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Non-genetic factors affecting phenotypic parameters of milk production and reproductive performance in lactating Egyptian buffaloes

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Abstract

Improving productive and reproductive performance in Egyptian buffaloes requires knowledge of the influence of environmental and genetic factors on phenotypic traits. This study aims to estimate the effect of some environmental factors on the productive and reproductive traits of Egyptian buffaloes. Egyptian buffalo data were obtained from the database of Bani Sanad station belonging to the Livestock development project under the administration of Assiut governorate, Egypt. 2,149 records were collected on the dairy Menoufi buffalo, covering the period from 1999 to 2018. For the analysis of variance, the general linear model GLM (SAS) was used to analyze the variance in milk production and reproductive traits. The effect of year of calving was significantly higher (P<0.001) on TMY, LL and DP, milk traits affected significantly by calving season, likewise, Parity had a highly significant (P<0.0001) effect on TMY, LL and DP. The highest milk production has been recorded at 4th and 5th parity and then decreased thereafter. The year of calving had a highly significant (P<0.001) effect on all reproductive traits. The calving season had a highly significant (P<0.001) effect on most reproductive traits in Egyptian buffaloes, as there were a significant difference in DO, CI, NSC and GL, while there were no statistically significant (P>0.05) differences in AFC between seasons. All reproductive traits (DO, CI, NSC, GL and AFC) were significantly (P<0.001) affected by parity. In conclusion, these results are very useful in selection and breeding programs for Egyptian buffaloes, also knowing the unsuitable environmental conditions and overcoming them to improve the productivity of buffalo.

Keywords: Egyptian buffalo, milk traits, reproductive traits, non-genetic factors, phenotypic parameters.

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1. Introduction

The dairy industry in Egypt represents 35% of the total livestock production sector (Hammoud *et al.,* 2010). Water buffalo is the second most important species in the world in terms of milk production after dairy cows. Therefore, buffalo breeding has become more important than ever (Safari *et al.,* 2018). Additionally, the Egyptian buffalo (*Bubalus bubalis*) is considered one of the most important buffalo breeds in the world, and it occupies a special importance in the Egyptian country, where it is considered the first milk-producing animal in Egypt, and an important source of red meat (Abu El-Magd *et al*., 2015). The total number of buffaloes in Egypt is estimated to be 4,164,928 heads that produce approximately 2,650,000 tons of milk (Hassanat *et al*., 2017). It also has a high ability to adapt under different environmental conditions and is resistant to diseases (Abu El-Magd *et al*., 2015). Most Egyptian consumers prefer buffalo milk and veal meat (Abu El-Magd *et al*., 2015). Buffalos' production represents 44% and 36% of the whole production for milk and meat in Egypt, respectively (FAO, 2019). There are many fertility indicators that can be used to evaluate the reproductive performance in dairy farms, like the number of services per conception (NSC) and days open (DO) that can directly affect the calving interval (CI), according to El-Tarabany and El-Bayoumi (2015). However, reproductive efficacy has a great impact on the overall profitability of dairy animal production (Berry and Cromie, 2009). Among the reproductive performance, fertility traits such as NSC and DO play an important role because these traits make the calving interval (CI) either longer or shorter (El-Tarabany and Nasr, 2015). The short day's open and lowest number of services per conception increases productive life of the animal and the number of calf crops (Ali *et al*., 2011). Monitoring and improvement of reproductive performance is a very important concern because after low milk production, poor fertility is the main reason for culling dairy animals (Ansari-Lari *et al*., 2012). The main objective of this current study was to determine the effect of some non-genetic factors on phenotypic parameters of milk production and reproductive performance in lactating Egyptian buffaloes.

2. Materials and methods

2.1 Experiment design and data collection

This experiment was designed in the Animal Production Department, Faculty of Agriculture, Al-Azhar University, Assiut, Egypt. Egyptian buffalo data were obtained from the database of Bani Sanad station belonging to the Livestock Development Project under the administration of Assiut governorate. Bani Sanad village is one of the villages belonging to the Manfalut center (25 km in the northwest of Assiut Governorate) in the Arab Republic of Egypt (located at latitude of 27° 10' 48.4824" N, longitude of 31° 11' 21.4188" E and about 56 meters above sea level). The climate of Assiut governorate is characterized as continental, with cold winters and hot summers. 2,149 records were collected on the dairy Menoufi buffalo, covering the period from 1999 to 2018, the herd nucleus was formed by purchasing from local markets and research centers since the beginning of the project and the establishment of the farm in 1969. Lactations without breeding dates and those cows aborted, infected with mastitis or other udder disorders were considered abnormal lactation and their records were excluded from data of animal origin prior to statistical analysis. Likewise, records of buffaloes sold for the purposes were also excluded from the data. The number of normal lactations given by the study buffaloes, distributed according to the different years, calving season and parity is shown in Table (1).

Table (1): Distribution of records on the year, season and parity for Egyptian buffaloes.

