European Journal of Biological Sciences 9 (4): 179-186, 2017
ISSN 2079-2085

DOI: 10.5829/idosi.ejbs.2017.179.186

Economics and Prevalence of Mastitis in Small Scale Dairy Farms of Adama Town, Oromia Regional State, Centeral Ethiopia

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Abstract: Two hundred and eighty (288) cows were randomly included for the determination of mastitis prevalence. Overall, the prevalence of sub clinical mastitis was 43.3% and 19.66% for cow and quarter levels, respectively and clinical mastitis prevalence was 6.9% and 3.58% for cow and quarter, levels respectively. A split udder investigation on 20 cross bred cows with sub clinical mastitis showed an average quarter production of 0.95kg per milking. Reduced milk production due to sub clinical mastitis was 1.2%, 6.3% and 32.8% with quarters with scores 1+, 2+, 3+ respectively. With the given distribution of CMT scores on the study populations, a quarter with sub clinical mastitis lost 12% of its milk production. Mastitis losses cost was 33978.68 birr in a single lactation or 103.58 birr per cow per lactation. Milk production losses, treatment and withdrawal contributed 49.8%, 31.5% and 18.6% respectively. Mastitis is a major problem causing significant losses so further preventive and control measures are recommended.

Key words: Economics · Mastitis · Milk · Prevalence

INTRODUCTION

Ethiopia has the largest cattle population in Africa, According to the livestock marketing authority; in Ethiopia the livestock resource base includes 35 million cattle, 24 million sheep and 18 million goats [1]. However, the contribution of cattle towards food supply and other needs is unable to meet the demands of the growing population as local cows produce on average 230kg/lactation [2]. The upgraded exotic cows in contrast yield 8.8kg per cow per day over a 328-day lactation period [3].

Among the challenge of dairy development in the tropics such as breed improvement, nutrition management, control of infections, tick born, blood and internal parasitic disease, mastitis is considered to be the most costly production disease in the dairy herds of developed countries [4] as is cause series wastage and undesirable milk quality.

Mastitis as a disease has received little or no attention in Ethiopia specially the sub clinical type [5]. Many efforts have been made on treatment of clinical cases rather than prevention and control. Most dairy farmers normally ignore sub clinical mastitis which incidentally occurs at a much higher frequency than clinical mastitis, yet it is the worst in terms of lowered productivity.

Economic analysis is required in order to balance the cost of controlling mastitis against economic loss attributable to this disease. This is the most an essential part of the modern planned animal health programs [6]. Although it may be economic to reduce a high level of disease in herd flock it may be an economic to reduce even further the level of a disease that is present at only low level. As with most infectious diseases the occurrences of a mastitis depends on three components, exposure to microbes, cow defense mechanisms and environmental and management factors [7].

The prevalence of infected quarters increases with age, peaking at 7 years [8]. Older cows, especially after four lactation are more susceptible to mastitis. It is postulated that young animals have a low susceptibility through a more effective host defense mechanism.

Most new infection occurs during the early part of the dry period and in the first two months of lactation, especially with environmental pathogens.

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The first months of lactation is the most sensitive period for mastitis risk in the cow even in the well-managed herds [9]. This is because of increased stress as a result of depressed immunity due to metabolic change and peak milk production.

Genetic predisposition to mastitis could be related to factors such as teat shape, sphincter tone, anatomy of the teat canal and susceptibility to weakening of the suspensor ligament (Pendulous udder) [10].

The ability of the pathogen, like, streptococcus dysagalactiae, Escherichia coli to survive in the cow's immediate Environment i.e their resistance to environmental influence including cleaning and disinfection procedures is a characteristic of each pathogen [10].

