevalence of 47% to 55%.

However, these approaches (the cross-sectional study) have some limitation (gaps) as they did not determine duration of time, do not provide a clear information how lameness is associated with its risk factors, how often new cases occur annually on a farm, or how quickly the disease spreads among cows of the same herd, cannot evaluate control program effectively and underestimate economic losses from long-lasting cases (Ekanayake *et al.*, 2021). Additionally, past studies conducted in Ethiopia have limited information on the detection of lameness and its treatment response. For this reason, longitudinal study which follows animals over time is more appropriate for the estimation of the frequency of lameness as well as the establishment of cause and effect relationship between lameness and its risk factors. It also make it easy to interpret the variation in the occurrences of lameness across different farms or management system, which can result in more effective treatment and control strategies than a single prevalence measurement (Thomas *et al.*, 2015). Thus, the early identification of lameness and treatment through longitudinal study can reduce economic loss, improve the health of animals and help lower the overall level of lameness on the farms.

Despite many research conducted on lameness prevalence, there is scarcity of studies on incidence, early treatment response and milk loss reduction in Bishoftu dairy farms and elsewhere regions in Ethiopia. So, this study aimed with:

General Objective

- To assess the incidence of lameness, associated risk factors, treatment response and determine its effect on milk yield loss reduction in Bishoftu dairy farms.

Specific Objectives

- To assess the incidence of lameness and identify its associated risk factors
- To diagnose lameness and score its severity using a visual locomotion scoring system
- To evaluate the treatment response of lameness and its effect on reduction of milk yield loss in lactating cows.

2. LERERATURE REIVIEW

2.1. Definition of Lameness

Although several researchers have given different definitions of lameness, the most accurate one is "an abnormal gait that is commonly caused by pain" (Whay and Shrear, 2017). Lameness, a sign of healthy claws, is the inability of an animal to move normally because of pain from an injury, illness, or claw condition (Vieira *et al.*, 2015; Tillack *et al.*, 2024). According to Nuffel *et al.* (2015), lameness is a painful disorder primarily affecting the locomotors system that causes poor mobility or a departure from normal posture or gait. In other words, lameness is defined as any condition affecting the feet or legs that impaired the mobility, posture, and gait of cows, whether it is infectious or non infectious agents (Sadiq *et al.*, 2021).

2.2. Etiology of Lameness

Lameness in dairy cows is frequently caused by a variety of complex factors, including housing, management techniques, improper foot trimming, infectious and non-infectious diseases, inadequate nutrition, and unique animal traits (Ranjbar *et al.*, 2016). To effectively prevent lameness in the farm, it's important to understand the risk factor in different geographical area (Relun *et al.*, 2013; Amory *et al.*, 2008). Several researchers have investigated that non infectious diseases like WLD, SU, Laminitis, or infectious hoof disorders such as digital dermatitis (DD), Interdigital dermatitis (ID), Heel erosion and (Foot rot) are the leading causes of lameness in dairy cattle (Kumar *et al.*, 2021; Sharma and Phillips, 2019). In addition to non-infectious and infectious agent, lameness can also be associated with trauma, lack of exercise, slippery floor, large body weight, breed of animals and injury in the nervous system (such as obturator paralysis) as well as the musculoskeletal system (such as fractures, arthritis and tendonitis) (Van Nuffel *et al.*, 2015).

2.3. Risk Factors affecting occurrence of lameness

Numerous studies have connected lameness to a variety of risk variables, including the kind of flooring, seasonal fluctuations, body condition, milk supply, parity, herd size, breed, age, and cleanliness of the floor and legs (Chapina *et al.*, 2014; Foditsch *et al.*, 2016; Oehm *et al.*, 2020; van Huyssteen *et al.*, 2020).

2.3.1. Environmental Factors

Environmental factors including temperature and humidity can weaken the digital skin, leading to ulceration, bacterial colonization, and lameness progression (Ramanoon *et al.*, 2018). Thus, cows' environments, including housing, flooring, and herd management procedures, can raise the risk of lameness (Solano *et al.*, 2015). Using mats or mattresses is associated with increased lameness, whereas deep bed with natural fibers or sand, rubber floors, and pasture access are associated with reduced levels of lameness (van Gastelen *et al.*, 2011). According to certain research, there is a dose-dependent link between lameness and bedding depth (Devries, 2020). A major risk factor for infectious lameness is the housing environment, which includes dirty surfaces with high fecal matter content and no bedding (Somers *et al.*, 2015).

2.3.2. Nutritional Factors

Imbalanced animal diet affects the development, growth, and keratinization of healthy hooves (Greenough, 2007). Minerals like calcium, zinc, vitamins, amino acids and fatty acids are all necessary for the formation of structurally sound hooves, where absence of this minerals result in weak horn formation that is more susceptible to lameness (Gravey, 2022). Crucially, feeding cattle high-energy diet with low roughage to concentrate ration can cause metabolic disorder such as ruminal acidosis, which is linked to laminitis and lameness (Mineur *et al.*, 2020). Variations in the percentage of starch in cattle feed may cause rumen injury, which can have systemic negative impacts on hoof anatomy like white line diseases and corium, which is linked to diseases that make the animal more likely to go lame and incur injuries, with huge financial losses in the farms (Tavares *et al.*, 2020).

2.3.3. Animal- Related Factors

Several factors related to the individual cow such as age, number of calving (parity), milk yield and body condition score (BCS) play a major role in increasing the likelihood of lameness (Oehm *et al.*, 2019; Oehm *et al.*, 2020). Research has shown that older cows, especially those in their third or later lactations, are more prone to becoming lame compared to younger animals (Browning *et al.*, 2016). One important link is between low BCS and lameness, as highlighted by Green *et al.* (2014). Cows that have a low BCS around calving or in early lactation tend to be more vulnerable to lameness. This is mainly because the body condition score is positively associated with the thickness of the digital cushion the fatty layer inside the hoof that helps absorb pressure and protects the inner tissues. When this cushion becomes thinner, the risk of hoof issues like sole ulcers and white line disease increases (Bicalho *et al.*, 2009).

The digital cushion acts like a natural shock absorber for the cow's foot. If it lacks enough fat, it won't be able to protect the hoof properly when the cow is walking or standing for long periods, leading to claw horn lesions (Foditsch *et al.*, 2016). Moreover, the more times a cow has calved, the more likely it is to develop lameness. This trend has been supported by studies that found a rising risk of lameness as cows go through multiple parities (Daros *et al.*, 2019). Specifically, Solano *et al.* (2016) reported that not only cows with four or more calving, but even those in their first to third calving stages, showed a higher chance of becoming lame compared to young heifers.

2.4. Impacts of Lameness

2.4.1. Impact on Milk Yield

Studies have shown that cows start producing less milk even before they receive treatment for infectious lameness. In fact, those showing clear signs of lameness tend to have a noticeable drop in milk yield on dairy farms (Reader *et al.*, 2011). Research by Charfeddine and Perez-Cabal (2018) also points out that although severe hoof lesions occur less frequently, they can cause financial losses up to three times higher than

moderate ones. A survey carried out in the UK found that cows suffering from white line disease or sole ulcers produced significantly less milk per lactation about 369 kg and 574 kg less, respectively (Amory *et al.*, 2008). Similarly, Kifle (2018) reported that for each cow affected by lameness, the cost of treatment along with reduced milk production led to an average economic loss of 125.30 Ethiopian Birr.

2.4.2. Impact on Economic Loss

Dairy farms suffer significant financial losses due to lameness, which also poses a welfare risk to the affected cows. After reproductive issues and clinical/subclinical mastitis, lameness ranks third in terms of economic loss in wealthy nations (Ózsvári, 2017). There are two types of economic losses brought on by lameness: direct expenses and indirect costs. Direct economic loss includes veterinary treatment costs (including milk discarded due to antibiotic therapy), additional labor costs (farm labor, hoof trimming), and the cost of early culling, while indirect loss includes reduced milk production, reduction of productive performance, loss of weight gain and causes of other diseases like ketosis and mastitis (Liang *et al.*, 2017; Dolecheck *et al.*, 2019).

Cows with lameness can reduce milk production by about 1.63 liters per day. Lameness can result in a large economic loss, with estimations of roughly 7.33 SUD (United State Dollar) per cow due to reduced milk output and treatment expenditures (Gessese *et al.*, 2024). In Great Britain, annual economic costs associated with lameness range from £1715 (€2013.60) to even £7500 (€8805.80) which accounted for 27% of the total animal health cost in a dairy herd (Afonso *et al.*, 2020).

2.4.3. Impact on Animal Welfare

Lameness represent a serious animal health and welfare concern since affected cows exhibit pain and behavioral abnormalities (Thomas *et al.*, 2016; Ramanoon *et al.*, 2018; Sadiq *et al.*, 2020a). Numerous studies have documented clinical sign of distress and pain in afflicted cows, making it a crucial welfare issue. Animal-based welfare measurements (ABWMs), such as hock and body condition, leg hygiene, lying behavior, social grooming, and body injuries, are essential metrics for evaluating the health and

productivity of dairy cows (Robichaud *et al*, 2019). Lameness, on the other hand, has a detrimental impact on the welfare of animals since it can lead to discomfort, aberrant gait, prolonged lying, changed feeding habits, a reduced ability to express natural behavior, and worsened pain (Marti, 2024). Lameness is also a serious welfare issue since it can affect a cow's normal activities, including rumination, social activities, laying time, and the intensity of estrus (Whay and Shearer, 2017). Both moderate lameness events and severely lame cows have been shown to exhibit these behavioral modifications (Bran *et al.*, 2018; Weigele *et al.*, 2018).

2.5. Lameness Diagnosis and Scoring

During lameness diagnosis, animals were watched as they are on move on non slippery surface area to identify any kind of abnormalities. Those that being moved with evident adduction, abduction, arched back, hobbling, impaired locomotion with asymmetrical stride length and put weight on one or more limbs were classified as lame. Following hoof cleaning and washing, physical examination was performed using hoof inspection and palpation technique to assess the location, kind of lesion, etiology and severity of lesion in lame animals.

Then Animals with clinical lameness and active injuries with persistent harm tissue, with or without blood, discharge, pus, abscess formation, or subsequent bacterial complication, were classified as positive for lameness. All dairy cows with locomotion scores between 2 and 5 are considered to be lame. A severity of lameness was scored as mild, moderate, or severe in all farms. Thus, all the cows at the farms would be visually inspected for lameness and the gait scored on a scale of 1- 5 points, with 1 = normal, 2 = mildly lame, 3 = moderately lame, 4 = lame, and 5 = very lame (Garvey, 2022) as described in Table (1) below as described in Table (1) below.

