EFFECT OF YEAR OF CALVING ON THE REPRODUCTIVE PERFORMANCE OF HOLSTEIN FRIESIAN COWS IN VOM PLATEAU STATE NIGERIA

ABSTRACT

The study was carried out to estimate the effect of year of calving on reproductive performance traits of Holstein Friesian cows that calved between 2006 – 2017. Five hundred and thirteen (513) calving records obtained from Integrated Dairy Farm Vom were collated for the study. Data was analyzed using the general linear models of SAS 2001 (version 8.0). Results revealed that the overall mean of Age at First Calving (AFC), Calving Internal (CI) and Days Open (DO) were 30.36±0.23 months, 379.70±13.34 days and 93.67± 9.74 days respectively. All the reproductive traits in the study have significant effect (P<0.05) on year of birth of dam. The first, third, fourth and fifth calving interval has significant effect (P<0.05) on year of birth while the second and sixth calving interval had no significant influence (P>0.05) on year of birth. The observed reproductive performance of Holstein Friesian cattle under Vom condition was generally commendable. This may be attributed to improved management practices (such as high quality feed), maternal gene effect, accurate heat detection, timely insemination and adaptation of Holstein Friesian breed to the climatic condition of the study area (due to lower temperature).

INTRODUCTION

In the tropics, despite the large and diverse animal genetic resources, the productivity of many livestock especially the indigenous dairy cattle remains low. The increasing demand for milk and dairy products in Nigeria due to increasing population and improved standard of living may worsen if the bulk of multipurpose indigenous cows are with genetically low productive potentials (Alphonsus *et al.*, 2014). This is because milk production depends on the reproductive efficiency of the cow, with the best cows being those that calve at early age with little number of services per conception and with minimum calving internal; thereafter (Ngodigha *et al.*, 2009).

Kiwuwa *et al.* (1983) reported that the reproductive performance of the breeding female is probably the single most important factor that is a prerequisite for sustainable dairy production system and influencing the productivity. The size of the calf crop is all important for herd replacement and the production of milk depends heavily on the cow reproductive activity. The overall productivity and

adaptive efficiency of cattle depends largely on their reproductive performance in a given environment (Wondossen et al., 2018). Any genetic improvement in dairy cattle requires information reproductive performance in a given population (Wondossen et al., 2018). Reproductive performance is biologically crucial phenomenon and vital measurement for the profitability of many animal production systems. Especially, the economics of diary enterprise is based on an efficient reproductive performance of dairy animals (Negussie et al., 1998). It is sometimes used interchangeably with fertility (Massawe Heriel, 2011).

Dairy industry in Nigeria produces an estimated 450,000 tons of milk per annum. This production has been found to be inadequate to satisfy the dairy demands of Nigerians (FAO, 2010). This is because the genotype of the African breeds of cattle can only produce an average milk of 1.27 litres per cow per day during the wet season and less than 0.36 litres during the dry season (Yuan *et al.,* 2010), whereas their counterparts in the European and American produce an average of 25 litres per day (Mallau-Aduli *et al.,* 2009). Consequently, protein deficiencies become a common phenomenon in Nigeria, especially among the poor segment of the society, which constituted majority of the populace (Saleh *et al.,* 2016)

According to Abdel Rahman and Aleman (2008) the Holstein-Friesian breed is known for high milk productivity under the temperate climate. The high productivity of Holstein-Friesian in temperate climates raises the question of how much of this superiority in production is maintained when the animals are transferred to tropical environment. Therefore, the objective of this study was to estimate the effect of year of calving and environment factors on the reproductive performance of Hosltein-Friesan cows in integrated Diary Farm, Vom.

MATERIALS AND METHODS

Description of Study Area

The study was conducted in Integrated Dairy Farm (IDF) Ltd, a private commercial dairy enterprise located at Vom Plateau State, Nigeria. Vom is situated on the Jos Plateau 29km south West of Jos city. The town lies between latitudes

9°43 60" N and longitudes 8° 46' 60" E and has an altitude of 1222M above sea level, with mean annual rainfall of 1400mm (55 inches). The area is defined by two seasons; rainy season (May to October) and dry season (November to April). The temperature ranges for 15–25°C, but from mid November to late January, night temperature drops as low as 11°C (Encyclopaedia Britannica, 2017).

