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FACTORS AFFECTING REPRODUCTIVE AND PRODUCTIVE EFFICIENCY OF NILI RAVI BUFFALOES (*Bubablus Bubalis*) IN PUNJAB, PAKISTAN

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ABSTRACT

The data on Nili Ravi buffaloes kept at Buffalo Research Institute (BRI), Pattoki, District Kasur, Punjab Pakistan were collected from 2010 to 2018 to estimate the factors affecting the reproductive and productive traits of Nili Ravi buffaloes. The reproductive parameters including age at maturity, age at first conception, age at first calving, gestation length, service period, calving interval and number of services per conception were 1029.59 ± 20.60 days, 1065.33 ± 20.20 days, 1417.6 ± 21.66 days, 312.27 ± 8.03 days, 227.16 ± 4.98 days, 485.15 ± 3.80 days and 1.60 ± 0.02, respectively. The productive parameters including 305-day milk yield, lactation length and dry period were 2211.05 ± 20.06 liters, 266.94 ± 1.49 days and 279.47 ± 5.19 days, respectively. The statistical analysis for the comparison among different treatments ANOVA technique was employed using GLM procedures. A significant effect of year and season of birth on age at maturity, age at first conception and age at first calving was observed ($P \leq 0.05$). The year of calving, season of calving and parity significantly affected calving interval, service period, services per conception and 305-day milk yield ($P \leq 0.05$). It is concluded that improvement in performance of Nili Ravi buffaloes can be made by better management, nutrition and effective heat detection program. Improved management of heifers may reduce age at maturity and age at first calving. Culling on the basis of production performance may improve productivity of buffalo in future.

Key words: Pakistan, Nili-Ravi Buffalo, productive traits, reproductive traits.
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INTRODUCTION

The livestock sector plays an important position in the economy of Pakistan. This sector has a 11.1 % share in national GDP and 58.9 % share in the agriculture GDP and showed increase of 3.8 % in gross value addition during year 2017-2018. The population of cattle is higher than buffalos in Pakistan (46.1 VS 38.8 million) but contribution of buffalo is more than cow (60.69 VS 36.11 %) towards total milk production of country (Anonymous 2018). Nili-Ravi is the most popular breed of buffaloes which constitutes about 76.7% of the total buffalo population in Pakistan (Garcia *et al*. 2016).

Buffalo (*Bubalus bubalis*) is main dairy animal in Pakistan and second most important dairy species in the world. The performance traits of buffaloes are influenced by several factors. These factors are year and season of birth, year and season of calving and parity. The true genetic merit of the animals may be masked by these factors. The study of these factors affecting performance traits of Nili-Ravi buffaloes is therefore very important for genetic evaluations of animals, developing breeding and general management strategies/programs. Mostly buffaloes are owned by small landless farmers keeping 2-3 animals only. Buffalo population of Pakistan is an important national asset comprising the best dairy breeds of the world, i.e., Nili Ravi and Kundi (Akhtar *et al*. 2006). Pakistani buffaloes have the ability to produce more than 5000 liter of milk per lactation under well-organized breeding, feeding and health care plan (Bilal *et al*., 2006). There are many constraints being faced by the dairymen, which can be classified as genetic and environmental (Elemam and Nekheila 2012). Higher age at first calving and long calving interval are not beneficial to the dairy producers. Calving interval, age at maturity, services per conception and birth weight are most important traits to gauge the farm economy. A farm with 15-month calving interval, 1.33 services per conception could be inexpensively advantageous. So it is imperative to assess the different productive and reproductive performance parameters like age at maturity, age at first conception, age at first calving, number of services or A.I per conception, service period, calving interval, lactation length, milk yield and dry period.

