African Journal of Agricultural Research

Full Length Research Paper

Major postpartum problems of dairy cows managed in small and medium scale production systems in Wolaita Sodo, Ethiopia

Getenet Ayele, Berhanu Mekibib and Desie Sheferaw*

School of Veterinary Medicine, Hawassa University, P.O. Box 05, Hawassa, Ethiopia.

Received 19 September, 2013; Accepted 4 August, 2014

A longitudinal study was conducted on post-partum reproductive problems in small and medium scale dairy production systems in Wolaita Sodo from October 2011 to May 2012. The objectives of the study were to identify the major clinically manifested postpartum problems, estimating the prevalence and investigating the potential risk factors related to the occurrence of postpartum problems of dairy cows in the area. From a total 634 dairy cow examined, 57(8.99%) cows had different types of partum and postpartum problems: abortion (0.63%), dystocia (0.79%), retained fetal membrane (3.36%), uterine prolapse (0.47%), milk-fever (1.42%) and metritis (2.84%). A significant difference was observed in the occurrence of postpartum problems among age groups of cows (P <0.05) and parity (P <0.05). Higher prevalence of postpartum problems was recorded in older (15.20%, CI=7.82-22.61) than the younger cows. The prevalence of postpartum problems was higher in cows with seven and more than seven parity (15.70%, CI=7.11-24.31) than those cows having less than seven parity. Dairy cows postpartum problems were found to be one of the major problems in Wolaita Sodo. To reduce the postpartum problems due attention should be given for proper herd or individual cow management, early identification and diagnosis of the reproductive problems and awareness creation for owners.

Key words: Postpartum problems, dairy, risk factors, Wolaita Sodo, Ethiopia.

INTRODUCTION

The reproductive performance of zebu and improved cattle in tropical regions remains low, as the annual calving rate is about 50% (Bastidas et al., 1984). This low reproductive efficiency is due to various factors, and it becomes the major limitation to meat and milk production (Rodríguez and Segura, 1995). Reproductive performance linked to the health of cows, which could be before and/or after calving. It has traditionally occupied a substantial amount of veterinarian’s attention (DeVeres, 2006). Roelofs et al. (2010) concluded that long postpartum anestrus, poor estrus detection and low conception rates contributed to extending calving intervals in *Bos indicus* cattle. The postpartum period plays a pivotal role in cattle reproduction. The duration of postpartum anestrus has an important influence on reproductive performance (Lucy, 2007). Factors such as limited energy intake, lower body reserves, and postpartum diseases can potentially delay the return to cyclicity.

The ‘Post-Partum Disease Complex’ consists of
ketosis, hypocalcaemia, metritis, retained fetal membranes, endometritis and uterine prolapse. All of these diseases are related to one another, with complicated cause and effect mechanisms in place. Numerous studies (Borsberry and Dobson, 1989; Gröhn et al., 1990; Rajala and Gröhn, 1998; Ferguson and Galligan, 2000; LeBlanc et al., 2002; LeBlanc, 2008) had shown that postpartum diseases can affect the length of calving interval, the number of days open, and the reproductive efficiency in general. These diseases can also affect the overall productivity of dairy cows by reducing milk yield.

Studies conducted so far in Ethiopia (Negussie et al., 1998; Shiferaw et al., 2003; Asseged and Birhanu, 2004; Nuraddis et al., 2011; Dinka, 2012) revealed poor reproductive performance of dairy cows in the tropics. For feasible intervention, the poor reproductive performance of dairy cows should warrant investigation on the types and magnitudes of the existing postpartum problems. Therefore, the present study was conducted to identify and estimate the prevalence of the major clinically manifested postpartum problems and to see the effect of some risk factors in the occurrence of postpartum problems in dairy cow in and around Wolaita Sodo.