The quality and management of housing for dairy cattle has a major influence on the type of mastitis pathogens, which can infect the mammary gland and the degree of infectious pressure. The size of the milking herd may positively be associated with an increased incidence of clinical mastitis because it is more difficult to control contagious mastitis in a herd with a grater prevalence of infection and a larger number of cows-to-cow contacts [10]. There are two main forms of mastitis sub clinical and clinical mastitis. Sub clinical mastitis refers to inflammation of mammary gland in the absence of visible changes in the udder but presence of pathogenic microorganisms in the milk. It can only be diagnose with indirect screening test or laboratory culturing. Clinical mastitis refers to inflammation of mammary gland with grossly visible changes in the udder and milk. It is characterized by abnormalities such as discoloration of the milk, redness, increased temperature pain and disturbance of function of the udder [11]. According to their severity clinical forms of mastitis are classified as sub-acute, which is characterized with only mild changes either in the milk or the udder, with absences of systemic sign, acute clinical mastitis which shows enlarged, hot and painful udder, as well as rise in body temperature and per acute form which is similar with acute one but it has additional systemic signs such as depression, anorexia and dehydration [12].

Mastitis milk can also pose a threat to human health. With severe clinical mastitis, gross abnormalities of milk are readily absorbed and milk is discarded by the producers. But with sub clinical mastitis milk caries bacteria that can cause severe human illness such as Tuberculosis and Brucellosis [13]. Another public health concern regarding mastitis is antibiotic residues in milk which initiate severe reaction in people allergic to antibiotics and development of antibiotic resistant strains of bacteria [14].

Mastitis is economically the single most important disease of the dairy cattle. It reduces milk yields, profits, quality of milk and milk products, can also pose a threat to human health via bacteria which are carried in the sub clinical mastitis [14]. There are no previous studies on the mastitis complex in Adama town which address the economic prevalence of mastitis to dairy farmers; hence this study was specifically designed to address economics together with prevalence of mastitis in the town. Therefore, the objectives of this study are:-

- To quantify economic impact of mastitis in the study area.
- To estimate prevalence of mastitis based on CMT and clinical examination
- To forward appropriate recommendations for the prevention and control of the disease.

MATERIALS AND METHODS

Study Area: Adama town is located 95kms south eastern Addis Ababa 39.17°N and 8.33°Ewith an altitude of 1770 meter above sea level (a.s.l), latitude 8.31°N and 39.16°E longitude. Adama is situated in the well-known East African rift valley. It has annual rain fall temperature ranging from 400mm-800mm and 13.9°c-27.7°c, respectively [15]. The town is one of the most populous from the regional state and is located at an important multidirectional trade route. The numbers of livestock on the bases of species are 70, 662 cattle; 36, 142 sheep; 42, 968 goat; 31, 905 equines; 42 camel and 195, 155 poultry [16]. There are a number of market oriented small scale dairy farms in the town with average of three cows per households (Figure 1).

Study Population: The target population for the study was all market oriented smallholder farms and cows in Adama town. The study involved 288 lactating cross breed cows. This figure was determined with an expected mastitis prevalence of 27% reported in Mekele by Wudu, Bedada and Hiko [17] at 95% confidence interval and 5% precision level. This is established by the previous studies in Mekele town with similar climatic condition to Adama town. The following formula was employed to get the target sample of milking cows above as described in Thrusfield [18].

$$N = \frac{1.96^2[P\exp(1-P\exp)}{d^2}$$

N = required sample size

1.96 = the value of Zat 95% confidence level

Pexp = expected prevalence of mastitis
d2 = desired absolute precision level at 95% confidence level

Study Design and Methods of Examination

Clinical Examination /Inspection/ of the Udder: Clinical mastitis was defined at cow or quarter levels by gross clinical sighs such as udder swelling, pain on palpation, a warmer than normal udder skin (Inflammatory sign) and abnormal secretion (Blood tinged milk, watery milk or milk with pus, flakes and clots) from the udder or both symmetry, consistency presence /absence of supper numeracy teats, presence/ absence of any lesions on the teat, evidence of swelling and also congruency of the quarters were noted. Teats were also examined for their functioning status. They were categorized as patent /functional or blocked /non-functional. Mastitis investigation was done on the functional quarters only, blocked quarters were simply enumerated for purposes of knowing their proportion in relation to the total quarters.

