

Reproductive Health Constraints in Dairy Cows Managed Under Smallholder Farms of East Shewa, Ethiopia

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Abstract

Reproduction is a basic requirement to increase stock size, successfully replace culled cows and maintain constant milk production in dairy farms. However, the reproductive physiology of dairy cows is disturbed by several factors, the most important of which are reproductive disorders. The current study was conducted to identify major reproductive health problems in two selected zones of Oromia National Regional State, Ethiopia. Reproduction and production performance history of selected cows were collected from 123 farm owners. The mean age, parity, age at first calving (AFC), age at first service (AFS), calving to first service (CFS), service per conception (SPC), average calving interval (ACI), the average lactation length and average daily milk yield were 65.8 ± 30.5 M, 2.48 ± 1.6 , 30 ± 8.6 M, 19.61 ± 6.3 , 3.3 ± 1.7 M, 2.75 ± 1.74 M, 14.3 ± 3.4 M, 11.5 ± 3.4 M and 12.3 ± 6.6 L, respectively. From a total of 252 studied dairy cows, 102 (40.5%) had either a history or active reproductive health problem. Among the problems identified, mastitis (43.6%), abortion (13.8%), retention of placenta (21.3%) and dystocia (7.4%) were found with high magnitude. While Vaginal prolapses (1.6%), repeated breeding (3.25%) and anoestrus (5.3%) were other reproductive health problems with a relatively lower incidence rate. Age ($p=0.01$), Breed ($p=0.04$) and body condition ($p=0.04$) were identified as risk factors for reproductive problem. The observed reproductive health problems were higher as compared to other reports. Therefore, the constraints need to be addressed using holistic interventions which consist of feeds and nutrition, breeding and health packages.

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1. Background and justification

Reproduction is a basic prerequisite to efficient livestock production. The general reproductive aim of all dairy farms is to obtain a calf every year without an extended calving interval. This is very important to increase stock size, successfully replace culled cows and maintain constant milk production in the farm. The reproductive and milk production performance of indigenous dairy cattle is generally low. In an attempt to increase milk production, pure exotic breed dairy animals are being imported to the country and indigenous cattle performance is being improved through cross-breeding.

Ethiopia is a country with vast productive livestock resources comprising about 59 million cattle, out of which milking cows constitute to be around 12 million (CSA n.d.). The livestock sub-sector contributes an estimated 12% of the total and over 45% to the agricultural GDPs (CSA n.d.). Moreover, livestock serves as an important source of livelihood to over 60% of the national population. The benefit harnessed from the sector, however, is far below the potential. This is mainly due to poor management practices, poor nutrition, high disease incidence, and low genetic potential (Yalew, Lobago, and Goshu 2011).

Reproductive disorders and associated losses prevent successful breeding and milk production at farm level which in turn hinders dairy development in a country (Nakada 2006). These disorders can result from infectious and noninfectious causes. Abortion, dystocia, retention of the placenta (ROP), metritis, prolapse (uterine and vagina), anoestrus and repeat breedings were reported as major conditions affecting dairy cows (Lobago et al. 2006; Shiferaw et al. 2005; Zemenu, Belete, and Ahmed 2018).

The above-mentioned disorders can also be emanated from the invasion of genital organs by pathogenic microorganism. The infectious causes of reproductive diseases in cattle so far reported in Ethiopia are viral: BVD, BHV, and IBR (Sibhat et al. 2018), bacterial: *Brucella spp.*, *Coaxella burnetii*, *Campylobacter fetus*, *Leptospira spp.*, and *Listeria monocytogenes* (Ibrahim 2018; Rashid n.d.; Town 2017; Zemenu et al. 2018), and protozoal: *Toxoplasma gondii*, *Neospora caninum*, *Trichomonas fetus* (Ibrahim 2018; Lema, Kassa, and Tegegne 2001). The current study was conducted to investigate the major reproductive constraints in two zones of the Oromia region.

2. Materials and methods

2.1 Study Area

The study was conducted in two zones of the Oromia region, namely East Shewa and Oromia Finfine Special Zone Dukem City Administration (OFSZDCA).

2.2 Study animals

The study animals were local and crossbred dairy cattle reared in smallholder and commercial dairy farms located in and on the outskirts of major towns of the study areas.