MATERIALS AND METHODS

Study area

The study was conducted in Wolaita Sodo, Southern Ethiopia, which is located at latitude of 6°54′N and 37°45′E. The altitude of the area ranges from 1,600 to 2,100 m above sea level. The study area is characterized by bimodal pattern of rainfall, and has an annual rain fall ranging from 450 to 1446 mm. The mean annual temperature of the area is about 10°C. The average maximum monthly temperature (18°C) is obtained in January and February while average minimum monthly temperature (11°C) is recorded in June and July (http://en.wikipedia.org/wiki/Sodo). The total cattle population of Wolaita Zone is estimated to be 723,343; of which 290,836 are 3 to 10 years old and 22,479 are older than 10 years (CSA, 2012).

Study population

The study population was dairy cows found in and around Wolaita Sodo with more than four months of pregnancy. Hence, they were calved in the study period, November 2011 to May 2012. A longitudinal study method was employed in which all selected cows were followed up to their parturition as well as during postpartum period. Reproductive history of study cows were collected carefully assessed and recorded, from record or owners’. Maximum effort was made to include all the pregnant, more than four months of gestation periods. At the beginning of the study, 634 cows were selected and registered, and then followed-up during their prepertum and on their postpartum periods.

Study methodology

All selected cows were given code number for ease of identification. Then, all the necessary informations: breed, age, parity, body conditions, management system, methods of service, date of service, date of calving, and reproductive health conditions before and after calving were recorded. Age of the study animals was estimated from the record as well as dentition (De-Lahunta and Habel, 1986), and accordingly, the cows were grouped as young adults (3 to 6 years), adults (6 to 10 years) and old (greater than 10 years). The parity was classified as few (with less than or equal to 3 calves), moderate (3 to 7 calves) and many (greater than or equal to 7 calves). The body condition score were estimated as described by Nicholson and Butterworth (1986) and finally, three categories were used: poor, medium and good. The breeds of the animals were identified based on phenotypically, history from owners and the available record. The management system was classified into good, medium and poor (based up on husbandry variables; management and labor force, record keeping, housing, presence of calving pen, floor type, drainage, and general farm hygiene). The study cows and/or farm were visited on weekly basis both before and after parturition. Moreover, maximum effort was made to follow-up clinical cases and the process of parturition through arranged call from the farm owners. Any abnormality or terminal event that include live birth, dystocia, still birth, uterine prolapse, metritis, hypocalcaemia others were recorded.

Case definition

Dystocia: Dystocia was determined based on the history of occurrence from the farmer and clinical examination of the dam that requires calving assistance.

Metritis: This was determined based on the history of occurrence, general examination for the presence of fetid vaginal discharges, straining by the cow, inflammation and oedema of the vulva and rectal examination of the uterus for its size and contents.

Milk fever: This was determined based on history of occurrence and clinical signs such as reduced rectal temperature, depressed mentale state, dry muzzle, weak pulse and heart sounds, generalized muscle weakness, ruminal atony and tympany, dilution of pupils with slow pupillary light reflex and recumbency.

Retained placenta: This was determined based on the history of a placenta that had not dropped within 12 h after calving and observation of the placenta hanging outside the vaginal opening or physical palpation per-vagina.

Abortion: This was determined based on observation and history of termination of pregnancy before the full term.

Uterine prolapse: This was determined based on the history of occurrence from the farmer and clinical observation of the organ hanging outside the vulva opening.

Data management and analysis

Collected data entered and stored in spread sheet of Microsoft Office Excel. Then, it was summarized by means of descriptive statistics. The $\chi^2$ test was employed for analysis of the various risk factors association with PPP. For this analysis, STATA software version 11, Stata Corp. 4905 Lake way drive College Station, Texas 77845, USA was used. The analysis considered the confidence level of 95% and $P<0.05$ was set for establishing significance.

RESULTS

Occurrence and prevalence of postpartum problems

Of the total 634 dairy cows examined 57 (9.0%) of them...
Table 1. Reproductive problems of dairy cows encountered during the study period (n=634).