The traits of greater importance in buffalo are fertility, milk production, fat production and productive life span. All these traits are dependent upon the reproductive efficiency of buffaloes. Cady *et al*. (1983)

evaluated performance of Nili-Ravi breed at two institutional herds and reported that herd, year and season of calving and parity affected (P≤0.01) productive and reproductive traits (milk yield, lactation length, days open, calving interval and services per conception). Naqvi (2000) included six military dairy farms to study the effect of parity and season of calving on service period in Nili-Ravi buffalo and reported reduction in length of service period with the increase in parity and significantly lower service period in spring and winter calvers as compared to summer and fall.

The objective of this study was to assess the parameters of reproductive and productive efficiency like; age at maturity, age at first conception, age at first calving, calving interval, service period, number of services per conception, gestation length, lactation length, dry period, milk yield and breeding efficiency in Nili-Ravi buffaloes maintained at BRI, Pattoki.

MATERIALS AND METHODS

The parameters of reproductive and productive efficiency of Nili Ravi buffaloes kept at Buffalo Research Institute (BRI), Pattoki, District Kasur, Punjab Pakistan (31° 1' **30.0324**" N and 73° 50' **52.3608**" E.) during 2010-2018 were studied. Data relating to reproductive and productive performance of Nili Ravi buffaloes at BRI were collected from history sheets for year 2010 to 2018.

During 2005-2006 Buffalo Research Institute, Pattoki District Kasur was established. At that time total of 400 Nili Ravi buffaloes were purchased from local breeders to be maintained at LES, Bhunikey. Nili Ravi buffaloes were kept in loose housing system with *ad libitum* supply of water. Buffaloes were also fed concentrate ration according to the body requirement based on production status along with green fodder and roughages. The buffalo herd was provided with adequate watering and bathing facilities throughout the year. All the buffaloes were inseminated with frozen thawed semen when they exhibited estrus. Teaser bulls were kept in the herd for detection of estrus in buffaloes. The activity of the teaser bull was observed by the experienced stockman.

The information was recorded from history / pedigree sheets on following aspects.

Identification number of buffalo, date of [birth, first insemination, successful service/ A.I, calving and drying], status of calving, total number of calving (lactation) and milk yield per lactation. These data were used to evaluate the factors affecting the following parameters pertaining to reproductive and productive efficiency of buffaloes like; Age at maturity, age at first conception, age at first calving, calving interval, service period, gestation length, service / A.I per conception, lactation length, dry period, 305-day milk yield and breeding efficiency.

Incomplete lactation record of ≤ 181 days due to culling, abortion, premature birth or diseases, etc were excluded from the data after Chaudhry (1992). The records of the animals with calving interval <300 or >730 days, gestation length <285 or >335 days, age at maturity >1825 days, age at first conception >2190 days, age at first calving <900 or >2400 days were also excluded (Cady *et al*. 1983).

To determine the effect of season on different parameters, the month of year were divided into five seasons as reported by Ali *et al*. (2011).

I. Spring____February, March and April
II. Dry Summer___May and June
III. Humid Summer___July, Aug and Sep
IV. Autumn____October and November
V. Winter_____December and January

The statistical model ANOVA employed using GLM procedures to analyze the productive and reproductive traits affected by different factors ie. year and season of birth/calving and parity. Significant treatment means were separated through SNK test.

Breeding Efficiency: Breeding efficiency is measure of capacity to reproduce by adult farm stock. Breeding efficiency or reproductive efficiency of Nili Ravi buffaloes on the basis of calving interval of 400 days had been calculated through formula by Sharma *et al*. (1980).

$$B.E\ (\%) = \frac{[900 + (n - 1)\ 400\ ] \times 100}{AFC\ (Days) + CI\ (Days)}$$

Where
n is the number of calvings or parturitions,
400 is the ideal calving interval in buffaloes.

Statistical Analysis: Descriptive statistics was employed in the form of averages and percentages along with appropriate graph type. For the comparison among different treatments ANOVA technique was employed using GLM procedures in SAS software (Version 9.1.). Significant treatment means were separated through SNK test.

