

1 **EFFECT OF NON-GENETIC FACTORS ON THE PRODUCTIVE (LACTATION)**
2 **PERFORMANCE OF HOLSTEIN FRIESIAN COWS IN VOM NIGERIA**

3
4 **ABSTRACT**

5 A total of one thousand eight hundred and thirty nine (1839) lactation records of
6 cows calved from 2006 to 2017 were analyzed to estimate the effect of non-genetic
7 factors on productive performance traits of Holstein Friesian cows in Integrated
8 Dairy Farm Vom, Nigeria. Data were analyzed using the general linear models of SAS
9 2001 (version 8.0). Results revealed that the overall least square means of
10 Lactation Milk Yield (LMY), Productive herd life (PHL), Herd life (HL), lifetime milk
11 yield (LTMY) and lactation length (LL) were 4716.1 ± 243 litres 1831.8 days, 2984.9
12 days, 15524 litres and 268.00 ± 432 days respectively. Years of calving have
13 significant ($P < 0.05$) effect on LMY, PHL, HL, LL and LTMY of the dam. Parity has
14 also significantly ($P < 0.05$) influenced the lactation milk yield of the dam. The
15 observed productive performance of Holstein Friesian cattle under Vom condition
16 was generally commendable. This may be attributed to improved management
17 practices (such as high quality feed), maternal gene effect and adaptation of
18 Holstein Friesian breed to the climatic condition of Vom area.

19 **INTRODUCTION**

20 In the tropics, despite the large and diverse animal genetic resources, the
21 productivity of many livestock especially the indigenous dairy cattle remains low.
22 This could be attributed to poor genetic potential, inadequate nutrition, poor health
23 services and management problems. Thus, the production of milk and milk products
24 in developing countries such as Nigeria is grossly inadequate and this has resulted in
25 importation of exotic breeds from developed countries to sustain the demand of
26 these products and increase livestock production through breeding strategies and
27 policies in order to meet the need for quick solution to the problem of deficit in milk
28 production (Adebambo, 2003). The increasing demand for milk and dairy products in
29 Nigeria due to increasing population and improved standard of living may worsen if
30 the bulk of multipurpose indigenous cows are with genetically low productive
31 potentials (Alphonsus *et al.*, 2014).

32 The lactation performance of dairy cattle is usually measured by determining
33 the total milk yield, lactation length, lactation persistency, milk lifetime production
34 and herd life or longevity (Van Raden, 2003). Milk production level and lactation
35 persistency are crucial factors determining the appropriate calving interval (Arbel *et*

36 *al.*, 2001). In most modern dairy farms, a lactation length of 305 days is commonly
37 accepted as a standard lactation length, but might not work for small holder dairy
38 cows in which the lactation length is extended considerably in most cases. (Teodoro
39 and Madalena, 2003; Masama *et al.*, 2003 and Msangi *et al.*, 2005).

40 The Holstein-Friesian bred of cattle is known for high productivity under
41 temperate climates (Abdel Rahman and Aleman, 2008). It has an outstanding milk
42 producing capability and is the worlds highest producing dairy animal (Paulson *et al.*,
43 2015). The high productivity of Holstein-Friesian in temperate climates raises the
44 question of how much of this superiority in production is maintained when the
45 animals are transferred to tropical environments. Therefore, the objective of this
46 study was to estimate the non-genetic factors on the productive (lactation)
47 performance of Holstein Friesian cows in integrated Dairy Farm Vom, Nigeria.

48 **MATERIALS AND METHODS**

49 **Description of Study Area**

50 The study was carried out in Integrated Dairy Farm (IDF) Ltd, a private
51 commercial dairy farm located at Vom, Plateau State, Nigeria. Vom is situated on the
52 Jos Plateau 29km South West of Jos city. It lies between latitude 9^o 43'N and
53 longitudes 8^o 45' E and has an altitude of 1222M above sea level, with mean annual
54 rainfall of 1400mm (55 inches). The area was defined by two seasons; rainy season
55 (May – October) and dry season (November – April). The temperature ranges from
56 15-25^oC, but from mid November to late January, night temperature drops as low as
57 11^oC.

58 **Herd Description and Animal Management**

59 The Holstein-Friesian cattle were maintained under intensive management
60 throughout the year. They were grazed on sown pasture in fenced paddocks
61 containing grasses and legumes in the morning and evening, after which they were
62 returned to the pen (stall). In the dry season mixture of concentrates and silage/hay
63 were used to feed the cattle twice in a day. Steaming up was practiced at later stage
64 of pregnancy (2-3 months before calving). The cows were milked twice daily
65 (morning and evening) in the milking parlour using the milking machine. Calves were

66 weighed 24 hours of life (after birth) and weekly thereafter. The animals were
67 vaccinated against prevalent diseases and ecto parasites were also controlled using
68 spray. Routine deworming was also carried out.