<table>
<thead>
<tr>
<th>Reproductive/metabolic problems</th>
<th>Frequency</th>
<th>Proportion (%)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abortion</td>
<td>4</td>
<td>7.0</td>
<td>0.3-13.7</td>
</tr>
<tr>
<td>Dystocia</td>
<td>5</td>
<td>8.8</td>
<td>1.3-16.2</td>
</tr>
<tr>
<td>Retained fetal membrane</td>
<td>23</td>
<td>40.4</td>
<td>27.5-53.2*</td>
</tr>
<tr>
<td>Uterine prolapse</td>
<td>3</td>
<td>5.3</td>
<td>0.1-1.11.1</td>
</tr>
<tr>
<td>Milk fever</td>
<td>9</td>
<td>15.8</td>
<td>6.2-25.4</td>
</tr>
<tr>
<td>Metritis</td>
<td>18</td>
<td>31.6</td>
<td>19.4-43.8*</td>
</tr>
</tbody>
</table>

* = Significantly different, \(\chi^2 = 589.8665\) P < 0.05.

Table 2. Prevalence of PPP in calving cows with the different putative risk factors.

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Number of cows examined</th>
<th>PPP No. (%)</th>
<th>95% CI</th>
<th>(\chi^2)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>386</td>
<td>23 (5.95)</td>
<td>3.59 - 8.33</td>
<td>3.66</td>
<td>0.056</td>
</tr>
<tr>
<td>Cross and exotic</td>
<td>248</td>
<td>25 (10.1)</td>
<td>6.32 - 13.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young adult</td>
<td>227</td>
<td>8 (3.5)</td>
<td>1.12 - 5.93</td>
<td>13.26</td>
<td>0.001</td>
</tr>
<tr>
<td>Adult</td>
<td>315</td>
<td>26 (8.3)</td>
<td>5.20 - 11.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old</td>
<td>92</td>
<td>14 (15.2)</td>
<td>7.82 - 22.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>256</td>
<td>25 (9.0%)</td>
<td>5.47 - 12.5</td>
<td>4.36</td>
<td>0.11</td>
</tr>
<tr>
<td>Medium</td>
<td>310</td>
<td>24 (7.70)</td>
<td>4.76 - 10.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>68</td>
<td>1 (1.50)</td>
<td>1.42 - 4.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of mating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AI</td>
<td>580</td>
<td>45 (7.80)</td>
<td>5.58 - 9.94</td>
<td>0.34</td>
<td>0.56</td>
</tr>
<tr>
<td>Natural (bull)</td>
<td>54</td>
<td>3 (5.60)</td>
<td>0.62 - 11.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\leq 3)</td>
<td>308</td>
<td>11 (3.60)</td>
<td>1.49 - 5.65</td>
<td>16.12</td>
<td>0.000</td>
</tr>
<tr>
<td>3-7</td>
<td>256</td>
<td>26 (10.20)</td>
<td>6.44 - 13.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\geq 7)</td>
<td>70</td>
<td>11 (15.70)</td>
<td>7.11 - 24.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>238</td>
<td>21 (8.80)</td>
<td>5.21 - 12.44</td>
<td>1.23</td>
<td>0.54</td>
</tr>
<tr>
<td>Medium</td>
<td>335</td>
<td>24 (7.20)</td>
<td>4.39 - 9.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>61</td>
<td>3 (4.90)</td>
<td>0.56 - 10.40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PPP = Post-partum problems, CI = Confidence Interval.

were affected by various types of reproductive problems (Table 1). Five (0.8%) cows were affected with more than types of postpartum problems.

Risk factors analysis for postpartum problems

The prevalence and analysis of postpartum problems among breed, age, body condition, methods of mating, parity and management system were shown in Table 2. The effect of the considered risk factor on the common postpartum reproductive problems was summarized, and shown in Table 3.