Year	Number	Season	Number	Parity	Number
1999/2000	13	Winter	445	1st parity	335
2001/2002	73	Spring	391	2nd parity	335
2003/2004	195	Summer	594	3rd parity	318
2005/2006	203	Autumn	717	4th parity	263
2007/2008	166			5th parity	221
2009/2010	222			6th parity	189
2011/2012	298			7th parity	133
2013/2014	390			8th parity	105
2015/2016	378			9th or more	249
2017/2018	209				

2.2 Animals management and nutrition

All animals were placed under the semi-open housing system; all the animals remained free, except for the time of examination or palpation. Buffalo cows were naturally mated with fertilized bulls; pregnant buffalo cows were examined by rectal palpation within 2 months of the last mating. After parturition all newborn calves were fed colostrum, all calves remained with their mothers until weaning (3rd month) or reaching a weight of 90 kg which is closer. Lactating buffalo cows were hand milked by trained milking workers twice daily at 6.00 am and 4.00 pm throughout the lactation period and milk production was recorded daily. Dairy buffaloes were dried approximately two months before the expected time of the next calving. The herd was vaccinated periodically against foot-and-mouth disease and any other diseases. Any buffalo cows suffering injury due to accidents, and reproductive failure, udder disorders and disease cases were eliminated from the study, it was done involuntarily. All animals under study were fed a concentrated feed mix (CFM) 16% protein, corn silage and rice straw all year round. Egyptian alfalfa (*Trifolium Alexandrinum*) was provided during the winter season (December to May), while alfalfa hay was provided with Darawa during the summer season (June to November). The concentrated mixture was served twice daily before milking according to the animal's body weight and milk production. Feed requirements were calculated according to the NRC (1975). Buffaloes producing milk yield more than 10 kg/day and buffaloes in the last two months of pregnancy were provided with additional concentrated rations according to their weight and pregnancy requirements. Clean fresh water and a mixture of vitamins and minerals were constantly provided. The traits examined in this manuscript were total milk production (TMY), lactation length (LL) and dry period (DP) as characteristics of milk production. There are also many reproductive traits discussed such as Calving interval (CI), Days open (Do), number of services per conception (NSC), gestation length (GL) and age at first calving, (AFC).

2.3 Data statistical analysis

All statistical procedures were performed using SAS statistical system package v9.2 (SAS 2002). The general linear model (GLM) was used to analyze the variance in milk production and reproductive traits. Duncan's Multiple Range Test (DMRT) was used to make multiple comparisons for each trait. The data of milk production traits (TMY, LL and DP) and reproduction traits (DO, CI, NSC, GL and AFC) for all available lactations' records were analyzed by adopting the following mixed model:

$$Y_{ijkl} = \mu + Y_i + S_j + P_k + e_{ijkl}.$$

Where, Y_{ijkl} = on observation on milk traits (*i.e*. TMY, LL and DP) and reproductive traits (*i.e*. CI, DO, NSC, GL and AFC)., μ = general mean, common element to al observation., Yi = fixed effect of the i^{th} calving year (i = 1999/2000 to 2017/2018)., S_j = fixed effect of the j^{th} season of calving (j = 1, 2, 3, and 4, 1=winter, 2=summer 3= spring and 4= autumn)., P_k= fixed effect of the k^{th} parity (k= 1^{st} ,2^{nd} ,3^{rd} ,4^{th} ,5^{th} ,6^{th} ,7^{th} ,8^{th} and 9^{th} parity). e_{ijkl} = random error.

3. Results and Discussion

3.1 Milk production traits

3.1.1 Effect of calving year on milk traits

Data presented in Table (2), showed that the effect of year on calving was significantly higher (P<0.001) on TMY. The highest TMY mean was 1904.74±53.57 kg in 1999/2000 year and the lowest TMY mean was 1801.54±14.91kg in 2005/2006 year. These results are in agreement with the results of many researchers who noted that the year of calving had a significant effect on the total milk production of buffaloes, for example, Eldawy *et al*., (2021) they showed that year of calving had a significant (P<0.001) effect on TMY. The observed variation in milk production in different years reflects the level of management as well as environmental influences. The level of management, favorable environmental conditions for the animals as well as forage cultivation, method and severity of culling may be responsible for the difference in TMY (Hussain *et al*., 2006).

Table (2): Effect of year of calving on total milk yield (TMY), lactation length (LL), and dry period (DP).