RESULTS

Effect of year of birth/calving: In this study, the data analysis of Nili Ravi buffaloes revealed that age at maturity, age at first conception, age at first calving, calving interval, service period, gestation length, number of service per conception, milk yield, lactation length and dry period (mean ± SE) averaged 1029.59 ± 20.60, 1056.46 ± 20.41, 1417.06 ± 21.66, 490.85 ± 3.82, 227.16 ± 4.98, 312.27 ± 8.03 days, 1.60 ± 0.29 numbers, 1917.07 ± 15.16 liters, 266.94 ± 1.49 and 279.47 ± 5.19 days, respectively (Table 1). Year of birth have significant (P ≤ 0.05) effect on age at maturity, age at first conception and age at first calving among the buffaloes born during different years (Table 2).

Year of calving have significant ($P \leq 0.05$) effect on calving interval, service period and 305-day milk yield among the buffaloes calving during different years (Table 5). Gestation length, lactation length and dry period were not affected by years (Table 5).

Effect of season of birth/calving: Season of birth have significant ($P \leq 0.05$) effect on age at maturity, age at first conception and age at first calving. The maximum (1216.10 ± 56.02 days) age at maturity was found in buffalo heifers born during winter and the minimum (942.74 ± 31.02 days) was found in autumn born heifers (Table 3). Age at first conception maximum (1221.43 ± 60.57 days) and the minimum (950.07 ± 33.03 days) was found in buffalo heifers born during winter and autumn, respectively (Table 3). Age at first calving maximum (1568.45 ± 64.31 days) was found in buffaloes born during winter season and minimum (1269.58 ± 40.67 days) was found in autumn born heifers (Table 3). Autumn born calvers have plenty of good quality fodder available during their early days of age (3-6 months) which may have helped them to growth rate in later period even in low quality fodder.

Season of calving have significant ($P \leq 0.05$) effect on calving interval, service period, number of services per conception, 305-day milk yield, lactation length and dry period. The average calving interval for winter calvers was the longest (532.43 ± 11.23 days). The shortest (450.94 ± 14.39 days) calving interval was found in Nili Ravi buffaloes calving during humid summer (Table 6). The possible reason may be seasonality of calving in buffaloes as winter calvers wait longer to rebreed as compared to summer calvers. Better management and feeding during winter season can reduce the calving interval. The average service period for spring calvers was the longest (249.95 ± 22.06 days). The shortest (450.94 ± 14.39 days) service period was found in Nili Ravi buffaloes calving during humid summer. The maximum (1.86 ± 0.12) and the minimum (1.41 ± 0.06) services per conception were found in buffaloes calving during dry summer and autumn, respectively (Table 6).

The season affected 305-day milk yield, the maximum (2352.56 ± 45.67 liters) was found in spring calvers and the minimum (2159.32 ± 19.44 liters) in summer calvers (Table 6). Poor milk yield in summer calvers than spring calvers may be due to high temperature and low availability of fodder. Season of calving influenced lactation length, the maximum (277.77 ± 3.90 days) lactation length was found in autumn calvers and minimum (254.63 ± 6.72 days) in dry summer calvers (Table 6). Lower lactation length is mainly due to insufficiency of fodder in summer season. Season of calving influenced dry period, the maximum (317.06 ± 19.88 days) dry period was found in spring calvers and minimum (234.62 ± 13.20 days) in autumn calvers, (Table 6). The shorter dry period in autumn may be attributed to longer lactation length of buffaloes. The gestation length is less studied trait in buffaloes. Season did not affect it (Table 6).

