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Research Article
A Three-year Prospective Study of the Incidence of Dystocia in Dairy Cows in Gatsibo District, Rwanda

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Abstract

Background and Objectives: The Rwandan government launched the Girinka ('One Cow Per Poor Family') program in 2006 through the use of Friesian/Holstein bulls and semen to inseminate indigenous, cross-bred and exotic breed dairy cows in a bid to reduce childhood malnutrition and alleviate poverty. Reproductive failure was one of the challenges encountered in this program. The current study was undertaken to determine the factors affecting the incidence of dystocia and postpartum complications in the dairy cows of Gatsibo district over a three year period (2011-2014). **Materials and Methods:** The breed, method of insemination, parity, sex of calf, postpartum complications and mortalities of calves or dams were recorded for a total of 5611 parturitions from 3007 cows between 2011 and 2014 in the Kiziguro sector of Gatsibo. Statistical analysis of data was carried out using Statistical Package for Social Sciences (SPSS) version 16.0. Chi-square contingency tables were used in data analysis and p values <0.05 were considered significant. **Results:** Higher incidence of dystocia ($p<0.05$) was reported in indigenous (17.31%) than in crossbred (5.47%) and exotic breeds (4.61%). Artificially inseminated cows had a higher incidence of dystocia (16.67%) than those serviced by bulls (4.96%) ($p<0.05$). In addition, primiparous cows showed a significantly higher dystocia incidence (11.34%) than pluriparous cows (5.95%) ($p<0.05$). The incidence of dystocia was significantly higher in dams carrying male calves (11.54%) than in those with female calves (6.80%) ($p<0.05$). Moreover, retained placenta (53.09%) was significantly the most common complication of dystocia in comparison to postpartum bleeding (19.14%) and calf death (20.37%) ($p<0.05$). Whilst calf death and postpartum bleeding had a significantly higher incidence ($p<0.05$) than cow death (3.09%) and hind limb paralysis (4.32%). There was, however, no significant difference between the incidence of postpartum bleeding and calf death ($p>0.05$), nor between cow death incidence and hind limb paralysis ($p>0.05$). The revenue losses resulting from dystocias encountered in this study amount to US$11 323.08. **Conclusion:** The study concluded that artificially inseminated primiparous indigenous cattle with male calves had the highest incidence of dystocia, suggesting that the introduction of high quality dairy bulls or semen was counter-productive if indigenous cows were not upgraded. More so, the use of pedigree semen or bulls in indigenous dairy herd improvement programmes in Gatsibo, Rwanda resulted in a significant increase in incidence of dystocia and postpartum complications.

Key words: Ankole, Friesian-Holstein, dystocia, incidence, parity, crossbreeds

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Rwanda's economy is based on agriculture, with more than 80% of the population engaged in agricultural activities[1]. The agricultural sector contributes 33% of the Gross Domestic Product (GDP) and of this, food crops make up 23%. Livestock contributes 8.8% of the GDP and about 30% of the agricultural GDP[2]. In Rwanda, as in many developing countries, livestock plays multiple roles. Apart from contributing to the country's agricultural GDP, animal resources play an important role in the socio-economic wellbeing of the population. Despite the large number of cattle and their economic importance, the increase in productivity is constrained by several factors such as disease, poor nutrition, poor management and poor genetic potential of indigenous breeds. These constraints result in the poor reproductive performance of dairy cattle. Dystocia and its associated complications have a direct impact on the reproductive performance of cows[3]. Several studies have implicated dystocia as a contributing factor to various factors such as deranged metabolism[4], deranged microbial ecology[5], subsequent production physiology[6,7] including reduced milk production[8,9] and poor fertility[10-12].

In general, dystocia occurs due to feto-maternal disproportion, abnormal presentation (breech, head or foot back) and abnormal posture[13]. Uterine inertia, weakness of the dam, stress, hormonal abnormalities and foetal abnormalities[13,14] have also been implicated in the causation of dystocia. Other factors include parity of dam[15-17], sex of the calf[8,16], whether the calf is a singleton or twin[8,18] and weight of the calf [9].

Vision 2020, which is an economic blueprint for the government of Rwanda has embarked on a program of poverty alleviation through the improvement of agricultural productivity in rural communities[19]. Central to this endeavour in the livestock production sector is increasing milk production through crossing of local cows with exotic breed males using artificial insemination in order to produce cows with higher milk yields. There is empirical evidence which suggested that crossing of dairy bulls which have larger body frames with smaller Ankole cows has inadvertently resulted in more cases of dystocia in Rwanda.