Herd Description and Animal Management

The Holstein Friesian cattle were maintained under intensive management throughout the year. They were grazed on sown pasture in fenced paddocks containing grasses and legumes in the morning and evening after which they were turned to the stall (pen). In the dry season mixture of concentrates and silage/hay were used to feed the cattle twice in a day. Steaming up was practiced at later stage of pregnancy (2-3 months before calving). The cows were milked twice daily (morning and evening) in the milking parlour using the milking machine. Calves were weighed 24 hours of life (after birth) and weekly thereafter. The animals were vaccinated against prevalent diseases and external parasites were also controlled using spray. Routine deworming was also carried out.

Mating System

Artificial insemination was the main breeding method in the dairy farm.

Experimental Design

The experimental design used was the completely Randomized Design (CRD).

Data Collection

Five hundred and thirteen (513) calving records of Holstein Friesian cows were collected from 2006 – 2017 for analysis. Data on Age at First Calving (AFC), Days Open (DD) and Calving Internal (CI) were obtained as measures of reproductive performance.

Statistical Analysis

Data obtained was subjected to analysis of Variance (ANOVA) using the General linear models (GLM) procedure of Statistical Analysis System (SAS, 2001 version). Where there is significant difference, means was separated using Duncan's New Multiple Range Test (DNMRT).

RESULTS

Age at First Calving (AFC)

The result showed that year of birth had significant (P<0.05) effect on Age at First Calving of Holstein Friesian cows at Integrated Diary Farm Vom. The overall mena for AFC was 30.36±0.23 months. The result also indicated that high AFC (32.94 months) was recorded in 2011 and heifers born in 2013 had the lowest mean AFC (26.94 months).

Table 1: Least Square Means (LSM) for Effect of Year of Birth. On Age at First Calving of Holstein Friesian Cows at Integrated Diary Farm Vom

Year of Birth	N	Age at First Calving (Months) LSM±SE
	365	*
2006	37	31.87±0.75^{ab}
2007	41	31.82±0.57^{ab}
2008	39	30.75±0.56^{b}
2009	32	32.89±0.69^{a}
2010	31	31.68±0.65^{ab}
2011	36	32.94±0.67^{a}
2012	42	28.86±0.69^{c}
2013	57	26.94±0.42^{d}
2014	50	28.61±0.52^{c}
Overall Mean		30.36 ±0.23

Note: ^{abcd} LS mean with different superscript in the same column are significantly different (P<0.05); *= P<0.05; N = Number of observation.

Days Open (DO)

The result showed that year of birth had significant (P<0.05) effect on Days open of Holstein Friesian cows in Integrated Dairy Farm Vom. The overall mean for DO was 93.67±9.74 days. The result indicated highest level of DO in 2011 (118.10±30.40) days and lowest DO in 2013 (83.85±7.30 days).

Table 2: Least Square Means of Effect of Year of Birth. On Days open of Holstein Friesian Cows at Integrated Diary Farm Vom

Year of Birth	N	Days Open (Days) LSM±SE
	226	*
2006	28	87.54±5.88[ab]
2007	26	86.19±6.44 [ab]
2008	22	95.86±4.35[ab]
2009	32	91.44±5.07[ab]
2010	26	91.85±6.47[ab]
2011	27	118.10±30.40[a]
2012	26	90.62±6.59[ab]
2013	34	83.85±7.30[b]
2014	5	97.60±15.20[ab]
Overall Mean		93.67±9.74

Note: [ab] LS Mean with different superscript in the same column are significantly different (P<0.05); * = P<0.05); * P<0.05; N = Number of observation.

Calving Interval (CI)

The result showed that year of birth had significant (P<0.05) effect on calving interval of Holstein Friesian cows in Integrated Dairy Farm, Vom. The overall mean for Calving Internal (CI) was 379.70±13.34 days. The highest calving interval was in 2008 (453.20±31.00 days) while the lowest was in 2014 (345.20±35.90 days) indicative of improved management.