69 **Mating system**

70 Artificial Insemination (AI) was the main breeding method used in the dairy
71 farm.

72 **Experimental Design**

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

74 **Data Collection**

75 A total of one thousand eight hundred and thirty nine (1839) lactation records
76 of Holstein Friesian cows were collected from 2006-2017 for analysis. Data on
77 lactation length, lactation milk yield, total milk yield, productive herd life and
78 longevity were computed from the lactation records as measures of productive
79 performance.

80 **Statistical Analysis**

81 Data obtained was subjected to Analysis of Variance (ANOVA) using the
82 General Linear Models (GLM) procedure of Statistical Analysis System (SAS, 2001
83 version). Where there was significant different, means were separated using
84 Duncan's New Multiple Range Test (DNMRT).

85 **RESULTS**

86 **Lactation Milk Yield (LMY)**

87 The result in Table 1 shows year of calving and parity have significant ($P < 0.05$)
88 effect on lactation milk yield (LMY) of Holstein Friesian cows in Integrated Dairy
89 Farm Vom. The first two parities have lower LMY compared to the third to seventh
90 parities which were statistically similar but significantly different with higher lactation
91 milk yield.

92 **Table 1: Least Square Means for Effects of Year of Calving and Parity on**
 93 **Lactation Milk Yield (LMY) of Holstein Friesian Cows at Integrated Dairy**
 94 **Farm, Vom.**

Factors	N	Lactation Milk Yield (Ltrs) LSM±SE
Year of Calving	1116	*
2006	197	4682±109 ^{cde}
2007	128	4601±308 ^{cde}
2008	150	5701±503 ^{ab}
2009	159	5328±142 ^{abc}
2010	135	5927±336 ^a
2011	106	5224±149 ^{abc}
2012	89	4981±170 ^{bcd}
2013	91	3941±190 ^{ef}
2014	49	3501±230 ^f
2015	12	3275±300 ^{def}
Parity	1116	*
1	416	4659±134 ^b
2	308	4867±162 ^b
3	195	5688±371 ^a
4	111	5203±176 ^{ab}
5	53	5283±264 ^{ab}
6	23	5199±378 ^{ab}
7	10	5661±419 ^{ab}
Overall Mean		4716.1 ± 243

95 Note: ^{abcdef}LSMean with different superscript in the same column for the same
 96 effect (factor) are significantly different; *= P<0.05 significant; N = Number of
 97 observation.

98 **Lactation Length (LL)**

99 Table 2 shows least square mean + SEM of lactation length. Year of calving
 100 significantly (P<0.05) affected the lactation length of Holstein Friesian cows at

101 Integrated Dairy Farm, Vom. The result revealed that the overall mean effect of LL
 102 was 268.00±432 days.

103 **Table 2: Least Square Mean for Effect of Year of Calving on Lactation**
 104 **Length (LL) of Holstein Friesian Cows at Integrated Dairy Farm, Vom.**

Year of Calving	N	Lactation Length (Days) LSM±SE
2006	880	*
2007	138	287.28±8.49 ^{ab}
2008	96	304.49±10.18 ^a
2009	113	299.50±9.39 ^a
2010	132	288.70±8.69 ^{ab}
2010	108	286.36±9.60 ^{ab}
2011	85	282.04±10.82 ^{ab}
2012	77	275.64±11.37 ^{bc}
2013	74	249.34±11.60 ^{bc}
2014	45	220.84±14.88 ^{cd}
2015	12	185.83±28.80 ^d
Overall Mean		268.00±432

105 **NOTE:** ^{abc} LSMean with different superscript in the same column are significantly
 106 different. * P<0.05; N=Number of observation.

107 **Productive Herd Life (PHL) and Herd Life (HL) or Longevity**

108 Table 4 shows least square mean ± SEM of the effect of years of calving on
 109 Productive Herd Life and Herd Life (longevity) of Holstein Friesian cows at integrated
 110 Farm, Vom. Year of calving significantly (P<0.05) affected both the productive herd
 111 life and longevity of Holstein Friesian Cows at Integrated Dairy Farm Vom. The result
 112 showed the overall mean of the PHL and HL were 1831.8 days (5.07yrs) and 2984.9
 113 days (8.2yrs) respectively.

