



# Weight at Birth of Holstein-Friesian Calves In Northern Gezira Dairy Project, Sudan .

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**Abstract.** The records of birth weights of 2716 Holstein-Friesian calves (1322 males and 1394 females) born during the period 1984-2002 in the Northern Gezira Dairy Project in Gezira State were analyzed. Being the biggest farm in its time to accommodate Holstein-Friesian cattle (started in the years 1984/1985 with 1000 heifers-in-calf) in Sudan, it becomes imperative to study birth weights and the factors affecting them. These include: year and season of birth, sex of calf, parity of dam and their interactions. The data were analyzed by the method of Least Mean Squares (Steel, Torrie and Dickey, 1977). They were subjected to analysis of variance using SPSS program version 12.5. The overall mean weight at birth of calves was  $33.87 \pm 0.12$  Kg. The mean weight at birth of male calves was  $35.08 \pm 0.28$  Kg, while that of female calves was  $32.89 \pm 0.31$  Kg. The difference between the two sexes was highly significant ( $P \leq 0.001$ ). The effect of the year of birth of the calves and the parity of the dam was also highly significant ( $P \leq 0.000$ ). The

season of birth did not exert any significant effect ( $P \geq 0.05$ ) on the weight at birth of the calves in this farm. The interactions of sex/year, sex/season, sex/parity and season/parity did not have any significant effect ( $P \geq 0.05$ ) on weight at birth while the interactions of year/season of birth and year/parity of dam did affect the weight of calves at birth ( $P \leq 0.05$ ). It is concluded that this study has given some information about birth weights of pure Holstein-Friesian calves born in the farm in Northern Gezira under the prevailing conditions of environment and management during the period under study.

**Key words:** weight at birth, sex of calf, year and season of birth, parity of dam, interactions.

## **I. INTRODUCTION**

Weight at birth is a measure of prenatal growth (Barlow, 1978) and prenatal growth partially affects post-natal development. Baily et al (1990) reported that the weight of body substance deposited daily is proportional to the weight of growing mass. As a consequence, the smaller the weight at birth, the lower the absolute daily gain at any given age up to weaning. Sofienaz, et al (2014) reported that calves of heavier weight at birth can grow faster compared to calves of lighter weight at birth. Singh et al (1987) found that in Haryana cattle, birth weight had affected body weights at puberty and first calving. Weaning weight of Canadian Holstein-Friesian calves in Ghana increased by 1.13 Kg per Kilogram increase in birth weight (Kabuga and Agyemang, 1986). Kaygisiz et al (2012) reported that weight at birth can be used as an early selection criterion in cattle breeding. Weight at birth is among the main determinants of calving ease (Almasri et al 2020). Chew BP et al (1981) and Rabie et al (2016) also reported a relationship between weight at birth of calves and the dam's subsequent 305- days milk yield.

It is obvious that weight at birth in cattle affects the future performance in one way or another; hence it has attracted considerable attention by many research workers in many parts of the world. Sudan has introduced exotic breeds many years back, but their weight at birth was not well investigated. The objective of this work was to study the weight at birth of Holstein-Friesian calves born in the farm of Northern Gezira Dairy Project in Sudan under the factors of sex, year and season of birth, parity of dam and their interactions.

## II. METHODOLOGY OF RESEARCH:

### 1. The data and source of data:

The source of data in this study was the farm of the Arab company of Agricultural Production and Processing at Albagair in Northern Gezira. The data used in the investigation included 2716 birth weight records of Holstein-Friesian calves of which 1322 were males and 1394 females born during the period 1984-2002 with the exception of those born in the year 1988 for which data were not available. The data were examined for the effects of sex of calf, year and season of birth, parity of dam and their interactions on weight at birth.

### 2. Statistical analysis:

The data were analyzed by the method of least Mean Squares (Steel, Torrie and Dickey, 1997). They were subjected to analysis of variance using SPSS version 12.5 programme. The following fixed model was used:

$$Y_{ijklm} = \mu + R_i + S_j + P_k + H_l + C_m + (R \times S) + (R \times H) + (R \times P) + (S \times H) + (S \times P) + (H \times P) + E_{ijklm}$$

Where:

