

# **Welfare assessment of hoof health in intensively managed dairy cattle**



By:

**Md. Tanvir-Ul- Alam**

**Roll No: 16/55; Reg No: 01674**

**Intern ID: 48**

**Session: 2015-2016**

A clinical report submitted in partial satisfaction of the requirements for the  
Degree of Doctor of Veterinary Medicine (DVM)

**Faculty of Veterinary Medicine  
Chattogram Veterinary and Animal Sciences University  
Khulshi, Chattogram-4225, Bangladesh**

October 2021

# **Welfare assessment of hoof health in intensively managed dairy cattle**



A Clinical Report submitted as per approved style and content

-----  
**Signature of Author**

**Md. Tanvir-Ul-Alam**

Roll No:16/55

Reg No: 01674

Intern ID: 48

Session: 2015-2016

-----  
**Signature of Supervisor**

**Dr. Mohammad Rashedul Alam**

Professor

Department of Physiology, Biochemistry  
and Pharmacology

Chattogram Veterinary and Animal  
Sciences University

**Faculty of Veterinary Medicine**  
**Chattogram Veterinary and Animal Sciences University**  
**Khulshi, Chattogram-4225, Bangladesh**

October 2021

# **List of Contents**

<b>Acknowledgment.....</b>	<b>iii</b>
<b>Abstract.....</b>	<b>iv</b>
<b>Chapter-I: Introduction .....</b>	<b>1-2</b>
<b>Chapter-II: Meterials and Method .....</b>	<b>3-6</b>
2.1 Study area and duration .....	3
2.2 Study design .....	3
2.3 Farm location and population .....	3
2.4 Physical examination of hooves .....	4
2.5 Data collection.....	6
2.6 Statistical analysis.....	6
<b>Chapter-III: Results .....</b>	<b>9-11</b>
<b>Chapter IV: Discussion .....</b>	<b>12-14</b>
4.1 Prevalence of hoof abnormalities .....	12
4.2 Relation between hoof abnormalities with lameness .....	12
<b>Chapter-V: Conclusion .....</b>	<b>15</b>
<b>Recommendation .....</b>	<b>15</b>
<b>Chapter-VI: References .....</b>	<b>16-18</b>
<b>Appendix.....</b>	<b>18-21</b>
<b>Biography .....</b>	<b>24</b>

## **List of Tables**

<b>Table 1: Farm location and population in studied area.....</b>	<b>3-4</b>
<b>Table 2: Definition of different abnormalities of hooves.....</b>	<b>5</b>
<b>Table 3: Prevalence of different hoof abnormalities in reported area.....</b>	<b>9</b>
<b>Table 4: Association of different hooves abnormalities with lameness.....</b>	<b>10-11</b>

## **List of Figures**

<b>Figure 1: Interdigital dermatitis.....</b>	<b>07</b>
<b>Figure 2: Digital dermatitis.....</b>	<b>07</b>
<b>Figure 3: Un-uniform length of hoof.....</b>	<b>07</b>
<b>Figure 4: Sole ulcer.....</b>	<b>07</b>
<b>Figure 5: Cock screw hoof.....</b>	<b>08</b>
<b>Figure 6: Curled claw.....</b>	<b>08</b>
<b>Figure 7: Heel erosion.....</b>	<b>08</b>
<b>Figure 8: White line disease.....</b>	<b>08</b>

## ***Acknowledgment***

*All the praises go to the Almighty Allah, the creator and supreme ruler of the universe, who enabled the author to complete the work successfully.*

*The author expresses his sincere gratitude, humble respect and immense indebtedness to his supervisor Professor Dr. Mohammad Rashedul Alam, Department of Physiology, Biochemistry and Pharmacology, Chattogram Veterinary and Animal Sciences University for his guidance, kind co-operation, sincere help, valuable suggestions, constructive criticism and for his active involvement with this study from its inception. The author also expresses his gratitude and deep sense of respect to all of his friends and well-wishers for their support and inspiration throughout the study period and for preparing this report.*

*Last but not least, the author extended his appreciation to all of his teachers and his parents for their unforgettable support, suggestion, criticism and cordial help from its inception to the last of his study.*

