

Study on the Prevalence and Risk Factors of Reproductive Disorder in Intensive and Extensive Dairy Farms in and around Mekelle

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Abstract

The study which employed both in questionnaire survey and regular follow up was conducted in and around Mekelle city with an objective of determining the prevalence and major risk factors associated with reproductive disorders in dairy cows between November 2017 and April 2018. A total of 560 dairy cows were examined by using questionnaire survey and regular follow up which were kept under different system of production/management (intensive=425, extensive=135). Out of which 237 (42.3%) dairy cows were found to be affected by one or more of the reproductive disorders. The major reproductive disorders identified during the study were anestrus (43.5%), repeat breeding (25.3%), retained fetal membrane (6.8%), abortion (5.1%) and mixed cases (13.9%), with the respective prevalence. Dystocia (2.1%), uterine prolapse (1.7%), vaginal prolapse (0.4%) and follicular cyst (0.4%) were the reproductive disorders encountered in the study area with a lower prevalence. The overall prevalence of the reproductive disorders showed a significant difference ($p < 0.05$) with respect to parity, body condition score and system of production and management on the occurrence of reproductive disorders. Therefore, providing the dairy cows with good supplementary feed and clean water, improvement of the cleanness of the cows and hygiene of the house, creation of awareness on the farm workers about how to manage their dairy cattle's should be recommended to be done by farm owners.

Keywords: Dairy Cows; Mekelle City; Prevalence; Reproductive Disorders; Risk Factors

Introduction

Ethiopia is one of the sub-Saharan Africa with a large potential for livestock production. The country is 1st among African countries and the 9th in the world [1]. The total cattle population for the country is estimated to be about 53.99 million. Out of this total cattle population the female cattle constitute about 55.5% [2].

Dairying is an important enterprise for many countries of the world and is especially important source of income generation for rural families in the developing countries like Ethiopia [3]. The development of the dairy sector in Ethiopia could contribute significantly to poverty alleviation and improvement in health and nutritional status of the whole community at large [4]. However, dairy industry in Ethiopia is not developed as that of other east African countries such as Kenya, Uganda and Tanzania [5].

The productivity of indigenous cattle breeds is low due to many constraints including diseases and parasites, poor nutrition, improper management systems, poor reproductive performance and large socioeconomic factors by decreasing reproductive efficiency, shortening the expected length of productive life and by lowering milk production. These constraints result in poor reproductive

performance of dairy cattle [6]. Reproductive problems are the most common which occur in lactating dairy cows and can dramatically affect reproductive performance of the dairy herd [7], due to slower uterine involution, prolonged inter conception and calving interval, negative effect on fertility, drop in milk production and early depreciation of potentially useful cows [8].

Reproductive disorders are one of the most important problems that affect the production and productivity of dairy cows [6]. Among the major reproductive problems that have a direct impact on reproductive performance of dairy cows, retained fetal membrane (RFM), repeated breeding (RB), abortion, anestrus, dystocia, metritis and prolapse (uterine and vaginal) have been reported to be the most common economic problems [9]. These reproductive disorders could also be categorized as before gestation (anestrus and RB), during gestation (abortion, vaginal prolapse and dystocia) and after gestation (uterine prolapse). The impaired function of the reproductive system results failure of a cow to produce a calf yearly and regularly [10].

Most cattle producers probably do not realize the extent of economic loss that can occur through reproductive failure in their cattle. There are many non-infectious factors that contribute to infer-

tility and reproductive loss other than infectious diseases. Dystocia is one of the main noninfectious reproductive disorders of dairy cows that is commonly known as difficult calving and defined as prolonged or difficult parturition [11].

There are also many infectious diseases of reproductive problems. Among these diseases, brucellosis is a common genital disease which induces abortion in animals and humans, continues to cause heavy economic losses and public health concern throughout the world [12]. Abortion in cattle is an important fertility problem causing a serious economic setback due to direct losses of concepts and consequent impairment of fertility. Moreover, the incidence of RFM after birth is often high in Brucella infected herds [13]. In Ethiopia, even though dairy cattle are maintained under different production systems [14], the differences in management/production systems and environmental conditions under which cattle are reared could greatly affect the occurrence of reproductive disorders.