Table 1: Locomotion Scoring Criteria in Dairy Cows

Score type	Indication (description)
Score 1 (normal)	Animal posture is normal both while walking and standing
Score 2 (minor lameness)	Animal’s mobility is affected but not severely seen Shows minor gait abnormality
Score 3 (moderate lameness)	The posture is arched both in standing and walking. Animal move with short stride with one or more legs. During movement, they raise and lowers their head
Score 4 (lameness)	Arcked back posture is correctly observed both in standing and moving time. Spent more time in recumbent (laying) Abduction of leg is observed
Score 5 (Sever lameness)	Animal’s movement is restricted Spent most time on lying and refused to standup Arcked back and lameness are strongly observed. Resting affected leg and Put weight on health leg.

Source: (Sprecher *et al.*, 1997)

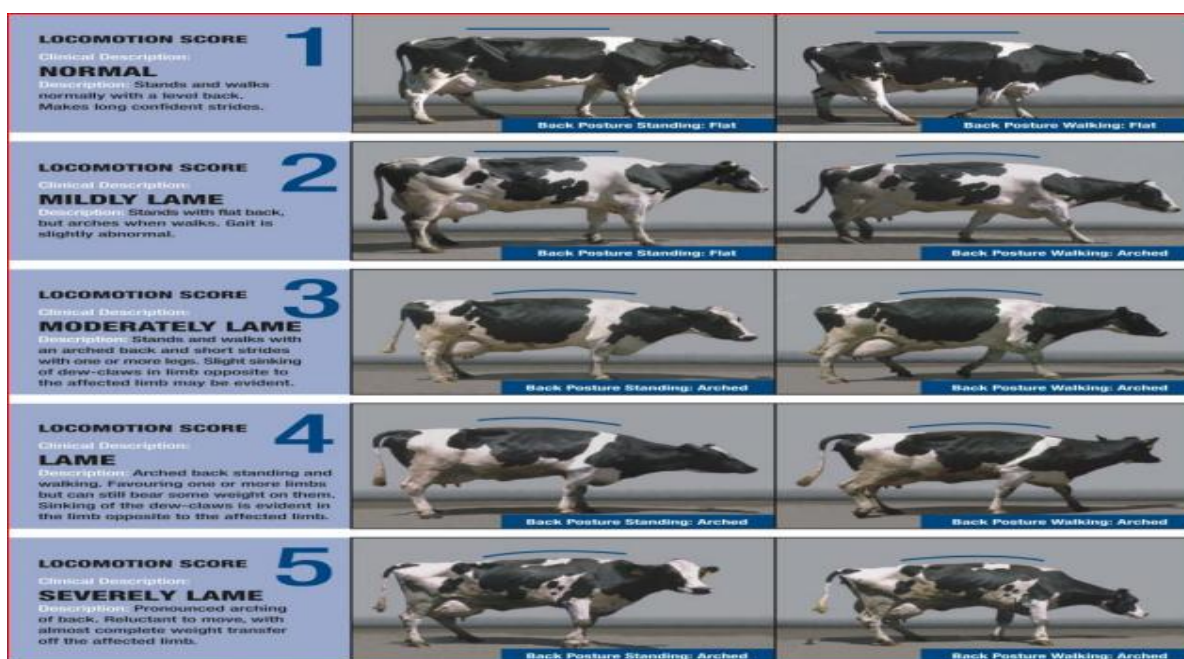


Figure 1: Five-Point Locomotion scoring System

Source: Werema *et al.*, 2022

2.6. Clinical Signs of Lameness

Dairy cows having lameness showed clinical signs like fever, anorexia, decreased milk output, pain, and leg swelling (Davis-Unger *et al.*, 2019; Matson *et al.*, 2022). Several gait parameters, including as stride length, asymmetrical steps, and weight distribution, have been used to detect lameness in cattle (Van Nuffel *et al.* 2015). Lamé cows walk slower than non-lame cows, with longer stride durations, shorter steps, and more uneven weight distribution across the limbs (Flower *et al.* 2005). In a similar manner, increased abduction of legs strong arched-back posture (both while walking and standing) and shifting body weight onto non affected limbs are also associated with lameness cattle when compare to non lame cattle (Rushen *et al.*, 2007; Maertens *et al.*, 2011).

2.7. Treatment of Lameness

Once the cow has been diagnosed as lame, the farmer, veterinarian, or trimmer can administer a specific therapy, with a predetermined likelihood of success for each applicant. However, very few researches have been conducted on the proper treatment of lameness and the majority of study focused only on treating digital dermatitis (Potterton *et al.*, 2012). Proper hoof trimming can help cure ulcers and traumatic sole injuries in their early stages. It's also utilized to repair the hoof horn and remove foreign substances from the body (Kleinhenz *et al.*, 2014).

Antibiotics, such as topical tetracycline spray (Cutler *et al.*, 2013) and oxytetracycline injection (Berry *et al.*, 2012), have been shown to improve digital dermatitis resolution. However, a recent meta-analysis found that the effectiveness of these treatments is unknown because the body of knowledge and current quality of evidence is limited (Ariza *et al.* 2017). Another key component of treatment, frequently used during corrective trimming, is the placement of a hoof block on the good claw to relieve pressure on the problematic claw. Because lameness produces discomfort in cows, one of the important therapeutic interventions is to alleviate pain sensations. Nonsteroidal anti-inflammatory drugs (NSAIDs) have been demonstrated to be an effective technique to

treat discomfort beyond corrective clipping and claw blocking (Groenevelt *et al.*, 2014; Roche *et al.*, 2024).

2.8. Prevention of Lameness

Farmers always tend to ignore the occurrence of lameness and never consider it as a problem on cow health, welfare and economic burden in different country including our country. Thus, prevention of lameness in dairy cows is crucial to minimize its impact on cow’s welfare, health and economics point of view as described in (Table 2).

Table 2: Summary of Lameness Prevention Strategies in Dairy Cow

Prevention strategies	Advantages	Source (References)
Regular hoof trimming	Helps proper weight bearing and lesion prevention	Greenough, 2007
Comfortable Housing and Flooring	Non-slip floors and Soft bedding reduce hoof injuries and prevent lameness	Espejo and Endres, 2007
Infectious control	Removing the infection reservoir reduces lameness incidence and the danger of transmission	Garvey, 2022
Biosecurity and farm management	Key factor to minimize lameness in dairy cow and maximizing productivity	Sadiq <i>et al.</i> , 2020b
Nutritional management	Balanced rations like carbohydrates, protein, trace minerals, and vitamins help to prevent in lameness in dairy cows	Bicalho <i>et al.</i> , 2009

2.9. Current Status of Lameness in Dairy Cow in Ethiopia

Over the past 30 years, global research has examined nearly 4,000 dairy herds and found that the rate of lameness with a severity score above 3 has varied widely from as low as about 5% to as high as 45%, with some individual herds reporting rates up to 88% (Thomsen *et al.*, 2023). In the UK, for example, Bell *et al.* (2006) reported that around 29.5% of dairy cows experience lameness within a single production season. A study in Brazil by Dionizio *et al.* (2022) found a clear link between lameness and seasonal changes: during the rainy season, the lameness rate reached 78%, while in the dry season

it dropped to 44%. This shows how environmental conditions can influence the problem. Overall, although the numbers vary from region to region, it's estimated that globally, between 13% and 50% of dairy cows may suffer from lameness at some point in their lives (Bjurstrom, 2025).

In Ethiopia, numerous studies have been carried out in different parts of the country to understand how common lameness is in dairy cows and what factors contribute to it. A summary of these findings is presented by Duba and Haramaya (2021) in Table 3. Most of the research has focused on dairy farms using either intensive or extensive systems, especially those located in or near urban areas. Based on previous findings, the prevalence of lameness at the individual cow level ranges from 3.5% to 25.6%, while at the herd or farm level, it falls between 47% and 55%. However, when it comes to tracking the actual incidence of new lameness cases over time, there is very limited data. In fact, only one study conducted by Abunna *et al.* (2017) reporting lameness incidence rate of 2.8 cases per 100 cow-years at risk.

Table 3: Current Status of Lameness Prevalence in Ethiopia

Study town (city)	Sample size	Prevalence (%)	Reference
Desie and kombolcha	433	5.77%	Mekonin <i>et al.</i> , 2025
Hawasa town	440	10.2%	Gessese <i>et al.</i> , 2024
Walaita Sodo	399	4%	Shiferaw <i>et al.</i> , 2021
Arsi Negelle	168	16.7%	Shiferaw <i>et al.</i> , 2021
Yirgalem	280	17.9%	Shiferaw <i>et al.</i> , 2021
Wondogenet	360	9.7%	Shiferaw <i>et al.</i> , 2021
Jimma (Dedo and Serbo)	933	3.5%	Sulayeman and Fromsa,2012
Bishoftu	431	13.9%	Abunna <i>et al.</i> , 2017
Adama	Not specified	25.6%	Kabeba, 2017
Addis Ababa	Not specified	4.5%	Aweke and mekbebe, 2017

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was carried out in Bishoftu town, which is in the East Shoa Zone of the Oromia Region, from November 2024 to April 2025. Bishoftu lies is about 45 kilometers southeast of Addis Ababa and is geographically located at 8° 44' 4 North latitude and 39° 0' 30 East longitude (see Figure 1). The town situated at an altitude of 1,850 meters above sea level and experiences an average annual rainfall of 801.3 mm. The range of monthly temperature is normally from a minimum of 37.7°C in July to a maximum of 27.7°C in May (Metages, 2018). The climate is generally moderate and falls in a tepid to cool sub-moist zone. Bishoftu was chosen for this research because it is one of the leading sources of Ethiopia's dairy industry. The area consists of many small and commercial- sized dairy farms with relatively high milk production. It is therefore, an ideal place to study lameness in dairy cows, as the number of cases would be significant enough to observe patterns and measure economic impacts such as loss of milk yield due to lameness.