$Y_{ijklm}$  = the trait studied

$\mu$  = overall mean

$R_i$  = effect of year of birth

$S_j$  = effect of season of birth

$P_K$  = effect of parity of dam

HL = effect of sex of calf

$C_m$  = interactions

$E_{ijklm}$  = Standard error

$C_m$  = interactions

$E_{ijklm}$  = Standard error

### III. RESULTS

#### 1. The Overall Mean Weight at Birth:

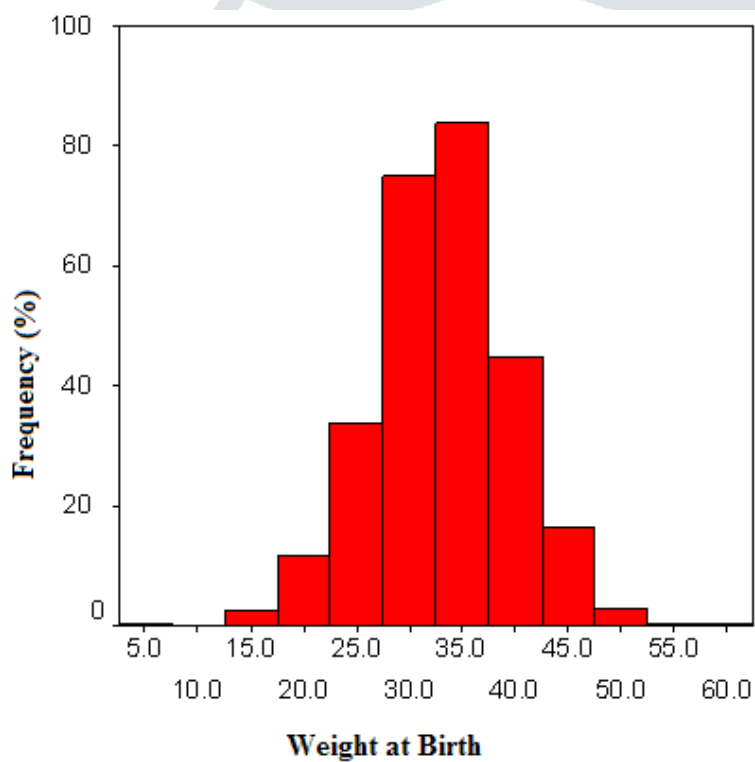
The statistical analysis of the data has disclosed that the overall mean weight at birth of Holstein – Friesian calves born in the farm of the Arab Company for Agricultural Production and Processing during the period 1984-2002 was  $33.87 \pm 0.21$ kg (Table 1). The frequency distribution of weight at birth for 2716 birth records is presented in Fig.(1). The histogram shows that most of the calves were born in the weight range of 30-40 kilogram.



**Table(1) :Overall Mean of Weight at Birth of Calves (kg).**

Dependent Variable: weight at Birth

Mean (kg)	Std. Error
33.87	0.21

**Figure (1): Frequency Distribution of Weight at Birth of Calves.**

## 2. Weight at Birth

### Levels of significance of fixed effects:

Levels of statistical significance of fixed effects on weight at birth are shown in Table (2). The difference between the two sexes in weight at birth was very significant ( $P \leq 0.001$ ). The year of birth of the calf and the parity of dam exerted a highly significant ( $P \leq 0.000$ ) effect on weight at birth, while season of birth had no significant ( $P \geq 0.05$ ) effect on this trait. The interactions of year/season of birth and years of birth/parity of dam had a significant ( $P \leq 0.05$ ) effect on weight at birth of calves born in the farm of study.

### Table (2):

#### The Analysis of Variance for the Effect of Sex, Years and Seasons of Birth, Parity and their Interactions on Weight at Birth of Calves.

Dependent Variable: Weight at Birth.

Source	df	Mean Square	F	Sig.
Sex	1	411.727	11.105	.001
Years of birth	7	229.286	6.184	.000
Seasons of birth	2	70.599	1.904	.149
Parity	7	259.828	7.008	.000
Sex * Years of birth	5	24.517	.661	.653
Sex * Seasons of birth	2	25.093	.677	.508

Years of birth * Seasons of birth	13	66.417	1.791	.039
Sex * Parity	7	16.160	.436	.880
Years of birth * Parity	40	57.986	1.564	.014
Seasons of birth * Parity	14	60.801	1.640	.062
Error	2480	37.074		

### 3. Effect of Sex of Calf:

In this study male calves were found to be heavier than female calves. The mean birth weight of males was  $35.08 \pm 0.28$  Kg while that of females was  $32.89 \pm 0.31$  Kg as shown in table (3). The difference between the two sexes was highly significant ( $P \leq 0.001$ ) as appeared in table(2).

**Table(3): Means and Standard Errors of Weight at Birth (kg) for Male and Female Calves.**

Dependent Variable: wt. at Birth

SEX	Mean (kg)	Std. Error
Female calves	32.89	0.28
Male calves	35.08	0.31

### 4. Effect of Year of Birth:

The year in which the calves were born was found to have a highly significant effect on weight at birth ( $P \leq 0.000$ ) as was shown in table (2). Table (4) shows that the heaviest calves with mean

weights of  $36.16 \pm 0.57$  Kg were born during the years 1993-1994, while the lighter calves of mean weight  $31.7 \pm 0.60$  kg were born during the period 1997-1998.