California Mastitis Test: Milk samples passed as normal on clinical examination were obtained from each cow. These samples were examined using CMT. Milk which is was grossly abnormal i.e. containing clots and flakes, watery or blood tinged was not screened by CMT. The screening was conducted just before milking following clinical examination. It was made that the first few squirts of milk were discarded to avoid chance of having false positives.

The CMT procedures were carried out as described in Quinn *et al.* [10]. This test identified sub clinical cases. Clinical cases, which were not overtly clear, were also defined by CMT. Two milliliters of milk from each patent quarter were taken in the corresponding cups/wells of the paddle and mixed with an equal volume of the CMT reagent. The mixture was swirled horizontally for a few seconds while observing gel formation. The results were interpreted as described in Quinn *et al.* [10].

Determination of Economic Impact of Mastitis: Primary findings and published works were both used to estimate the economic losses of mastitis. Milk production losses due to sub clinical mastitis were determined by help of split udder result, while those due to sub clinical mastitis were estimated using published works. Treatment and withdrawal losses were estimated from primary findings.

Economic Losses Due to Mastitis: The economic losses were estimated with a financial function of the form. Y= a+b+c where Y= Total mastitis losses, a= reduction in milk yield, b= cost of treatment, c= milk withdrawal losses. Losses in milk yield and treatment costs were considered at quarter level. Losses estimation was based on the following consideration [19].

- A cow was assumed to have a uniform quarter production of 2.2 liters/day based on the established daily yield of 8.8kg/day/cow with 2897kg in 328 day lactation period.
- A cow suffered sub-clinical mastitis (SCM) at most for one quarter during the lactation period. Thus the SCM lasted for 82days out of 328 days of lactation.
- A cow suffered clinical mastitis 4 times and therefore received treatment four times.
- Treatment was only restricted to clinical cases since majority of the farm owner were not even aware of the presence of sub clinical mastitis. Twenty percent (20%) of the clinical mastitis cows were assumed to have acute form of the disease and therefore received both intra mammary infusions and parentral treatment.
- Following treatment, milk from treated animals was withdrawn for a total of 12 days, per lactation, since the withdrawal period recommended by most drug companies is 3 days.
- Each cases of clinical mastitis lasted at least 5 days.

Treatment Cost: Treatment drugs and their prices were identified from veterinary drug shops and field veterinarians. No one drug was preferred to the other depending on its availability, price and also on the veterinarians preference. The average prices of the commonly used intra mammary and parenteral antibiotics were used in the estimation. Information about veterinarian fees through oral interview was collected from the veterinary clinic in Adama town.

- Cost of intra mammary treatment (x) =price per unit x treated quarters x treatment duration x number of times a cow was at risk in lactation.
- Cost of parenteral treatment (y) = number of cows treated x dose in milliliter per cow x treatment duration x number treatment a cow is at risk in a lactation.
- Veterinarians fees (z) = number of cases x charge per cases x number of time a cow is at risk in a lactation. Total treatment cost =x+y+z [19].

Withdrawal Losses: Cows treated x losses amounted to cows treated x milk production /cow/day x treatment duration x milk price x risk period in lactation.

Milk Production Losses: It was difficult to assess milk production losses due to lack of record keeping, large dairy farms and awareness of farm owners regarding sub clinical mastitis. However a split udder investigation was carried out on 4 farms having approximately similar feeding system and cross breed (Indigenous x Holstein) dairy cows. Cows were hand milked in to separate bucket per quarter over a period of 4 days. Sub clinical mastitis was diagnosed by CMT. This approach was attempted to determine milk production with or without sub clinical mastitis. A cow with at least one health quarter (CMT score 0) was included in this trial.