***Author***  
***October 2021***

## **Alam, MTU (2021): Welfare assessment of hoof health in intensively managed dairy cattle**

### **Abstract**

The objective of this study was to assess the welfare of hoof and its predisposing factor in intensively managed dairy cow. A total of 139 dairy cows at 8 dairy farms in the Narsingdi and Chattogram districts were investigated. The prevalence of different hoof abnormalities and their association with lameness was evaluated in studied cow. The result showed that, un-uniform length of hooves and curled claw were mostly prevalent (35.6%, each) at the studied farms. Moreover, digital dermatitis, heel horn erosion, cock screw hoof, sole ulcer, white line disease, interdigital dermatitis and interdigital hyperplasia were 34.5%, 21.6%, 11.5%, 10.7%, 7.2%, 5.8% and 0.7%, respectively. Lameness was present in 53% cow having sole ulcer. 55%, 20%, 13.8%, 25%, 37.5%, 20%, 100%, 16.3% lameness occurred due to the presence of white line disease, cock screw hoof, interdigital dermatitis, heel erosions, interdigital hyperplasia, curled claw hooves respectively. Lameness was found to be significantly ( $p < 0.001$ ) associated with sole ulcer, interdigital hyperplasia and interdigital dermatitis. This study is concluded that hoof abnormalities are significantly responsible for lameness. If hoof health welfare will be improved at farms, dairy farming will be more sustainable.

---

**Keywords:** Hoof health, Lameness, Welfare, Dairy cow

# **Chapter-I**

## **Introduction**

The economy of Bangladesh is based primarily on agriculture, and livestock is an essential component of the rural economy. Dairying is one of the major components of animal agriculture and part of mixed farming system in Bangladesh (Saadullah, 2001). In Bangladesh, the demand for milk and milk products is increasing because of the rapid increase population and growing nutrition awareness. The World Health Organization (WHO) has recommended 250 ml milk consumption per person every day. However, at present the country is producing only 43% of the milk demand in Bangladesh (DLS 2013-2014). Miyan (1996) stated that dairying is the predominant source of income generation. For sustainable dairy farming, welfare of the animal should be ensured.

Animal welfare is relatively new topic in Bangladesh. The welfare of an animal has been defined as “its state as regards its attempts to cope with its environment” (Broom, 1996) or as “the satisfaction of wants and desires” (Duncan, 1996). The term is more used in commercial animal farming as it is indirectly related with the production amount and the performance of the animal. Animal health and welfare planning constitutes an approach to integrate farmers participation and encouragement. Previously animal welfare was understood to relate just to major concerns, such as serious hunger, thirst, injuries and illness. For many years, welfare considerations have included discomfort, distress, fear, pain and absence of normal behavior (Stull et. al., 2005). It is now multidimensional concept that includes physical and mental health, the absence of hunger and provision for a manifestation of the typical behavior for that species (Webster, 2005).

The importance of hoof health is immense to build a sustainable dairy farm. A cow hoof is cloven, or divided, into two approximately equal parts, usually called claws, which is weight bearing organ. The weight is pretty evenly placed around the hooves. Approximately 95% lameness in dairy cattle occurs in the feet (Murray et. al,1996). For dairy farm profitability, lameness is the third most important cow health issue, behind only infertility and mastitis. Hoof health and lameness are major issues in dairy cattle that can cause tremendous economic losses. Lameness in dairy cattle is a continuing problem that greatly affects the welfare of the animals (FAWC, 1997). Several factors that affect dairy cattle lameness have been suggested.

Housing environment (e, g. pasture, concrete floors) has been found to be significantly associated with locomotive problems (Gitau et. al., 1996; Somers., 2003).

Depending on severity, the following losses components can be identified: body weight loss (Neveux et. al., 2016), decreased milk production (Green et. al., 2002; Huxley 2013), decreased dry matter intake (Charfeddine and Perez-Cabal, 2017), decreased herd longevity (Randall et al, 2016), and impaired reproductive efficiency (Bruijnis et. al., 2010). Prevention, early detection, and prompt treatment can minimize losses, improve recovery, and reduce animal suffering (Osorio et.al., 2016). Increasing dairy farmers awareness regarding foot health and following best practices could reduce the economic consequences while simultaneously could improve animal welfare (Bruijnis et. al., 2010). Regular hoof care (hoof trimming, disinfection) may increase the chances of good hoof health, but improper use of footbaths can potentially even do more damage than good (Holzhauer et. al., 2008).

In Bangladesh, dairy cattle reared mostly in intensive condition, that's why the animal cannot show their normal physical activity. As they stand longer period at the same place and no chance of physical activity, the weight bearing organ hoof are mostly affected and found different abnormality in the hooves. The common hoof abnormalities include presence of foreign material in sole, cock screw hoof, interdigital dermatitis, vertical and horizontal fissure, Un-uniform length of hooves, curled claw, sole ulcer, digital dermatitis, heel erosion, white line disease etc. For above mentioned reasons, in this investigation an attempt was made to study about hoof health welfare in intensive dairy farming. The objective of the present study was;

1. To investigate the hoof welfare of intensively managed dairy cow
2. To find out predisposing factors, that are associated to hoof health abnormalities



## Chapter-II

### Materials and Method

#### 2.1 Study area and duration

The study was undertaken in Shibpur Upazila under Narsingdi district and Potenga, Hathazari, Chandgoan upazila under Chattrogram district of Bangladesh. The areas are rich in dairy population, and this type of study was not conducted before this area, that's why the areas are chosen for this study. The timeline for this study was from 15<sup>th</sup> February 2021 to 20<sup>th</sup> September 2021. Due to corona pandemic, access to all the dairy farms in study area was not managed. That's why the study population was short to conduct proper survey.