Although the authorities might have seen this scenario playing out in Rwanda, there seems to be no published evaluation of the incidence of dystocia. It therefore behooves of us to investigate the incidence of dystocia, its nature, causes and the predisposing factors in order to provide evidence based information for the government of Rwanda's livestock development program. The present study was designed to investigate the incidence of dystocia and to gain insights into the features of dystocia in the dairy cows of Kiziguro sector in Rwanda.

The main objectives of this study were (1) To determine the incidence of dystocia in the dairy cattle in Kiziguro sector of Gatsibo district, (2) To investigate factors affecting the incidence of dystocia (3) To estimate economic losses associated with dystocia and (4) To find out the major postpartum complications resulting from dystocia.

MATERIALS AND METHODS

A three-year prospective cohort study was conducted from June 2011 to June 2014 and the study involved 3007 dairy cows from four cells from the Kiziguro sector of Gatsibo district in the Eastern province of Rwanda. Some of these 3007 cows had more than one parturition during the period of the study, giving a total of 5611 parturitions. A total of 651 dairy cows were utilized for this study in Rubona cell, 837 in Ndatemwa, 713 in Mbogo and 806 in Agakomeye. A total of 496 dystocias were recorded from the 5611 parturitions during the period of this study. Information on the breed, method of service, parity, sex of calf, postpartum complications and mortalities of calves or dams was recorded for each parturition throughout the duration of the study. When natural service was used, Friesian/Holstein bulls were used for servicing all the dairy cows in this sector. In cases where artificial insemination was used, imported Friesian/Holstein semen was used in all instances. Farmers' choice, feasibility and convenience were the main determinants for the use of either natural service or artificial insemination.

Study area: This study was done in Kiziguro sector of Gatsibo district in the Eastern province, Rwanda. The Kiziguro sector is comprised of four cells, namely Agakomeye in the West, Mbogo in the East, Rubona in the South and Ndatemwa in the North. The sector is bordered in the East by Rukara sector, in the West by Murambi sector, in the North by Rugarama sector and in the South by Kiramuruzi sector.

Climate: The district where Kiziguro is located experiences low precipitation and hot temperatures. The mean annual rainfall ranges between 800 and 900 mm and temperatures can go beyond 30°C in February and between June and August[20]. The area is characterized by two main seasons; a long dry season that varies between 3 and 5 months (May-September) with annual average temperatures ranging between 25.3 and 27.7°C. The monthly distribution of the rains is erratic and amounts vary widely from one year to the next.

Statistical analysis: Statistical analysis of data was carried out using Statistical Package for Social Sciences (SPSS) version 16.0. Chi-square contingency tables were used to examine deviations from expectations and p values <0.05 were considered significant[21].

RESULTS

A total of 496 dystocias were recorded from 5611 parturitions of 3007 cows since some of the dams had more than one parturition during the study period. The overall incidence of dystocia during the study period was 8.84%. The statistical analysis was aimed at unravelling the dystocias according to breed, method of service, parity of dam and sex of calf. The results showed that primiparous indigenous cows that were artificially inseminated resulting in pregnancies carrying male foetuses had the highest risk of dystocias at parturition. The results also showed that pluriparous exotic cows served by bulls resulting in pregnancies carrying female foetuses had the lowest risk of dystocias at parturition.

The incidence of dystocia according to the breed of the cow is presented in Table 1. These results showed that the number of dystocias in indigenous dams was significantly higher than those in cross breeds and pure exotic dams ($p<0.05$). There was no significant difference in the number of dystocias between the cross breed and the pure exotic dams ($p>0.05$).

Effect of natural service and artificial insemination: More cows (3751) were serviced by bulls in comparison to those serviced by artificial insemination (1860). The statistical analysis of the data revealed a significantly higher incidence of dystocias (16.67%) in artificially inseminated cows than in those serviced by bulls (4.96%) ($p<0.05$).

Effect of parity: A total of 3007 parturitions were from primiparous cows whilst 2604 parturitions were from pluriparous cows. The statistical analysis of the data revealed a significantly higher incidence of dystocias in primiparous cows (11.34%) than in pluriparous cows (5.95%) ($p<0.05$).

Effect of sex of calf: A total of 3193 cows gave birth to female calves, whilst 2418 gave birth to male calves. A statistical analysis of the data revealed a significantly higher incidence of dystocias in the cows carrying male calves (11.54%) than in those carrying female calves (6.80%) ($p<0.05$).

Incidence of complications after dystocia: There were complications associated with dystocias in 162 of 496 dystocias. A statistical analysis of the data revealed a significantly lower incidence of dystocias with complications (32.36%) than in those without complications (67.64%) ($p<0.05$).