Items	Least squares mean± standard error		
	TMY (Kg)	LL, (day)	DP (day)
Year of calving	**	**	**
1999/2000	1904.74±53.57[a]	341.11±13.10[a]	75.85±10.96[d]
2001/2002	1902.73±23.96[a]	331.96±5.86[a]	80.16±4.90[cd]
2003/2004	1876.15±15.77[ab]	322.66±3.85[ab]	79.44±3.22[d]
2005/2006	1801.54±14.91[c]	295.31±3.64[b]	87.33±3.05[cd]
2007/2008	1890.80±15.79[bc]	297.00±3.86[b]	89.73±3.23[cd]
2009/2010	1858.14±13.22[ab]	286.08±3.23[c]	96.17±2.70[c]
2011/2012	1865.78±11.34[ab]	281.09±2.77[bc]	108.13±2.32[b]
2013/2014	1825.59±10.00[b]	268.10±2.44[cd]	115.14±2.04[ab]
2015/2016	1875.16±10.54[ab]	271.50±2.58[cd]	124.55±2.15[a]
2017/2018	1854.31±14.63[ab]	259.53±3.58[d]	128.12±2.99[a]
Overall mean	1865.50±18.37	295.43±4.49	98.46±2.375

**= significant (P<0.01). Means with different superscript letters ([a,b,c]) are significantly different (p<0.05). TMY: Total Milk Yield; LL: lactation length; DP: dry period.

3.1.2 Effect of calving season on milk traits

Season of calving had been recognized as an important factor affecting milk yield in Egyptian buffaloes. Furthermore, the results in Table (3), showed that there was a highly significant (P<0.001) effect of the calving season on the total milk production (TMY), lactation length (LL) and dry period (DP). The overall means of total milk production (TMY), lactation length (LL) and dry period (DP) were 1865.50±10.49kg, 295.43±2.57 days and 98.46±2.145 days, respectively. The results showed that there was a significant increase in the amount of milk produced by buffaloes calving in winter by 23.39 % and 17.06 % than buffaloes calving in the summer and autumn seasons, respectively. The LL was 302.60±2.82 days in spring, and the shortest period was 286.57±2.27 days in autumn. The higher yield in the winter and spring months can be attributed to the favorable climatic conditions for abundant growth and availability of high-quality Egyptian Alfalfa (Berseem) during the lactation advantages stage.

Table (3): Effect of calving season on total milk yield (TMY), lactation length (LL), and dry period (DP).

Items	Least squares mean± standard error		
	TMY (Kg)	LL (day)	DP (day)
Season of calving	**	**	**
Winter	2068.96±10.68[a]	295.46±2.61[b]	94.29±2.18[b]
Spring	1956.16±11.53[ab]	302.60±2.82[a]	97.2±2.36a[b]
Summer	1669.43±10.48[b]	297.10±2.56[b]	101.92±2.14[a]
Autumn	1767.42±9.30[ab]	286.57±2.27[c]	100.42±1.90[a]
Overall mean	1865.50±10.49	295.43±2.57	98.46±2.145

**= significant (P<0.01). Means with different superscript letters (a,b,c) are significantly different (p<0.05). TMY: Total Milk Yield; LL: lactation length; DP: dry period.

The results reported here agree with Biswal *et al*. (2017), who showed that the length of the lactation period (LL) is significantly influenced by the calving season of dairy cows (P<0.05). The present results agree with most previous studies on Egyptian buffaloes who found that there are statistically significant differences between seasons in total milk production (ShafiK, 2017). According to Abo Gamoes, (2012) reported that the month or season and year of calving had highly significant (P<0.01) effect on milk yield. In addition, El-Awady *et al*. (2016), they also reported that month or season and year of calving had highly significant (P<0.01) effect on lactation period. The difference in the amount of milk produced during different seasons is often due to the difference in the amount of feed, weather, and care regimes.

3.1.3 Effect of parity on milk traits

Parity is one of the most important non-genetic factors affecting milk production. Results expressed in Table (4), showed that the overall mean of TMY, LL and DP were 1865.50±14.79 kg, 295.43±3.168 days and 98.46±3.024 days, respectively. Parity had a highly significant (P<0.0001) effect on TMY, LL and DP. The highest milk production has been recorded at 4th and 5th parity and then decreased thereafter. The longest milking period ever recorded at 4th, 5th and 6th parity, while the longest dry period was observed at the first calving (1st parity) 139.70±2.32 days and then followed by the 2nd parity 113.39±2.42 days and 9th parity 111.8±3.21 days, respectively.

Table (4): Effect of parity on total milk yield (TMY), lactation length (LL), and dry period (DP).

Items	Least squares mean± standard error		
	TMY(Kg)	LL (day)	DP (day)
Parity	**	**	**
1st parity	1610.85±11.34^{d}	276.69±2.77^{c}	139.70±2.32^{a}
2nd parity	1833.36±11.84^{cd}	286.61±2.89^{bc}	113.39±2.42^{ab}
3rd parity	1998.24±12.38^{ab}	299.25±3.03^{b}	89.85±2.53^{c}
4th parity	2075.63±13.25^{a}	306.10±3.24^{ab}	82.46±2.71^{cd}
5th parity	2062.38±14.35^{a}	311.17±3.51^{a}	77.83±2.93^{d}
6th parity	1954.82±15.49^{b}	309.12±3.79^{a}	87.99±3.17^{cd}
7th parity	1854.47±18.28^{c}	300.00±4.47^{b}	90.59±3.74^{c}
8th parity	1747.60±20.52^{d}	286.42±5.02^{bc}	92.46±4.19^{c}
9th parity or more	1652.08±15.71^{d}	283.52±3.84^{bc}	111.8±3.21^{b}
Overall mean	1865.50±14.796	295.43±3.168	98.46±3.024

**= significant (P<0.01). Means with different superscript letters (^{a,b,c}) are significantly different (p<0.05), TMY: Total Milk Yield; LL: lactation length; DP: dry period.