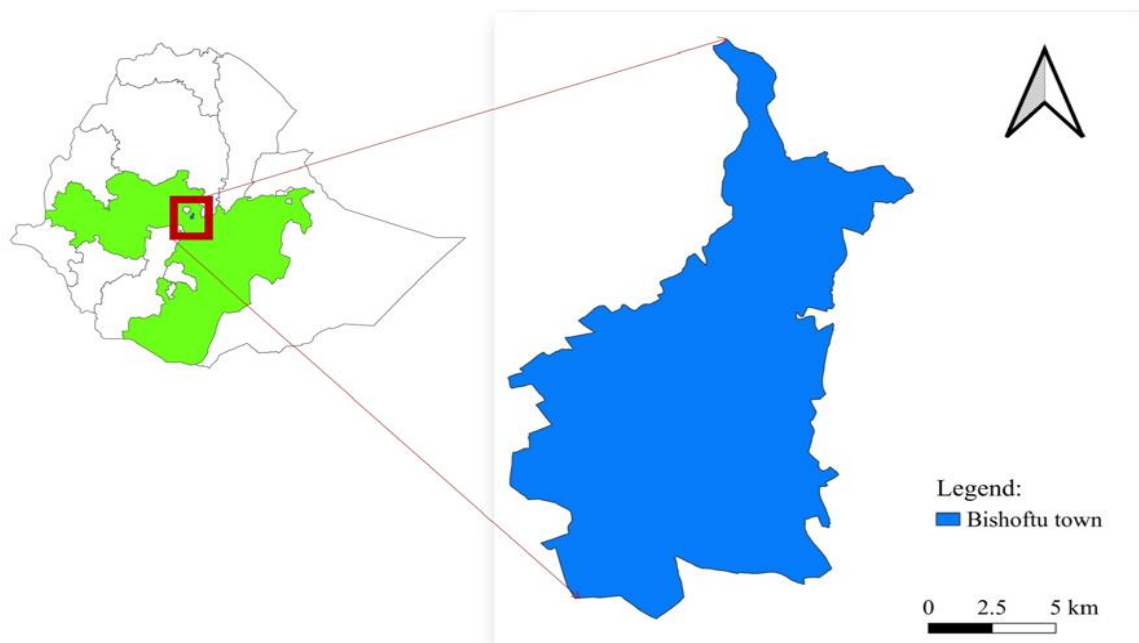


Figure 2: Map of study area, Bishoftu town (QGIS Version 3.3).

3.2. Study Population

30 cows developing clinical sign of lameness within 7 months were used as sample size for this study. Two breed (exotic and cross) cows were included and age of the cow were determined by observing their record on the farms but if it was not enough, it was determined by looking animal's dentition as described by Mushong *et al.* (2020). Accordingly, cow aged less than 4 years were considered as young and those greater or equal to 4 years were grouped as adult and old. Animal's BCS were recorded by observing animals body based on Anonymous (2024) guidelines, which categorize animal having score 2 or below as poor BCS, 3 as medium and 4 as good body condition score (see Annex 10).

3.3. Study Design and Sampling Methods

From November 2024 to April 2025, a longitudinal observational study was performed in Bishoftu dairy farms to investigate how often lameness occurs in dairy farms, how they responded to treatment and how this condition affects milk production. According to a 2024 report by the Bishoftu City Livestock and Fishery Development Office (BCLFDO), a total of 142 dairy farms were identified and grouped into three categories: 24 were classified as large-scale, 68 as medium-scale, and 50 as small-scale farms. From these 142 dairy farms, 30 farms were purposively selected for this research based on different factors (Criteria) such as farmers' willingness to allow their farms, the management practices used, ease of access to the farms, the presence of reliable records, and whether the farms had a known history of lameness. These 30 farms were allocated using proportional sampling methods to reflect the overall distribution of farm sizes by taking 6 farms from large, 14 from medium, and 10 farms from small respectively.

Before the study was started, the purpose of the study was clarified to the farmers and their consent was obtained. The 30 farms selected for this study were visited before starting the works to verify that they had no existing case of lameness. This was important to ensure that only new cases (incidence) would be recorded during the study period. Any cow that had already been lame before the study began was not included,

since the focus was on identifying new cases rather than ongoing or past ones. To collect accurate and complete data, a personal observation checklist (provided in Annex 1) was developed. This checklist helped track not only cases of lameness but also several possible risk factors, such as herd size, type of feed used, cleanliness of the farm, frequency of hoof trimming, as well as cow-specific details like breed, age, whether the cow was being milked, and which leg was affected. Each farm was visited once a week throughout the study period, and lameness was closely monitored to record any new cases as they appeared.

3.4. Simple Size Determination

For this study, sample size determination was obtained based on the availability of lameness case in the study farms since the study design is longitudinal (incidence) rather than cross-sectional. So, sample size was determined after follow-up by observing animals that showed clinical signs of lameness within seven months of the study period. Accordingly, out of 574 total cows followed within seven months, 30 cows that showed clinical sign of lameness had been considered as a simple size for this study.

3.5. Lameness Diagnosis and Locomotion Scoring

To diagnose lameness and identify its cause in dairy cows, a series of standard steps were followed. These included visually observing the animals (as an initial check), performing locomotion scoring (to semi-quantitatively assess their movement), doing physical examinations (hands-on inspection), using a hoof tester (to apply pressure and identify painful areas), and carefully recording all findings. The cows were first checked visually, both in tied stalls and when allowed to move freely. For cows in free-stall systems, they were observed walking on a flat, non-slippery surface to spot signs such as an arched back, hesitation to move, head bobbing, unusual leg movements, or a shortened walking stride. In tied stalls, the cows were monitored for weight shifting, uneven weight-bearing (such as resting a painful leg), or standing on the edge of the stall floor (these are also indicators of discomfort or pain). Once visual signs of lameness were confirmed, locomotion scoring was carried out using the Visual Locomotion Scoring (VLS) system,

based on the method developed by Sprecher *et al.* (1997). This widely accepted five-point scoring system helps identify how severely a cow is affected by analyzing signs like back posture while walking or standing. Cows suspected of lameness were allowed to walk freely on smooth, level ground so their movement could be properly assessed, following the approach described by Shearer *et al.* (2012). Photos of the lame cows were also taken with a digital camera, and their gait was evaluated using a scoring guide (see Annex 3), which classifies their locomotion from 1 (normal) to 5 (severely lame), according to Werema *et al.* (2022). Any cow that received a locomotion score of 2 or higher was officially considered lame, based on the criteria set by Thomsen *et al.* (2008).

After figuring out which leg is affected using Visual Locomotion Scoring (VLS), the next step is to safely restrain the cow to perform a thorough physical check. Each leg and hoof is carefully examined to look for any abnormalities like swelling, wounds, foreign objects, or other signs of injury, as described in (Annex 4). Next, a hoof tester is used to gently prod different areas on the hoof to see how the cow reacts such as stepping back, kicking, or jumping away that may identify if the discomfort is within the foot. If the cow does show discomfort on this test, the hoof is washed, cleaned, and clipped to be able to see and determine the actual problem. But in case there is neither observable pain nor lesion in the hoof, the examination continues with palpation of the joints, muscles, tendons, and bones. The leg is also bent, straightened, and moved side to side to look for issues of upper leg. From these processes, seven hoof deformities were developed, i.e., sole ulcers, laminitis, digital dermatitis, Interdigital dermatitis, White line disease, foot rot, and hoof overgrowth, as detailed in (Annex 5).

3.6. Treatment Protocols

Lame cows received treatment based on the specific cause of their condition. The management approach for lameness treatment involves a combination of hoof trimming, the use of Anti-pain, administration of antibiotic and cyclo wound spray for topical treatments. Once a cow was identified as lame, it was properly restrained, and NSAIDs such as intramuscular Meloxicam at dosage of 0.5mg/kg body weight was administered

subcutaneously for one to three consecutive days as first line of treatment to reduce pain and inflammation since lameness causes pain in cows (Roche *et al.*, 2024).

Next, the hoof was properly cleaned and trimmed in order to correct excessive hoof development, balance sole thickness, eliminate dead tissue, and relieve pressure on the affected sole, as shown in (Annex 4). Trimming away damaged and soft tissue or weakening horn helps to establish an oxygen-rich environment, inhibiting the growth of anaerobic bacteria and preventing abscess formation (Kleinhenz *et al.*, 2014). Following proper hoof trimming, preventative dressings (bandages) were provided, along with iodine tincture and oxytetracycline spray, particularly for conditions like sole ulcers, digital dermatitis, and foot rot, as shown in (Annex 6). Lastly, a broad-spectrum antibiotic, specifically short-acting oxytetracycline at a dosage of mg/10 kg body weight was injected intramuscularly for one to three consecutive days, depending on the severity of the case.

3.7. Follow-Up and Evaluation of Treatment Effect on Milk production

For each of the selected dairy farms and cows, weekly visit (follow ups) were performed to monitor lameness cases, including new cases and recovery times for previously treated case. Follow-up assessment was done after treatment specially on 7 days and then again repeated at two week (at 14 days), three week (at 21 days) and at 28 day to ensure sign of improvement and recovery time by performing earlier diagnosis parameters such as visual observation, clinical examination and locomotion score assessment as indicated in (Annex 6). To assess the effect of treatment on milk yield in lactating cows (N=19) with lameness, daily milk yield was measured using a plastic measuring jar with calibrated litter (L) marks for high precision, as showed in (Annex 8). Thus, each cow's milk yield was measured for three consecutive days before the treatment and again for three consecutive days after treatment (at 14 day post-treatment to evaluate the long term impact of treatment on milk production). Pre-treatment and post-treatment daily averages were then calculated for each cow to compare milk production before and after treatment, in order to determine whether the treatment had an effect on milk yield that could be seen.

3.8. Data Analysis and Management

The lameness data that was recorded during the study time was organized and stored in a Microsoft Excel spreadsheet. To analyze the data, R Studio (version 4.3.2), which is a statistical software program (Ludecke *et al.*, 2021) was used. Poisson regression analysis was applied to find out how different factors were related to the rate of lameness. The strength of association between each risk factor and incidence of lameness was expressed in term of Incidence Rate Ratio (IRR), obtained by exponentiation the regression estimates. A paired t-test was used to compare milk production before and after treatment to see if there was a significant improvement. For all the statistical tests performed, a 95% confidence interval with a 5% margin of error was used and any result with a p-value less than 0.05 were considered statistically significant.