**Table (4): Means and Standard Errors of Weight at Birth (kg) in Different Years of Birth.**

Dependent Variable: weight at Birth.

Years of Birth	Mean (kg)	Std. Error
1984-1985	33.52	1.49
1989-1990	34.97	0.60
1991-1992	34.72	0.38
1993-1994	36.16	0.57
1995-1996	33.72	0.42
1997-1998	31.70	0.60
1999-2000	31.98	0.57
2001-2002	33.79	1.08

## 5. Effect of Season of Birth:

In this study the mean weights at birth of calves born in winter ,dry summer and wet summer were  $34.36 \pm 0.35$  ,  $34.19 \pm 0.42$  and  $33.11 \pm 0.34$  Kg respectively (Table 5) .The season of birth had no significant effect ( $P \geq 0.05$ ) on birth weight (Table 2).

**Table (5): Means and Standard Errors of Weight at Birth (kg) in Different Seasons of Birth.**

Dependent Variable: weight at Birth

SEASON	Mean (kg)	Std. Error
Winter (Nov. – Feb.)	34.36	0.35
Dry Summer(March - June)	34.19	0.42
Wet Summer(July – Oct.)	33.11	0.34

## 6. Effect of Parity of Dam:

Calves born to dams at different parities revealed some variations in their birth weights. The first three parities gave calves of lighter birth weights (1<sup>st</sup> 32.86±0.43, 2<sup>nd</sup> 31.68±0.38 and 3<sup>rd</sup> 33.53±0.33 kg ) than later parities as seen in Table(6) .Table (2) shows that parity of dam had exerted a highly significant ( $P \leq 0.001$ ) effect on weight at birth of calves.

**Table (6): Means and Standard Errors of Weight at Birth (kg) in Different Parities of Dams.**

Dependent Variable: weight at Birth

PARITY	Mean	Std. Error
1	32.86	0.43
2	31.68	0.38
3	33.53	0.33
4	34.66	0.47

5	35.06	0.54
6	34.40	0.79
7	34.73	1.20
8	36.33	1.64

#### IV. Discussion:

The mean weight at birth ( $33.87 \pm 0.21$  kg) revealed in this study was more than that recorded for Friesian calves in Saudi Arabia (32.00kg), Syria (31.00kg), Kuwait (31.50 kg), Egypt (30.10kg), and comparable to that in Tunisia (34.20kg), Algeria (33.80 kg), Iraq (33.00kg), Libya (34.20kg) and Morocco (33.20kg). It was far below weights at birth of Holstein calves in Jordan (37.50kg), Algeria (40.00kg) and Iraq (37.00kg), AOAD (1983) probably due to the larger size of the Holsteins as compared to the Friesians.

The results were also below those of Israeli Friesians ( $39.6^{\text{♂}}$  &  $36.67^{\text{♀}}$ ) as reported by Vaccaro (1975). In Africa South of the Sahara female calves of Friesians of Dutch origin in Zaire scored less weights (31.40kg) than females in this study ( $32.89 \pm 0.31$ kg), but males scored more (37.7kg vs.  $35.08 \pm 0.28$ kg), while in Nigeria Friesians of British origin scored 35.7kg for male calves and 34.10kg for female. In Uganda Canadian Holsteins averaged 33.00kg for males and 30.70kg for females (Vaccaro 1975) which were less than the scores reported in this study. This author also reported that in Latin America mean birth weights for pure Holsteins in the region were within the range 30.60-38kg. The lighter weights (30.60kg) were from first parity cows and they were lighter than similar calves in this study ( $32.86 \pm 0.43$ kg). The heavier weights (38kg) were from older cows in Colombia which were a bit heavier than the scores reported in this study.

(36.33± 1.64kg). Kabuga and Agyenang (1986) reported an average birth weight of 35.6 kg for Canadian Holstein – Friesian calves in Ghana. In India and the Far East birth weights of purebred Holsteins ranged from 24.60-37.50kg for males and 35.00kg for females. Vaccaro (1975) also reported that weights at birth for purebred Holsteins in Bettsville Research Centre, Maryland, U.S.A, averaged 36.80kg. Sieber et al (1989) reported higher weights at birth of 39.5±5.8 kg for the same breed in U.S.A. also. Lazarevic(1983) reported that the average birth weights of male and female Friesian calves in Yugoslavia were 35.40 and 33.40kg ,respectively, which were comparable to the findings in this work. Tuzemen (1993) reported an average weight at birth of 38.7 ± 1.97 kg for Holstein – Friesian calves in Turkey which was higher than the results in this investigation .