#### 2.2 Study design

The farms were chosen in random manner and each farm consisting of at least 5 dairy cows. A total of 139 dairy cows were studied from 8 dairy farms under Narsingdi and Chattrogram districts. Each district included four farms. In Narsingdi district, four farms include 35 cows and in Chattrogram four farms contain 104 cows. In Narsingdi district, dairy farming is growing day by day.

#### 2.3 Farm location and population

In table-1, farms location and population of each farm were described. Farm population varies farm to farm, it depends on farmers capacity, experiences, willingness of farming, profit of farming etc. In Chattrogram district, the population size is higher than Narsingdi districts. Most farms in Chattrogram district are located near the main cities, transportation and marketing facilities are good comparative to Narsingdi. That's why farmers are more interested to increase the number of farms population.

**Table 1: Farm location and population in studied area**

Name of farms	Location	Total population	Age of farming (years)
Sayem Agro	Dulalpur, Shibpur, Narsingdi	10	4
ZR agro farm	Dulalpur, Shibpur, Narsingdi	10	4

Tareq- Sabbir farm	Polash, Narsingdi	8	2
Amar khamar	Manikdi, Narsingdi	7	3
Molla dairy farm	South Potenga, Chattrogram	30	30
Jarif dairy farm	West sikhapur, Hathazari, Chattrogram	27	30
The Farmory	Mohora, Chandgaon, Chattrogram	13	3
Wellagro	Mohora, Chandgaon, Chattrogram	34	7

## 2.4 Physical examination of hooves

Physical examination of hooves was carried out for each animal. All the signs and symptoms were recorded during examination. The hooves were examined after showering of the cows. During examination the animal was restrained properly and examined the hoof carefully by avoiding any discomfort of the animal. Physical examination includes close and distant inspection, palpation of different parts of hooves of animal. Distant inspection was used to examine the hock joint and knee joint, cock screw hoof, un-uniform length of hooves. Close inspection was used to detect the vertical and horizontal fissure, interdigital hyperplasia, fresh or hairy wart. Palpation method was applied and examine hoof wall, sole ulcer, digital dermatitis, white line disease, heel erosion, interdigital dermatitis etc. The abnormalities of hoof were defined in table 2.

**Table 2: Definition of different abnormalities of hooves**

<b>Traits</b>	<b>Definition</b>
<b>White line disease</b>	White line disease is characterized by hemorrhage into or separation(avulsion)of the abaxial wall, most commonly at the heel-sole junction.
<b>Sole ulcer</b>	A sole ulcer is a circumscribed lesion located in the region of the sole/bulb junction, usually nearer the axial than abaxial margin
<b>Digital dermatitis</b>	Dermatitis in the adjacent skin of the hoof.
<b>Un-uniform hooves</b>	Distinct difference between the length of two claws
<b>Heel erosion</b>	A change in the appearance of the surface of the bulb of the heel
<b>Interdigital dermatitis</b>	Dermatitis between the digits
<b>Interdigital hyperplasia</b>	Outward growth between the digits
<b>Vertical fissure</b>	Sand cracks or cracks in the wall of the claw
<b>Horizontal fissure</b>	Run parallel to the coronary band
<b>Cock screw claw</b>	Twisted throughout its length in a configuration that displaces the abaxial wall by up to 360 degrees.
<b>Curled claw</b>	Inward curling of the claw of the hoof
<b>Hock joint</b>	In bow legged, the hock will go outward. In cow hocked the hock will come inward
<b>Knee joint</b>	A vertical line may be drawn from the point of shoulder to the middle of the claw. This line should intersect the knee in normal. In bow legged the knee will go outward and in knock kneed the knee will go inward

## **2.5 Data collection**

A questionnaire was made according to the objectives of the study. Maintaining the information related to the prepared study, the questionnaire was built. There were both open ended and close ended questions and the data were collected by face-to-face interview. The hoof related issues were mostly emphasized during the questionnaire building. The species, age, sex, breed, pregnancy, present lactation number, last parturition date, lameness, acidosis, mastitis with fever, FMD, last trimming date history were recorded.

## **2.6 Statistical analysis**

The collected data were analyzed with mainly in tabular method. The collected data were calculated and analyzed in MS excel software. The frequency, percentages, means were calculated to explain data scientifically. Associations in different factors were done by Chi-square test in STATA-14 (Stata corps, Texas, USA). The probability level of significance was considered as  $p < 0.05$ .