2.3 Study Design

A cross-sectional study using a semi-structured questionnaire was conducted to investigate the major reproductive health problems in the area. The study was done by selecting dairy cows in representative farms. Clinical examination was performed at the spot and history on production and reproduction performance was taken from owners and from individual cow records, when possible, to determine the patterns, magnitude and causes of reproductive disorders.

2.4 Sampling Approach

Study zones, districts and peasant associations were selected using multi-stage random sampling procedure. Households and study animals were selected purposively. The selection criteria were ease of access and the presence of one or more dairy cows in the farm at the time of the study. All dairy cows in selected farms with or without a history of reproductive disorders were considered for the study.

2.5 Study methods

A semi-structured questionnaire was designed, tested in a pilot study and employed to collect information about livestock holding pattern, management practices, production and reproductive performance, existing constraints and the magnitude and clinical presentation of reproductive disorders. The clinical study was performed on selected animals at the time of investigation and cases were diagnosed tentatively.

Assessment of reproductive disorders from all the study animals, information concerning herd size, age, breed, parity, and history of reproductive disorders were recorded using the specific format prepared for the evaluation. Diagnosis of reproductive disorders was made based on history and observation of clinical sign of animals. The body condition score (BCS) of the animal was determined as 1,2,3,4 and 5. Based on body condition score, animals were categorized into three groups; poor (BCS=1-2), medium (BCS=3) and good (BCS=4-5).

2.6 Statistical analysis

Data were collected using questionnaires, observational assessments and clinical inspections. The collected data was organized, cleared and coded using Ms Excel (2016) and transferred to SPSS and SAS for analysis. Descriptive statistics was performed using SPSS V20, results are presented as tables and figures. The interrelationship among reproductive disorders and association between production system and reproductive disorders was analysed with Bivariable and multivariable analysis using SAS 9.03. Variable having a p-value less than 0.05 in bivariate analysis were further analysed in multivariate analysis; a p-value of less than 0.05 in the final model were considered as statistically significant.

3. Result and discussion

A total of 123 dairy farms were selected for the study. Most of the respondents were male (52.8), and residents of East Shewa (48%) and Oromia special zone (OSZSFDAC) (52%). Most of the farms were intensive (84.4%), while around 11.5% and 4.1% were managed by semi-intensive and extensive systems, respectively. The majority of the respondent (91.8%) were smallholder farmers (Table 1)

Table 1: respondents' profile

Question	Response category	Respondents No.	%
Zone	East Shewa	59	48
	OFSZDCA	64	52
Sex	Male	65	52.8
	Female	58	47.2
Management system	Intensive	103	84.4
	Extensive	5	4.1
	Semi intensive	14	11.5
Farm ownership	Private commercial	8	6.6
	Cooperative	2	1.6
	Small Holder	112	91.8
Years in dairy farming	1-15 Years	93	76.2
	15-30 Years	15	12.3
	Above 30 Years	14	11.5

Most farms (84%) raised their own stock; only 16% of the farms purchased dairy animals from other farms. About half of the farms (56%) kept dairy cattle while the remaining farms (44%) keep diverse species of animals. Crossbreed dairy cows were found to be dominant in farms (63.1%) followed by exotic (27.9) and local (9) breed cows (Fig 1).