At such a time female buffalo reach mature body weight and this is associated with complete development in size and function of digestive, circulatory, mammary and the other body systems, as well as in mammary glands. Therefore, the amount of feed intake, feed utilization and efficiency of milk synthesis are greatly increased, with advance in age there after the physiological activity of all body systems start to decrease and the secretary tissue of the udder is partially degenerated leading to a gradual decrease in the amount of milk production (Eldawy *et al.*, 2021). Also, the same authors concluded that age correction factors vary from season to another and from geographical region to another (Amimo *et al.*, 2007). These results are in agreement with Hassan, *et al*. (2017) they found a significant effect of parity (P<0.001) on the milk traits. Ramadan (2018) reported that Parity recorded highly significant (P<0.001) effect on the studied milk yield traits. In contrast, Abo-Gamil *et al*. (2017) they reported that parity had a non-significant effect on milk traits.

3.2 Reproductive traits

3.2.1 Effect of year on reproductive traits

Data presented in Table (5) showed that the overall means of DO, CI, NSC, GL and AFC were 79.70±5.47, 393.75±5.71, 1.65±0.086, 314.06±0.52 and 39.46±0.597 days, respectively in a year of calving of Egyptian buffaloes. The year of calving had a highly significant (P<0.001) effect on all reproductive traits. These results showed that the longest DO mean was 97.96±15.6 days in 1999/2000 year and the lowest DO mean was 66.86±4.34 in 2005/2006 year. Year of calving showed a significant effect on days open by Osman *et al*., (2013). The longest CI mean was 417.19±16.3 days in 1999/2000 year of calving and the lowest CI mean was 381.96±4.08 days in 2009/2010 year of calving. The same results were reported by Eldawy *et al*. (2021) indicated that year of calving highly significant (P<0.01) effect on CI. However, Afifi *et al*. (1992) reported that year of calving had no effect on calving interval. Services per conception were affected significantly (P<0.001) by calving year, during the period from 2005/2006 to 2009/2010 year, buffaloes needed significantly (P<0.001) fewer services per conception than another period. In the same direction, year had affected NSC significantly (P< 0.05) was reported by Haile-Mariam *et al.* (1993). Goshu, *et al*. (1993) demonstrated that, year significantly (P<0.05) affected the NSC, DO and CI. The results showed that there were a significant (P<0.001) differences in the gestation period and that the least gestation period was during the years 2013/2014 (309.78±0.28) and 2015/2016 (309.38±0.29), while the longest gestation period was during the years 1999/2000 (319.23±1.50) and then thereafter 2001/2002 (318.24±0.67). These results are on the same line with Fooda *et al.* (2011) reported that, the effect of year of calving on number of service (NS) and gestation period (GP) were highly significant (P<0.01) in Egyptian buffaloes. Sekerden (2013) demonstrated that calving year is related to significant variance in calving interval and gestation period.

Table (5): Effect of year of calving on days open (DO), calving interval (CI), number of services per conception (NSC), gestation length (GL) and age at first calving (AFC).

Items	Least squares mean± standard error				
	DO (day)	CI (day)	NSC	GL (day)	AFC (month)
Year of calving	**	**	**	**	**
1999/2000	97.96±15.6[a]	417.19±16.3[a]	1.59±0.25[bc]	319.23±1.50[a]	35.61±1.75[bc]
2001/2002	94.23±6.98[a]	412.48±7.27[a]	1.71±0.11[ab]	318.24±0.67[a]	34.61±0.76[c]
2003/2004	84.98±4.59[b]	402.57±4.79[ab]	1.60±0.07[b]	317.59±0.44[a]	33.84±0.48[c]
2005/2006	66.86±4.34[d]	382.68±4.52[c]	1.36±0.07[c]	315.82±0.42[ab]	35.30±0.46[bc]
2007/2008	71.91±4.60[cd]	386.56±4.79[bc]	1.59±0.07[bc]	314.65±0.44[ab]	34.93±0.49[c]
2009/2010	69.67±3.85[d]	381.96±4.08[c]	1.59±0.06[bc]	312.28±0.37[b]	37.60±0.42[b]
2011/2012	77.46±3.30[c]	388.74±3.44[b]	1.62±0.05[b]	311.27±0.31[b]	40.39±0.37[ab]
2013/2014	73.39±2.91[cd]	383.17±3.03[c]	1.72±0.04[ab]	309.78±0.28[b]	43.49±0.32[ab]
2015/2016	86.78±3.07[ab]	396.17±3.20[ab]	1.98±0.05[a]	309.38±0.29[b]	47.49±0.32[a]
2017/2018	73.61±4.26[cd]	385.98±4.44[bc]	1.99±0.07[a]	312.36±0.41[b]	51.35±0.43[a]
Overall mean	79.70±5.471	393.75±5.713	1.65±0.086	314.06±0.524	39.46±0.597

**= significant (P<0.01). Means with different superscript letters ([a,b,c]) are significantly different (p<0.05). DO: days open; CI: calving interval; NSC: Number of service /conceptions; GL: Gestation length; AFC: Age at first calving.