Basic descriptive statistics like frequency and percentage were used to explain how often lameness occurred in different types of farms. The overall incidence of lameness at the individual cow level was found by taking the number of new lameness cases, dividing it by the total number of cows examined during the study period, and then multiplying by 100 to get a percentage. At the herd level, I calculated incidence by checking how many herds had at least one new case of lameness and dividing that by the total number of herds in the study. I also looked at within-herd incidence, which involved dividing the number of lame cows in each herd by the total number of cows examined in that particular herd. To visually present the results, I used R software to create bar charts and pie charts. These graphs helped show the different types of hoof lesions found, the severity of lameness based on scoring, and which limbs were most commonly affected.

3.9. Ethical Clearance

Before beginning this work, a research ethics application for research clearance explaining the purpose of the study was submitted to AAU, CVMA of research committee. The committee approved the study after evaluating its value from many perspectives and gives me approval sheet with Ref. No: VM/ERC/04/57/17/2025 as attached in (Annex 11). Thus, the research was carried out with animal welfare in mind and in accordance with Addis Abeba University's research ethics.

4. RESULTS

4.1. Incidence of Lameness in Individual Farms

The study showed that, out of 574 cows followed for seven months, 30 cows showed lameness with overall incidence rate of 5.23 cases per 100 cow month at risk at cow level (0.0523 per cow-seven months at risk). From 30 observed farms, lameness has been occurred in 19 farms and there was no lameness in 11 farms (Table 4). Thus show that, incidence rate of lameness at herds level was 63.3% (19 out of 30 farms) with ranging from 0% to 22.2% within farms.

Table 4: Incidence of Lameness in Individual Farms (N=574)

Farm examined	Herd size	No of positive	Incidence (%)
Farm 1	47	3	6.4%
Farm 2	26	0	0.0%
Farm 3	38	2	5.3%
Farm 4	37	0	0.0%
Farm 5	25	2	8%
Farm 6	36	0	0.0%
Farm 7	40	2	5%
Farm 8	28	1	3.6%
Farm 9	23	0	0.0%
Farm 10	35	2	5.7%
Farm 11	17	1	5.9%
Farm 12	16	1	6.3%
Farm 13	11	0	0.0%
Farm 14	14	1	7.1%
Farm 15	17	2	11.8%
Farm 16	19	0	0.0%
Farm 17	15	1	6.7%
Farm 18	18	2	11.1%
Farm 19	16	0	0.0%
Farm 20	15	0	0.0%
Farm 21	10	2	20%
Farm 22	6	0	0.0%
Farm 23	9	2	22.2%
Farm 24	8	1	12.5%
Farm 25	8	0	0.0%
Farm 26	7	1	14.3%
Farm 27	6	1	16.7%
Farm 28	9	1	11.1%
Farm 29	10	2	20%
Farm 30	8	0	0.0%
Total	574	30	5.23%

4.2. Association of Risk Factors with Lameness Incidence

In this finding, major risk factors (variables) including herd size, breed, age, BCS, milking status, feed type, exercise activity, hoof trimming frequency, and housing hygiene was statistically examined using a poisson regression model in R version 4.3.2. The finding showed that the herd size, breed, age, BCS, and milking status were statically significant ($p < 0.05$). However, feed type, exercise activity, hoof trimming frequency and housing hygiene were no statically significant ($p > 0.05$) (Table 5).

The Incidence Rate Ratio (IRR) in this study indicated that, when controlling for other variables, cows in medium and large herd sizes experienced significantly lower rates of lameness compared to cows in small herd sizes. Specifically, cows in medium herds had about a 70% reduction in lameness incidence (IRR = 0.298, 95% CI: 0.102–0.873, $p = 0.027$), and those in large herds had approximately a 75% reduction (IRR = 0.151, 95% CI: 0.094–0.671, $p = 0.00583$). The result also revealed that in local breed, the incidence rate of lameness has been decreased by 85.6 % than exotic breed by holding other variables as constant (Since IRR=0.158 and CI: 0.037-0.685).

The IRR revealed that, older animals (Aged ≥ 4 years) was approximately 3.5 times higher lameness incidence rate than in younger animals (Aged < 4 years) assuming other variables held constant. This indicate that, older animals were significantly more likely to develop lameness compared to young animals (IRR = 3.471, 95% CI: 1.191–10.117, $p = 0.023$). The incidence rate of lameness in lactating cows was approximately 2.4 times greater than in non-lactating cows (IRR = 2.443, 95% CI: 1.108-5.386, $p = 0.0268$).

The study revealed that cows with medium and good body condition scores had dropped 74% and 82.5% of the risk of lameness incidence rate, respectively, when compared to poor body condition scored cows by holding other variables constant (because IRR=0.264 and CI: 0.088-0.787). The study also showed that, regular hoof trimming, good housing hygiene, allowing animal to exercise and giving balanced feed to animals lowers the occurrences of lameness in the farm.

Table 5: Incidence of Lameness with its Associated Risk Factors (N=574)

Risk factors	Groups	No of examine d	No of lame (%)	IRR	95% CI	P- value
Farm size	Small (<=10)	81	10 (12.35)			
	Medium (11-30)	158	8 (5.06)	0.298	0.102- 0.873	0.0272
	Large (>30)	335	12 (3.58)	0.251	0.094- 0.671	0.0058
Breed	Exotic	363	28 (7.13)			
	Cross	211	2 (0.95)	0.158	0.037- 0.685	0.0102
Age (years)	<4 year	241	4 (1.66)			
	>=4 year	333	26 (7.81)	3.471	1.191-10.117	0.0225
Milking status	Non milking	189	7 (3.70)			
	Milking	385	23 (5.97)	2.443	1.108- 5.386	0.0268
BCS	Poor	207	21 (10.14)			
	Medium	124	4 (3.23)	0.264	0.088- 0.787	0.0169
	Good	243	5 (2.06)	0.175	0.061- 0.503	0.0012
Feed type	More concentrate	203	13 (6.40)			
	Equal concentrate and roughage	157	11 (7.01)	0.736	0.305- 1.775	0.4946
	More roughage	214	6 (2.80)	0.948	0.313 - 2.876	0.9254
Hoof trimming frequency	Once per 6 month	203	3 (1.48)			
	Only when lame	371	27 (7.28)	1.693	0.434 - 6.610	0.4485
Exercise	Allowed	190	3 (1.58)	0.646	0.145 - 2.879	0.5671
	Not allowed	384	27 (7.03)			
Housing hygiene	Poor	331	23 (6.95)			
	Medium	62	4 (6.45)	1.027	0.271- 3.896	0.9685
	Good	181	3 (1.66)	0.464	0.098- 2.198	0.3334

4.3. Locomotion Score for Lamé Animals

Animals with clinical signs of lameness were scored for movement in both tied and free stalls. All dairy cows with locomotion scores between 2 and 5 were classified as lame. A study of 30 animals with lameness revealed that 26.7% (N = 8) were minor lameness, 40% (N = 12) were moderate lameness, 20% (N = 6) were lame, and 13.3% (N = 4) were severe lameness. As shown in the bar graph (Figure 3), score 3 (moderately lame) was the most common recorded score, while score 5 (severely lame) was the least frequently seen score observed during the study period.

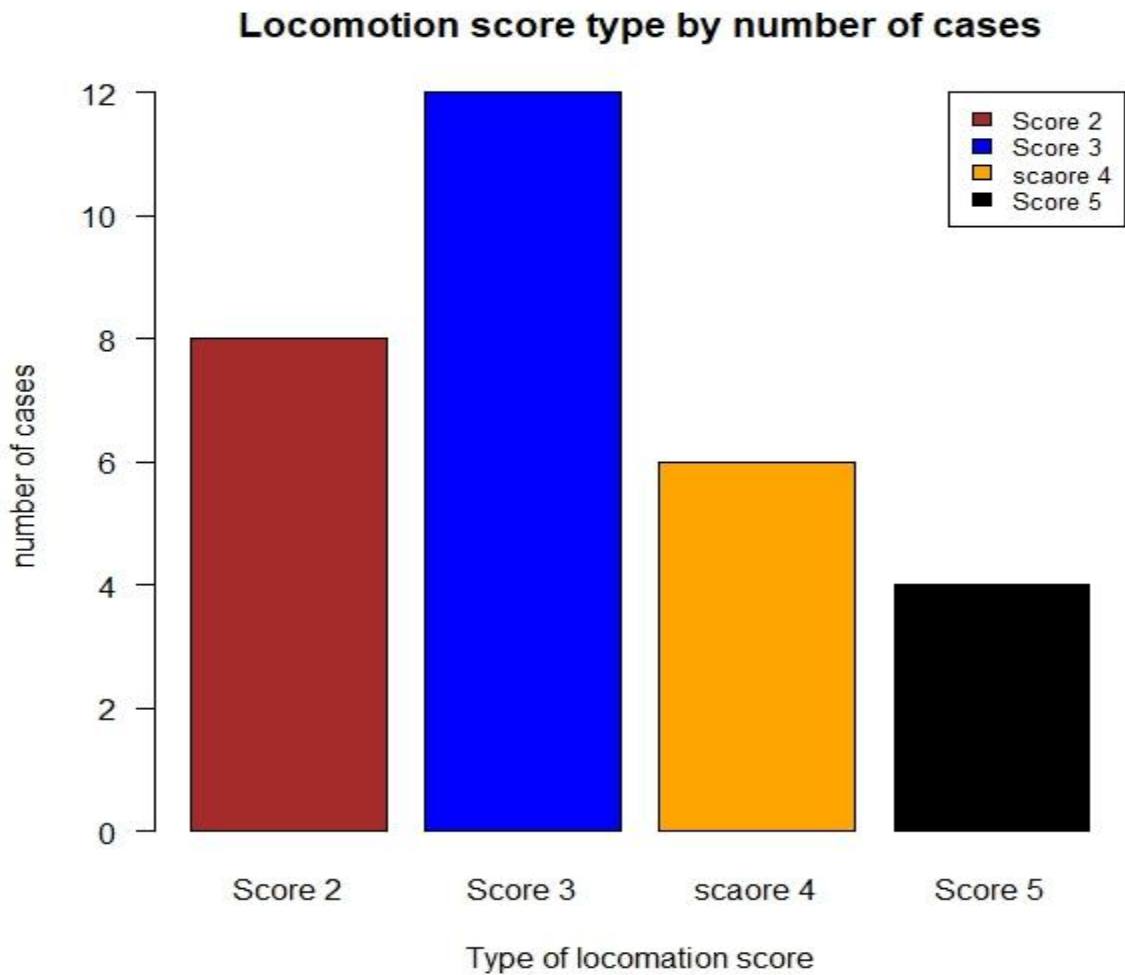


Figure 3 Bargraph indicating Degree of Lameness Score

4. 4. Incidence of Lameness across Four Limbs

The study indicated that, the affected limbs due to incidence of lameness were 7 (23.3%) Right forelimb, 5 (16.7%) Left forelimb, 6 (20%) Left Hind limb and 12 (40%) Right Hind limb respectively. The below pie chart (Figure 4) revealed that, the hind limbs were more affected 60% (18 out of 30) than the forelimbs 40% (12 out of 30) most likely because of the hind limbs' greater weight-bearing role during locomotion and standing, as well as potential environmental or management factors that expose the hind limbs to more stress or damage.