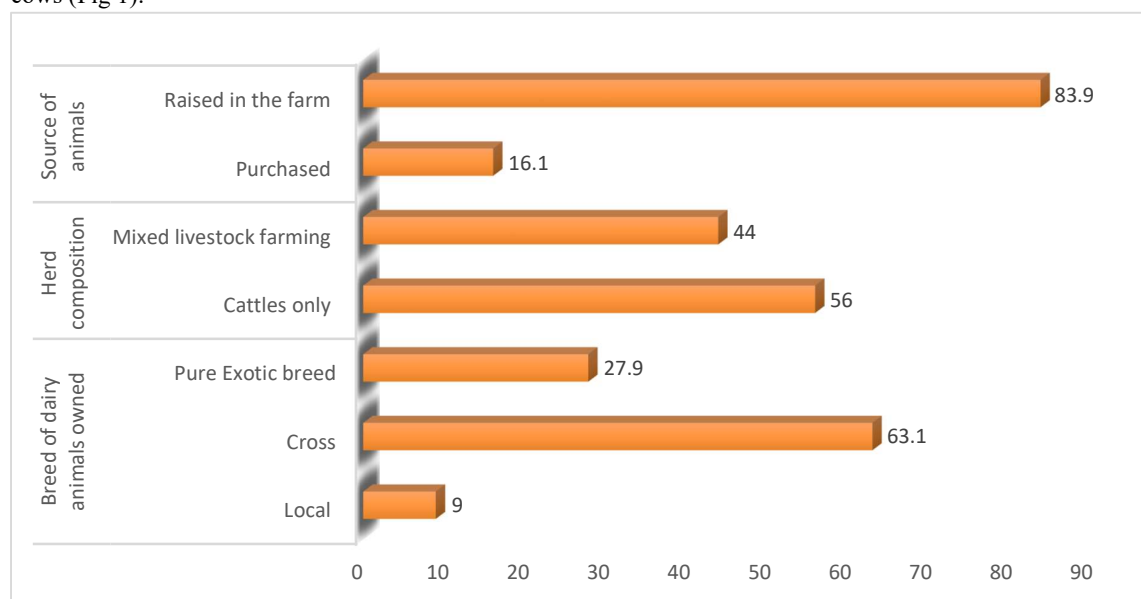


Figure 1: Livestock ownership and composition of selected farms

3.1 Housing Condition

A little more than half of the respondents keep their animals in a simple barn built adjacent to the living house (Table 3). The roofs of the barns were covered by a corrugated iron sheet (73.3%), hay (2.6%) or plastic/rubbers (24.1%). The walls were made of metal sheet (48.3%), wood (26.3%), plastic sheets (16.9%) and mud (6.4%). The floor system was mainly concrete (70.7%) and mud and stone (25%). Biosecurity measures were in place in only 15% of the farms.

Table 2: housing condition of selected farms

Question	Response category	Respondents No.	%
Housing systems	Simple Shed beside home	63	52.5
	Barn in separate compound	57	47.5
Roof	Iron sheet	85	73.3
	Grass	3	2.6
	Rubber and plastic	28	24.1
Wall	Iron sheet	57	48.3
	Woods only	31	26.3
	Blocks	2	1.7
	Plastic/Rubber	20	16.9
	Mud and Wood	8	6.7
Floor	Concrete	82	70.7
	Soil	29	25.0
	Mud and Stone	5	4.3

3.2 Reproductive performance of selected cows

Data on reproductive and production performance was taken for 250 cows selected from 123 households. The average parity of selected cows was 2.48 ± 1.6 with the age range of 24 – 180 months (65.8 ± 30.5). The AFS and the AFC of selected cows were 19.61 ± 6.3 and 30 ± 8.6 , respectively. The average CFS, SPC, ACI, the average lactation length and average daily milk yield were 3.3 ± 1.69 months, 2.75 ± 1.74 months, 14.3 ± 3.4 months, 11.5 ± 3.4 months and 12.3 ± 6.6 L, respectively. Calf mortality was reported in 75 farms; each farm on average losses 1.71 calves (Table 3).

Table 3: Means (months) of age at first service, Age at 1st caving, Calving to the first service, No. of services per conception and calving interval of cows managed under smallholder farms.

Parameters	N	Mean \pm SD	Other reports	References
Parity	250	2.48 ± 1.6		
Age (M)	211	65.8 ± 30.5		
AFS (M)	189	19.61 ± 6.3	26-29 M	(Shiferaw et al. 2003; Siyoum et al. 2016)
AFC (M)	196	30 ± 8.6	35- 41 M	(Shiferaw et al. 2003; Siyoum et al. 2016; Yalew et al. 2011)
CFS (M)	207	3.03 ± 1.7	4.73 M	(Shiferaw et al. 2003)
NSPC	149	2.75 ± 1.7	1.75 M	(Shiferaw et al. 2003)
CI (M)	212	14.28 ± 3.403	15- 18 M	(Shiferaw et al. 2003; Siyoum et al. 2016; Yalew et al. 2011)
Lactation length (M)	235	11.54 ± 3.418		
Daily milk yield in (L)	250	12.35 ± 6.697		
Calf mortality	75	1.71 ± 1.566		

Description:: AFS= Age at first service AFC Age at 1st caving; CFS=Calving to first service, NSPC=No. of services per conception, CI= Calving interval; M=month

The mean AFS, AFC and CI were lower than previous reports. A 26 years retrospective analysis made by Yalew et al. (Yalew et al. 2011), a reproductive constraint in crossbred dairy cows under four different production systems in the central highlands of Ethiopia by Shiferaw et al. (Shiferaw et al. 2003), reproductive performances of Jersey dairy cattle maintained at Adeaberga dairy farm by Siyoum et al. (Siyoum et al. 2016) showed the mean AFS, AFC and CI to be 26-29 M, 35-41M and 15-18M, respectively. The difference might be attributed to the impact of training and large-scale dairy technology demonstration performed in the area and the interventions of various stakeholders on dairy feeding and nutrition, management and health, to better the reproductive and productive performance.