Effect of Parity: The effect of parity/lactation number on calving interval, service period, number of services per conception, 305-day milk yield and dry period was found to be significant ($P \leq 0.05$). The highest (537.52 ± 8.02 days) and the lowest (434.44 ± 36.67 days) calving interval was observed in 1st lactation and 8th lactation, respectively (Table 4) showing gradual decrease from first to later parities. The calving interval has two components i.e. lactation length and dry period. The increased calving interval may be due to high dry period. The lactation length was not affected by parity in this study so dry period decreased along with parity which reduces the calving interval in later ages. The service period, highest (297.84 ± 9.59 days) and the lowest (157.51 ± 28.16 days) was observed in 1st lactation and 7th lactation, respectively (Table 4) showing gradual decrease from first to later parities. First calvers suffer more from stress due to growing, producing and insufficient energy available to them, so there may be difficulty for early conception in first calvers. The service period and gestation length are two component of calving interval. Only service period can be altered to reduce the calving interval. The parity affected number of services per conception. The services per conception were more in earlier parities as compared to the later parities (Table 4).

Significant effect of parity on 305-day milk yield was observed, the highest (2243.79 ± 34.25 liters) and the lowest (2005.44 ± 101.30 liters) milk yield was observed in 2nd lactation and 8th lactation, respectively (Table 4). Parity affected dry period, the highest (349.90 ± 14.51 days) dry period was found in first calvers, it decreased with increased in parity and reached to the lowest (203.54 ± 33.21 days) in 7th lactation (Table 4). The longer dry period was due to poor lactation yield in first parity buffaloes.

The effect of parity on gestation length and lactation length found to be non-significant ($P > 0.05$). The gestation length was not affected by parity (Table 4). Parity did not affect lactation length, the lactation length was highest (277.17 ± 4.88 days) in second calvers, it decreased with increased in parity and reached to the lowest (243.33 ± 13.91 days) in 8th lactation (Table 4).

Breeding Efficiency: The data analysis of 250 Nili Ravi buffaloes revealed that the breeding efficiency is 86.45 % (Table 7).

Table 1. Reproductive and Productive traits (Mean ± SE) in Nili Ravi Buffaloes

Reproductive and Productive Performance Parameter	No. of Observations	Overall Mean ± SE
Age at Maturity (Days)	192	1029.59 ± 20.60
Age at first Conception (Days)	191	1056.46 ± 20.41
Age at first Calving (Days)	218	1417.06 ± 21.66
Calving Interval (Days)	855	490.85 ± 3.82
Service Period (Days)	1074	227.16 ± 4.98
Gestation Length (Days)	1553	312.27 ± 8.03
Services Per Conception (No.)	1716	1.60 ± 0.29
305- day Milk Yield (Liters)	1117	2211.05 ± 20.06
Lactation Length (Days)	1146	266.94 ± 1.49
Dry Period (Days)	940	279.47 ± 5.19

Table 2. Effect of Year of Birth on Age at Maturity, Age at first Conception and Age at first Calving (Mean ± SE) in Nili Ravi Buffaloes

Year of Birth	Age at Maturity (Days)	Age at first Conception (Days)	Age at first Calving (Days)
2010	1270.10 ± 29.25^{ab} (46)	1275.84 ± 31.10^{ab} (47)	1590.71 ± 31.12^{b} (57)
2011	1220.96 ± 44.52^{ab} (42)	1220.9 ± 47.40^{b} (42)	1528.69 ± 46.11^{bc} (58)
2012	1340.21 ± 68.60^{a} (15)	1353.92 ± 73.05^{a} (15)	1715.61 ± 84.80^{a} (24)
2013	1075.13 ± 55.15^{b} (19)	1108.31 ± 58.72^{c} (19)	1419.01 ± 62.41^{c} (23)
2014	951.96b ± 54.21^{bc} (26)	960.63 ± 57.65^{d} (27)	1238.67 ± 57.84^{d} (29)
2015	759.14 ± 35.45^{c} (40)	798.96 ± 40.01^{e} (37)	1060.13 ± 54.57^{e} (21)
2016	570.83 ± 98.43^{d} (4)	634.16 ± 104.81^{f} (4)	1001.65 ± 88.43^{f} (6)

The values with different superscript in each column differ significantly ($P \leq 0.05$) but the values sharing at least one superscript in each column did not differ significantly ($P \leq 0.05$).