DISCUSSION

The finding of this study showed that more postpartum
Table 3. Analysis of reproductive problems in cows vs. putative risk factors.

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>No. of cows examined</th>
<th>Abortion No. (%)</th>
<th>Dystocia No. (%)</th>
<th>RFM No. (%)</th>
<th>UP No. (%)</th>
<th>MF No. (%)</th>
<th>Metritis No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>386</td>
<td>3(0.8)</td>
<td>4(1.0)</td>
<td>9(2.3)</td>
<td>1(0.3)</td>
<td>3(0.8)</td>
<td>11(2.9)</td>
</tr>
<tr>
<td>Cross and exotic</td>
<td>248</td>
<td>1(0.4)</td>
<td>1(0.4)</td>
<td>14(5.6)*</td>
<td>2(0.8)</td>
<td>6(2.4)</td>
<td>7(2.8)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young adult</td>
<td>227</td>
<td>0</td>
<td>5(2.2)*</td>
<td>4(1.8)</td>
<td>1(0.4)</td>
<td>0</td>
<td>4(1.8)*</td>
</tr>
<tr>
<td>Adult</td>
<td>315</td>
<td>3(1.0)</td>
<td>0</td>
<td>13(4.1)</td>
<td>1(0.3)</td>
<td>4(1.3)**</td>
<td>10(3.2)</td>
</tr>
<tr>
<td>Old</td>
<td>92</td>
<td>1(1.1)</td>
<td>0</td>
<td>6(6.5)</td>
<td>1(1.1)</td>
<td>5(5.4)</td>
<td>4(4.4)</td>
</tr>
<tr>
<td>Body condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>256</td>
<td>2(0.8)</td>
<td>3(1.2)</td>
<td>10(3.9)</td>
<td>3(1.2)</td>
<td>5(2.0)</td>
<td>7(2.7)</td>
</tr>
<tr>
<td>Medium</td>
<td>310</td>
<td>2(0.7)</td>
<td>2(0.7)</td>
<td>12(3.9)</td>
<td>0</td>
<td>4(1.3)</td>
<td>1(3.6)</td>
</tr>
<tr>
<td>Poor</td>
<td>68</td>
<td>0</td>
<td>0</td>
<td>1(1.5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mating method</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AI</td>
<td>580</td>
<td>2(0.4)**</td>
<td>4(0.7)</td>
<td>21(3.6)</td>
<td>3(0.5)</td>
<td>9(1.6)</td>
<td>16(2.8)</td>
</tr>
<tr>
<td>Natural(bull)</td>
<td>54</td>
<td>2(3.7)</td>
<td>1(1.9)</td>
<td>2(3.7)</td>
<td>0</td>
<td>0</td>
<td>2(3.7)</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤3</td>
<td>308</td>
<td>3(1.0)</td>
<td>5(1.6)</td>
<td>6(2.0)</td>
<td>1(0.3)</td>
<td>0</td>
<td>6(2.0)</td>
</tr>
<tr>
<td>3-7</td>
<td>256</td>
<td>0</td>
<td>0</td>
<td>12(4.7)</td>
<td>2(0.8)</td>
<td>4(1.6)**</td>
<td>9(3.5)</td>
</tr>
<tr>
<td>≥7</td>
<td>70</td>
<td>1(1.4)</td>
<td>0</td>
<td>5(7.1)</td>
<td>0</td>
<td>5(7.1)</td>
<td>3(4.3)</td>
</tr>
<tr>
<td>Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>238</td>
<td>2(0.8)</td>
<td>2(0.8)</td>
<td>10(4.2)</td>
<td>2(0.8)</td>
<td>5(2.1)</td>
<td>6(2.5)</td>
</tr>
<tr>
<td>Medium</td>
<td>335</td>
<td>2(0.6)</td>
<td>3(0.9)</td>
<td>11(3.3)</td>
<td>1(0.3)</td>
<td>3(0.9)</td>
<td>11(3.3)</td>
</tr>
<tr>
<td>Poor</td>
<td>61</td>
<td>0</td>
<td>0</td>
<td>2(3.3)</td>
<td>0</td>
<td>1(1.6)</td>
<td>1(1.6)</td>
</tr>
</tbody>
</table>

**Indicates highly significant difference (P <0.01), * Indicat ses significant different (P <0.05), BC = body condition, RFM = Retained fetal membrane, UP = Uterine prolapse, MF = Milk fever.