In this study sex of calf had significantly affected weight at birth of Holstein – Friesians. Males were found to be 2.19 kg heavier than females. This might be attributed to the fact that the male sex hormones play a role in more muscular development in male calves and also the latter are carried intra-uterine longer than females (1.3 days more), Koonce and Dillard (1967) as cited by Khalafalla (1977). This goes in line with the findings of Mwandotto ( 1982) in cattle in Kiboga in Kenya where male calves were heavier by 1.60 kg than females. It also agreed with the findings of Vaccaro et al (1986) in Holstein – Friesian calves in Venezuela where males were heavier than females by 1 .0 kg.This was also augmented by the findings of Azevedo et al (1986) in Tabapua cattle in Brazil, Nobre et al (1986) in Nellore cattle in Brazil ,Singh and Parekh (1986) in Jersey x Gir F2 cross in India and Sieber et al (1989) in Holsteins in U.S.A. The same observation was also reported by Oliveira (1990) in the Santa Gertrudis breed, Saravaiya et al (1993) in Surti buffaloes and Guaragna et al (1993) in Holsteins in Brazil where males were heavier by 2.90 kg than females. However, Nair et al (1986) reported that sex o calf has no effect

on weight at birth in cross bred cattle (Jersey – Friesian, Holstein – Friesian and Brown Swis). This was also supported by the findings of Dhumal et al (1988) in Red Kandhari cattle and their crosses with Jersey.

The significant effect of year of birth on weight at birth of calves revealed in this study agreed with the findings of Kabuga and Agyemang (1986), Azevedo et al (1986), Milagres et al (1986), Srivastava et al (1986) and Togashi et al (1986). It was also supported by the works of Rodriguez et al (1986), Sharma et al (1986), Singh and Parekh (1986) Oliveira (1990) and Guaragna et al (1993). However the findings in this study and the reports of the previously mentioned works were all contradicted by the results reported by Duarte et al (1986) in a Charolais herd where the year of calving had no effect on weight at birth of calves. The significant variation of weight at birth between year periods seen in this study might be attributed to different management levels in different years. This goes in line with the fact that the farm had really witnessed fluctuations in the standards of feeding of animals during different years. This agrees with what has been shown in the literature review about the effect of prepartum care on weight at birth.

The variations in weight at birth of calves born in different seasons of the year were not significant as revealed by this study. It might be said that short-term differences in management level could not significantly affect weight at birth. This point might need more investigation and justification. However, the insignificant effect of season of birth on weight at birth revealed in this study agreed with the findings of Bustamante (1986), Khedkar et al (1986), Nair et al (1986), Dhumal et al (1988), Ologun and Egbunike (1993) and Guaragna et al (1993). There were other workers who reported a significant effect of season or month of birth on weight at birth of calves,

hence contradicting the findings of this study. These include Mwandotto (1982) who reported a significant effect of the year x month interaction on weight at birth and Durate et al (1986), Azevedo et al (1986), Milagres et al (1986), Srivastava et al (1986), Rodriguez et al (1986), Sharma et al (1986) and Singh and Parekh (1986) who stated that season or month of calving had a significant effect on weight at birth of calves .

In this study weight at birth of calves was lowest ( $31.68 \pm 0.38\text{kg}$ ) in the 2nd parity and highest in the 8th parity ( $36.33 \pm 1.64 \text{ kg}$ ). Weight at birth increased steadily from the 3rd to the 5th parity and then decreased in the 6th and 7th parities and peaked again in the 8th parity. This might be attributed to the increased size and physiological development of ovaries and uterus as dams increased in size and capacity as age and parity advanced. This highly significant variation agreed with the findings of Mwandotto (1982) who reported that calves born to dams aged 6-7 years were heavier than calves born to dams aged 2-3 years . Lee et al (1986) also reported that parity of dam had an important effect on weight at birth especially from the 3rd -6th parity and then decreasing thereafter . This was augmented by the findings of Silva (1986) in Nellore cattle in Brazil . For the same breed of cattle. Milagres et al (1986) had also reported a significant effect of age of dam on weight at birth. Sieber et al (1989) reported an increasing weight at birth as parity advanced (1<sup>st</sup> parity  $37.9 \pm 4.40$ , 2nd  $39.70 \pm 5.80$ , 3rd  $41.10 \pm 5.30$ , 4th  $41.1 \pm 6.20$  and 5th parity  $41.60 \pm 5.40\text{kg}$ ). Olivera (1990) reported that weight at birth was highest for calves from dams aged 6-7 years while Guaragna et al (1993) reported that heaviest calves were born to dams aged 8.60 years. Contrary to the results of this study were the findings of Bustamante (1990), Duhumal et al (1988) and Vallejo et al (1990) who stated that age and parity of dam had no significant effect on weight at birth of calves.

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