Even though, there are a number of dairy farms available in and around mekelle city, only a few studies have been conducted on the prevalence and risk factors of major reproductive health disorders in dairy cattle's. Therefore, the objectives of this study were

- To determine the prevalence of major reproductive health disorders of dairy cattle in and around Mekelle city
- To assess the possible risk factors that play an important role in the occurrences of such problems in dairy farms and
- To forward possible recommendations for the prevention and control approaches

Materials and Methods

Study area

The study was conducted in and 10 Km around Mekelle city in the semiarid highlands between November, 2017 and April, 2018. Mekelle is the capital city of Tigray Region, which is located in the northern part of Ethiopia extending at latitude and longitude of (13°29'N 39°28'E) and with an elevation of 2084 meters above sea level. Amount of rainfall is variable in Mekelle; on average about 600 mm, and more than 70% of it falls between July and August, followed by long dry season and a mean minimum, mean maximum and mean average monthly temperatures of 8.7, 26.8 and 17.6° C, respectively [15].

Study design

A cross sectional and cohort study was under taken between November, 2017 and April, 2018 in and around Mekelle city to assess the prevalence and risk factors of reproductive disorders of dairy cattle both in intensive and extensive type of production/management system. The study was employed on randomly selected commercial and small holder local farmers by using questioner and regular follow up.

Source population and study participation

The source of study group was included from large, medium and small scale intensive farms and from small holder local farmers with extensive management system in and around Mekelle city and a Questionnaire was distributed to an individual's that participated on dairy production. Regular follow up also conducted in selected intensive and extensive dairy farms. About 91 individual farmers and workers were participated on the study. 429 cross HF and local dairy cows were examined from 91 intensive and extensive dairy farms using a questionnaire survey and 131 dairy cows from 12 dairy farms.

Sample size determination

The sample size required for this study was determined depending on the expected prevalence of reproductive problems and the desired absolute precision by the formula given by Thrusfield [16]. Therefore, using 95% confidence interval, 5% precision and 50% expected prevalence, the number of dairy cows needed to demonstrate the prevalence of reproductive health problems in and around Mekelle city were 384 dairy cows, but 560 dairy cows were examined to increase accuracy of the result with different system of management, parity status and breed.

Both cross (HF) =317, and local breed=112, dairy cattle's which were kept under different production system were examined using questionnaire survey and 131(110=cross HF and 21=local) dairy cows were examined during regular follow up.

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

Where,

N= Sample size,

P_{exp}= Expected prevalence,

d=Desired absolute precision

Data collection methods

A cross sectional survey was conducted on the selected participants in and around Mekelle city and then questioners will be developed and administered to the owners. The questionnaire formats was prepared in English and interpret in to Tigrigna (language native language) for appropriateness and easiness in approaching the study participants. Then the data was collected by questionnaire survey and regular follow up also conducted to get additional data directly by observing dairy cows with reproductive problems.

Data quality assurance

A questionnaire was first formulated in English version and then translated in to Tigrigna language. Each questionnaire was check for incompleteness, any miss values and unlikely responses, and then manually cleans upon such indications. The data was cross checked for consistency and accuracy.

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Data analysis

The data which was collected by a questionnaire survey and regular follow up from the study area was recorded in the format developed for this purpose and later on entered in to Microsoft Excel sheet 2010; finally the data was analyzed using SPSS 16 version. The degree of association between or among each risk factor was assessed using Chi-square test. P-value of less than 0.05 was taken as significant in all analyzed data's.

Result

From the total 560 dairy cows examined during questionnaire survey and regular follow up, 237(42.3%) of them were found to be affected by one or more of the reproductive disorders. see table 1 below.

