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Retained Fetal Membrane in Tanzanian Dairy Cows: Economic Impacts and Subsequent Reproductive Performances

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Keywords: Retained fetal membrane; Risk factors; Financial losses; Tanzanian dairy herds.

Abstract

Background: Retained Fetal Membrane (RFM) is among of the most common disorders affecting reproduction of dairy cattle. It has subsequent adverse effect on milk production, delays uterine involution, predispose cows to endometritis and decreased fertility. The present study was carried out to investigated the incidence, risk factors, reproductive and financial losses and subsequent reproductive effects associated with RFM in three dairy herds in Tanzania.

Methods: A retrospective cross-sectional study was conducted from January to June 2020. Animal records covering the period of six consecutive years of from 2014 through 2019 and comprising 1431 calvings originating from 241 cows: 140 Holstein cows kept in full-time pasture grazing system and 101 cross-bred dairy cows maintained under semi-confined production system were included in the data set. Animal records collected were occurrence, risk factors and treatment methods of RFM, calving order/parity, periods from parturition to first estrus, postpartum service interval, open days, calving interval, number of services per conception and milk production. The data were compiled and analyzed by using SPSS program.

Results: The overall incidence of RFM was 10.73%. The incidence was significantly higher in pure Holstein genotype (13.45%) kept at Farm A than in crossbred cows reared in farm B (7.19%) and Farm C (11.56%). A combination of manual removal and intrauterine antibiotic administration was the only method used for treatment of RFM in all three farms. Abortions (52.76%), parity (50.25%) and rainy season (63.6%) were associated with the occurrence of RFM. The occurrence of RFM greatly ($P<0.05$) influenced the interval from parturition to the first postpartum oestrus, number

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of open days, calving intervals and number of services per conception. The estimated average financial loss due to RFM per cow in a lactation was 364,133.00 Tanzanian shillings (157.00 USD $) with major losses attributable to reduced milk yield (95.43%) than treatment costs (4.51%). Higher losses (P<0.05) were recorded in Farm A than Farm B and Farm C of dairy herds.

Conclusion: These findings point out the economic importance of RFM in the dairy industry causing great economic losses and leaving the animal subfertile even after successful treatment and recovery. Therefore, we recommend for control of risk factors with ultimate of reducing the occurrence of RFM.

Introduction

The profitability of dairy farming depends greatly on the reproductive efficiency of dairy cows [1]. Reduced reproductive efficiency may lead to decreased production lifetime, tremendous drop of economic gains, increased calving interval and cost of treatment of the affected farm animals [2,3]. The major causes of reproductive disorder in cows are abortion, dystocia, retained fetal membrane, pyometra, metritis, uterine and vaginal prolapsed, anoestrus and repeated breeding [3,4].

Retention of fetal membranes is the most common condition occurring in cattle following parturition [5,6]. The occurrence of RFM has multifactorial causes including physiological, pathological, environmental, nutritional and animal-related factors [4,7]. Normally fetal membranes drop within 8 hours of parturition, if it is retained up to 12 hours then it is called as 'delayed removal' and if retained for more than 24 hours of parturition then it is called as 'Retained fetal membrane' [8,9]. Expulsion of placenta within the stipulated time period is important for subsequent reproductive efficiency as it hasten in timely involution and resumption of postpartum cyclicity.

Retention of RFM leads to a number of problems as it provides a suitable medium for growth microorganisms which ultimately leads to uterine inflammation (metritis and endometritis), fever, reduced feed intake and loos of body condition [10,11]. In cows, the incidence of RFM varies from 1.0% to 30% and it has been reported to be much higher especially in problematic herds [12,13]. RFM incidence of 24.9 per cent has been reported in Egypt [14], 13% to 26% in India [15], 17.2% in some smallholders' dairy herds of Tanzania [16], 8.0% to 11.26% in China [17], and 13.4% in Bangladesh [18]. Risk factors for RFM vary among different regions, countries, environment and different management practices [19]. However, the most commonly risk factors for RFM in cattle include: dystocia, abortion, stillbirth, twinning, hormonal imbalances, immunosuppression, calving season, cow parity, nutritional deficiency, management and infectious diseases [12,19-22]. The therapeutic approaches commonly used in veterinary practices for RFM are of relative effectiveness, often coupled with conflicting results, or have potential negative effect on future reproduction of animals [23]. Commonly used methods for treatment of RFM include manual removal, intrauterine or systemic application of antibiotics, uses of ecbolics (Oxytocin and Prostaglandins) and estradiol [23-27], ozone therapy [28] and collagenase treatment [29,30].