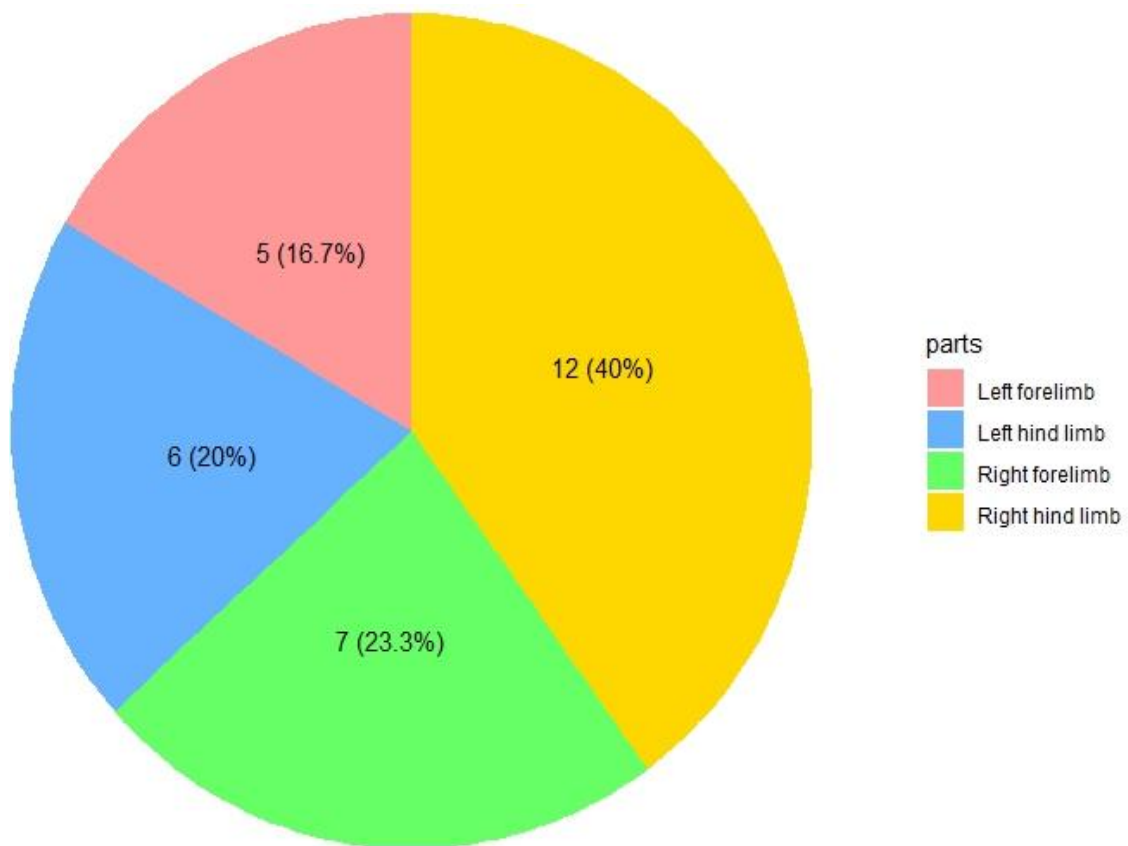
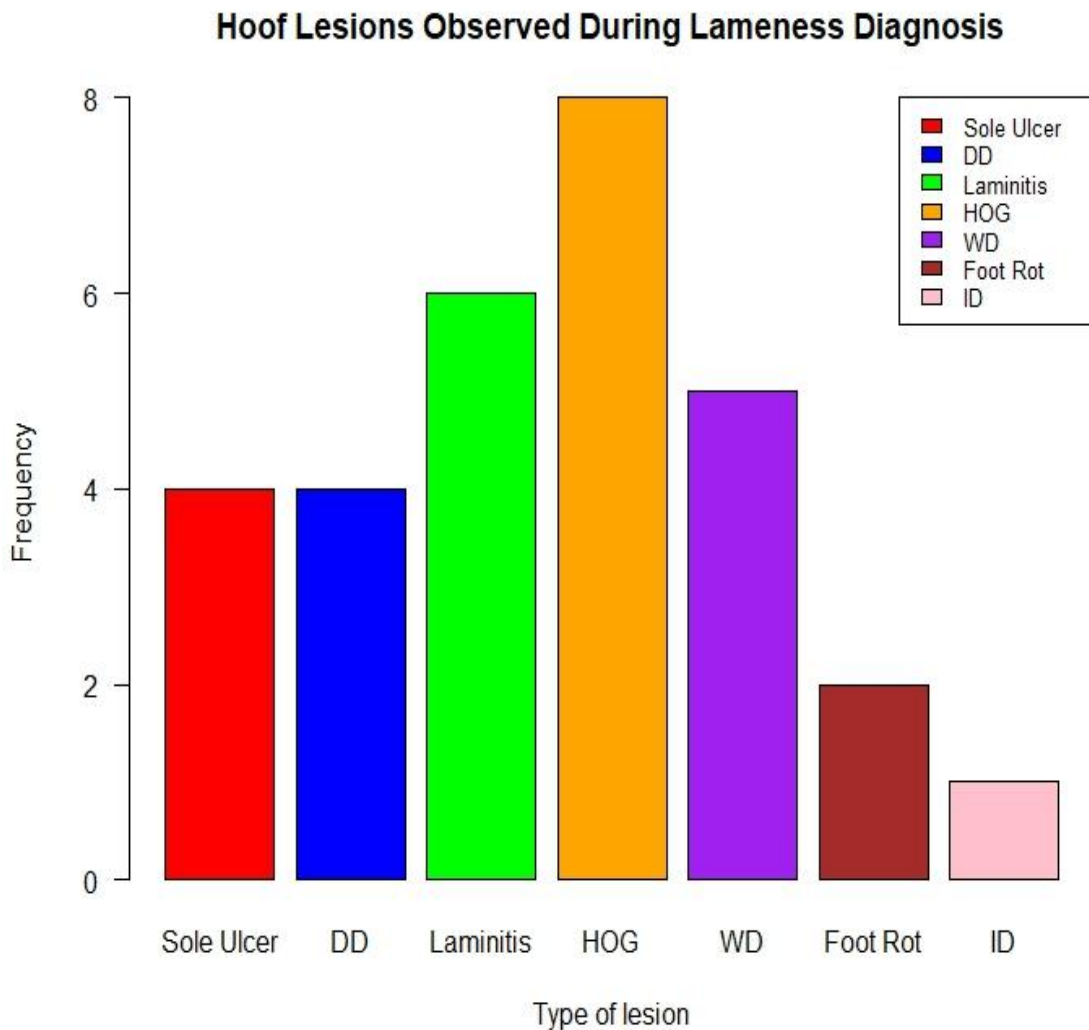


Figure 4: Percentage of Lameness Distribution by Affected Limbs Type

4.5. Hoof Abnormality Identified for Lameness Animals

The major lesion identified for the causes of lameness during the study were 26.67% (8/30) hoof overgrowth, 20% (6/30) laminitis, 16.6% (5/30) White line disease 13.33% (4/30) sole ulcer, 13.3% (4/30) Digital Dermatitis, 6.67% (2/30) Foot rot and 3.33% (1/30) Interdigital dermatitis. The study found that hoof overgrowth and laminitis were the leading causes of lameness in dairy farms, as shown by the bar graph in (Figure 5).



NB: DD= Digital dermatitis, HOG= hoof overgrowth, WD= White line diseases and ID= Interdigital Dermatitis

Figure 5: Bargraph indicating Hoof abnormality identified for lame animals

4.6. Treatment Outcomes and Recovery Time from Lameness

After treatment and follow ups, the amounts of recovered animals from lameness were recorded in order to evaluate treatment response. The current findings revealed that, out of 30 treated animals during the study period, 100% (30/30) of them fully recovered from lameness with different recovery time. Following treatment, 30 cows' recovery times were monitored to determine when they regained normal health and milk production. According to the pie chart (Figure 6), 46.7% (14 of 30) of the cows had recovered by day 14, 33.3% (10 of 30) by day 7, 13.3% (4 of 30) by day 21, and only 6.7% (2 of 30) by day 28. The present research revealed that the majority of cows recovered by day 14, indicating that the treatment was successful within the first two weeks, but a lesser number recovered later (by day 28), most likely due to the severity of their condition and how they were managed on the farm.

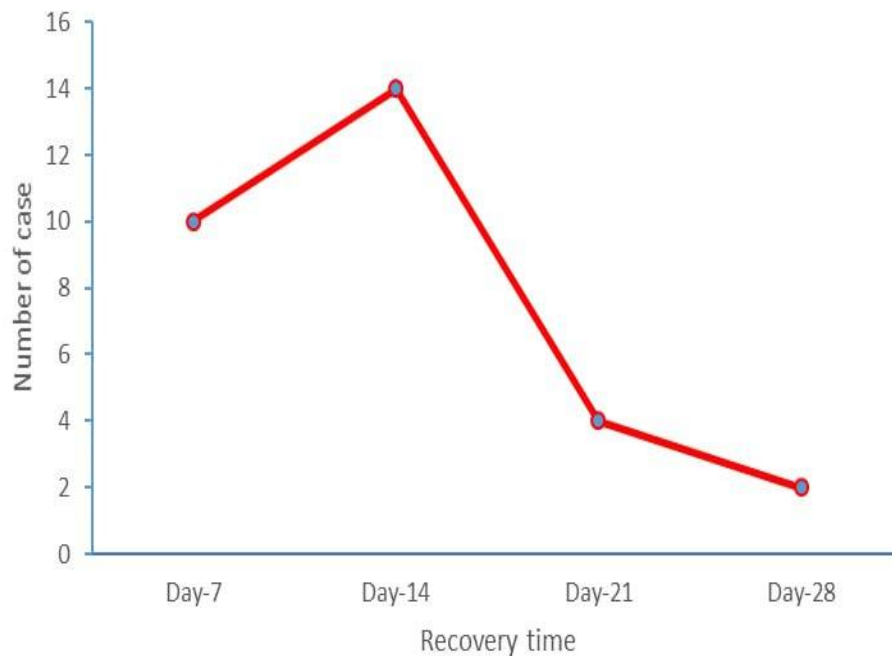


Figure 6: Line graph indicating Recovery Time for Treated Cows (N=30)

4.7. Evaluation of Treatment Effect in Lactating cows

The paired t-test in this finding revealed that, there was strong statistical difference in milk yield before and after treatment (df=29, t=11.62, p = 0.0001), with cows producing an average of 2.9 to 3.4 litter milk yield per day after treatment (Table 6). Thus, early treatment of lameness has a significant impact on milk loss reduction in dairy cows.