## Figures of hoof abnormalities in studied dairy farms



**Figure 1: Interdigital dermatitis**



**Figure 2: Digital dermatitis**



**Figure 3: Un-uniform length of hooves**



**Figure 4: Sole ulcer**





**Figure 5: Cock screw hoof**



**Figure 6: Curled claw**



**Figure 7: Heel erosion**



**Figure 8: White line disease**

## Chapter-III

### Results

**Table 3: Prevalence of different hoof abnormalities in reported area (n=139)**

Variable	Category	Number (n)	Prevalence (%)
White line disease	Absent	129	92.8
	Present	10	7.2
Cock screw hoof	Absent	123	88.5
	Present	16	11.5
Interdigital dermatitis	Absent	131	94.2
	Present	8	5.8
Ununiform hooves	Absent	90	64.8
	Present	49	35.2
Sole ulcer	Absent	124	89.2
	Present	15	10.7
Digital dermatitis	Absent	91	65.5
	Present	48	34.5
Heel erosion	Absent	109	78.4
	Present	30	21.6
Interdigital hyperplasia	Absent	138	99.3
	Present	1	0.7
Curled claw	Absent	90	64.8
	Present	49	35.3

In table 3, result of different hoof abnormalities was shown. From table 3, it was reported that un-uniform length of hooves and curled claw were mostly prevalent (35.3% each) in reported area followed by digital dermatitis (34.5%), heel horn erosion (21.6%), cock screw hoof (11.5%), sole ulcer (10.7%), white line disease (7.2%), interdigital dermatitis (5.8%) and interdigital hyperplasia (0.7%).

**Table 4: Association of different hooves abnormalities with lameness (n=139)**

Variable	Exposure group (n)	Lameness (%)	P- value
Sole ulcer	Absent (124)	10.5%	0.001
	Present (15)	53%	
White line disease	Absent (129)	14.7%	0.654
	Present (10)	20%	
Cock screw hoof	Absent (123)	13.8%	0.240
	Present (16)	25%	
Interdigital dermatitis	Absent (131)	13.7%	0.069
	Present (8)	37.5%	
Ununiform length of hooves	Absent (90)	13.3%	0.429
	Present (49)	18.4%	
Digital dermatitis	Absent (91)	18.7%	0.105
	Present (48)	8.3%	
Heel erosion	Absent (109)	13.8%	



	Present (30)	20%	0.596
Interdigital hyperplasia	Absent (138)	14.5%	0.017
	Present (1)	100%	
Curled claw	Absent (90)	14.4%	0.767
	Present (49)	16.3%	

---

Hoof abnormalities are the major cause of lameness. Table 4 stated the association of different hooves abnormalities with lameness. The result showed that about 53% lameness occurred where sole ulcer present. Moreover, 20%, 25%, 37.5%, 18.4%, 8.3%, 20%, 100%, 16.3% lameness present due to white line disease, cock screw hoof, interdigital dermatitis, ununiform length of hooves, digital dermatitis, heel erosion, interdigital hyperplasia, curled claw, respectively.

## **Chapter IV**

### **Discussion**

#### **4.1 Prevalence of hoof abnormalities**

Hoof abnormalities constitute an important problem for intensive dairy operations all over the world (Chapinal et. al., 2013). This might be due to loss of natural environment and increased use of modern housing systems with hard flooring surfaces, which facilitate increased spread of contagious diseases as well as greater hoof wear and exposure to wet manure (Cramer et. al., 2009). In table 3, prevalence of different hoof abnormalities was shown. From table 4, it was reported that un-uniform length of hooves and curled claw were mostly prevalent (35.5% each) in reported area followed by digital dermatitis (34.5%), heel horn erosion (21.6%), cock screw hoof (11.5%), sole ulcer (10.7%), white line disease (7.2%), interdigital dermatitis (5.8%) and interdigital hyperplasia (0.7%). It is interesting to compare our prevalence estimates with those presented by Andersson and Lundstrom (1981). Andersson and Lundstrom (1981) reported that the most-common lesions were heel horn erosion (41%), curled claw (28%), interdigital or digital dermatitis (27%) and un-uniform length of hooves (21%). Less prevalent lesions were: white-line diseases (14%), cock screw hoof (8.6%). The prevalence was slightly different from the reported area. It was due to the difference of geographical location, housing, feeding, management of those farms. The prevalence of sole ulcer (10.7%) agrees with Enevoldsen (1991), who reported that cow prevalence of sole ulcer in the different European and USA studies varied from 3 to 28%. The prevalence of interdigital dermatitis was 5.8%, which was similar to the results of Talukdar (2004) and it was higher than a study reported by Zerlli et. al., (1994). The prevalence of interdigital hyperplasia was 0.72%, which is remarkably lower than the results of Talukdar (2004), who showed interdigital hyperplasia in cattle was 18.5%. But Clarkson (1994) showed interdigital hyperplasia in cattle was 6.7%.