Method of study	No of dairy cows examined	No of cows not affected	No of cows affected
Questionnaire	429	234(54.5%)	195(45.5%)
Follow up	131	89(67.9%)	42(32.1%)
Total	560	323(57.7%)	237(42.3%)

Table 1: Reproductive disorders of dairy cattle city based on different method of study.

In intensive system of management (31.1%) of dairy cows were affected and in extensive system of management (78.2%) were affected by reproductive disorders. (p<0.05), this value indicated that the difference in production/management system strongly affected the prevalence of reproductive disorders. See table 2 below.

Most common reproductive disorders encountered on the dairy cows during the study were; anestrus, RB, RFM, abortion and mixed cases as shown on table 3 below.

Variable	System of production			X ²	p-value	
	Affected	Intensive	Extensive			Total
Reproductive disorders	Affected	133(31.1%)	104(78.2%)	237(42.3%)	91.960	0.000
	Not affected	292(68.9%)	31(21.8%)	323(57.7%)		
	Total	425(100%)	135(100%)	560(100%)		

Table 2: The effect of system of production on the prevalence of reproductive disorders.

Reproductive disorders	Questionnaire survey (%)	Regular follow up	Overall prevalence
Abortion	7(3.6%)	5(11.9%)	12(5.1%)
Dystocia	3(1.5%)	2(4.8%)	5(2.1%)
RFM	10(5.1%)	6(14.3%)	16(6.8%)
Anestrus	89(45.6%)	14(33.5%)	103(43.5%)
RB	49(25.1%)	11(26.2%)	60(25.3%)
Metritis	1(0.5%)	1(2.4%)	2(0.8%)
Uterine prolapse	4(2.1%)	0(0.0%)	4(1.7%)
Vaginal prolapse	1(0.5%)	0(0.0%)	1(0.4%)
Follicular cyst	0(0.0%)	1(2.4%)	1(0.4%)
Mixed cases	31(15.9%)	2(4.8%)	33(13.9%)
Total	195(100%)	42(100%)	237(100%)

Table 3: Summary of relative frequency and prevalence of major reproductive disorders of dairy cattle in intensive and extensive farms.

As shown on table 4 the body condition strongly affected the prevalence of reproductive disorders (p<0.05). Body condition scoring was taken according to Jeffrey (2005): Very poor=1, Poor=2, Good=3, Fat=4, grossly fat=5

The method of service has no significance difference on the occurrence of reproductive disorders as (p>0.05). See the table 5 below.

Variable	Body condition score							X ²	P-value
		1	2	3	4	5	Total		
Reproductive disorder	Affected	2(100%)	20(80.0%)	16(19.0%)	1(6.7%)	3(60.0%)	42(32.1%)	43.378	0.000
	Not affected	0(0.0%)	5(20.0%)	68(81.0%)	14(93.3%)	2(40.0%)	89(67.9%)		
	Total	2(100%)	25(100%)	84(100%)	15(100%)	5(100%)	131(100%)		

Table 4: Association of major reproductive problems with body condition score encountered on dairy cows in regular follow up.

Variable	Reproductive disorders encountered			X ²	p-value
	Yes	No	Total		
Method of service	AI	25(78.1%)	7(21.9%)	3.488	0.175
	Bull	29(93.5%)	2(6.5%)		
	Both	25(89.3%)	3(10.7%)		
	Total	79(86.8%)	12(13.2%)		

Table 5: The effect of method of service on the occurrence of reproductive disorders in dairy farms (questionnaire survey).

The time of service has a slight significant effect on the occurrence of reproductive disorders in dairy farms as ($P < 0.05$) indicated on the table 6 below.

Parity has a significant effect on the occurrence of various reproductive disorders. Maximum incidences of reproductive disorders were reported between 1st and 3rd parity followed by fourth parity. ($p < 0.05$), indicated that the effect of parity on the prevalence of reproductive disorders is highly significant as summarized on table 7.