The difference between the milk yield of 'trace' 1+, 2+, 3+ and that of the normal quarter constituted the loss at the corresponding CMT score. The quarter milk losses were derived by multiplying the number of different CMT scores of positive quarters by their corresponding milk production and their average.

Quarter milk loss = (All quarter scored 3+ x quarter production at the same CMT) +(All quarter scored 2+ x quarter production with the same grade) +(All quarters scored 1+ x quarter production at the same grade) /total number of positive quarter.

- SCM losses = a*b*c*d where a, was quarters affected in the positive animals, b, was daily milk yields per quarter, c, the percent losses and d, days in the lactation when a cow had the diseases.
- Clinical mastitis losses = quarter affected x duration of clinical case x number of times at risk x %loss per quarter. Cows with untreated clinical mastitis loss up to 50% quarter milk production [6]. The two estimates were summed to give milk losses in birr.

Prevalence Study: Prevalence of mastitis was determined cross sectional from within a study period, in Adama town at cow quarter and farm level based on clinical manifestation for clinical prevalence and indirect test (CMT) for sub clinical prevalence.

Prevalence was calculated according to the formula given in Thrusfield [6].

Over all prevalence of sub clinical/ clinical Mastitis = Number of cows with mastitis/ Total number of lactating cows x 100%

Quarter wise prevalence of mastitis = Number of positive quarters/ Total number of quarter screened x 100%

Prevalence of blind quarter in examined cows =Number of quarter blind / Total number of quarter x 100%

Prevalence of Mastitis at farm level = Number of positive farm/ Total number of farm examined x 100%

RESULTS

Prevalence of Mastitis: A total of 288 lactating dairy cows from 102 market oriented private small hold dairy farms in Adama town were investigated cross sectional to determine the magnitude of mastitis. Clinical examination and CMT screening was used to determine the prevalence.

A total of 1152 quarters were considered in the in the prevalence study but 33(2.96%) of them were blind/ non functional. The functional quarters were 1119 (97.1%). Right front and left front quarter had 6 (0.52%), 7(1.6%) respectively, while right rear, 18 (1.56%) and left rear 2 (0.17%) had blocked quarter. Quarter CMT result indicated that 69, 105, 46 and 859 quarters were CMT score strong positive (3+), positive (2+), trace (1+) and negative (0) respectively.

Prevalence of Clinical Mastitis: The prevalence of clinical mastitis was determined by clinical examination. This was done by the detection of clinical signs such as change in consistency of the milk such as the presence of pus, clots watery milk or blood. Two hundred eighty eight cows with 1119 functional quarters were clinically positive and 20(6.9) cows had mastitis clinically. The overall prevalence of clinical mastitis was 6.9% and 3.58% at cow and quarter level respectively.

Prevalence of Sub Clinical Mastitis: The distribution of the prevalence of sub clinical mastitis was based on cow and quarter level. It was determined by California mastitis test. 288 cows had their quarters tested using CMT, 33 (2.96%) of the quarters were blind at the time of collection. Out of 1119 quarters screened, 220 (19.66) quarters were CMT positive and 125 (43.4%) cows were positive sub clinically. The overall prevalence of sub clinical mastitis was 43.4% and 19.66% at cow and quarter level respectively.

Economic Analysis

Split Udder: 29 quarter had CMT score '0' 14, 10 and 7 quarter had 3+, 2+ and 1+ respectively. CMT score 'trace was added to CMT score 1+ for analysis. Average milk production per quarter was 0.95kg per milking. CMT score 0, 1+, 2+ and 3+ had average production of 1.043kg, 1.033kg, 0.968kg and 0.741kg . The difference (loss due to SCM) in production quarter with CMT score 1+, 2+ and 3+ compared to quarter CMT score 0 was 0.01 kg (1.2%), 0.057 kg (6.3%) 0.302 kg (32.8%).