Table 6: Evaluation of Treatment Effect in Lactating cows (N=19)

Animal condition	No of lactating cows	Average daily milk yield	Mean(CI)	t (p) value
Before treatment	19	8.6	2.92(2.39-3.44)	11.615 (0.0001)
After treatment	19	11.5		

5. DISCUSSION

In recent years, various dairy farm systems such as small, medium, and large have been set up across different regions of Ethiopia to help address food shortages and economic challenges. However, the dairy sector hasn't delivered the expected benefits for farmers or consumers due to problems like poor farm management and common diseases such as mastitis, lameness and infertility. Although several cross-sectional studies have looked into lameness, they haven't fully solved the problems or explored its link to specific risk factors and the frequency of new cases per farm each year. In contrast, this longitudinal study identified the key causes of lameness, promoted early diagnosis and timely treatment to improve animal health and welfare, and enhanced farmers' economic outcomes by increasing milk production after treatment.

In the present finding, the incidence of lameness at cow level was 5.23% (case/100 cows over a seven month period at risk). Notably, this incidence is higher than the report that was presented by Abunna *et al.* (2018) in that 2.8% (case/100 cow-year at risk) in Bishoftu town intensive dairy farm. This incidence was approximately double that of the previous study reported at bishoftu town since, the previous study was a retrospective assessment of data sets gathered from farmers where the staff had not received formal training on how to identify, diagnosis, score, treat and follow up lame cattle, but the present study was prospective in approach and researchers undergo follow up and standard diagnosis on how to identify, diagnosis and score the extent of lameness in individual cattle. This finding also higher than the study recorded by Gitau *et al.* (1996), which found incidence rate of lameness as 1.46% per cow per month (8 cases in 548 cow per months) and Hannfors (2016), who reported 3% annual incidence rate under field condition in Bihar.

However, the incidence rate of lameness in this finding is lower than published incidence of 9.94% (cause/100 cow per year at risk) reported by Koçak *et al.* (2006) in South-eastern Anatolia region of turkey. Similarly, Eriksson *et al.* (2020) revealed a higher incidence rate (82%) depending on weekly monitoring of dry cows over a nine week period. Clarkson, *et al.* (1996) also indicated that a higher average annual incidence of

54.6% for the 37 farms new lameness cases per 100 cows. The variation in lameness incidence between the present and the previous research conducted in various regions could be due to the variation in Management practice, number of animal examined, seasonal differences, breeds type and physical status of the animals. The differences in incidence described can also be due to the variability in lameness and scoring definitions used in different country by different researchers reported by Green *et al.* (2002).

In the current finding, incidence rate at herd level was 63.3% with ranging from 0% to 22.2% within the farms. This reflects that lameness is a widespread issue across herd during this study due to lack of awareness, irregular examination of lameness and the differences in management practice in different farms. This finding is lower than the previous study done by Hedges *et al.* (2001) who reported the overall incidence rate of lameness as 68.9 per 100 cows per year with a variation of 31.6 to 111.5 per farm in United Kingdom on five commercial farms.

In present study, the IRR showed that the incidence of lameness in older animals (Aged \geq 4 years) was approximately 3.5 times higher than in young animals (Aged $<$ 4 years). This finding corresponds to previous study recorded by Gessese *et al.* (2024) in which the risk of lameness was increased more in older animal than younger. Similarly, this finding align with Tesfaye *et al.* (2024)) who reported that the occurrences of lameness was increased in older animal than younger animals. This result also aligned with many studies in the past (Bicalho *et al.*, 2008; Bicalho *et al.*, 2009) whose findings were higher lameness with advancing age. According to the literature, older aged cows have a higher likelihood of being lame than younger cows (Manske *et al.*, 2002). This is due to the fact that in older animals, hoof trauma and other claw disorder are more difficult to heal from it since their tissue's capacity for repair decreases.

In contrast to this finding, other studies (Sulayeman and Fromsa, 2012; Abunna *et al.*, 2018; Mekonin *et al.*, 2025) have reported that age was not associated with increased prevalence of a cow being lame. This difference observed among the current study and the previous one might be related to variation in herd structure (older animals in our study), management systems, culling strategies (older animals may be remaining longer

due to economic factors that expose other animals to lameness) and environmental factors that exacerbate the susceptibility of older animals in our study scenario.

The finding of the current study indicates that lameness tend to be more prevalent in cows with poor body condition scores (BCS), and a statistically significant relationship was observed between low BCS and lameness incidence. This verifies the observation that cows of lower body condition have a higher risk of lameness, which is similar with previous reports by Solano *et al.* (2015) and Patoliya *et al.* (2024). However, inconsistent results were reported by Randall *et al.* (2015), who found no statistically significant association between low BCS and lameness in all the herd groups. This variation might be due to poor management practices in the farms, methods of BCS examination, different feed types (nutrition) given to animals and milking status of the examined cows during study period. All this difference suggested that lameness is multifactorial and that BCS may be interacting with other risk factors in an interactive way.

In this study revealed, that exotic breed cows had a higher rate of lameness compared to crossbreeds. This result is similar to what Barker *et al.* (2010) reported, where Holstein-Friesian (exotic) cows were shown to have a greater risk of developing lameness. However, a study by Challa *et al.* (2018) reported the opposite that crossbred cows had more cases of lameness than exotic ones. The difference in these findings might be explained by the fact that exotic breeds tend to have softer or more delicate hooves, which makes them more vulnerable to hoof problems like injuries, sole ulcers, or infections. Also, since exotic cows are bred mainly for high milk production, their bodies face more metabolic stress. This extra pressure can lead to poor body condition and a higher risk of lameness, especially if they aren't given proper nutrition and care.

In current study, small herd sizes (1-10 cows) were more affected than large herd size (> 30 cows). In agreement with this finding, Abraham *et al.* (2024) also reported higher lameness prevalence in small (1-10) herd size than in large (>50) herd size. However, contrary to this finding, Bicalho *et al.* (2008) and Alawneh *et al.* (2011) reported lameness incidence risks of 23.3% in a study of 3,623 cows and 15.0% in a study of 463 cows from a single farm, respectively, suggesting an increase in lameness prevalence

with increasing herd size. The higher incidence of lameness observed with small herd sizes compared to large herds in this study may be caused by several factors such as lack of resources, poor record-keeping and health monitoring, less awareness of lameness detection, poor cleanliness of the housing and lack of routine hoof trimming practice in the farm.

The strong association between lameness and milking status observed in this study agrees with the result of Patoliya *et al.* (2024), who reported a higher prevalence of lameness among lactating cows compared to dry cows. This may be attributed to as hypothesized by Green *et al.* (2002). However, Randall *et al.* (2015) reported that lactation status did not show a consistent association with lameness across herds, implying that other interacting factors such as body condition, age and management practices may be more significant role. These variations highlight the multifactorial etiology of lameness as well as the importance of considering herd-specific conditions. Consequently, the hypothesis was formulated that increasing milk production could result in thinner digital cushions that expose cows to condition as sole ulcers and white line disease (Bicalho *et al.*, 2009). The current finding supports this scenario by observing lameness is more in milking cow than in drying cows, which is economically important in dairy farms due to its impact on milk production. Thus, the farmers need to offer appropriate care and early diagnosis to lactating cows for providing early treatment without missing several milk productions.

In the present study, higher concentrate supplementation of feed increases the IRR of lameness animals. This is similar with the previous finding reported by Urban-Chmiel *et al.* (2024) and Weber *et al.* (2013) who indicated that feeding high-energy diets with a low roughage-to-concentrate ratio can promote metabolic diseases in cows, including ruminal acidosis, which is associated with laminitis and lameness. However, this scenario was not accepted by Plaizier *et al.* (2008) as they noted that although cows are predisposed to SARA by high concentrate diets, the direct association between SARA and lameness is not sufficiently evident in all researches. Increased lameness among cows that fed more concentrate in this study can be due to the season of the year when farmer provide too much concentrate to cows in order to boost milk production and this exposes cows to ruminal acidosis, thereby leading to higher incidence of lameness in

lactating cows. In this study, Hind limb was most affected relative to front limb as the hind limbs are more exposed to manure and moist conditions. This finding was aligned with the previous reported studies (Hedges *et al.*, 2001; Sulayeman and Fromsa, 2012; Gessese *et al.*, 2024). The present study revealed that, trimming animal hoof every six month decreased the cases of lameness compared to trimming only when animal is lame. This is aligned with findings by Bergsten *et al* (2015) that trimming twice yearly is associated with lower prevalence of severe claw horn lesions. General, our findings and most the previous researches demonstrate that trimming hoof frequent decreases lameness incidence in dairy farms.

Hoof overgrowth (HG) was the most cause of lameness in the current study followed by laminitis. This was aligned with other researchers (Abuna *et al.* 2017; Sulayeman and Fromsa, 2012) whose report shows the same results. Another report by (Bell 2015) also registered the same result. The high occurrences of hoof overgrowth and laminitis in this study may be attributed to several management-related factors, including a lack of regular exercise activity, infrequent hoof trimming practices, excessive supplementation of concentrate feed and long time standing of cows on slippery or concrete flooring. These conditions can predispose dairy cow to lameness by altering the structure of the hoof and causing metabolic disturbances that weaken the hoof tissues.