The manual removal of the RFM, although commonly practiced by many veterinarians worldwide [31,32], has been critically discussed for many years. Among the downsides of the manual removal as a routine procedure for RFM treatment includes traumatic injury to uterine mucosa, intrauterine bacterial contamination, disturbance of intrauterine cellular defenses, and impairment of subsequent fertility [24,32]. Currently, many veterinarians from developing countries as well as many parts of Europe, United States of America and Canada use a combination of manual removal of fetal membrane and intrauterine antibiotics administration as treatment approach to RFM [32,33]. Although intrauterine therapy such as tetracycline/sulfonamide boluses are used in most RFM cases [34], its application does not reduce the incidence of metritis or improve fertility [24], and it inhibits the metalloproteinase matrix, and possibly perpetuates bacterial resistance [35]. Systemic antibiotics are believed to be beneficial in RFM cases where fever is also present although is not clear whether the resolution of fever is due to antibiotics or to the cow's own immune defense mechanisms [26,36]. Only antibiotic treatment has been shown to be beneficial in cases of acute postpartum metritis [37]. Prostaglandins and oxytocin are most commonly used hormones in treating RFM playing a role in uterine contraction, and thus effective in treating RFM following uterine atony [21]. However, it has been reported that uterine atony accounts for a very small percentage of retained placenta cases [24,38]; therefore, these hormones are not supported for their use in treatment of RFM [23].

Retained fetal membrane causes severe economic impacts, particularly in dairy herds such as reduced milk production [15,39], increased costs related to veterinary services and treatment, unintentional culling [21], delayed uterine involution and resumption of ovarian activity, increase in days open, increased services per conception, reduction in pregnancy rate and reduction in conception rate [40,41]. Other major negative squeals of RFM include increased frequencies of endometritis, puerperal metritis and mastitis in affected animals [14,42]. Dairy industry in Tanzania has increased drastically in response to increased milk consumption as sequels to expanding human population. However, as commercialization of dairy cattle increases, retention of fetal membrane is posing a big challenge to Tanzanian dairy industry. Limited studies have been conducted to characterize the risk factors, economic impact and subsequent reproductive performance of cattle affected with RFM. The purpose of this study was to establish the prevalence, related risk factors, economic impact and subsequent reproductive performances of dairy cattle affected with retained fetal membranes in three medium dairy farms managed under semi-confined (housing and pasture feeding) as well as free-pasture production system in Tanzania.

Materials and methods

Study area

Retrospective data were collected from January to June 2020 in three dairy farms (designated as farm A, B and C) in Tanzania. Farm A (Kitulo Livestock Multiplication Unit; Kitulo LMU) is situated at an altitude of 2630 – 2820 meters above sea level in Makete district, Njombe region. The farm is in a semi-temperate climate with maximum and minimum temperatures ranging from 4°C to 8°C and from 14.5°C to 18.5°C, respectively. The area receives unimodal rainfall with a range of from 1200 to 1600 mm per annum. The rain season starts in October and ends in May and it is followed by a cool dry period up to August.

Farm B (Mazimbu dairy farm) and C (Magadu dairy farm), both belonged to the Sokoine University of Agriculture, and are located within the same climatic zone in Morogoro municipal-

ity, Tanzania. Geographically, the area is elevation of 500 to 600 m above sea level with a mixture of warm and cool temperatures ranging between 27 to 33.7°C in the dry/warm season and 14.2 to 21.7°C in cool/wet season. The area experiences a sub-humid tropical climate with a bimodal rainfall pattern characterized by two rainfall seasons in a year with a dry season separating the short rains (October to December) and long rains (which fall from March to May/June). There are about 6 months of dryness, the peak being September. The mean annual rainfall is about 870 mm and the total annual evapotranspiration is about 1300 mm.