Table 1: Clinical, blind and CMT scores of each quarter of lactating dairy cow in 102 small dairy farm holders

CMT score	Right back	Right front	Left back	Left front	Total
Negative(0)	205	217	225	212	859
Trace (+1)	9	9	12	16	46
Positive (+2)	32	29	23	21	105
Strong positive(+3)	14	17	19	19	69
Clinical	9	13	6	12	40
Blind	18	6	2	7	33
Total	288	288	288	288	1152

Table 2: Prevalence of clinical mastitis at cow and quarter level

Clinical mastitis type	No of cows	Prevalence	No of quarters	Prevalence
Positive	20	6.9%	40	3.50%
Negative	268	0%	1079	0%
Total	288	6.9%	1119	3.50%

Table 3: Prevalence of sub clinical mastitis at cow and quarter level

Sub-clinical mastitis	No of cows	Prevalence	No of quarters	Prevalence
Positive	125	43.3%	220	19.66%
Negative	163	0%	899	0%
Total	288	43.3%	1119	19.66%

Table 4: Over all prevalence of mastitis at cow and quarter level

	Cow level		Quarter level	
Mastitis type	Positive	Prevalence	Positive	Prevalence
Clinical	20	6.9%	40	3.58%
Sub clinical	125	43.4%	220	19.66%
Total	145	50.35%	260	23.24%

Table 5: Summary of milk production losses in lactation

Number of quarter (a)	% loss in ¼ production (b)	¼ production without mastitis /lactation (c)	Loss made d=c x b
SCM (121 cows) 220	11.8	39688	4762.56
CM (20 cows) 29	50	1760	880.0
		41448 kg	5642.56kg

Sub Clinical Mastitis Losses (SCM Losses): Finding of the split udder and the prevalence results estimated milk loss per quarter due to sub clinical mastitis. 220 quarter were positive on prevalence study, out of which 69, 105, 46 were CMT score 3+, 2+ and 1+ respectively. (Table 1)

Average quarter production with sub clinical mastitis = (69x0.741) +(105x0.988) + (46+x1.033) =0.92kg
?220
Loss per quarter due to SCM was =1.043-0.92=0.123 kg (12.8%)

- SCM losses =220 x8.8/4 x 328/4 x 0.118 = 4680.4/lactation
  Losses per quarter was = 4680.4/220x82 = 0.167kg/quarter
  Or (0.167 kg x4) = 0.668 kg /cow/ milking
  Loss per cow was estimated at 3 birr/day loss in 82 days she was affected = 0.668x3x82=164.25 birr.

- Clinical mastitis losses = 40 x 5 x 4 x 8.8/4 x 0.5 = 880 kg
  (40=no of quarter, 4 = risk period in lactation, 5 = duration of clinical cases)
  Loss per cow /day due to CM = 880 kg x4 /4x20= 4.4 (13.2 birr)
  Per day and 264 birr in 20 days she suffers.

- Total milk production losses amounted was 5642.56 kg x 3 = 16927.68 birr / lactation
  The loss per quarter / day due to mastitis was, 5642.56 kg/ 41448 x 100 = 13.6%
  The loss made = 0.136 x 2.2 x3 =0.9birr /quarter /day where 3 was milk price / kg

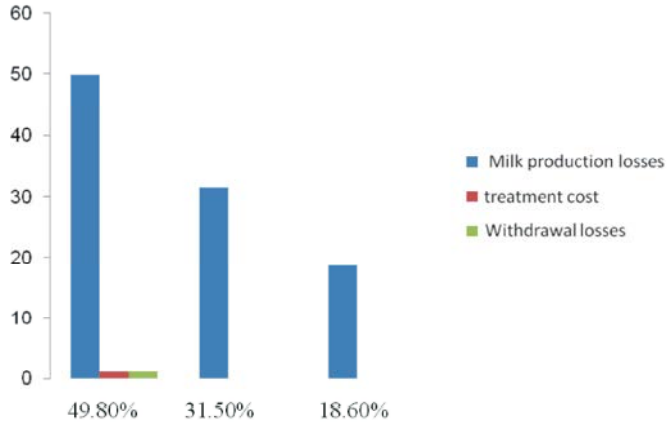

Fig. 1: Contribution of Each Component to Total Mastitis Losses

Treatment Cost: It comprises v veterinarian charges and cost of medicines.