Problems occurred in older cows (15.2%, CI=7.8-22.6) than the younger. This finding is in agreement with Thompson et al. (1983) who reported higher chance of postpartum problems in lactating old age cows and also increased with parity. According to Kahn and Line (2005) and Halpern et al. (1985) older cows have higher prevalence of parturient paresis, and are also at increased risk of retained placenta and metritis. These problems could be associated with reduced defense mechanisms in older and multiparous cows compared to younger cows. Moreover, older cows especially those that gave birth to many calves were exposed to repeated traumatic damage of reproductive tract, and hence, have poorly regenerating endometrium (LeBlanc, 2008; Ball and Peters, 2004). During this study, retained fetal membrane and metritis were more frequently observed. The problems were reported from various parts of the country (Bitew and Prasad, 2011; Lemma and Kebede, 2011) as one of the major postpartum problems in dairy cows. Retained fetal membrane (40.4%) was the most prevalent postpartum problem observed in the study area (Table 1). This problem was higher in older cows (6.5%) and followed by adult (4.1%), and young adult cows (1.8%). Similarly, Cows with more than or equal to seven parities were more frequently affected (7.1%) than the others. This observation was in agreement with Erb and Martin (1980) who reported that fetal membrane retention increased with advancing of parity or aging of cows. Ferguson and Galligan (2000) also reported about 10%, ranging from 6.3 to 14.6%, incidence rate of retained placenta in older cows. This problem, retained placenta can predispose to impairment of subsequent reproductive performance (Ball and Peters, 2004). Tefera et al. (2001) reported that placental retention was followed by significantly increased periods of abnormal vaginal discharge, intervals to uterine involution, intervals to first ovulation and rates of endometritis as compared with cows that were not affected. In addition, there is an increased frequency of abortions during subsequent pregnancies, possibly as a result of scar tissue formation within the uterine wall limiting expansion of the uterus and/or nutrition of the fetus (Noakes et al., 2001). The
prevalence of metritis, the second (Table 1) most common post partum problem (2.8%), which was significantly (P <0.05) was influenced by age and parity (Table 3). Higher prevalence of metritis was observed in older cows (4.4%) and cows with more than or equal to seven parity (4.3%). Erb and Martin (1980) reported that older cows were 1.6 to 2.5 times as likely to develop metritis as were younger cows. Even though several factors are implicated as predisposing to reproductive tract infection, retained placenta and dystocia result in a greater incidence of reproductive tract infections (LeBlanc, 2008; Yoseph et al., 2005). According to greater incidence of reproductive tract infections, retained placenta and dystocia result in a factors are implicated as predisposing to reproductive tract infection, retained placenta and dystocia result in a greater incidence of reproductive tract infections (LeBlanc, 2008; Yoseph et al., 2005). According to Abuom et al. (2012) cows that developed retained placenta and dystocia were 5.2 and 3.9 times more likely to develop metritis, respectively. Therefore, retained fetal membranes was an important risk factor for vulval discharge (Peeler et al., 1994) and increased risk of metritis (Konyves et al., 2009), which can in turn influence the reproductive performance. Milk fever was the third prevalent (1.4%) postpartum problems encountered during this study period in Wolaita Sodo (Table 1). This problem could be associated with the ration particularly in minerals. Reist et al. (2003) reported that raised milk acetone concentrations (>0.40 mmol/L) were associated with endometritis. This suggests that metabolic disorders like milk fever and ketosis may predispose to, or be associated with, the uterine infection, and also provides a possible means of identifying cows at risk, so that appropriate interventions can be considered.