Variable	Reproductive disorders encountered			X ²	p-value
	Yes	No	Total		
Time of service	Uncontrolled	23(100%)	0(0.0%)	6.427	0.040
	Within 12 hrs	18(75.0%)	6(25.0%)		
	Within 24 hrs	38(86.4%)	6(13.6%)		
	Total	79(86.8%)	12(13.2%)		

Table 6: Summary of effect of time of service on the occurrence of reproductive disorders in dairy farms (questionnaire survey).

Variable	Reproductive disorders											
	Abortion	Dystocia	RFM	Anestrus	RB	Metritis	Uterine prolapse	Vaginal prolapse	Follicular cyst	Mixed cases	Total	
Parity status	Hiefer	0(0.0%)	3(60.0%)	1(6.2%)	2(1.9%)	3(5.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	9(3.8%)	
	First	1(8.3%)	2(40.0%)	4(25.0%)	27(26.2%)	18(30.0%)	0(0.0%)	0(0.0%)	0(0.0%)	7(21.2%)	59(24.9%)	
	Second	5(41.7%)	0(0.0%)	6(37.5%)	39(37.9%)	19(31.7%)	0(0.0%)	3(75.0%)	0(0.0%)	0(0.0%)	10(30.3%)	82(34.6%)
	Third	4(33.3%)	0(0.0%)	4(25.0%)	19(18.4%)	11(18.3%)	1(50.0%)	1(25.0%)	0(0.0%)	0(0.0%)	8(24.2%)	48(20.3%)
	Fourth	2(16.7%)	0(0.0%)	1(6.2%)	12(11.7%)	6(10.0%)	1(50.0%)	0(0.0%)	1(100%)	1(100%)	4(12.1%)	28(11.8%)
	Fifth and above	0(0.0%)	0(0.0%)	0(0.0%)	4(3.9%)	3(5.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	4(12.1%)	11(4.6%)
	Total	12(100%)	5(100%)	16(100%)	103(100%)	60(100%)	2(100%)	4(100%)	1(100%)	1(100%)	33(100%)	237(100%)

Table 7: Summary of the effect of parity status on the prevalence of reproductive disorders

$$X^2=83.140, Df=7, p\text{-value}=0.000$$

Discussion

This study documented the common reproductive disorders encountered under small scale and large scale intensive farms and small holder extensive farms in and around Mekelle city. Reproductive disorders and the associated risk factors were recorded during the study. The reproductive disorders occurred in the study area were anestrus, repeat breeding (RB), retained fetal membrane (RFM), dystocia, abortion, uterine and vaginal prolapses and follicular cyst. Anestrus, RB and RFM were the most prevalent disorders. According to the study, the associated risk factors that affected the occurrence and prevalence of reproductive disorders were inappropriate management, poor nutrition, breed of the dairy cattle, poor body condition and time of service.

From the total dairy cows (n=560) examined both in questionnaire survey and regular follow up, (42.3%) of them were found to be affected by at least one reproductive disorder. Out of the total dairy cows (n=429) examined during questionnaire survey, (45.5%) and from the total dairy cows (n=131) examined during regular follow up, (32.1%) of them were affected by one or more of the reproductive disorders. The prevalence of major reproductive disorders reported in this study (42.3%) is in close approximation with earlier studies conducted by Adane, *et al.* [17], Dawit and Ahmed [18], who reported (43.3%) and (40.3%) of the dairy cows were affected with one or more of the major pre-partum and post-partum reproductive disorders in urban and per urban area of Hosanna, southern Ethiopia and in Kombolcha, Northeast Ethiopia, respectively. But, higher than (31.76%) which was reported by Bitew and Prasad [19], who studied on the overall prevalence of major reproductive disorders in indigenous and cross breed cows in and around Bedell, South west Ethiopia. The variation in the prevalence may be due to variation in management system, nutritional factor, environmental factor and breeds of the dairy cows.