114 **Table 3: Least Square Means For Effects of Year of Calving on productive**
 115 **Herd Life and Herd life of Holstein Friesian Cows of IDF Vom.**

Year of calving	N	Productive Herd Life (days) LSM±SE	Herd life (days) LSM±SE
	137	*	*

2006	30	2187.0±103.0 ^a	3337.0±132.0 ^a
2007	28	1799.0±85.2 ^{bc}	3052.6±84.1 ^b
2008	30	1992.8±70.5 ^{ab}	3037.9±78.4 ^b
2009	34	1592.3±47.4 ^c	2859.0±46.3 ^{bc}
2010	15	1588.1±63.6 ^c	2638.0±117.0 ^c
Overall Mean		1831.8±73.9	2984.9±91.6

116

117 **NOTE:** ^{abc} LS Mean with different superscript in the same column are significantly
 118 different; * = P<0.05, N=Number of observations.

119 Lifetime (Total) Milk Yield (LTMV)

120 The result in Table 4 shows that year of calving have significant (P<0.05)
 121 effect on life time milk yield of Holstein Friesian Cows at Integrated Dairy Farm,
 122 Vom. The overall mean of LTMV was 15524 ltrs.

123 **Table 4: Least Square Mean for Effects of Year of Calving on Life time**
 124 **(Total) Milk Yield of Holstein Friesian Cows at Integrated Dairy Farm,**
 125 **Vom.**

Year of calving	N	Productive Herd Life (days) LSM±SE
	321	*
2006	56	16671±1478 ^a
2007	51	14360±3827 ^{ab}
2008	41	18556±1513 ^a
2009	45	18181±1283 ^a
2010	47	16152±1135 ^a
2011	41	13653±912 ^{ab}
2012	40	11098±659 ^b
Overall Mean		15524±1544

126 **NOTE:** ^{ab}LSMean with different superscript in the same column are significant
 127 different (P<0.05); *=P<0.05; N = Number of observations.

128 DISCUSSION

129 Lactation Milk Yield (LMY)

130 The mean LMY in the present study was found to be 4716.1 litres (Table 1).
 131 This is similar to the study of Makuza and Mc Daniel (1996) who reported mean LMY

132 of 4791 litres in Holstein Friesian breed at Zimbabwe. The mean LMY observed in
133 the present study is higher than the mean LMY of 3710 litres reported by Tadesse *et al.*
134 *et al.* (2010), 3386.22 litres reported by Zelalem *et al.* (2015), 2757.3 litres reported by
135 Sena *et al.* (2014) and 2149.19 litres reported by Kebede (2015). The lower LMY of
136 Holstein Friesian cows reported in previous studies might be indicative of poor
137 adaptation of the exotic breed to climatic and management condition in the study
138 areas. However, the higher mean LMY in the present study might be associated with
139 progressive improvement in management and adaptation of Holstein Friesian cows
140 to the environment through time. Jariath *et al.* (1995) for Holstein Friesian in
141 Canada and Kollalpitiya *et al.* (2012) in Sri Lanka reported higher Mean LMY of 5152
142 litres and 5519 litres respectively.

143 The significant effect for year of calving on LMY in the present study is in
144 agreement with the findings of Tadesse *et al.* (2010) and Haile (2014) who reported
145 significant effect of LMY on year of calving. The decreasing trends of years of calving
146 ranging from 5927 litres to 3275 litres (2010 – 2015) in the present study could be
147 attributed to changes in management/poor nutrition and climatic factors which
148 played important role in milk yield. Failure to supplement hay/silage to lactating
149 cows leads to low milk production. Access to good drinking water also increases
150 LMY. Since 87% of milk is water, lactating cows should have free access to water.
151 Any restriction in water supply will result in a drop in milk production (Massawe,
152 2011).

153 In the present study, there was definite increment of LMY from parity 1 to
154 parity 3 (4659 litres – 5688 litres) and then decline from parity 3 (5688) to parity 6
155 (5199l) before increasing again in the seventh parity (5661 litres). This variation
156 indicates that milk yield of cow increased with the maturity of udder but when the
157 cows become older, milk production reduces and the structure of the udder may
158 change due to fat deposition. however, maturity of udder is greatly influenced by
159 feeding and management practices of cows. The variation of LMY from one parity to
160 another could also be attributed to maternal effect of additive gene transfer from the
161 dam to its offspring. Mwatawaba (2006) and Migose *et al.*(2006) also reported
162 significant effect of parity on milk yield.

163 **Lactation Length LL**

164 The overall mean lactation length in the present study was 268.00days (8.93
165 months). This agrees with Haile (2014) and Kebede (2015) who reported LL of
166 264.63 days and 252.23 days respectively in Holstein Friesian cows. However, it was
167 shorter than 318.86 days, 366.5 days, 11.96 months, 9.1 months, 321.28 days and
168 333.9 days for Holstein Friesian cows reported by Massawe (2011), Usman *et al.*
169 (2012), Zelalem *et al* (2015), Sena *et al* (2014) Fernando (2016) and Ayalew and
170 Asefa (2013) respectively.