Postpartum problems were more prevalent in exotic and crosses, with greater than or equal to 50% exotic blood, cows. The higher prevalence observed in improved breeds could be associated with the lower degree of adaptation to the existing climate and poor management practice. Moreover, stress, the inability of cows to cope up with its environment, can predispose to postpartum problems, and hence, they fail to achieve their genetic potential (Dobson and Smith, 2000). It is quite clear that poor metabolic status, negative energy balance in particular, can predispose to some postpartum problems (Ball and Peters, 2004).

The prevalence of dystocia was significantly higher (P <0.05) in young adult cows (Table 3). Though dystocia has maternal and fetal causes, the most common causes of dystocia are fetal in origin and these are invariably due to either fetal oversize or abnormal disposition of the fetus (Ball and Peters, 2004). Premature breeding in young cows, the common feto-pelvic disproportion in local cows mated with improved sire, and the increased fat around the perineum of over fed cows could be the possible reasons (Hafez and Hafez, 2006; Noakes et al., 2001).

Abortion was another reproductive problem in Wolaita Sodo, which was about 10 times more frequent in naturally mated cows (3.7%) than the artificially inseminated cows (0.4%).

Generally all the postpartum problems observed in the study area have great influence on productivity of the cows. According to Rajala and Gröhn (1998) and Lucey et al. (1986), retained placenta had a significant negative effect on milk yield for several weeks after calving. There is a considerable milk loss as a result of difficult of calving (Dematawewa and Berger, 1997). Metritis result in decreased dry matter intake, and hence, multiparous cows with metritis in early lactation produce less milk than the healthy cows. This difference is greatest during the first 20 weeks of lactation (Wittrock et al., 2011).

Conclusions

This study indicated that retained fetal membrane, metritis and milk fever were the most important reproductive problems in the study area. Age, breed, parity and mating methods were the most important predisposing risk factors for the various reproductive problems. The higher prevalence of postpartum problems can mainly attribute to the age and breed of cows in the study area. Postpartum problems can lead to heavy economic losses through reduced milk production (that is, by reducing the quality and quantity of milk), increasing veterinary expenses and poor reproductive performance (Fertility of such cows often reduced in terms of calving interval, calving to conception interval and pregnancy rate to first insemination). Therefore, owners’ awareness creation and preventive measures for postpartum reproductive health problems should be instituted.

Conflict of Interest

The authors have not declared any conflict of interest.

ACKNOWLEDGMENTS

Special thanks go to Sodo Regional Veterinary Laboratory, Sodo University and Hawassa University staffs for provision of hospitable working environment and literatures.

REFERENCES

PMid:15563027.
Erb HN, Martin SW (1980). Interrelationships between production
219. http://dx.doi.org/10.1136/vr.138.9.217

Characteristics (Private Peasant Holdings), Agricultural Sample
Federal Democratic Republic of Ethiopia

WB. Saunders Company, pp. 4-16.

Dematawewa CMB, Berger PJ (1997). Effect of dystocia on yield,
fertility, and cow losses and an economic evaluation of dystocia
http://dx.doi.org/10.3168/jds.S0022-0302(97)75995-2

Dairy Sci. 89:3876-3885.
http://dx.doi.org/10.3168/jds.S0022-0302(06)72430-4

Dinka H (2012). Reproductive performance of crossbred dairy cows
under smallholder condition in Ethiopia. Int. J. Livestock Prod. 3:25-
28.

Dobson H and Smith RF (2000). What is stress, and how does it affect
http://dx.doi.org/10.1016/S0378-4320(00)00084-4

Erb HN, Martin SW (1980). Interrelationships between production
reproductive diseases in Holstein cows, age and seasonal patterns.
J. Dairy Sci, 63(11):1918-1924
http://dx.doi.org/10.3168/jds.S0022-0302(80)83159-6

Ferguson JD, Galligan DT (2000). Assessment of Reproductive
22:5150–5158.