Proportions of complications resulting from dystocias: The various complications resulting from dystocias included excessive bleeding during parturition, retained placentas, hind limb paralysis, death of calf and death of dam. The proportions of the encountered complications are presented in Table 2.

These results showed that the incidence of retained placentas in cows experiencing dystocia was significantly higher ($p<0.05$) than all the other complications associated with this condition. The results also showed that the incidences of bleeding were significantly higher than hind limb paralysis and dam mortality ($p<0.05$). The incidence of calf mortality was also significantly higher than hind limb paralysis and dam mortality ($p<0.05$). There was, however, no significant difference between the incidence of calf mortality and retained placentas ($p>0.05$).

Proportion of techniques used to resolve dystocias: Manual traction was used in most (477) of the dystocias in this study, whilst 11 and eight of them were resolved by fetotomy and caesarean section, respectively. The statistical analysis confirmed that the proportion of dystocias resolved by manual traction (99.17%) was significantly greater than the proportions of either fetotomy (2.22%) or caesarean section (1.6%) ($p<0.01$).

Monetary cost of dystocias: It was clear during this study that dystocias resulted in revenue losses for the affected farmers. The monetary cost of the dystocias encountered in this study are illustrated in Table 3. These results showed that during dystocia management, the highest revenue losses were incurred through payment for manual traction ($p<0.05$). Significantly more revenue was lost through the mortality of

Table 1: Incidence of dystocia according to the breed of cow

Breed of dam	No. of parturitions	No. of dystocias	Incidence of dystocias (%)
Indigenous	1612	279	17.31*
Cross	3782	207	5.47
Pure exotic	217	10	4.61
Total	5611	496	8.84

*Chi-square value = 201.45; p = 0.00; N = 5611. Difference between incidence in indigenous versus either Cross or Pure Exotic breeds was significant ($p<0.05$)

dams and calves than through Caesarean sections and fetotomies ($p<0.05$). There was, however, no significant difference between the revenue lost due to calf mortalities and that lost due to dam mortalities ($p>0.05$). There was also no significant difference between the revenue lost due to Caesarean sections and that lost due to fetotomies ($p>0.05$).

DISCUSSION

The results of this study indicated that the incidence of dystocia was 8.8% (Table 1). This incidence is higher than the international average of 2-7% as reported by Mee[11]. However, these results are consistent with the findings of McDermott *et al.*[22] who reported a dystocia prevalence of 8.7% in dairy cows. Berry *et al.*[9] also reported a dystocia prevalence of 7%. These values (Table 1), however, are much lower than that those reported by Chatikobo *et al.*[23] who reported about 37%. The current study also showed that the incidence of dystocia was higher (16.67%) in artificially inseminated cows than in naturally serviced cows (4.96%) as shown in Table 2. This could be due to a wide genetic difference in calf weights for the bulls used for natural service (generally local and crossbreeds are small to average in size) compared to the bulls that were used for artificial insemination (heavy exotic breeds) with the latter having genetics which result in the production of heavier calves. In addition, most of the dystocia cases occurred in indigenous and crossbred cows than in pure Holstein-Friesian or pure Ankole breeds (Table 1). The most likely reason for these observations is that most of the artificial inseminations were performed on Girinka cows as opposed to pure Ankole as was the case of what happened 5-23 years earlier when the study by Chatikobo *et al.*[23] was carried out.

"Girinka" cows were donated to poor families under one cow per poor family program. These cows (½ Ankole: ½ Friesian-Holstein) were crosses of pure Friesian-Holstein bulls and pure Ankole cows. Artificial inseminations that were being performed at that time were being done using the progeny of the crosses produced during the first phase of crossing. This makes the results of Chatikobo *et al.*[23] plausible as their study was carried out during the phase when Friesian-Holstein bulls with larger frames were being directly crossed with Ankole cows resulting in larger calves which resulted in higher rates of dystocia.

The results showed that dystocia cases occurred more frequently when the calf that was born was male (11.54%) than when the calf was female (6.80%). These results are similar to those reported by Johanson and Berger[16], McDermott *et al.*[22] and Ettema and Santos[8] who reported the incidence of dystocia as being higher in pregnancies associated with male calves than with female calves. Gaafar *et al.*[24] and Norman *et al.*[25] also reported that dystocia associated with male calves was 4.5% and only 2.2% with female calves. Therefore birth weight is directly related to the sex of the calf and this is in agreement with Dhakal *et al.*[26] and Johanson *et al.*[27] who reported that increased birth weight is associated with an increased incidence of dystocia and an associated increase in calf mortality. They further suggested that, irrespective of breed, the birth weight of male calves is consistently higher than their female contemporaries.