The commonly used mastitis drugs were multiset, pen strip and oxytetracycline. Parenteral treatment = pen strip and oxytetracycline minimum of average 16 ml/day with 0.3 birr per milliliter (ml) with expected 250-300 of cow kg weight.

Cost of intra mammary = 16x40x3x4=7680 birr. (16, cost of treatment, 40 treated quarters, treatment duration, 4 numbers of times a cow was at risk).

Parenteral treatment cost =20/100 x 20 x 16 x 0.3 x 4 x 3 = 230.4 birr (20 /100proportion of cows

With acute mastitis 20 cows treated, 16 dose rate /day, 0.3 charge /ml, 3 duration of treatment, 4 risk times in lactation.

Veterinarian fees = 20 x35 x40= 2800 birr (20, number of case treated, 35, veternerian fee/ case, 4 risk period in lactation).

Total treatment lost = cost of intra mammary + cost of parentral antibiotics +veterinarians fee//case.

7680 + 230.4 +2800 = 10710.4birr.

Withdrawal Losses: Milk from 20 cows with clinical mastitis was discarded during and following treatment.

20 x 8.8 x0.5 x 3 x 3 x 6 x 4 = 6336 birr (20 cows treated, 8.8 milk production/cow/day, 0.5 losses amount to cows treated 3. Milk price, 6 milk discarded time, 4 risk period in lactation.

Milk loss, treatment and withdrawal contributed 49.8% 31.5% and 18.6% to the total mastitis losses, respectively (Figure 1).

- Total losses of mastitis = 16927.68 + 10710 + 6336 = 33973.68

  Total loss per cow per lactation is 103.58 birr

DICUSSION

This study was carried out to determine the prevalence of mastitis and economics in small holder dairy farms of Adama town. A total of 288 cows (Cross breed) in 102 smallholder farms were investigated cross-sectionaly.50.35% of examined animas had abnormalities in their udders, teats and milk as evidence of mastitis. This finding closely agrees with those of Mungube [19], Takele [20] and Tesfaye [21] who had reported a prevalence of 53%, 53.3% and 52.2% respectively. On the other hand this rate is relatively higher than the finding of Gizat [14], Demelash [22] and Birhanu [23] had reported a prevalence of 33.0%, 38.5% and 38.4% respectively. However there is a great variation from Biru [24] and Tarekeny [25] who reported a prevalence of 61% and 67.4% respectively.

In this study the prevalence of sub clinical mastitis at a cow level is (43.4) which is in agreement with the finding of Mungube [19] and Shirmeka [26] who had reported sub clinical mastitis at a cow level of 40.95% and 46.6% respectively. However the present finding is higher than that reported by Gizat [14], Birhanu [23] and Bishi [27] who had reported sub clinical mastitis at a cow level of 31.7%, 34.30% and 34.4% respectively. The prevalence of clinical mastitis investigated as 6.9% is comparable with that of Mungube [19] and Birhanu [23] who had reported a nearly similar prevalence of clinical mastitis of 7.8% and 6.6% respectively. Mastitis is a complex disease and the difference in results could be due to difference in management system, climate and other risk factors between farms.