Gröhn YT, Erb HN, McCulloch CE, Saloniemi HS (1990). Epidemiology
of reproductive disorders in dairy cattle: Associations among host
http://dx.doi.org/10.1016/0167-5877(90)90020-I


Halpern N, Erb HN, Smith RD (1985). Duration of retained fetal
membranes and subsequent fertility in dairy cows. Theriogenology

Inc., Philadelphia

Könyves L, Ottó Szenci O, Jurkovich V, Tegzes L, Attila Tirián A,
Solomos N, Gyulay G, Bryd E (2009). Risk Assessment and
Consequences of Retained Placenta for Uterine Health,
Reproduction and Milk Yield in Dairy Cows. Acta Vet., Brno, 78:163-
72. http://dx.doi.org/10.2754/avb200978010163

LeBlanc SJ, Duffield TF, Leslie KE, Bateman KG, Keefe GP, Walton JS,
Johnson WH (2002). Defining and Diagnosing Postpartum Clinical
Endometritis and its Impact on Reproductive Performance in Dairy
http://dx.doi.org/10.3168/jds.S0022-0302(02)74302-6

http://dx.doi.org/10.1016/j.tvjl.2007.12.019 PMid:18328749

on reproductive performance of dairy cows in market oriented urban
dairy farms in and around Addis Ababa. Revue Méd. Vét.,
162(11):526-530.

Lucy MC (2007). Fertility in high-producing dairy cows: reasons for
decline and corrective strategies for sustainable improvement. Soc.
Reprod. Fertil. Suppl. 64:237–254.PMid:17491151


Reproductive performance of dairy cattle at Assessa livesteal farm,
http://dx.doi.org/10.1111/j.1439-0388.1998.tb00348.x

of Zebu Cattle. International Livestock Research Center for Africa,
Addis Ababa.

of Elsevier Limited, pp. 188-338.

Performance of Crossbred Cattle (Holstein Friesian x Zebu) in

Peeler EJ, Otte M, Esslemont RJ (1994). Inter-relationships of
http://dx.doi.org/10.1136/vr.134.6.129 PMid:8171781

Rajala PJ, Gröhn YT (1998). Effects of Dystocia, Retained Placenta,
http://dx.doi.org/10.3168/jds.S0022-0302(98)75863-7

Reist M, Erdin DK, Voneuw D, Tschüperlin KM, Leuenberger H,
Hammon HM, Künzi N, Blum JW (2003). Use of threshold serum and
milk ketone concentrations to identify risk for ketosis and endometritis
http://dx.doi.org/10.2460/ajvr.2003.64.188 PMid:12602588

Rodríguez ROL, Segura CV (1995). Effect of once-daily suckling on
postpartum reproduction in zebu-cross cows in the tropics. Ani.

Roelofs J, López-Gatius F, Hunterd RHF, van Eerdenburge FJCM and
Hanzenf C (2010). Review: When is a cow in estrus? Clinical and
practical aspects. Theriogenology, 74:327–344
http://dx.doi.org/10.1016/j.theriogenology.2010.02.016
PMid:20363020

performance of crossbred Dairy Cows in different production systems
561.http://dx.doi.org/10.1023/A:1027377722576

specific protein B (bPSPB) and progesterone monitoring of
postpartum dairy cows with placental retention. J. Vet. Med. Series A-

Thompson JR, Pollak EJ, Pelissier CL (1983). Interrelationships of
postpartum problems, production of subsequent lactation,

Short communication: Metritis affects milk production and cul rate of
Holstein multiparous and primiparous dairy cows differently. J. Dairy
PMid:21524531

disorders of crossbred dairy cows in the Central Highlands of
7050-5