Table 3. Effect of Season of Birth on Age at Maturity, Age at first Conception and Age at first Calving (Mean ± SE) in Nili Ravi Buffaloes

Season of Birth	Age at Maturity (Days)	Age at first Conception (Days)	Age at first Calving (Days)
Winter	1216.10 ± 56.02^{a} (16)	1221.43 ± 60.57^{a} (14)	1568.45 ± 64.31^{a} (27)
Spring	1086.57 ± 48.66^{b} (22)	1130.43 ± 52.13^{b} (21)	1499.21 ± 56.08^{b} (29)
Dry Summer	1116.19 ± 52.09^{b} (19)	1116.19 ± 55.47^{b} (19)	1452.86 ± 62.77^{b} (28)
Humid Summer	959.51 ± 21.33^{c} (92)	990.07 ± 33.03^{c} (94)	1342.79 ± 23.62^{c} (85)
Autumn	942.74 ± 31.02^{c} (43)	950.07 ± 33.03^{d} (43)	1269.58 ± 40.67^{d} (49)

The values with different superscript in each column differ significantly ($P \leq 0.05$) but the values sharing at least one superscript in each column did not differ significantly ($P \leq 0.05$).

Table 4. Effect of Parity on Reproductive and Productive traits (Mean ± SE) in Nili Ravi Buffaloes

Parity	Services/ Conception	Service Period	Calving Interval	305-day Milk Yield	Lactation Length	Dry Period
1	1.24 ± 0.06 (357)	297.84 ± 9.59^{a} (267)	537.52 ± 8.02^{a} (188)	2193.75 ± 28.36^{ab} (271)	276.02 ± 4.39 (278)	349.90 ± 14.51^{a} (238)
2	1.42 ± 0.07 (261)	253.49 ± 11.56^{b} (184)	513.16 ± 9.13^{ab} (145)	2243.79 ± 34.25^{a} (182)	277.17 ± 4.88 (185)	294.46 ± 14.10^{b} (160)
3	1.73 ± 0.07 (231)	220.06 ± 12.89^{c} (148)	486.18 ± 10.04^{b} (120)	2178.26 ± 38.23^{ab} (155)	269.13 ± 5.01 (158)	282.04 ± 16.74^{b} (131)
4	1.93 ± 0.07 (262)	195.14 ± 12.47^{d} (158)	462.98 ± 9.29^{b} (140)	2137.77 ± 35.94^{b} (182)	259.31 ± 5.59 (185)	252.39 ± 20.25^{bc} (151)
5	1.78 ± 0.08 (216)	173.68 ± 13.59^{e} (133)	451.96 ± 9.84^{bc} (125)	2080.79 ± 38.11^{bc} (153)	264.20 ± 6.26 (156)	239.42 ± 21.00^{c} (131)
6	1.74 ± 0.09 (162)	165.79 ± 16.91^{e} (86)	447.96 ± 12.07^{bc} (83)	2109.83 ± 44.12^{b} (109)	261.28 ± 6.89 (113)	233.04 ± 22.94^{c} (86)
7	1.47 ± 0.12 (92)	157.51 ± 28.16^{e} (31)	461.85 ± 18.86^{b} (34)	2051.42 ± 65.55^{c} (50)	261.72 ± 8.88 (55)	203.54 ± 33.21^{d} (32)
8	1.24 ± 0.20 (33)	182.12 ± 55.44^{de} (8)	434.44 ± 36.67^{c} (9)	2005.44 ± 101.30^{d} (14)	243.33 ± 13.91 (14)	213.50 ± 52.70^{cd} (9)

The values with different superscript in each column differ significantly ($P \leq 0.05$) but the values sharing at least one superscript in each column did not differ significantly ($P \leq 0.05$).