This research indicated that, the IRR of lameness was high in poor housing hygiene. Consistent to the current study, the previous studies reported by Patoliya *et al.* (2024) and Solano *et al.* (2015) showed that dirty conditions predispose cows to lameness. However, in opposite to this study Kabeba (2017) reported no significant association between frequency of barn cleaning and lameness in the farms. This study showed that, floor type was not statically significant risk factors for lameness incidence. However, the finding reported by Abuna *et al.* (2017) revealed that floor type as a significant risk factor for lameness in intensive dairy farms.

The current study showed that, all of the treated cows (100%) 30 out of 30 were fully responded to treatment with different recovery time. This indicated that, the treatment was successfully conducted because of early detection and treatment during follow-up

period. In this study, majority of animals recovered at day 14 followed by day 7 while only few of them become non lame at day 28. So, the median day when animal become sound is 14 day since around 50% of animals recovered at day 14. This is approximately similar with (Mason *et al*, 2023) who reported the overall median days from lameness to becoming normal was 18 days and it took 7 days for at least 10% of animals to become normal, 11 days for 25%, 28 days for 75% and 35 days for 90%. In other word the recovery time from lameness in the current study was lower than the previous research done by Thomas *et al*. (2015) who reported in a randomized clinical trial on acutely lame animals in the UK, soundness cure risks of 24–55% was at 35 days after treatment. In opposite to current study, Sadiq *et al*, (2022) reported that 40-75% of lame animals had returned to normal health by 28 days.

The variation between recovery times from the current study compared to the previous study may be due to several factors. Firstly, the use of a treatment protocols including timely hoof trimming, use of anti-inflammatory, administration of antibiotic played a significant role in enhancing the healing process. Secondly, early detection and immediate treatment of lameness at frequent follow-up visits by researchers in current study most likely contributed to better outcomes and allowing for faster recovery. Moreover, utilization of meloxicam as the anti-inflammatory and analgesic drug employed in this study may have had a dramatic impact on recovery time.

In this study, mean daily milk yield of lame cow after treatment (11.5) was higher than mean daily milk yield of lame cow before treatment (8.6) and on average cows produce 2.4 to 3.4 litter milk yield per day post-treatment. The study shows that there was strong significant difference milk yield between before and after treatment. The current study align with the Previous study by Green *et al*. (2010) who reported for all causes of lameness, milk yield increased in the month following treatment 1,635 Holstein Friesian cows from seven farms. Statistically strong difference between pre- and post-treatment milk yields in the current study emphasizes the importance of early diagnosis and effective management of lameness during the study time. Thus, treating lameness can help sustain milk output, improve animal health and optimize farm performance in general.

5. CONCLUSSION AND RECOMMENDATIONS

The Incidence of Lameness is very high in the study area, especially among lactating, older, poorly conditioned and exotic breed cows with a lot of variation between farms. The most common causes of lameness were hoof overgrowth followed by laminitis. Hind limbs were more frequently affected than forelimbs and locomotion score 3 was the most frequently observed during the study period. All treated cows achieved a full response to treatment, with most of them becoming sound by day 14 after treatment. A significant increased milk production following treatment proves the benefit of early diagnosis and proper treatment. However, the study had certain limitations, such as relaying on visual gait evaluation, which can be subjective and less reliable than modern automated systems, furthermore, the study's seven month duration limited the ability to asses-long term trends and seasonal impacts on lameness. So, based on these conclusions the following recommendations were given.

- Providing farmer awareness on lameness risk factors and its economic impact should be conducted.
- Early detection and timely treatment of lameness should be implemented to reduce recovery time.
- A long-term study (more than seven months) is recommended to better understand the link between lameness, seasonal risk factors, and economic burden.
- Automated lameness detection systems that use sensors or alert-based technologies should be conducted by other researchers to get correct definition of lameness.

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7. ANNEXIS

Annex 1: Personal Check List for Lameness Risk Factors in the Farm

Name of farm-----owner's name-----year of service-----
place---

1. Herd size-----numbers of cows-----Heifers----- Calves-----

2. Name of (ear tag no) of the cow----- age-----

3. Breed of animal: Exotic-----cross-----

4. Milking status: milking (lactating) -----non milking (dry)

5. Body Condition Score (BCS): poor (1-2) -----medium (3) -----good (4-5) -----

6. Exercise activity: Allowed to exercise-----not allowed to exercise-----

7. Types of production system intensive-----semi-intensive- -----extensive-----

8. Are the animals allowed to exercises yes -----No-----

9. Types of floor of the stall concrete-----Soil-----Stone layered-----Wood layered-----
-

10. Types of animal the animals are feed; more concentrate----- equal concentrate and
roughage----- more roughage -----

11. Hoof trimming frequency: Once per 6 month-----Only when lame-----

12. Identification of foot lesion (Hoof abnormality)

Solar ulcer RF-----RH-----LF----- LH-----

Digital dermatitis RF-----RH-----LF-----LH-----

White Line Disease: RF-----RH-----LF-----LH

Laminitis: RF-----RH-----LF-----LH

Foot Rot: RF-----RH-----LF-----LH----

Hoof over growth: RF-----RH-----LF-----LH

Interdigital dermatitis RF-----RH-----LF-----LH-----

Both claw overgrowth RF-----RH-----LF-----LH---

Unequal size claw RF-----RH-----LF-----LH-----

Annex 2: Lameness Assessment Procedures

2.1. Assessing Lameness in Tied Stalls Cows:

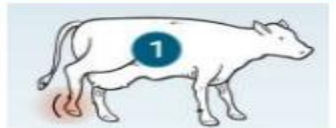

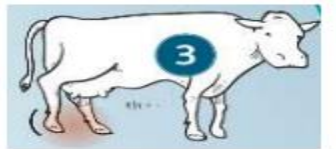
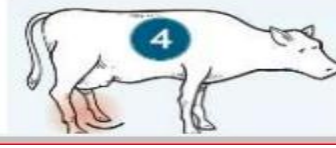
First step: Any cows that were lying down were encouraged to rise and left for at least 3 minute before being assessed (allows for urination/defecation and recovery of balance).

Second step: Then observe the cows to assess their locomotion. If the cow urinates or defecates during the assessment, stop scoring and return to assess her later, or ignore the behaviors just before and during urination or defecation, and continue scoring once the animal has returned to normal resting posture.

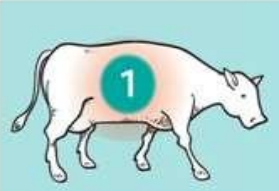
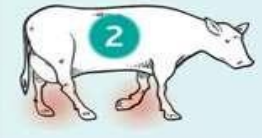
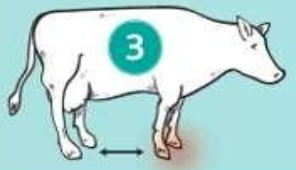
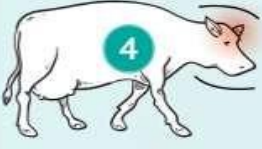
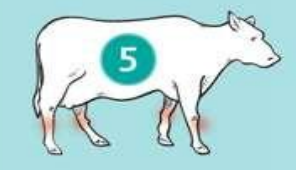
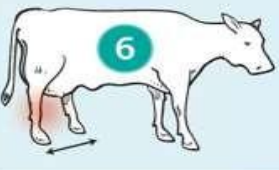
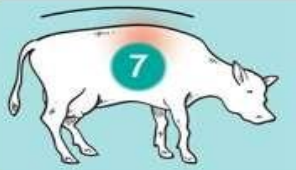
Third step: Stand approximately one meter away and to one side of the cow to get a good view of both her front and hind feet.

Forth step: Then take a full minute to observe each foot for frequent ‘stepping’ (shifting weight from one foot to another), resting a foot (one more than the other), standing on the edge of a step and unwillingness to bear weight on a foot (Leach *et al.*, 2009).

Fifth step: Record the presence of **EDGE**, **SHIFT** and **REST** indicators for each position

WEIGHT SHIFT	Regular, repeated shifting of weight from one hoof to another. Repeated shifting is defined as lifting each hind hoof at least twice off the ground (L-R-L-R or vice versa). The hoof must be lifted and returned to the same location and does not include stepping forward or backward	
EDGE	Placement of one or more hooves on the edge of the stall while standing stationary. Standing on the edge of a step when stationary, typically to relieve pressure on one part of the claw (Figure 1). This does not refer to when both hind hooves are in the gutter or when cow briefly places her hoof on the edge during a movement/step.	
UNEVEN WEIGHT (REST)	Repeated resting of one foot more than the other as indicated by the cow raising a part or the entire hoof off the ground. This does NOT include raising of the hoof to lick or during kicking (Figure 2).	
Cow moved from side to side		
UNEVEN MOVEMENT	Uneven weight bearing between hooves when the cow was encouraged to move from side to side. This is demonstrated by greater rapid movement of one hoof relative to the other, or by an evident reluctance to bear weight on a particular foot.	

2.2. Assessment of Cow in Free Stall: In this method, animals were examined when they were moving (exercise, watering and while they are going to milking to milking parlor) for finding any type of locomotion and animals moving with apparent abduction or adduction, hobbling, exhibited distinctly impaired movement with irregular stride length and seemed unwilling to support weight on one or more limbs were diagnosed as lame.