Table 3: Least Square Means of Effect of Year of Birth on Calving Interval of Holstein Friesian Cows at Integrated Diary Farm Vom

Year of Birth	N	Calving Interval (CI) LSM±SE (Days)
	215	*
2006	26	388.88 ± 8.64^{bc}
2007	26	389.80 ± 16.20^{b}
2008	19	453.20 ± 31.00^{a}
2009	29	384.76 ± 8.20^{bc}
2010	25	375.20 ± 14.00^{bc}
2011	26	354.04 ± 6.17^{c}
2012	25	367.24 ± 5.53^{bc}
2013	34	358.97 ± 7.77^{bc}
2014	5	345.20 ± 35.90^{c}
Overall Mean		379.70±13.34

Note: ^{abc} LS Mean with different superscript in the same column are significantly different ($P<0.05$); * = $P<0.05$; N = Number of observation.

Table 4: Least Square Means for Effect of Year of Birth on First to Sixth Calving Interval of Holstein Friesian Cows at Integrated Diary Farm Vom

Year of Birth	First CI (days) LSM±SE	Second CI (days) LSM±SE	Third CI CI (days) LSM±SE	Fourth CI (days) LSM±SE	Fifth CI (days) LSM±SE	Sixth CI (days) LSM±SE
	*	ns	*	*	*	ns
2006	388.88±8.64^{bc} (26)	367.80±15.40 (19)	381.60±15.7^{b} (13)	346.30±14.2^{b} (12)	359.6±8.16.4^{b} (7)	372.4±18.9 (7)
2007	389.8±16.20^{b} (26)	386.8±18.50 (13)	404.80±31.6^{ab} (6)	424.01±23.0^{a} (4)	434.0±21.4^{a} (4)	427.7±20.2 (3)
2008	453.2±31.0^{a} (19)	393.60±15.40 (19)	437.90±20.6^{a} (17)	373.7±16.7^{ab} (10)	413.2±22.4^{ab} (6)	
2009	384.76±8.20^{bc} (29)	380.10±10.80 (21)	376.60±13.3^{b} (18)	334.0±14.6^{b} (12)	366.0±25.2^{ab} (3)	
2010	375.20±14.0^{bc} (25)	361.80±15.20 (24)	383.0±13.0^{b} (14)	375.3±33.5a^{b} (4)		
2011	354.04 ±6.17^{c} (26)	375.00±11.90 (15)	346.5±28.4^{b} (6)			
2012	367.24±5.53^{bc} (25)	361.20±19.20 (11)	339.0±00^{ab} (2)			
2013	358.97±7.77^{bc} (34)	344.90±15.3 (7)				
2014	345.20±35.90^{bc} (5)					
N	215	129	75	42	20	10

Note: ^{abc}LSMean with different superscript in the same column are significantly different (P<0.05); ns = Not significant; * = P<0.05; n = Total number of Observation in each factor; CI = Calving Interval; ( ) = Values in parenthesis are number of observations.

DISCUSSION

Accurate estimation of reproductive performance of Holstein Friesian is very important for improving the management practices and profitability of dairy farms (Wondossen *et al.*, 2008).

- AFC has a great economic importance in the efficiency of dairy cattle production as it affects productive life of a cow (Wondossen *et al.*, 2018). The overall mean in this study (30.36 months) was higher than the recommended AFC of 23-25 months for heifers to calve, but was similar to the work of Gwaza *et al.*(2007) and Ajili *et al.*(2007) who reported AFC values of 309 and 29.28 months respectively. It was however shorter than 39.2, 42.16, 33.27, 36.48, 33.73 and

39.4 months reported by Tadesse et al. (2010), Fekadu *et al.*(2011), Kollalpitiya et al. (2012), Kebede (2015), Zelalem *et al.* (2015) and Wondossen *et al.*(2018) respectively. The AFC in this study agrees with the average AFC in many tropical countries and if indicated improve management practice in the farm such as good nutrition.

In the present study, AFC was significantly (P<0.05) influenced by year of birth. The AFC was found to be shorter in the latter years especially cows born in 2012, 2013 and 2014 (28.86, 26.94 and 28.61 months respectively) compared to the ones born in previous or former years (2006 – 2011) with longer AFC. This could be attributed to change in herd management in the latter years such as improved feeding, health and reproductive health. Therefore, decreasing AFC implies a progressive improvement in management practices of heifers and improved reproductive health. This work agrees with earlier findings by Haile (2014) and Habfamu *et al.* (2010) who reported that changes in feeding management environmental conditions which varied from year to year as well as differences between year in the quality and quantity of forage available.