Study animals

In the study, two types of dairy cattle were involved. Farm A had Friesian cattle full time grazed on planted template pastures comprising mainly of *Lolium perenne, Lolium multiflurium* and *Infolium repens*. Milking cows were supplemented with farm-made concentrate composed of maize bran and rice polish, (60-70%), sunflower seed cake or cotton seed cake (25%), mineral supplement 2% and 1% salt during milking. All lactating and heavily pregnant cows were offered twice a day with concentrates especially during milking. Lactating cows were machinery milked and all animals had ad-libitum water supply. The farm practiced both artificial insemination and natural breeding. Animal are routinely vaccinated against common diseases, regularly dewormed and dipped against external parasites. Farms B and C had crossbred dairy cattle which were allowed to graze on pasture for about 8 hours and fed with hay after returning to the housing pallor in the afternoon. Milking cows were supplemented with farm-made concentrate and machinery-milked twice daily. All farms used both artificial insemination and natural breeding methods.

Treatment for RFM

Qualified veterinarians were involved in the treatment of RFM in each farm. Within 24 hours after parturition, cows were examined clinically for body temperature, respiratory rates, and detachment of fetal membrane. For cows diagnosed to have retention of fetal membranes 24 hours after parturition, a combination of manual removal of the RFM and intrauterine administration of antibiotic pills (500 mg Oxytetracycline in the form of tablets) was practiced. Cows were then re-examined daily for 14 days for temperature reactions, character of discharge from the vulva, and any other signs of illness. Cows diagnosed to have clinical endometritis (discharge containing 50% off-white mucopurulent material, occasionally sanguineous) were retreated with intrauterine antibiotics. Cows exhibited signs of puerperal metritis (high fever; ≥ 39.5°C, abnormally enlarged uterus, fetid watery mucohaemorrhagic vaginal discharge, and other signs of systemic illness such as decreased milk yield, dullness etc.) received a systemic antibiotic treatment with procaine penicillin and dihydrostreptomycin sulphate (Norbrook Lab. Uk), 20 mg/kg intramuscularly per day for 3 to 5 consecutive days) with oxytocin (100 IU) injection for evacuation of discharge from the uterus.

Reproductive performance data

A total of 1431 calving records (830 from Farm A, 385 Farm B and 216 Farm C) were used in the present study. Collected data covered the period of six consecutive years; 2014 through 2019. The retrospective data included calving order/parity, periods from parturition to first estrus, postpartum service interval, open days, calving interval, and number of services per conception, occurrence of retained feta membrane (occurrence of RFM 24 hours after delivery) and RFM treatment method as reproductive traits in addition to average daily milk yield as productive trait.

Retained fetal membrane economic impact calculation

Trends in milk production for a minimum of 60 days' milk yields after the occurrence and treatment of RFM were recorded to gather data on the economic losses. Information on average daily milk yield, prevailing price of milk in the location, reduction in milk yield after occurrence and treatment, number of days before milk production picked to normal, and veterinary expenses was collected from the farms. The loss of milk was calculated by the difference between the average milk yield potential of the dairy cows and average milk yield during recovery period. The quantity of milk (in liters) that was reduced due to RFM during recovery period of 60 days in average was considered as milk loss. The economic loss due to RFM was calculated by looking on values such as loss of revenues for discarded milk during withdraws period, reduction in milk production after treatment period, Veterinary fees and drug costs [43]. However, the farms involved in this study employ their own veterinarian with fixed salary, thus, making it a fixed cost, so we did not have to take the veterinary fees into account in our calculations.

Risk factors for RFM

The risk factors involved in the occurrence of RFM were assessed through the application of a semi-structured questionnaire containing data from the animal and open questions, answered by the dairy producer or farm managers. The risk factors evaluated in relation to the cow included level milk production, parity, body condition score, pre-partum dietary supplementation, previous occurrence of RFM, duration of gestation, eutocic or distocic delivery, number of calves born, gender and size of calf, and the clinical health conditions of the affected animals (rectal temperature, appetite, and concomitant diseases).