3.3 Major reproductive problems encountered

Among the selected 252 dairy cows, 102 (40.5%) encountered reproductive health problem at least once in their production time. The major reproductive disorders recorded with high prevalence in the present study were mastitis

(43.6%), abortion (13.8%), ROP (21.3%) and dystocia (7.4%). While Vaginal prolapses (1.6%), repeated breeding (3.25%) and anoestrus (5.3%) were other reproductive health problems with a lower incidence rate (Table 4).

Table 4: Major reproductive problems observed in selected cows

Question	Response category	No.	%
Reproductive health problem encountered (n = 252)	Yes	102	40.5
	No	134	53.2
	Not sure	16	6.3
Major reproductive health problems observed (n = 94)	Mastitis	41	43.6
	ROP	20	21.3
	Abortion and stillbirth	13	13.8
	Dystocia	7	7.4
	Anoestrus	5	5.3
	Uterine Prolapse	5	5.3
	Repeated Breeding	3	3.2
Measures taken (n = 94)	Animal Treated	88	93.5
	Not treated	6	6.5
Response to treatment (n=86)	Good	81	89.4
	Poor	10	11.6

The prevalence of mastitis reported in this study is high as compared to the reports of Lema et al. (Lema et al. 2001) in central highlands of Ethiopia and Tolosa et al. (Tolosa, Netsere, and Habtamu 2021) in Bale with a morbidity rate of 19% and 20%, respectively. The difference might be attributed to the breed of cows and the average milk yield of studied animals. Cows with high milk yield and high exotic blood level are prone to mastitis.

Retention of the placenta was the second-highest reproductive disorder observed in the current study. ROP is the most undetermined reproductive disorder in dairy farms. But the condition might contribute to lower milk yield, long calving interval, repeated service per conception and high risk of fatty liver (Han and Kim 2005; Rajala and Grohn 2000). ROP is mainly caused by a failure in hormonal regulation (Ibrahim 2018); the level of estrogen in a pregnant cow should reach peak, a week before parturition to produce strong motility in the uterus and to get rid of the fetal membranes after birth. To this effect, the body must favour estrogen synthesis by declining the level of progesterone. The process is induced by fetal cortisol via the production of the enzymes, 17 - hydroxylase and aromatase (Ibrahim 2018).

Anoestrus and repeated breedings were reported as a major cause of reproductive health problem in northern Ethiopia, Nazereth (Adama), central Ethiopia, Kombolcha, and around Assella, Hossana and Fiche with a magnitude of 6.1%, 2.2%, 6.7%, 9.1%, 14.6%, 2.6% and 8.4%, respectively (Abdella and Regassa 2013; Bekena, Ekman, and Kindhal 2011; Dawite and Ahmed 2013; Haile, Tsegaye, and Tesfaye 2014; Hunduma 2013; Micheal 2003; Tesfaye, Tirsit, and Yitagesu 2017). Moreover, a prolonged anoestrus of 47% was also reported by Siyoum et al. (Siyoum et al. 2016) in Jersey breeds reared in Adea Berga dairy farm. A higher magnitude of repeat breeding was observed in Hawassa (Micheal 2003), Central Ethiopia (Abdella and Regassa 2013), Hossana (Haile et al. 2014) and around Fiche (Tesfaye et al. 2017).