In intensive system of management (31.1%) of dairy cows were affected and in extensive system (78.2%) were affected by reproductive disorders. The high prevalence rate of the reproductive disorders in dairy cows with extensive system of management was due to high occurrence of anestrus and RB. The major reproductive problems identified were anestrus (43.5%), RB (25.3%), RFM (6.8%), abortion (5.1%), dystocia (2.1%), uterine prolapse (1.7%), vaginal prolapse (0.4%), follicular cyst (0.4%) and mixed cases (13.9%). Mixed cases includes abortion and RFM; RFM and anestrus; dystocia and RFM; metritis and RB and RFM and metritis were the most commonly occurred in the study area.

This study indicated that anestrus, RB, RFM and abortion were the major reproductive health disorders; while dystocia, metritis, uterine prolapse, vaginal prolapse and follicular cyst were the minor reproductive disorder encountered in the study area. Shiferaw, *et al.* [20], who reported an overall prevalence of (6.3%) abortion which is slightly higher than the prevalence of the current study (5.1%). The difference in the prevalence of this type of disorder may be due to the frequency of infectious diseases; level of toxic-

ity, nutritional status and parity status of the dairy cows. Conditions such as high environmental temperature (heat stress), poor hygiene and sanitation of the dairy house and improper dead animal/aborted fetus carcasses and fetal membrane removal were the most important risk factors for the occurrence of abortion in the study area.

Another reproductive disorder most commonly encountered in the study area is anestrus. The prevalence of anestrus in the current study (43.5%) is greatly higher than the result of Befekadu [21] and Khan [22] who reported (24%) in cross breed dairy cows in central high lands of Ethiopia and (31.79%) in dairy cattle under semi-intensive system of rearing in North-Eastern India, respectively. The difference in the prevalence may be as a result of difference in breed of the dairy cows and management practices. Main risk factors for anestrus in dairy cattle are poor nutrition, breed of the dairy cattle, lack of enough green fodder availability, higher incidence of infectious diseases and lack of scientific knowledge and poor management practices.

The prevalence of RFM in this study (6.8%) is relatively higher than, that of Bahlibi [23] who reported (1.1%) in central zone of Tigray region; Northern Ethiopia and dystocia case result (2.1%) is lower than the work of Dawit and Ahmed [18], who reported an overall prevalence of (7.7%) in Kombolcha, Northeast Ethiopia. The variation in the incidence of RFM may be attributed to variations in predisposing factors to which the animals are subjected to; among which include nutritional status and management such as lack of exercise [17]. Weak expulsive force during parturition is an important factor for the occurrence of RFM.

The prevalence of RB in the present study (25.3%) is slightly higher than the study by Mekonnen [24], who reported a prevalence of (21.8%) from Ada'a district of Central Ethiopia, and in close approximation with the result by Hunduma [1], who reported a prevalence of (26.8%) in and around Asella town, Central Ethiopia. RB can be caused by a number of factors, such as infertile semen or sub fertile bulls, endocrine imbalance, poor nutrition, cystic ovarian disorder, anovulation, delayed ovulation, early embryonic mortality, reproductive tract infections diseases and poor management practices such as wrong time of insemination or faulty heat detection, inexperienced inseminator, inappropriate semen handling and insemination techniques. Metritis, milk fever, dystocia, and RFM had a significant effect on the occurrence of RB [25].

Uterine prolapses in this study was occurring at the rate of (1.7%) which is slightly in agreement with Bitew and Prasad [19], who reported (1%) in and around Bedell, South west Ethiopia and the prevalence rate of vaginal prolapse (0.4%) is lower than the result of Dawit and Ahmed [18], who reported (1.24%) in Kombolcha, Northeast Ethiopia. The prevalence of follicular cyst and metritis is reported to be (0.4%) and (0.8%), respectively.