The difference in the duration of pregnancy may be due to maternal, fetal, genetic and environmental factors (Jainudeen and Hafez, 2000). The longest age at first calving in this study was observed within a year 2017/2018 (51.35±0.43 months), while the lowest age at first calving was seen within a year 2003/2004 (33.84±0.48 months). Year of birth was found to have significant effect (P<0.01) on age at first calving by many investigators (Bashir *et al*., 2015; Hussain *et al*., 2006, Rehman *et al.*, 2014). A significant effect (P<0.01 or P<0.05) of year of calving on reproductive traits in buffaloes was attributed by different investigators to fluctuations in environmental conditions, particularly those associated with managemental procedures, weather conditions, nutritional level, and feeding practices that are changing over the years in the buffalo farms (Ahmad and Shafiq, 2002).

3.2.2 Effect of calving season on reproductive traits

The results of the current data (Table 6) showed that the calving season had a highly significant (P<0.001) effect on most reproductive traits in Egyptian buffaloes, as there was a significant difference in days open, calving interval, number of service per conception and gestation length, while there was no statistically significant (P>0.05) differences in age at first calving between seasons. Data presented in Table 6. showed that the overall mean of DO, CI, NSC, GL and AFC were 79.70±3.057, 393.75±3.185, 1.65±0.05, 314.06±0.292 and 39.46±0.335, respectively. Statistical analysis of the data shows that the Spring-calving buffaloes had the highest DO 88.38±3.36 days, CI 403.36±3.50 days, NSC 1.83±0.05 and GL 314.98±0.32 days. On the other hand, the Autumn-calving buffaloes had the shortest DO 69.69±2.71 days, CI 382.93±2.82 days, NSC 1.49±0.04 and GL 313.24±0.26 days. the winter-calving buffaloes had a highest AFC 40.22±0.34 months. The herein results exhibit that the optimum reproductive performance of buffaloes was recorded in the Autumn season. There is agreement between these results and the results of previous studies, Shafik (2017) noted that season of calving had a significant effect (P≤0.05) on calving interval and days open. Eldawy *et al*. (2020) reported that there was a significant effect of season of calving-on-calving interval and days open. Likewise, Hassan *et al.* (2017) who found that buffaloes that calved during winter had the greatest reproductive performance, while such season possesses the shortest DO (97.88 days) and CL (13.61 months) than those calved in the other seasons. The optimal reproductive performance of buffaloes in the fall season may be due to the appropriate environmental conditions (lower temperature, relative humidity, and temperature and humidity (THI) for production in our country and the availability of feed during that period, which leads to an improvement in ovarian functions (Salzano *et al*., 2018). Heat stress during the summer can negatively affect oocyte quality and hormones (Shehab-El-Deen *et al.*, 2010). (López-Gatius and Hunter, 2020) found that increasing heat stress on milking animals leads to a decrease in blood flow towards the uterus, an increase in the temperature of the uterus and a change in the internal environment of the uterus. These physiological differences, lead to a decrease in the fertility rate, reduce the pregnancy rate and increase early abortion during the hot season. These reasons explain the differences between seasons in the performance of production and breeding in dairy buffaloes.

Table (6): Effect of calving season on days open (DO), calving interval (CI), number of services per conception (NSC), gestation length (GL) and age at first calving (AFC).

Items	Least squares mean± standard error				
	DO (day)	CI (day)	NSC	GL (day)	AFC (month)
Season of calving	**	**	**	**	ns
Winter	80.17±3.11[b]	393.98±3.24[ab]	1.65±0.05[ab]	313.81±0.30[b]	40.22±0.34[a]
Spring	88.38±3.36[a]	403.36±3.50[a]	1.83±0.05[a]	314.98±0.32[a]	39.00±0.37[a]
Summer	80.51±3.05[b]	394.73±3.18[ab]	1.72±0.05[ab]	314.22±0.29[a]	38.74±0.33[b]
Autumn	69.69±2.71[c]	382.93±2.82[b]	1.49±0.04[b]	313.24±0.26[b]	39.88±0.30[a]
Overall mean	79.70±3.057	393.75±3.185	1.65±0.05	314.06±0.292	39.46±0.335

**= significant (P<0.01). Means with different superscript letters ([a,b,c]) are significantly different (P<0.05). DO: days open; CI: calving interval; NSC: Number of service /conceptions; GL: Gestation length; AFC: Age at first calving.