Statistical analysis

The present study was designed as a case-control study. Cows diagnosed and treated for RFM during the five years of study period were selected as case cows whereas cows non- affected with RFM were classified as control cows. The obtained data were compiled and statistically analyzed by SPSS Window version 10.0 programs to evaluate the incidence and chi-square method used for comparison of the findings. For all tests, a value of $p < 0.05$ was considered significant.

Results

During the study period, a total of 1431 vaginal deliveries (calvings) were identified; retained fetal membrane was diagnosed in 163 (10.73%) calvings, and ranged from 4.0 to 16.4% among three dairy herds for the year 2014 to 2019 (Figures 1&2). The highest incidence of RFM (13.45%) was in farm A which had large number of pure Holstein dairy cattle than in other two farms (7.19% farm B and 11.56% farm C) which had relatively lower number of crossbred dairy cattle. Of the calvings associated with RFM, 52.76% (86/163) were dystocic and 47.24% (77/163) were normal. The occurrence of clinical endometritis and metritis were observed in 46.01% (n=75) and 20.86% (n=34), respectively, of the cows with RFM. All cows with clinical endometritis recovered from the infection after prompt with intrauterine antibiotic treatment. From the 34 cows with metritis complications, 91.2% (31/34) successfully recovered after systemic antibiotic treatment, whereas the remaining 8.8%

(3/34) did not recover and thus succumbed to death.

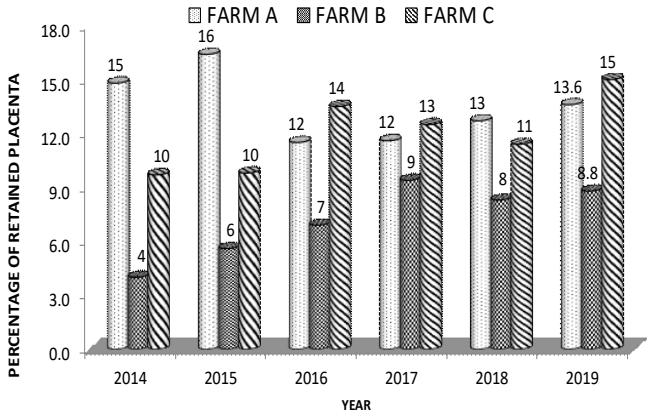

Figure 1: Incidence of retained placenta in 1431 calvings on three dairy farms for year spanning from 2014 – 2019.

In this study, the maximum number of RFM cases was observed in cattle of fourth and above parity (42.2%) followed by third (24.0%), first (17.4%) and second (16.6%) parity. The highest incidence of RFM was observed during rainy season (63.6%; n=77) than in dry season (36.4%). Among the 121 calvings with RFM, (90.9%; n = 110) parturients had one subsequent delivery, whereas, 9.1% (n=11) had at least one additional event of RFM in any of their subsequent deliveries. The genotype had significant effect (P<0.05) with the highest prevalence (13.2%; n= 80) observed in pure Friesian cows reared in Farm A than in crossbred cows kept in Farm B and Farm C. Furthermore, there were no differences between the groups when there were assessments of pre-partum supplementation, yearly milk yield/cow, duration of pregnancy, and herd sizes.

The retention of fetal membrane greatly influenced the reproductive performance of animals (Table 1). Open days were longer (P<0.05) in cows exhibiting retained placenta as compared to normal cows by about 52 days. This is because more than 50% of normally calved animals had days open within the three months post-partum, while more than 70% of cows with retained placenta conceived within after 150 days. Calving interval was longer (P<0.05) in cows exhibiting retained placenta as compared to normal cows by about 61 days. Number of services per conception for cows exhibiting RFM was higher (P<0.05) as compared to normal cows (2.9 vs. 1.9). Highest percentage of normally calved cows (58.65%) conceived during the period from 61 to 90 days after parturition, whereas, highest percentage of cows with RFM (88.50%) conceived at more than 120 day after parturition. Furthermore, RFM increased (P <0.05) the interval from calving to the first postpartum estrus of cows by about 30 days.