Based on the regular follow up, the body condition of dairy cows highly affected the prevalence of reproductive disorders. (100%)

and (80.0%) of the affected animals were categorized under very poor and poor body conditions, respectively followed by grossly fatty body conditioned dairy cows with the prevalence of (60.0%) (19.0%) and (6.7%) of affected dairy cows were under good and fatty body condition, respectively. Aschalew, *et al.* [26], who reported (20%) and (83.3%) of affected animals were categorized under good and poor body condition, which is slightly agreed with the report of this study (19.0%) and (80.0%). Very poor and poor body conditioned (1 and 2) dairy cows were as a result of poor nutrition and parasitic disease especially in dairy farms with extensive system of production. This study indicated that, dairy cows with very poor and poor body conditions highly affected with a reproductive disorders, may be due compromised immunity [27].

The method of service is not significantly affected the occurrence of reproductive disorders in the dairy farms. From the total dairy farms used AI and used bulls, (78.1%) and (93.5%) of them were affected by one or more reproductive disorders, respectively. farms used both AI and bull for breeding were affected by reproductive disorders with a prevalence rate of (89.3%).

The time of service slightly affected the occurrence of reproductive disorders on the dairy farms. Time of service is an important factor that affects the prevalence of RB. Delaying the time of insemination/mating after estrus is one important reason for the occurrence of RB. Farms that brought their dairy cows to AI/bull within 24 hrs intervals (86.4%) were affected by one or more reproductive disorders. However, all the farms used uncontrolled method of service (100%) was affected by reproductive disorders.

Parity of female is one of the most important factors associated with reproductive disorders. The parity 1st-3rd is the most productive phase of female cattle followed by parity 4th-5th. Due to high milk production up to third parity, animals becomes in Negative Energy Balance (NEB). As the poor farmers could not provide the high cost of concentrate feed, the productive animals fail either to return to cyclicity resulting prolonged calving to conception interval leading to anestrus or it may result into endocrine disturbances leading to failure of ovulation, failure of fertilization, early embryonic mortality resulting in RB [22].

Based on this study, reproductive disorders were highly prevalent in first, second and third parity with a rate of (24.9%), (34.6%), (20.3%), respectively. Heifers (3.8%) and fifth parity and above (4.6%) dairy cows were least affected by a reproductive disorders followed by fourth parity with a prevalence rate of (11.8%). Abortion, RFM, anestrus, RB and uterine prolapse were highly prevalent in a second parity with a prevalence of (41.7%), (37.5%), (37.9%), (31.7%) and (75.0%), respectively. Dystocia (60.0%) was commonly occurred in heifers based on the present study. Vaginal prolapse (100%) and follicular cyst (100%) were more common in fourth parity dairy cows.

Conclusion and Recommendation

This study revealed that a reproductive health disorders such as anestrus, RB, RFM, dystocia, abortion, prolapses (vaginal and uterine) and metritis were one of the major causes of low reproductive performance in dairy cows in and around Mekelle city. This study showed that about (42.3%) of dairy cows both in extensive and intensive system of production/management were found to be affected by one or more of the reproductive disorders. The possible risk factors responsible for the occurrence of the reproductive disorders identified during the study were parity of the animal, system of production/management, body condition score, time of service during heat, system of breeding and nutrition. In general, anestrus and RB were among the common reproductive health disorders encountered on dairy cattle's in the study area, may be due to improper management and nutritional deficiency. Therefore, based on the above conclusion the following recommendations are forwarded;

- The dairy workers and farmers should be advised to provide their dairy cows with good supplementary feed, improve the cleanness of the cows and hygiene of the house, which can minimize the risk of occurrence of reproductive disorders.
- Further investigations should be performed to isolate the causes of the reproductive disorders and associated risk factors in the study area.
- Create awareness to owners, farm workers and farmers about how to manage their dairy cattle's before pregnancy, during pregnancy and after pregnancy to avoid or minimize the risk of reproductive disorders.
- Policy makers at various levels should also give emphasis for the development of the dairy sector by mobilizing resources to the proximity of small holder dairy farmers.

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