A split udder investigation to determine losses due to sub clinical mastitis revealed that on average, a quarter produces 0.95kg per milking hence a total of 7.8 kg per cow per day. This was higher compared to 6.56 kg

reported by Mungube [19] while comparable to Mekonenin *et al.* [3] who established 8.8 kg per cow per day, an average of 2.2 kg per quarter the selection criterion did not consider stage of lactation and parity rather their management system. Quarter with CMT scores 0, 1+, 2+ and 3+ yielded 1.043 kg, 1.33 kg, 0.986 kg and 0.741 kg per milking, respectively, which varies greatly from Mungube [19] who had reported 0.9188 kg, 0.9080 kg, 0.861 kg and 0.616 kg respectively. Loss per quarter was subsequently 0.01 kg (1.2%) 0.057.kg (6.3%) and 0.302 kg (32.5%) for CMT scores0, 1+, 2+ and 3+ respectively. The losses due to CMT score 1+ and 2+ are less than those of CMT score 3+. This is because CMT 1+ and 2+ are less established compared to those of CMT 3+ which are long standing and well established with extensive distraction of the udder tissue hence the big losses. Other possible reasons for lower estimates could be poor management, inferior genetics coupled with nutritional inadequacies leading to lower productivity. The average quarter milk loss due to sub clinical mastitis for the cross breed cows in Ethiopia was estimated to be 17.1% [19] which was higher than the present studies 12%, otherwise, no local research report on quarter milk production losses due to sub clinical mastitis are available for comparison purposes.

Mastitis losses were estimated to be 33978.68 birr i.e 103.58 birr per lactation per cow which varies greatly, almost greater than half, with that of Mungube [19] who had reported 210.8 birr per cow per lactation. This loss could be reduced or totally avoided with proper mastitis control measure in place. Milk production losses contributed 49.8% of the total losses. Sub-clinical mastitis contributes 95.8 % and clinical mastitis 4.2% of the milk losses. Sub clinical mastitis losses contributed 42.06% of the total losses, which are primarily due to reduced milk production. There is a difference between what was reported by Mungube [19] who reported 38.4% and current study of milk production loss, whichdue to couldarise increased in milk price. However there is similarly between sub clinical and clinical mastitis loss from milk production loss accounting for 94% and 6% respectively. Treatment costs inclusive drug and veterinarian charge accounted for 31.5% and with drawl losses were 18.6% which disagrees with that reported by previous study being 9.3% and 3.3% respectively. This is due to great change in treatment cost and vet fee. Regarding the variation with regard to withdrawal losses only 3 days after treatment were considered in the previous study, however 3 days during treatment also calculated here. The present study does not include the loss due to culling which was almost half of total loss in previous study. This is due to lack of record keeping in the farm.

CONCLUSION

Mastitis especially sub clinical mastitis is a problem which, escapes the notice of farmers that is why farm owners usually complain about the decrease in milk yield in respective of adequate feed provision and de-worming practice. Diagnosis of sub clinical mastitis is almost nonexistent due to lack of the necessary kits (California Mastitis Test reagent). No control strategies of mastitis are in use currently. These therefore, require clear cut preventive and or control measure to be instituted in order to reduce the high prevalence and minimize the associated economic losses. In view of this, the following control measures are recommended.

- Farmer education on the control of spread of mastitis i.e use of separate towels on each milking cow, dry cow therapy adoption, use of one milkier per farm to avoid contamination through milkier.
- Milking of mastitis cow at last.
- Improve hygienic standards like use of post and pre milking by using detergent like soap.
- Culling of cows with problem of leaking milk and those with chronic mastitis, which does not respond to therapy. Older cows to be culled also as they stand a higher risk of contracting clinical mastitis.
- Improve feeding to help offset the negative energy imbalance. Feeding should be encourage after milking as many of the cows tend to lie down immediately after being milked.
- Housing practices, manure handling and water and sewerage management to be improved.
- Treatments given to be timely and complete as many of the clinical cases encountered were chronic.

ACKNOWLEDGEMENT

I would like to thank Adama district Livestock and Fishery Resource developement Office and Adama town dairy owners for their cooperation done during this research work.

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