Table 5. Effect of Year of Calving on Reproductive and Productive traits (Mean ± SE) in Nili-Ravi Buffaloes

Year of Calving	Service Period	Gestation Length	Calving Interval	Lactation Length	Dry Period	305-day Milk Yield	Services per Conception
2010	221.28 ± 12.03^{ab} (232)	314.74 ± 0.82 (242)	481.53 ± 8.73^{ab} (198)	257.22 ± 5.38 (208)	303.21 ± 15.78 (222)	2127.04 ± 27.40^{b} (206)	2.25 ± 0.77 (283)
2011	259.09 ± 13.75^{a} (214)	313.26 ± 0.75 (269)	515.84 ± 9.99^{a} (178)	258.12 ± 4.79 (231)	292.79 ± 15.16 (210)	1973.90 ± 30.07^{c} (230)	1.73 ± 0.08 (303)
2012	261.03 ± 16.75^{a} (140)	313.30 ± 0.85 (187)	499.36 ± 13.56^{ab} (104)	274.32 ± 5.37 (175)	267.27 ± 18.17 (131)	2282.24 ± 32.38^{ab} (172)	1.62 ± 0.09 (222)
2013	247.92 ± 15.21^{a} (159)	312.25 ± 0.57 (223)	524.54 ± 11.13^{a} (137)	265.64 ± 5.02 (182)	269.43 ± 17.83 (146)	2328.82 ± 32.53^{a} (170)	1.72 ± 0.08 (241)
2014	251.39 ± 20.81^{a} (107)	312.14 ± 0.85 (206)	519.50 ± 14.40^{a} (88)	259.72 ± 6.04 (145)	264.44 ± 21.54 (96)	2232.65 ± 36.99^{ab} (140)	1.36 ± 0.10 (225)
2015	256.53 ± 24.39^{a} (77)	313.58 ± 0.90 (160)	525.11 ± 18.78^{a} (68)	282.91 ± 7.03 (98)	256.50 ± 22.64 (69)	2359.28 ± 44.42^{a} (98)	1.21 ± 0.11 (166)
2016	208.29 ± 18.63^{ab} (92)	310.67 ± 1.50 (106)	469.10 ± 13.78^{b} (71)	278.48 ± 6.67 (81)	235.19 ± 22.56 (62)	2422.97 ± 71.96^{a} (81)	1.28 ± 0.16 (109)
2017	162.18 ±	311.39 ± 1.01	422.28 ±	264.42 ±	250.25 ±	2414.35 ±	1.61 ± 0.11

	25.61[b] (51)	(109)	41.57[c] (11)	10.96 (26)	74.53 (4)	61.10[a] (20)	(122)
2018	36.00 ± 22.66[c] (2)	314.60 ± 1.49 (51)	486.00 ± 14.47[ab] (39)	261.39 ± 3.63 (95)	192.72 ± 12.67 (46)	2536.05 ± 64.26[a] (46)	2.22 ± 0.20 (45)

The values with different superscript in each column differ significantly ($P \leq 0.05$) but the values sharing at least one superscript in each column did not differ significantly ($P \leq 0.05$).

Table 6. Effect of Season of Calving on Reproductive and Productive traits (Mean ± SE) in Nili Ravi Buffaloes