In this study, out of 5611 calvings, the incidence of dystocia in pluripara cows was 5.95%, while that of primipara cows it was 11.34% (Table 3). These results concured with the results of Eriksson *et al.*[28] who reported that in dairy cattle, the prevalence of dystocia was approximately 6% at first parity and 1-2% at later parities. Gashaw *et al.*[29] reported that dystocia was almost three times as common in heifers (primipara) as in cows (pluripara). Gundelach *et al.*[30] and Wehrend *et al.*[31] also reported that dystocia was more common in primipara than in pluripara cows. According to Roughsedge and Dwyer[14], parity is associated with the age of the dam and the size of the dam's birth canal and the prevalence of dystocia decreases with the progression of age.

Table 2: Proportion of various complications resulting from dystocia

Complications	No. of cases	Incidence of complication (%)
Bleeding	31	19.14[b]
Retained placenta	86	53.09[a]
Hind limb paralysis	7	4.32[c]
Death of calf	33	20.37[a]
Death of dam	5	3.09[c]
Total	162	100.01

[a,b,c]Values for incidence of complications (%) that do not share a common superscript are significantly different ($p<0.05$)

Table 3: Monetary cost of dystocias over 3 years

Source of cost	No. of cases	Unit cost (Rwf)	Total cost (Rwf)	Contribution (%)
Dead cow	5	230 000.00	1, 150 000.00	13.11[b]
Dead calf	33	45 000.00	1, 485 000.00	16.93[b]
Caesarean section	8	70 000.00	560 000.00	6.38[c]
Foetotomy	11	30 000.00	330 000.00	3.76[c]
Manual traction	477	11 000.00	5, 247 000.00	59.82[a]
Total		-	8, 772 000.00	100.00

[a,b,c]Values for contribution (%) that do not share a common superscript are significantly different ($p<0.05$)

The current study did not come across any twinning and all the 5611 births were singletons. It is generally accepted that dystocia is more frequent in twin calves than in single calves. Hossein-Zadeh[18], Norman *et al.*[25], Gregory *et al.*[32], Echternkamp and Gregory[33] and Del Rio *et al.*[34]. McDermott *et al.*[22] also reported that twinning occurred at a low prevalence of 4.1% in cows.

Results of the current study indicated that the farmers in Kiziguro sector lost about RWF8.772 million (about US$11 323.08) as a result of dystocia (Table 3). This gives an estimated total loss of RWF 65,765,333.00 (about US$84 891.21) annually for Rwanda. This may appear to be a small amount but when one consider that the per capita income in Rwanda during this time was only US$582.79[35], it clearly shows that the economic consequences of dystocia are enormous. The biggest single economic loss is due to early calf mortality. Sloss and Dufty[36] reported that about a third of the total of 17% of foetal and calf losses occur at the time of parturition and that most of these arise from dystocia. Survival analysis studies on calves born to cows which had suffered from dystocia showed that they were more likely to die than those from normal births[37]. Other losses are through maternal deaths and subsequent infertility which results from dystocia and diminished productive capacity of the dam.

In the course of this study, it was found that the efficiency of veterinary services was far less than the demands by farmers. For example, only 8.28% of the cows were 'Pregnancy diagnosed'. This low percentage can result in inadequate herd management and lead to reproductive disorders and dystocia in particular.

In addition to dystocia, there are other peri-partum complications. Retained placentas, hind limb paralysis and uterine bleeding were the major complications that were identified with percentages of 53.09, 4.32 and 19.14%, respectively (Table 2).

CONCLUSION

It is clear from the results of this study that dystocia contributes significantly to livestock products losses. There is therefore a need to improve the availability of veterinary services and farmer education so that this problem can be steadily addressed.

IMPLICATIONS AND LIMITATION

The findings of this study implore us to reassess the breed combination which is chosen for the national dairy scheme by Rwanda.

Due to financial limitations, the study was carried out in a small part of the country and the results may not necessarily be applicable to all parts of the country due to differences in Dairy Management Systems in high and low rainfall areas of the country.

SIGNIFICANCE STATEMENTS

The study reveals that artificially inseminating indigenous heifers, especially if the resultant pregnancy carries a male foetus, predisposes to dystocia at parturition. However, if artificial insemination is used on multiparous cows and the resultant pregnancy carries a female foetus, the risk of dystocia is lower. These results caution that using pedigree semen to produce high milk-producing progeny from indigenous breeds for impoverished communities in developing countries is not a panacea to guarantee the success of donor-funded programmes.

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