The prevalence of abortion unveiled by the current study is high. Many authors report the impact of abortion on dairy reproductive performance in different parts of the country. A much higher (28.9%) abortion rate was reported by Siyoum et al. (Siyoum et al. 2016), whereas Abunna et al. (Abunna et al. 2018) and Tolosa et al. (Tolosa et al. 2021) reported 8% and 4.1%, abortion rate respectively, in different breeds and farm settings. The presence of abortion in a dairy farm extends the calving interval which largely affects the profit of the dairy farm. Abortion resulted from pathogenic microbial invasion may cause prolonged infertility or sterility. Abortion and stillbirth increase the rate of pregnancy wastage in the form of embryonic, fetal and newborn losses. Thus, it can be considered as an important farm animal reproductive constraint. Abortion can be caused by numerous factors including dam's physiology, reproduction capacity and diseases of bacterial, viral, protozoan and fungal origins. Abortion resulted from reproductive tract infections also pose a serious zoonotic risk (Parkinson, Noakes, and England 2001).

Uterine prolapse is another reproductive system problem observed in the current study. The condition is almost common in dairy animals and when it occurs it usually affects the cow by reducing the postpartum return to estrus, conception rate and calving interval in dairy cattle (Kumar and Yasotha 2015), which in turn affects the operation of the dairy farm. There is no definite cause for the problem even though it is mostly associated with milk fever (hypocalcemia), poor uterine tone, increased straining, the weight of the retained fetal membrane, tympany and excessive estrogen content in the feed (Hanie 2006; Jackson 2004; Kumar and Yasotha 2015).

3.4 Risk factors for reproductive health problem

Reproductive problems observed more frequently in aged cows than young cows; in Good body condition than medium body condition cows; and in crossbreed cows than local breed cows (Table 5).

Table 5: the prevalence of reproductive health problems categorized in different variables

Risk factors	Category	Cows	Affected cows	
			N	%
BCS	Good Body condition	235	57	24.3
	Medium Body Condition		44	18.7
Age	0-5 years	198	28	14.1
	Above 5 Years		62	31.3
Parity	1-3 calves	234	77	32.9
	More than 3 calves		24	10.3
Age at maturity	Less than 24 months	174	65	37.4
	Above 24 months		10	5.7
Age at first calving	Below 30 months	181	64	35.4
	30 months and above		15	8.3
Breed of Cow	Local breed	235	19	8.1
	Crossbreed		83	35.3

The prevalence of reproductive problems showed significant difference with respect to the age of cows ($p=0.01$), body condition ($p=0.04$) and breed of cow ($p=0.04$) (Table 6).

Table 6: Strength of association between reproductive health problems and associated risk factors

Variables * rep problems	B	S.E.	Wald	Sig.	Exp (B)	95% CI
Age of Cow	.989	.398	6.18	.01	2.689	1.23 - 5.863
Body condition	-.68	.338	4.04	.04	.507	.261 - .983
Breed of cow	.914	.438	4.35	.04	2.495	1.05 - 5.889

However, the occurrence of reproductive problems was statistically insignificant with respect to parity, age at first calving, breeding method, farming system and age at maturity ($p>0.05$). The overall incidence of reproductive disorders in this study and the identified risk factors were also reported earlier (Tolosa et al. 2021). The presence of reproductive disorder of any kind exerts its negative effect on farms. Long calving interval and low conception rate in dairy cows may increase the risk of involuntary culling (Gröhn and Rajala-Schultz 2000).

4 Conclusion and recommendation

The current study showed major reproductive problems in the selected study area. The overall prevalence (40.5%) noted in this study is relatively higher than various reports. Mastitis, abortion, ROP and dystocia were identified as the major reproductive problems of high magnitude. While Vaginal prolapses, repeated breeding and anoestrus occurs with a lower incidence rate. Breed of selected cow, age of cows and body condition were found to be a risk factor for observed reproductive problems. Therefore, a planned intervention comprising feeds and nutrition, breeding and health packages is required to reduce the occurrence of reproductive health problems in the area. Most of the farms do not keep performance records like breeding, production and health records. These records apart from performance measurement can help to identify factors that may be associated with the observed reproductive problems, which in turn used to design and implement intervention options. Therefore, farmers should be advised and trained to keep performance recording.

The current study was based on a questionnaire survey with rapid clinical inspection thus lacks laboratory confirmation of the cases. It is also difficult to tell the exact reason behind the abortion, stillbirth and mastitis observed in the study. Therefore, exhaustive laboratory investigations are needed to identify infectious and non-infectious causes of reproductive health problems at a grass-root level.

Further studies are required to develop, evaluate and validate intervention and management methods across different management system to minimize the antepartum and postpartum reproductive problems.

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