Table 2 presents the component wise economic losses due to occurrence of retained fetal membrane in farms. The financial losses attributed to reduced milk production per cow associated with the occurrence of RFM in this study ranged from 336,000.00 to 462,400.00 Tanzanian shillings (145.0 – 200.00 US Dollar) while the average economic loss attributed to RFM per cow in one lactation was estimated at 364,133.00 Tshs (157.00 US Dollar). Higher losses were attributable to the milk loss due to reduced milk production (95.43%) than treatment costs (4.57%). A higher loss was estimated in Farm A (53,526,000.00 Tshs; 23,080.00 $) due to presence of large number of cow affected by the disease than Farm C (8,900,000.00 Tshs; 3,838.00 $) and Farm B (8,478,000.00 Tshs; 3,656.00 $) dairy herds.

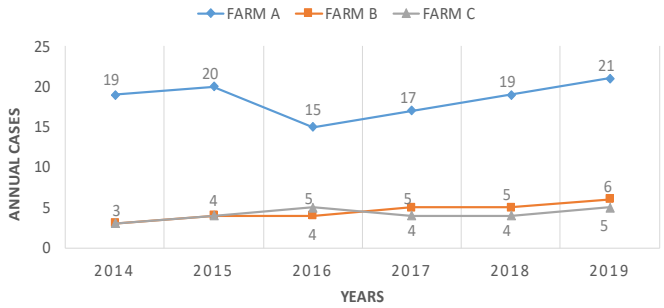

Figure 2: Annual trends of retained placenta observed between 2014 and 2018.

Table 1: Association of days open, number of services and calving interval with retained fetal membrane.

Farm	Number of cows		First estrus (days)		Average number of days open		Average number of services per conception		Average calving interval (days)	
	Normal	RFM	Normal	RFM	Normal	RFM	Normal	RFM	Normal	RFM
FARM A	719	111	36 ± 5.6	90 ± 1.5	90 ± 5.6	150 ± 1.5	1.8 ± 0.2	3.0 ± 1.8	372 ± 9.6	435 ± 11.8
FARM B	358	27	42 ± 5.7	76 ± 11.5	102 ± 5.7	156 ± 11.5	2.1 ± 0.7	2.7 ± 0.5	381 ± 15.8	437 ± 12.3
FARM C	191	25	36 ± 4.6	80 ± 4.5	96 ± 14.6	140 ± 4.5	1.7 ± 0.5	2.9 ± 0.6	369 ± 14.6	432 ± 8.9
Average	423	54	37 ± 8.6	87.7 ±5.8	96 ± 8.6	148.7 ±5.8	1.9 ± 0.5	2.9 ± 1.0	374 ± 13.3	434.7±11.2

Table 2: Estimated economic losses due to retention of fetal membrane in cows.

Farm	Number of cows	Normal calving milk production (Lt) in the first 6 weeks post-calving	RFM associated calving milk production (Lt) in the first 6 weeks post-calving	Average Loss of Milk (Lt) in association with RFM	Treatment cost in Tshs (drug cost x No. of animals)	Total economic loss due to RFM in Tshs.

		Average milk production per day ± SE	Average milk production per day ± SE	Average milk per day	Average milk Production loss per cow in Tshs (Milk lost * days* price)	Total milk loss per farm (cow milk production loss x No. of animals)		
Farm A	111	30 ± 5.9	19 ± 6.8	11 ± 6.1	462,400.00	51,326,400.00	2,200,000.00	53,526,400.00
Farm B	27	20 ± 1.9	13 ± 2.1	7 ± 1.8	294,000.00	7,938,000.00	540,000.00	8,478,000.00
Farm C	25	25 ± 1.7	17 ± 1.5	8 ± 1.8	336,000.00	8,400,000.00	500,000.00	8,900,000.00
Overall mean		25 ± 3.2	14 ± 3.5	8.7 ± 3.2	364,133.00	22,554,800.00	1,080,000.00	23,634,800.00