- The overall mean for Days Open (DO) was 93.67 days. This falls within the desired optimum value of 85 – 115 days and 75 – 90 days reported by Hammoud *et al.* (2010) and Fernando *et al.* (2016) respectively required for improve herd management. Days open is part of calving that can be reduced by improving herd management. The value obtained in this study can be attributed to normal calving to service period, regular oestrus and good management such as proper feeding.

The study showed that year of birth had significant (P<0.05) effect on Days open. This agrees with the finding of Haile (2014) who reported significant effect for years of calving on Days open.

The value obtained in this study is shorter than 208, 179.9 and 156.44 days reported by Haile (2014), Wondossen *et al.* (2018) and Fernando et al. (2016) respectively. Long DO may affect the overall economic revenues of the dairy herd. Delayed resumption of ovarian activity after calving and management factors such as

184 inadequate heat detection, decisions of breeding after parturition, nutrition and
185 diseases are some of the causes of higher length of DO.

186 ➢ The study showed that years of birth significantly (P<0.05) affected the calving
187 interval. This agrees with the work of Haile (2014) and Tadesse *et al*. (2010) who
188 reported significant effect of CI on year of birth for Holstein Friesian cows.

189 The overall mean calving interval of 379.70 days (12.5) months) in this study falls
190 under the optimum recommended level of 12-13 months as reported by Hammoud
191 *et al*. (2010) and Fernando *et al.* (2016) for a well managed farm. This also agrees
192 with previous reports of Hunduma (2012), Ogundipe and Adeoye (2013) and Sena *et*
193 *al*. (2014) who reported 12.4 months, 374 days and 13.06 months respectively. The
194 value may be as a result of normal calving to service period, environmental factors
195 and good reproductive managements such as accurate heat detection, timely
196 insemination and efficiency of AI technicians and also adequate and high quality
197 feed supply. Many researchers in the tropics reported higher level of CI such 436
198 days, 462.87 days, 14.64 months, 431.41 days and 469.2 days reported by
199 Ogundipe and Adeoye (2013), Kebede (2015), Zelalem *et al*. (2015), Fernando *et al*.
200 (2016) and Wondossen *et al* (2018) respectively.

201 The study also showed significant decline of CI as the calving year advanced from
202 2008 (453.20 days) to 2014 (345.20 days). The marked decrease observed shows
203 an improvement in the levels of management such as supplementation of lactating
204 cows, better oestrus detection, better ratification insemination services and improved
205 regular follow up of breeding cows.

206 Table 4 in the current study showed year of birth had significant (P<0.05) effect on
207 the first, third, fourth and fifth calving interval but showed non significant (P>0.05)
208 effect on the second and sixth calving interval. The variation in all the calving
209 intervals from year to year indicated a progressive improvement in management,
210 maternal gene effect, accurate heat detection and timely insemination.

211

212

CONCLUSION

The reproductive performance assessed in the present study showed that year of calving had significant ($P<0.05$) affected virtually all the factors (Age at first calving, days open and calving interval). The ultimate goal of a breeder is to lower the age at first calving, Days open and calving interval. The reproductive performance of the Holstein-Friesian cows in Vom Integrated Dairy Farm was commendable when compared to other tropical conditions.

Based on the above conclusion, the following recommendations were forwarded.

- Further studies should be carried out on the effect of season and parity on reproductive performance in the same farm.
- Better management practices such as improved nutrition and use of new reproductive technology can help improve the reproductive performance of the HF cows in Vom to perform similar to the temperate ones.
- Setting up of more farms in Vom area by private individuals, investors, multi-nationals and Federal Government of Nigerian can help reduce the incessant herders/farmers crisis that always led to loss of lives and properties in Nigeria. It will further increase protein (milk) intake of Nigerians.
- Climatic records such as temperature, relative humidity and rainfall should be kept in the farm to distinguish the variations across the years.

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