#### **4.2 Relation between hoof abnormalities with lameness**

Ninety percent or more of lameness in dairy cattle involves the foot. Confinement on hard surfaces is sufficient alone to cause a mechanical form of laminitis that, subsequent to overgrowth and overloading of the hoof alone, could lead to hoof abnormalities. Sole ulcers tend to be one of the most debilitating of lameness conditions affecting dairy cattle .Sole ulcer

is defined as bruising of the pododerma, which leads to an interrupted sole and a specific lesion of the sole horn, situated in the axial region of the hoof, just distal to the tuberculum flexorium (Blowey, 1993). Sole ulcer has great effects on lameness. In table 4, it was reported that lameness was present 53% where sole ulcer was present, and lameness 10.5% only where sole ulcer was absent. The level of significance at 95% interval was 0.001 that's mean the association of sole ulcer with lameness is highly significant. But this result is higher than the study of Sanders et.al., (2009), who stated that the lameness occurred only 16% for sole ulcer. The white line is the junction between the wall and sole horn of the bovine claw. The white line may become a point of entry for foreign material, which can result in white line disease and lameness. On closer inspection, these lesions are actually observed to be a consequence of thinning of the sole resulting in a break or separation of the sole away from the white line (Van Amstel and Shearer, 2008). Lameness occurred 20% where white line disease present and lameness occurred 14.7% where white line disease absent (Table-4). Its indicates that white line disease causes lameness. This result is higher than the study of Sanders et. al., (2009). Sanders et. al., (2009) stated that the lameness occurred 10% due to white line disease. Cock screw claw (also called screw claw) is a twisting of the toe in a way that places the side wall of the hoof in direct contact with ground. In table 4, it was reported that lameness occurred 25% where cock screw hoof present, and lameness 13.8% where lameness was absent. This study is contradicted with Puneet (2021), who reported that 5% lameness associated with cock screw hoof.

Interdigital dermatitis appears as an infection of the skin between the claws and is usually very mild. There may be fluid or a scab in that area, and there is rarely lameness. There is then progression to the heels which become raw and cattle will experience pain. Chronic cases will show changes of the hoof including hyperplasia of the interdigital tissues and muscle atrophy in the affected limb. The horn may become underrun (Blowey, 2008). Lameness was reported 37.5% where interdigital dermatitis present and 13.7% lameness was present where interdigital dermatitis was absent (table 4). It was higher (15%) than a study reported by Zerlli et. al., (1994). The level of significance of interdigital dermatitis with lameness was highly significant ( $p=0.039$ ). The prevalence of lameness due to un-uniform length of hooves was 18.4%. (Table 4). The association was not statistically significant, due to low number of study population.

Globally, digital dermatitis is a leading cause of infectious lameness in dairy cattle (Wilson-Welder et. al.,2005). The reported area, lameness occurred 8.3% where digital dermatitis was present, and lameness occurred 18.7% where digital dermatitis was absent (Table 4). The

prevalence of lameness was higher in the absence of digital dermatitis. That's mean they have no association and it was due to taking preventive measure against infections like using foot-bath. Heel erosions or underrun heels begin at the bulb of the heel. A new sole develops underneath and material becomes packed in between the layers. This condition is usually seen in confined cattle in wet, dirty lots. Overgrown hooves shift the weight toward the heels, exposing the heels to erosion, mostly in the hind claws. In table-4, it was reported that, lameness (20%) occurred more frequent where heel erosion was occurred. That indicates the positive relation among heel erosion and lameness. This result is similar with Somers et. al., (2005), who reported that the prevalence of lameness due to heel erosion was 19.5%. Interdigital hyperplasia is a firm, fibrous mass that protrudes from the interdigital space of the feet of cattle. Lameness was reported 100% where interdigital hyperplasia was present (Table-4). The level of significant was 0.017, that's mean it was highly significant. But that result contradicted Somers (2005), who reported that the prevalence of lameness only 16% due to interdigital hyperplasia. In table-4, it was reported that lameness occurred higher (16.3%) where curled claw was present. But the level of significance was greater than 0.05, that's why it was not statistically significant, it might be lower population size and randomly selected population.