3.2.3 Effect of parity on reproductive traits

Results in Table (7) indicated that the overall least squares mean (± standard error) of DO, CI, NSC, GL and AFC were 79.70±4.31, 393.75±4.491, 1.65±0.064, 314.06±0.411 and 39.46±0.469. All reproductive traits (DO, CI, NSC, GL and AFC) were significantly (P<0.001) affected by parity. Buffalo cows at the first parity showed the longest DO (103.2±3.30 days), CI (393.75±4.491 days), NSC (1.65±0.064) and AFC (39.46±0.469 months), while the 8th parity calvers showed the lowest one. Similarly, Ibrahim (1998) showed that number of services/conception (NS/C) decreased with parity progress. Ramadan (2018) revealed that the NSC and CI of the second parity were significantly different (P<0.05) than NSC and CI of other parities. Motlagh, *et al*. (2013) found that, the effect of parity on services per conception and calving interval was statistically significant (P<0.05). In a study of Somida (2021) working on Egyptian buffaloes reveled that, all studied traits, such as AFC, DO, and CI were significantly affected by year of calving, season of calving and parity. The longest GL was 317.34±0.44 days in the 9th parity of calving while the shortest GL was 312.46±0.33 days in the 2nd parity of calving, then the first and third parity. parity of calving had a highly significant (P<0.001) effect on GL. In the same way, parity and season of calving accounted for significant amounts of variation in gestation period (Misra, *et al*., 1970). Foote (1981) stated that breeds, parity of dam, sex of the calf and twinning are among factors found consistently to affect gestation length. Tomasek, *et al*. (2017) discovered that parity had a highly significant effect (P<0.01) on GL. Our results showed that, improvement in reproductive traits as the number of births increases (multiparous) than first parity (primiparous) buffaloes may be due to completeness of body development, sexual maturity, and reproductive organs in mature animals compared to buffalo calves.

Table (7): Effect of parity on days open (DO), calving interval (CI), number of services per conception (NSC), gestation length (GL) and age at first calving (AFC).

Items	Least squares mean± standard error				
	DO (day)	CI (day)	NSC	GL (day)	AFC (month)
Parity	**	**	**	**	**
1st parity	103.2±3.30^{a}	416.03±3.44^{a}	2.33±0.05^{a}	312.82±0.31^{b}	45.28±0.36^{a}
2nd parity	86.40±3.45^{ab}	398.86±3.59^{a}	1.97±0.05^{a}	312.46±0.33^{b}	44.24±0.38^{a}
3rd parity	76.09±3.61^{b}	389.05±3.76^{ab}	1.74±0.05^{ab}	312.95±0.34^{b}	42.83±0.40^{ab}
4th parity	75.01±3.86^{b}	388.35±4.02^{ab}	1.66±0.06^{b}	313.34±0.37^{ab}	41.58±0.43^{ab}
5th parity	75.29±4.18^{b}	389.21±4.36^{ab}	1.54±0.06^{bc}	313.91±0.40^{ab}	40.14±0.46^{b}
6th parity	82.44±4.51^{ab}	396.94±4.70^{a}	1.58±0.07^{b}	314.50±0.43^{ab}	38.46±0.50^{bc}
7th parity	76.34±5.33^{b}	390.79±5.55^{b}	1.45±0.08^{bc}	314.45±0.51^{ab}	36.42±0.58^{bc}
8th parity	64.41±5.98^{c}	379.19±6.23^{b}	1.34±0.09^{c}	314.77±0.57^{ab}	34.31±0.65^{bc}
9th parity or more	77.97±4.57^{ab}	395.32±4.77^{a}	1.44±0.07^{bc}	317.34±0.44^{a}	31.89±0.46^{c}
Overall mean	79.70±4.31	393.75±4.491	1.65±0.064	314.06±0.411	39.46±0.469

**= significant (P<0.01). Means with different superscript letters (^{a,b,c}) are significantly different (p<0.05). DO: days open; CI: calving interval; NSC: Number of service /conception; GL: Gestation length; AFC: Age at first calving.

5. Conclusion

Environmental conditions play important roles in productivity, profitability, and economic efficiency of Egyptian dairy buffaloes. Our results showed that buffaloes at the fourth parity and those calving in the winter season had the highest milk yield, lactation length and the least dry period. Furthermore, after the fifth parity, productivity of Egyptian buffaloes began to decline and harsh environmental conditions in autumn and summer seasons adversely affect buffalo’s productivity which negatively affected its profitability. Multiparous buffaloes and those calving in the autumn season had the highest fertility traits than primiparous buffalo cows and those calving in other seasons. These results are very useful in selection and breeding programs for Egyptian buffaloes, also knowing the unsuitable environmental conditions and overcoming them to improve the productivity of the Egyptian buffalo.

References

Abo Gamoes, R. H. (2012), *Genetic evaluation of production traits in Egyptian buffaloes*, Ph.D. Thesis, Faculty of Agriculture, Mansoura University, Egypt.