Discussion

We present here the occurrence, risk factors, economic impact and subsequent reproductive performance of dairy cattle affected with retention of fetal membrane in three dairy farms managed in different climatic conditions. The overall RFM prevalence (10.35%) reported in this study is similar to the finding observed in crossbred cattle elsewhere [13, 16, 44] but higher than 6.1% to 7.1% reported in North West Ethiopia [45]. However, our findings are lower than (16.8% to 18.3%) that reported in different regions of Ethiopia [7]. 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, breed variations and management conditions. Retained fetal membrane is a major key factor for endometrial inflammation, metritis, delayed uterine recovery, endometrial dysfunction and ovarian cycle disorder [46 – 50]. In this study, clinical endometritis (46.01%), metritis (20.86%), and deaths (2.45%) were the recorded negative sequelae of RFM as previously reported [14,51].

Retained fetal membrane was significantly associated with parity, genotype, abnormal parturition and farm management in this report. Cows' parity was related to increased risk of retained fetal membranes, and this agrees with previous studies [17,19, 52], which reported the incidence of RFM to increase with advancing parity. The genotype had significant effect ($P<0.05$) on RFM; higher prevalence (13.45%) was observed in Holstein Friesian cattle than in crossbred cattle (7.19% and 11.56%). Different researchers [2,18,53] had reported similar trend that the occurrence of RFM was higher in pure breeds of dairy cattle than in *Bos indicus* and *Bos taurus* crosses. On the other hand, increased risk for RFM was linked with the occurrence of dystocia, which is consistent with other reports [16,17,19,21,52]. Cows with abortion, stillbirth and difficult calving suffer from circulatory disorders that impair normal fetal detachment, leading to RFM. Farm size and managemental factors (grazing – housing or full-time grazing) had significant effect on the occurrence of RFM. In this study, the highest incidence of RFM observed in Farm A could be attributed with herd size and free grazing system as reported elsewhere [18].

The intervals from calving to first service and conception were higher in the cows with RFM than in the cows with normal parturition, which is consistent with other reports [8, 14, 19]. However, the effect of RFM was much greater on the interval from calving to conception than the effect on the delay in the interval from calving to first service in this study, consistent with the findings reported elsewhere [19,54]. The mean number of services per conception in cows with RFM reported here correlates with other findings reported elsewhere [10,14,19,55]. The average number of open days in cows with RFM agrees with the findings reported by other researchers [10,14]. Retention of placenta is associated with secondary uterine infections, which may be related to probability of subsequent conception [56]. Cows with retained fetal membranes had longer intervals from calving to first service and to conception and required more services per conception and lower pregnancy rate and conception to first service.

The direct costs of RFM are difficult to derive because are heavily influenced by individual farm treatment protocols and the level of veterinary involvement [57]. The huge economic losses (8.5 to 53.5 million Tshs; 90.50 – 270.60 US Dollar) revealed in our study concurs with the results of several other studies [9,24,58] which reported considerably economic loss in dairy herds due to occurrence of RFM, especially when incidence exceeds the average of 5-10%. Furthermore, RFM had a significant negative effect on milk yield for up to six weeks after calving and had a considerable milk loss as reported previously [59]. The estimated financial losses observed in this study could be used to advocate for the implementation of prevention and control methods which may reduce the occurrence and consequently the impact of RFM in Tanzanian dairies as reported elsewhere [60-63].

Conclusions

The results provided information on Tanzanian dairy farm loss of income attributed by retention of fetal membranes. The retention of fetal membranes was high and negatively affected the milk yield and reproductive performance of animals. Management, genotype, increased parity and abnormal calving were the main risk factors for RFM in dairy cows on the three dairy herds. Therefore, appropriate control of risk factors causative factors are known to reduce the occurrence of retention of fetal membrane in dairy farms.

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Conflicts of interest

The authors declare that they have no financial or personal relationships which may have inappropriately influenced them in writing this article.

Authors' contributions

IPK conceptualized the project, drafted and finalized the manuscript. AAN preformed most of statistical analysis of data

and contributed in tabulations and drawing of figure. All authors read and approved the final manuscript.

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