## **Chapter-V**

### **Conclusion**

Hoof problems constitute a major health problem for many dairy herds. The majority of lameness (> 90%) involves the hooves. This study demonstrates that hoof disorders have an important association on lameness. Claw diseases (sole ulcers and cork screw hoof) are a primary cause of lameness in most herds and are predisposed by confinement on concrete. Interdigital hyperplasia, interdigital dermatitis significantly causes lameness in intensive dairy farming. White line disease, un-uniform length of hooves, heel erosion also plays a vital role for lameness of cattle. A good program for hoof trimming including preventive measures is of major importance in preventing hoof disorders.

### **Recommendation**

- The animal should be provided the soft ground like covered barn floors with sheets of soft rubber. The soft ground acts as a shock absorber and thus maintains the integrity of the animal's hooves.
- In intensive condition, the cow should be released in sandy yards to exercise for a certain period of time.
- In farm, footbaths should be used with copper sulfate solutions as it decreases both the incidence and severity of hoof lesions and is relatively inexpensive.
- It is recommended to trim hooves at least once or twice a year because regular trimming of a cow's feet can give the hoof stability and enable the cows to distribute weight equally between the hooves.

## Chapter-VI

### References

- Andersson L. and Lundström K. (1981).** The influence of breed, age, body weight and season on digital diseases and hoof size in dairy cows. *Zentralblatt für Veterinärmedizin A* 28, 141-151.
- Blowey R.W, (2008).** Cattle Lameness and Hoof care, 2nd edition, Old Pond Publishing Ltd.
- Blowey, R. W. (1993).** Solar hemorrhages in dairy cattle, *Veterinary Record* (1993).
- Broom D. M. (1996).** Animal welfare: concepts and measurement. *Journal of Animal Science*. 69:4167-4175.
- Bruijn M. R. N., Hogeveen H., and Stassen E. N. (2010).** Assessing economic consequences of foot disorders in dairy cattle using a dynamic stochastic simulation model. *Journal of Dairy Science*, 93, 2419–2432.
- Chapinal N., De Passille M., Rushen J. and Wagner S. (2013).** Automated methods for detecting lameness and measuring analgesia in dairy cattle. *Journal of Dairy Science*, 93, 2007–2013.
- Charfeddine N., and Perez-Cabal M.A. (2017).** Effect of claw disorders on milk production, fertility, and longevity, and their economic impact in Spanish Holstein cows. *Journal of Dairy Science*, 100, 653–665.
- Clarkson M. J. (1994).** A study of the epidemiology of bovine. *Proceedings of 12th Lameness World Buyatrycs-Blogna-Italy*. pp. 3338-3343
- Cramer G., Lissemore K. D., Guard C. L., Leslie K. E., and Kelton D. F. (2009).** Herd-level risk factors for seven different foot lesions in Ontario Holstein cattle housed in tie stalls or free stalls. *Journal of Dairy Science*, 92, 1404–1411.
- Department of Livestock Services (2013-2014).** Annual Report on Livestock, Division of Livestock Statistics, Ministry of Fisheries and Livestock, Farmgate, Dhaka, Bangladesh.
- Duncan, (1996).** Animal welfare: concepts and measurement. *Journal of Animal Science*. 69:4167-4175.
- Enevoldsen, (1991).** Sole ulcer in dairy cattle-association with season, cow characteristics, disease and production *Epidemiology of lameness in dairy cattle: description and analysis of foot lesions*.
- Farm Animal Welfare Council (FAWC), (1997).** Report on the Welfare of Dairy Cattle. Ministry of Agriculture, Fisheries and Food, Surbiton, Surrey, UK.
- Gitau T., Mc Dermott J. J. and Mbiuki S. M., (1996).** Prevalence, incidence, and risk factors for lameness in small-scale farms in Kikuyu division, Kenya. *Preventive Veterinary Medicine* 28, 101–115.