Abo-Gamil, Z., El-Bayomi, K. M., Abo-Salem, M., Ramadan, S. and Darwish, S. (2017), "Estimation of gentic and phenotypic parameters for some productive and reproductive traits in Egyptian buffoloes", *Benha Journal of Applied Sciences*, Vol. 2, pp. 53–59.

Abu El-Magd, M., Zaki, A. G., Kahilo, K. A., Barakat, M. E. S. and Hassan, I. F. (2015), "Effect of SNPs in prolactin promoter on milk traits in Egyptian buffalo", *Advances in Dairy Research*, Vol. 3 No. 1, pp. 128.

Afifi, E. A., Khalil, M. H., Bedeir, L. H. and Zeidan, S. M. (1992), "Genetic analysis of reproductive traits in Egyptian buffaloes", *Egyptian Journal of Animal Production*, Vol. 29, pp. 139–154.

Ahmad, M. and Shafiq, M. (2002), *Effect of season on fertility rate and milk production in Nili-Ravi buffaloes,* In 23rd Annual Report, Livestock Production Research Institute, Bahadurnagar, Okara, Pakistan.

Ali, A., Javed, K., Ahmad, N. and Rehman, S. (2011), "Environmental factors affecting some reproductive traits in Nili Ravi buffaloes", *Journal of Animal and Plant Science*, Vol. 21, pp. 868–871.

Amimo, J. O., Wakhungu, J., Inyangala, B., and Mosi, R. (2007), "The effects of non-genetic factors and estimation of genetic and phenotypic parameters and trends for milk yield in Ayrshire cattle in Kenya", *Livestock Research for Rural Development*, Vol. 19, pp. 1–7.

Ansari-Lari, M., Mohebbi-Fani, M. and Rowshan-Ghasrodashti, A. (2012), "Causes of culling in dairy cows and its relation to age at culling and interval from calving in Shiraz, Southern Iran", *Veterinary Research Forum*, Vol. 3, No. 4, pp. 233.

Bashir, M. K., Khan, M. S., Lateef, M., Mustafa, M., Khalid, M., Shahidur-Rehman, F. U. and Sciences, S. (2015), "Environmental factors affecting productive traits and their trends in Nili-Ravi buffaloes", *Pakistan Journal of Life*, Vol 13, pp. 137–144.

Berry, D. and Cromie, A. (2009), "Associations between age at first calving and subsequent performance in Irish spring calving Holstein–Friesian dairy cows", *Livestock Science*, Vol 123, pp. 44–54.

Biswal, S., Thirunavukkarasu, M., Venkataramanan, R. and Pandian, A. (2017), "Factors influencing lactation curve parameters in dairy farms", *International Journal of Statistics and Applied Mathematics*, Vol. 2, pp. 282–285.

El-Awady, H., Salem, A. and Shoaib, A. (2016), "Effect of level of milk production on profitability in lactating Egyptian buffaloes", *Agriculture Research of Kafr El-Sheikh University*, Vol. 42, pp. 105–114.

Eldawy, M. H., Lashen, M. E. S., Badr, H. M. and Farouk, M. H. (2021), "Milk production potential and reproductive performance of Egyptian buffalo cows", *Tropical Animal Health Production*, Vol. 53, pp. 1–12.

El-Tarabany, M. S. and El-Bayoumi, K. M. (2015), "Reproductive performance of backcross Holstein × Brown Swiss and their Holstein contemporaries under subtropical environmental conditions", *Theriogenology*, Vol. 83, pp. 444–448.

El-Tarabany, M. S. and Nasr, M. A. (2015), "Reproductive performance of Brown Swiss, Holstein and their crosses under subtropical environmental conditions", *Theriogenology*, Vol. 84, pp. 559–565.

Fooda, T. A., Elbeltagi, A. R., Laila, R. H. and Set El-Habaeib, A. S. (2011), "Assessment of Egyptian buffaloes crossing with Pakistani and Italian buffaloes for some production traits", *Journal of American Science*, Vol. 7 No. 1, pp. 269–276.

Foote, R. H. (1981), "Factors affecting gestation in dairy cattle length", *Theriogenology*, Vol. 15 No. 6, pp. 553–559.

Gebeyehu, G., Belihu, K. and Berihun, A. (2007), "Effect of parity, season and year on reproductive performance and herd life of Friesian cows at Stella private dairy farm, Ethiopia", *Livestock Research* *for Rural Development*, Vol. 19, Article ID: 98.

Haile-Mariam, M., Banjaw, K., Gebre-Meskel, T. and Ketema, H. (1993), "Productivity of Boran cattle and their Friesian crosses at Abernossa ranch, Rift Valley of Ethiopia. I. Reproductive performance and pre-weaning mortality", *Tropical Animal Health and Production*, Vol. 25, pp. 239–249.

Hammoud, M. H., El-Zarkouny, S. Z. and Oudah, E. Z. M. (2010), "Effect of sire, age at first calving, season and year of calving and parity on reproductive performance of Friesian cows under semiarid conditions in Egypt", *Archiva Zootechnica*, Vol. 13 No. 1, pp. 60.