171 The overall mean in the present study was shorter than the optimum value of
172 305 days required to maintain the optimum calving interval of 12-13 months. But if
173 still falls within the range of 244-324 days reported by Syrstad (1995) for LL in the
174 topics. The report in the current study shows year of calving to significantly ($P<0.05$)
175 affect the LL. This also agrees with the findings of Peters *et al.* (2007), Mgeni (2010)
176 and Haile (2014) who reported significant effect of LL on year of calving. Accurate LL
177 could be indicative of progressive improvement in management such as proper
178 feeding regimes, adequate dry period and disease control.

179 **Productive Herd Life (PHL)**

180 The overall mean PHL in the current study was 1831.8 days (5.02 yrs). This
181 was slightly shorter than 5.85 years reported by Bognar *et al.* (2008) in Romania
182 who reported a technical optimum milk production in Holstein Friesian cows. It was
183 however higher than 1116 days, 1301 days and 1753 days reported Haile (2014),
184 Gosha (2005) and Gebeyelu *et al* (2007) respectively. This makes the current result
185 in the study to be commendable compared to others in the tropics. The year of
186 calving significantly ($P<0.05$) influence PHL of Holstein Friesian cows at Integrated
187 Dairy Farm Vom. 2009 – 2010 year of calving recorded significantly lower PHL
188 compared to previous calving years (2006 -2008). This could be attributed to
189 variations in management in the years. The progressive decline in PHL over the
190 years might also be associated with high rate of involuntary culling at early years.

191 **Longevity or Herd Life (HL)**

192 The overall mean of HL in the present study was 2984.9 days (8.2 years) for
193 Holstein Friesian cows. Longevity is of major economic importance in dairy cattle
194 because it affects profitability by reducing replacement costs (Van Raden, 2003).
195 The overall mean HL is similar to the work of Gebeyehu et al.(2007) who reported
196 HL of 3048 days (8.3 years) on Holstein Friesian cows at Stella Dairy Farm, Ethiopia.
197 However, it was higher than 2128 days and 2858 days reported by Haile (2014) and
198 Goshu (2005) respectively. The mean HL was shorter than the optimum
199 recommended HL of 9.35 years that optimize the economic and biological limits of
200 dairy cows.

201 **Life time (Total) Milk Yield (LTMY)**

202 In the present study year of calving significantly ($P<0.05$) affected LTMY of
203 Holstein Friesian cows. This agrees with the work of Haile (2014) who reported that
204 year of calving significantly ($P<0.01$) influence life time (total) milk yield. The overall
205 mean LTMY in the current study was 15524 litres. This was slightly shorter than the
206 findings of Kabuga and Agyemang (1984) who studied 103 calving records of 35
207 Canadian Holstein Friesian imported into Ashanti (Ghana) and found the average life
208 time production per cows to be 16186kg and ranged 13235 to 23689kg. the result of
209 the current study is higher than 13517.5kg, 12749kg and 4665.75kg reported by
210 Massawe (2011), Goshu (2005) and Haile (2014) respectively. However, studies in
211 Tropical climate on Holstein Friesian cows in Pakistan by Atil *et al* (1999) reported
212 higher LTMY value of 25423kg. the lifetime milk production is a determinant of net
213 economic merit of dairy animals, therefore an animal is most profitable when its total
214 life time milk production is maximum.

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216

217 **CONCLUSION**

218 The productive (lactation) performance estimated in the present study
219 showed that year of calving had significantly ($P<0.05$) affected LMY, LL, PHL, HL
220 and LTMY. Also parity significantly ($P<0.05$) affected lactation milk yield.

221 The present study showed that the mean of calving had significantly ($P<0.05$)
222 affected LMY, LL, PHL, HL and LTMY. Also parity significantly ($P<0.05$) affected
223 lactation milk yield.

224 The present study showed that the mean that of lactation milk yield, lactation
225 length, productive herd life, herd life and life time milk yield falls within the optimum
226 standard recommended for productive efficiency of Holstein Friesian cattle in the
227 topics. Although lactation length is slightly below the 305 days optimum standard in
228 temperate region but falls within the 244-324 days recommended in the tropics and
229 herd life was slightly below the recommended 9.35 years. Lactation milk yield
230 increases as the parity increases due to increase in development of the udder.

231 The Holstein Friesian (HF) cattle can be bred and maintained in tropical
232 environments, although performing a little lower than those maintained in temperate
233 climates, but the observed performance of Holstein Friesian in Vom Nigeria was
234 generally commendable compared to other tropical condition. This could be
235 attributed to progressive improvement in management practices such as high quality
236 feed, maternal gene effect, disease control and adaptation to climatic condition due
237 to a lower temperature.

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