- Green L.E., Hedges V.J., Schukken Y.H., Blowey R.W. and Packington A.J. (2002):** The impact of clinical lameness on the milk yield of dairy cows. *Journal of Dairy Science*, 85, 2250–2256
- Holzhauer M., Hardenberg C., and Bartels C. J. M. (2008).** Herd and cow-level prevalence of sole ulcers in the Netherlands and associated-risk factors. *Preventive Veterinary Medicine*, 85, 125–135.
- Huxley J. N. (2013):** Impact of lameness and claw lesions in cows on health and production. *Livestock Science*, 156, 64–70.
- Miyan H. A. (1996).** Towards sustainable development, the national conservation strategy of Bangladesh. Consultancy report on the livestock sector. Ministry Environment and Forestry, Dhaka, Bangladesh.
- Murray, R. D., Downham D. Y., Clarkson M. J., Faull W. B., Hughes J. W., Manson F. J., Merritt J. B., Russell W. B., Sutherst J. E. and Ward W. R. (1996).** Epidemiology of lameness in dairy cattle, description and analysis of foot lesions, 1996 Jun 15;138(24):586-91.
- Neveux S., Weary D. M., Rushen J., Von Keyserling M. A. G. and De Passille A. M. (2016).** Hoof discomfort changes how dairy cattle distribute their body weight. *Journal of Dairy Science*, 89, 2503–2509.
- Osorio J. S., Batistel F., Garrett E. F., Elhanafy M. M., Tariq M. R., Socha M.T. and Loor J.J. (2016).** Corium molecular biomarkers reveal a beneficial effect on hoof transcriptomics in periparturient dairy cows supplemented with zinc, manganese, and copper from amino acid complexes and cobalt from cobalt glucoheptonate. *Journal of Dairy Science*, 99, 9974–9982.
- Puneet Singh, (2021).** Prevalence of lameness and associated foot lesions in Sahiwal dairy cows may 2021, *International Journal of Animal Science*.
- Randall L. V., Green M. J., Chagunda M. G. G., Mason C., Green L. E., and Huxley J. N. (2016).** Lameness in dairy heifers; impacts of hoof lesions present around first calving on future lameness, milk yield and culling risk. *Journal of Dairy Science*, 133, 56– 63.
- Saadullah M., (2001).** Smallholder Dairy Production and Marketing in Bangladesh. Paper presented at South-South Workshop on Smallholder Dairy Production and Marketing. NDDDB-ILBS. 13-16. March. 2001, Ahmedabad, India.
- Sanders A. H., Shearer J. K., and Vries A. De. (2009).** Seasonal incidence of lameness and risk factors associated with thin soles, white line disease, ulcers, and sole punctures in dairy cattle (August 2009). *Journal of Dairy Science* 92(7):3165-74.
- Somers J. G. C. J. (2005).** Risk factors for interdigital dermatitis and heel erosion in dairy cows kept in cubicle houses in the Netherlands.
- Stull, C. L., Reed, B.A. and Berry, S. L. A. (2005).** Comparison of three animal welfare assessment programs on California dairies. *Journal of Dairy Science*. 2005, 88, 1595–1600.

- Talukdar M. M. A. (2004).** Claw affection in an organized dairy farm. MS Thesis, Department of Surgery and Obstetrics, Bangladesh Agricultural University, Mymensingh, pp.35-39. Veterinary Record 138:586–591.
- Van Amstel S. R. and Shearer J.K. (2008).** Clinical report: Characterization of toe ulcers associated with thin soles in dairy cows, Bovine Practical., 42: 1-8.
- Webster, J. (2005).** The assessment and implementation of animal welfare: Theory into practice. Revue Scientifique et technique (International Office of Epizootics) 2005, 24, 723-734.
- Wilson-Welder J., Alt DP. and Nally JE. (2015).** Digital dermatitis in cattle: current bacterial and immunological findings. Animals 5:1114–1135.
- Zerlli M., Guesmi R., Chehida N.B., and Malek A. (1994).** Study of foot disease on dairy farms in northern Tunisia. The Veterinary Record 12: 45-47.



# Appendix

## Questionnaire prepared for data collection

All data are preserved for research publication

### **Welfare assessment of hoof health in intensively managed dairy cattle**

#### Questionnaire

**Date:**

**Start Time:**

**Total Time:**

#### **General Information of Farm and Farmer:**

1. Name of the farm:
2. Farmer's name:
3. Educational Qualification:
4. Union:
5. Upazila:
6. District:
7. Years of farming:
8. Cause of starting the farm:
9. Farming is: primary/not primary income source
  - a. If not primary, then what is the primary income source?.....
  - b. If farming is primary source, then what is the secondary income source?.....
10. Time given in farm: .....Hours/daily
11. Works performed every day: Milking/Grass cutting/ Cleaning of shed/ providing grass/ providing concentrate/ Showering the cows/Drug dispensing (Tick all the performed tasks)/Others.....
12. Any training received on farming:
13. If yes, duration of training:                      How long ago was the training:
14. Guideline of the shed making: From Youtube/ From a nearby farmer/By his own idea/ Quack's Idea/ Vet's advice/Others...../ No established shed [In Bangladesh, in many areas' cows are left tied in the backyard with a polythene roof only]