 <p>1</p> <p>Reluctance to bear weight Cows redistribute weight to prevent weight bearing on the painful limb, resulting in a limp.</p>	 <p>2</p> <p>Asymmetric/irregular stepping Non-lame cows have a regular pattern and rhythm when walking; lame cows may have an uneven rhythm as they spend less time using a painful limb.</p>
 <p>3</p> <p>Poor tracking Rear hooves of sound cows generally follow in the tracks of the front hooves; rear hooves of lame cows may not, as cows will be short-strided.</p>	 <p>4</p> <p>Jerky head movement Sound cows have a steady head carriage and move their heads up and down slightly and consistently; lame cows may show jerky head motions as they use their head to reduce weight bearing on sore limbs or feet.</p>
 <p>5</p> <p>Joint stiffness Limb and back movement of non-lame cows is smooth and fluid, with good joint flexion and extension.</p>	 <p>6</p> <p>Rear leg lateral movement Viewed from the rear, rear legs of lame cows will sometimes move out or in a semi-circular motion to avoid leg flexion or weight bearing on sore claws.</p>
 <p>7</p> <p>Arched back Non-lame cows tend to walk with a straight and flexible back. Lame cows may have a fixed upward arch to their back.</p>	

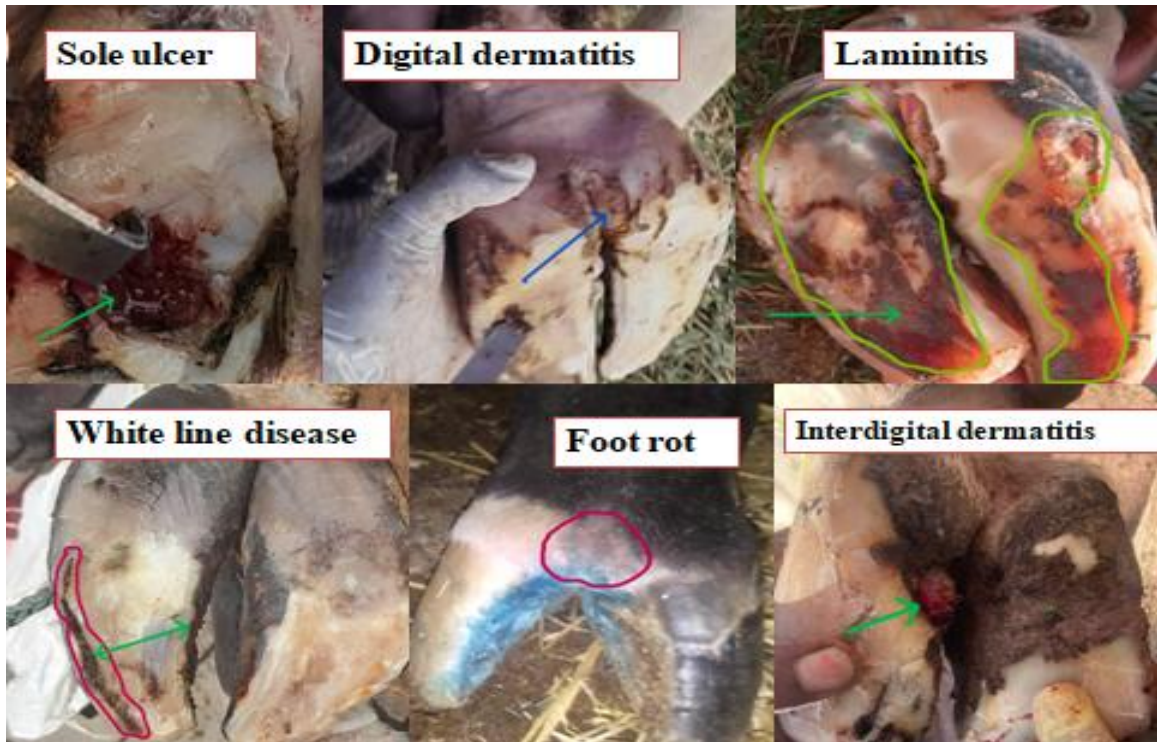
Annex 3: Image indicating 2 to 5 point Locomotion Scoring



Annex 4: Image indicating Lameness Examination



Annex 5: Image indicating Hoof Abnormality during Study Period



Annex 6: Applying Topical Spray, Bandage on affected sole and recovered cows



Annex 7: Welfare Principles Check list during Lameness Diagnosis and Treatment

1. Use proper restraint methods

- Use humane restraint methods (e.g., a well-maintained crush).
- Avoid overly tight or restrictive restraints that may cause discomfort or injury.
- Ensure **proper restraint** that does not add discomfort during examination or treatment

2. Minimizing Stress and handling animals gently

-
- Use low-stress handling techniques to reduce stress during examination and treatment
- Avoid shouting, hitting, or using electric prods.
- Ensure the cow is familiar with the handling facilities

3. Pain Management

Administer non-steroidal anti-inflammatory drugs (NSAIDs) to relieve pain.

- Consider local anesthetics when performing hoof trimming or corrective procedures.
- Ensure proper hoof trimming to relieve pressure on the affected limb.

4. Provide a Comfortable Environment during examination

- Provide a clean, dry, and non-slip surface for examination during scoring
- Minimize loud noises, sudden movements, or distractions in the treatment area.
-

5. Time Management

-
- Minimize the time the cow spends restrained to reduce stress.
- Plan diagnostic procedures efficiently to avoid prolonged discomfort

Annex 8: Picture of Equipment used for Lameness Diagnosis and Treatment



Annex 9: Five steps for Clinical Examination of Lame Cow

Step 1: Observe cow in motion to identify which leg is lame

- ✓ if Head down, check the hind leg
- ✓ if Head up check the forelimb
- ✓ Use a lameness scoring system (e.g., a 5-point scale) to assess severity.

Step 2: Inspect the hoof and limb of lamed cow

- ✓ Lift the affected limb and clean the hoof to check for injuries, swelling, or foreign objects to find foot rot, sole ulcer, Digital dermatitis and etc
- ✓ Examine the sole, white line, interdigital space, and hoof wall for cracks (sand crack) ulcers, or infections.

Step 3: Check any crack on external surface of the hoof of lame leg

- ✓ if there is vertical and horizontal crack it may be sand crack and axial wall crack

Step 4: Clean the surface of hoof with brush and water

- ✓ to see if there is swelling, damaged skin, and bad smell between the toe, and discoloration on the hoof

Step 5: Remove any damaged skin on sole, overgrown wall horn and dead tissue to identify the diseases

- ✓ if red discoloration with bleeding and ulcer, it is sole ulcer
- ✓ if there is dark separation between the junction of wall and sole, it is white line diseases
- ✓ if Red paint splashes, spot or in sole without bleeding, it is possible laminiti

Annex 10: Body Condition scoring of scale 1 to 5

Body parts	Scoring (scale 1 to 5)
BCS 1	
Short ribs •	Ends sharp to touch •Loin prominent, shelf-like appearance • Obvious scalloping over top and ends
Backbone	•Vertebrae prominent in chine, loin, and rump area • Individual bones easily visible
Hook and pin bones •	Sharply defined, very angular in appearance • No discernable fat pa
Tail head	•Sunken and hollow on either side of tail head with obvious folds of

	skin • Ligaments connecting pin bones to spine are sharply defined • Vulva prominent
BCS 2	
Short ribs	<ul style="list-style-type: none"> • Ends not as prominent as BCS 1, but can be felt • Edges easily felt, with slight fat cover, and slightly more rounded appearance • Overhanging shelf effect less apparent
Backbone	<ul style="list-style-type: none"> • Vertebrae in chine, loin and rump area, less visually distinct • Easily feel individual vertebrae
Hook and pin bones	<ul style="list-style-type: none"> • Bones still prominent, angular • No fat pad palpable
Tail head	<ul style="list-style-type: none"> • Both sides of the tail head are sunken and hollow • Sharply defined ligaments connecting pin bones to spine
BCS 3	
Short ribs • Ends can be felt with	<ul style="list-style-type: none"> • moderate pressure • Ribs appear smooth without noticeable scalloping • Overhanging shelf effect much less apparent
Backbone	<ul style="list-style-type: none"> • Vertebrae in chine, loin and rump area appear rounded • Backbone visible, but individual vertebrae not distinct
Hook and pin bones	<ul style="list-style-type: none"> • Visible, but smooth, with rounded appearance • Fat pad palpable
Tail head	<ul style="list-style-type: none"> • Both sides of tail head somewhat hollow, but skin folds not distinct • Ligaments connecting pin bones to spine are rounded in appearance
BCS 4	
Short ribs	<ul style="list-style-type: none"> • Individual rib ends not visible, only felt with firm pressure • Overhanging shelf effect slight, barely visible
Backbone	<ul style="list-style-type: none"> • Vertebrae in chine rounded, smooth • Loin and rump areas appear flat
Hook and pin bones	Rounded, with obvious fat coverin
BCS 5	
Short ribs	<ul style="list-style-type: none"> • Ends can't be seen or felt • No overhanging shelf effect
Backbone	<ul style="list-style-type: none"> • Vertebrae in chine, loin and rump not visible • Difficult to feel individual vertebrae
Hook and pin bones	<ul style="list-style-type: none"> • Very round, buried (almost disappearing) in fat tissue
Tail	head • Hollow filled in • Areas on both sides of tail head buried in fat tissue

Source: (Anonymous, 2024).

Annex 11: Picture of Ethical Clearance Certificate

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ADDIS ABABA UNIVERSITY
College of Veterinary Medicine
and Agriculture
Bishoftu

Animal Research Ethical Review Committee

Ethical clearance certificate

Certificate Ref. No: VM/ERC/04/57/17/2025

Name of Applicant: **Ayana Bane Desta** (DVM, MSc student)

Address: Department of Clinical Studies, College of Veterinary Medicine and Agriculture, Addis Ababa University

Title of the project *Incidence of Lameness, associated risk factors, treatment response and milk loss reduction in Bishoftu Dairy Farms*

Date of application: **December, 2024**
 Nature of the project: **Farm investigation**
 Target animal species: **Dairy cattle**
 Number of animals involved: **574**
 Study area: **Bishoftu, Ethiopia**

Minutes No. and date of review: **VM/ERC/04/17/025, 25/02/2025**

The Institutional Animal Care and Use Committee of the College of Veterinary Medicine and Agriculture of the Addis Ababa University has reviewed the above research project and unanimously approved the application of Ayana Bane.

Professor Getachew Terefe (DVM, PhD)
Chairman



(Handwritten signature)

Signature

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DEPARTMENT OF CLINICAL STUDIES

INCIDENCE OF LAMENESS, ASSOCIATED RISK FACTORS, TREATMENT
RESPONSE AND MILK YIELD LOSS REDUCTION IN BISHOFTU DAIRY
FARMS, OROMIA, ETHIOPIA

MVSc RESEARCH THESIS

BY:

AYANA BANE

ADVISOR: FIKADU REGASSA (DVM, MSc, PhD, PROFESSOR)

CO-ADVISOR: TESHIALE SORI (DVM, MSc, PhD, PROFESSOR)

JUNE, 2025
BISHOFTU, ETHIOPIA

INCIDENCE OF LAMENESS, ASSOCIATED RISK FACTORS, TREATMENT RESPONSE AND MILK YIELD LOSS REDUCTION IN BISHOFTU DAIRY FARMS, OROMIA, ETHIOPIA By AYANA BANE

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