Hassan, F. A., Ali M. A. and El-Tarabany, M. S. (2017), "Economic impacts of calving season and parity on reproduction and production traits of buffaloes in the sub-tropics", *Environmental Science and Pollution Research*, Vol. 24 No. 11, pp. 10258–10266.

Hassanat, F., Gervais, R. and Benchaar, C. (2017), "Methane production, ruminal fermentation characteristics, nutrient digestibility, nitrogen excretion, and milk production of dairy cows fed conventional or brown midrib corn silage", *Journal of Dairy Science*, Vol. 100, pp. 2625–2636.

Hussain, Z., Javed, K., Hussain, S. M. I. and Kiyani, G. S. (2006), "Some environmental effects on productive performance of Nili-Ravi buffaloes in Azad Kashmir", *Journal of Animal and Plant Science*, Vol. 16, No. 3-4, pp. 66–69.

Ibrahim, S. A. (1998), "Analysis of non-genetic factors affecting calving interval and post-partum traits in Egyptian buffaloes", *Egyptian Journal of Animal Production*, Vol. 35, pp. 597–607.

Jainudeen, M. R. and Hafez, E. S. E. (2000), "Gestation, prenatal, physiology, and parturition", In: *Reproduction in Farm Animals*, 7^{th} edition, Hafez, Ed. B. and Hafez, E.S.E., Lippincott Williams & Wilkins, Maryland, USA, pp. 140–155.

López-Gatius, F. and Hunter, R. H. F. (2020), "Local cooling of the ovary and its implications for heat stress effects on reproduction", *Theriogenology*, Vol. 149, pp. 98–103.

Misra, B. S., Raizada, B. C. and Tewari, R. B. (1970), "Gestation length, birth weight of calves and body weight changes during pregnancy in buffaloes bred during summer", *Indian Journal of Animal Sciences*, Vol. 40, pp. 103–109.

Motlagh, M., Roohani, Z., Shahne, A., and Moradi, M. (2013), "Effects of age at calving, parity, year and season on reproductive performance of dairy cattle in Tehran and Qazvin provinces, Iran", *Research Opinions in Animal Veterinary Sciences*, Vol. 3 No. 10, pp. 337–342.

Osman, M., El-Bayomi, K. and Moawed, S. (2013), "Genetic and non-genetic factors affecting some productive and reproductive traits in Holstein-Friesian dairy cows raised in Egypt for the first two lactations", *Suez Canal Veterinary Medical Journal*, Vol. 18, pp. 99–113.

Ramadan, Sh. I. (2018), "Effect of some genetic and non-genetic factors on productive and reproductive traits of Egyptian buffaloes", *Journal of Advanced Veterinary and Animal Research*, Vol. 5, pp. 374–380.

Rehman, Z., Khan, M. S. and Mirza, M. A. (2014), "Factors affecting performance of Sahiwal cattle- A Review", *The Journal of Animal and Plant Sciences*, Vol. 24 No. 1, pp. 1–14.

Safari, A., Ghavi Hossein-Zadeh, N., Shadparvar, A. A., and Abdollahi Arpanahi, R. (2018), "A review on breeding and genetic strategies in Iranian buffaloes (*Bubalus bubalis*)", *Tropical Animal Health and Production*, Vol. 50 No. 4, pp. 707–714.

Salzano, A., Spagnuolo, M. S., Lombardi, P., Vecchio, D., Limone, A., Censi, S. B., Balestrieri, A., Pelagalli, A. and Neglia, G. (2018), "Influences of different space allowance on reproductive performances in buffalo", *Animal Reproduction*, Vol. 14, pp. 429–436.

Sekerden, Ö. (2013), "Comparison of some reproductive traits of Anatolian and F1 crossbred (Anatolian × Italian) buffalos under village conditions in Turkey", *Journal of Animal Science*, Vol. 3 No. 1, pp. 3–7.

ShafiK, B. (2017), "Environmental factors affecting some productive and reproductive traits in Egyptian buffaloes", *Benha Veterinary Medical Journal*, Vol. 32, pp. 153–159.

Shehab-El-Deen, M. A. M. M., Leroy, J. L. M. R., Fadel, M. S., Saleh, S. Y. A., Maes, D. and Van Soom, A. (2010), "Biochemical changes in the follicular fluid of the dominant follicle of high producing dairy cows exposed to heat stress early post-partum", *Animal Reproduction Science*, Vol. 117, pp. 189–200.

Somida, R. A. (2021), "Genetic parameters for some reproductive traits in Egyptian buffaloes", *Egyptian Journal of Animal Production*, Vol 58 No 2, pp. 57–61.

Tomasek, R., Rezac, P. and Havlicek, Z. (2017), "Environmental and animal factors associated with gestation length in Holstein cows and heifers in two herds in the Czech Republic", *Theriogenology*, Vol. 87, pp. 100–107.