**Shed Info:**

1. Shed type: face in/Face out/One row
2. Shed length direction: East-West/North South
3. Total number of cows in a row: ..... & ..... and in shed: .....
4. Sunlight can come to: 100%/ 75%/ 50%/ 25%/ 0% area of shed
5. Floor made of: Just brick/Brick attached with cement/ Concrete-cemented/soil
  - a. Movement of Brick: Yes/No
  - b. Floor surface: Slippery/Not slippery
  - c. Condition of the floor: Dry/ moist/ water clogged/ Feces spread all over by the cows
  - d. Crack (>1 inch) in the cemented floor: Yes/No
6. Slope of the lying space: Absent/ Present ..... degree
7. Length of the lying space (from manger to gutter): ..... feet.....inch
8. Length of row:
9. Seepage of water from the wall of manger: Yes/No
10. Presence of drain: Yes/No
  - a. Slope in drain: Yes/ No
  - b. Depth of drain in the two terminal points:.....inch and ..... inch
  - c. Width of drain:.....inch
11. Washing of the floor: how many times:...../day
  - a. Scooping of the feces: How many times:...../day
  - b. Washing the floor: without scooping feces/after scooping the feces
  - c. Showering the cows: In winter.....times /day, in summer.....times /day
12. Untying in the cows within shed: Performed/Not performed. If performed, how long in a day? .....hour/day
13. Grazing: yes/no, if yes how long?..... hours/ day
  - a. Types of grazing land: Dry/Swamp
14. Releasing the cows in yard: Performed/not performed
  - a. If performed how many hours/day.....
  - b. If performed what type of land does that yard have? Sand/ loose soil/ dry soil/ grassy soil

### Individual Cow data

Traits	Cow 1	Cow2	3	4	5	6	7	8	9	10
Cow no (In the Cow list)										
BCS <sup>a</sup>										
Breed (HF/Shahiwal/Deshi/Cross/Others)										
Age										
Sex (Bull/Cow/Bullock)										
Present Lactation no										
Last Parturition date										
Pregnant (Yes/No/NC= Not confirmed)										
Position of the cow in the serial (From left side)										
Feces condition (Normal/Loose/Diarrheic)										
Presence of floor mat (Yes/No)										
Condition of it: Intact/ torn up (~30% area)/ torn up (>30% of mat)										
Lameness (present/Absent) in last 12 months										
a. Treatment given (Y/N)										
b. Treatment prescribed by										
c. Drugs given (Generic name)										
d. Outcome (Did not heal/Recurred)										
<b>Traits</b>	<b>Cow 1</b>	<b>Cow2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
Acidosis in a year (Occurred/Not)										
Mastitis with Fever in a year (Occurred/Not)										
Did the cow faced FMD in a year (Yes/No)										
Complete fracture of any limb (Number #)										
Did the cow slip in a month (Number #)										
Did the cow fall down in a month (number #)										

Used for natural mating (Number # in last 1 yr)										
Last trimming performed (.... Months ago)										
Prescribed by (Dr/Quack/Farmer/Worker)										
Performed by (Dr/Quack/Farmer/Worker)										
Rope length from neck to tying position (inch)										
Length of cow (From neck rope to pin bone)										
Hock Joint (Normal/Bow/hocked) *										
Knee joint (Normal/Knock kneed/Bow legged)**										
<b>Fore left = FL, Fore Right = FR, Hind left = HL, Hind Right = HR</b>										
Presence of foreign material in sole (No/Foot)										
Types of material (Made of and sharp/blunt)										
Cock screw hoof <sup>j</sup> (Feet name)										
Hoof affected (Axial/ Abaxial)										
Criss cross posture in forelimbs (Present/absent)										
<b>Traits</b>	<b>Cow 1</b>	<b>Cow2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
Inter-digital Dermatitis <sup>f</sup> (Feet name)										
Inter-digital hyperplasia <sup>g</sup> (Feet name)										
Vertical fissure <sup>h</sup> (Feet name)										
Horizontal fissure <sup>i</sup> (Feet name)										
Un-uniform length of hooves (Absent/Foot name)										
Longer hoof in the hind limb (Axial/Abaxial)										
Longer hoof in the fore limb (Axial/abaxial)										
Curled claw (Absent/Feet name)***										
Hooves affected [Axial(A)/Abaxial (Ab)/Both(B)]										
Sole ulcer <sup>d</sup> (absent/feet name)										

Hooves affected [Axial(A)/Abaxial (Ab)/Both(B)]										
Simple ulcer/ Hemorrhage/Abscess in those feet										
Digital Dermatitis <sup>e</sup> (Feet name)										
Fresh/hairy wart										
Heel erosion ***** (Absent/Feet name)										
White line disease <sup>c</sup> (Foot name)										
Hemorrhage in white line (Yes/No)										
Abscess in white line (Yes/No)										

## **Biography**

The author Md. Tanvir-Ul-Alam, son of Md. Abul Kalam and Rahima Akter passed his Secondary School Certificate (SSC) examination from Lakhpur Shimulia High School, Narsingdi in 2012 and Higher School Certificate (HSC) examination from Narsingdi Model college, Narsingdi in 2014. Thereafter he enrolled for Doctor of Veterinary Medicine (DVM) degree in Chattogram Veterinary and Animal Sciences University (CVASU), Bangladesh and now is an intern student in this university.