Season of Calving	Service Period	Gestation Length	Calving Interval	Lactation Length	Dry Period	305-day Milk Yield	Services per Conception
Winter	243.50 ± 21.81[a] (148)	315.64 ± 0.71 (228)	532.43 ± 11.23[a] (118)	275.43 ± 5.16[a] (165)	307.64 ± 17.07[a] (130)	2273.26 ± 40.85[b] (160)	1.78 ± 0.09 (250)
Spring	249.95 ± 22.06[a] (132)	314.85 ± 0.79 (194)	528.90 ± 11.57[a] (106)	258.09 ± 5.57[b] (140)	317.06 ± 19.88[a] (100)	2352.56 ± 45.67[a] (135)	1.71 ± 0.08 (224)
Dry Summer	214.37 ± 21.20[b] (93)	312.26 ± 0.91 (115)	483.86 ± 19.85[b] (74)	254.63 ± 6.72[b] (71)	297.92 ± 21.91[ab] (75)	2292.42 ± 64.45[ab] (70)	1.86 ± 0.12 (138)
Humid Summer	194.75 ± 8.59[c] (464)	310.22 ± 0.49 (647)	450.94 ± 14.39[c] (368)	263.94 ± 3.35[ab] (484)	238.50 ± 11.15[b] (407)	2159.32 ± 19.44[c] (472)	1.48 ± 0.05 (706)
Autumn	212.11 ± 13.24[b] (237)	311.91 ± 0.57 (369)	485.02 ± 8.31[b] (189)	277.77 ± 3.90[a] (286)	234.62 ± 13.20[b] (228)	2173.34 ± 26.39[bc] (280)	1.41 ± 0.06 (398)

The values with different superscript in each column differ significantly ($P \leq 0.05$) but the values sharing at least one superscript in each column did not differ significantly ($P \leq 0.05$).

Table 7. Breeding Efficiency (%) of Nili Ravi Buffaloes

Category	Observations	% age
Buffaloes	250	86.45

DISCUSSION

The reproductive and productive efficiency of Nili Ravi buffaloes kept at Buffalo Research Institute (BRI), Pattoki, District Kasur, Punjab Pakistan were studied. Data concerning the reproductive and productive performance of Nili Ravi buffaloes of BRI were collected from 2010 to 2018 history sheets.

Reproductive Parameters: In this study, average age at maturity in Nili Ravi buffaloes was lower as compared to the values (1365.06 ± 12.85 days) reported by Sule *et al* (2001) and to the values (1166 ± 287.4 days) recorded by Naz and Ahmad (2006) at LPRI, Bahadurnagar, Okara. This difference might be due to difference in management and nutrition level as well as presence of good effective heat detection set up along with good teaser bulls. In this study, average age at first conception in Nili Ravi buffaloes was lower as compared to the value 1418.6 ± 13.16 days presented by Sule *et al* (2001). This difference might be due to difference in management and nutrition level as well as good effective heat detection set up along with good teaser bulls. In this study, average age at first calving was comparatively lower the value presented by Hussain *et al*. (2006) where the age at first calving was 1646.87 ± 36.31 days in Azad Kashmir. This difference might be due to effect of adverse winter season in Azad Kashmir, difference in management, availability of green fodder and effectiveness of heat detection program. In this study, average calving interval was comparatively lower the value presented by Karim *et al*. (2014) where the calving interval was 547.92 ± 10.88 days. The lower calving interval in present study might be due to ideal number of services per conception, good management, and better feeding. The service period and gestation length are two components of calving interval. Only service period can be altered to reduce the calving interval. The data analysis of Nili Ravi buffalos revealed that average service period in this study was comparatively lower than the value presented by Naqvi and Shami (1999) in different Military farms where the service period was 280.96 ± 9.32 days. This difference might be due to difference in effective heat detection program along with good teaser bull and breeding

program. On the other hand, in the study conducted in Egypt, Fooda *et al*. (2011b) found very short service period in Egyptian buffaloes and crossed Italian buffaloes 38.00 ± 22.07 days and 76.08 ± 38.87 days respectively. This might be result of having ideal breading system along with excellent heat detection program. The data analysis of Nili Ravi buffaloes revealed that number of services per conception was 1.60 ± 0.29. But Fooda *et al*. (2011b) found lower number of services per conception in Egyptian buffaloes 1.20 ± 0.59. This might be due to difference in heat detection program. The data analysis of Nili Ravi buffaloes revealed that the breeding efficiency is 86.45 percent in this study which is comparatively higher the value 82.98 percent of Murrah buffaloes in India reported by Sharma and Chaudhary (1986). This difference might be due to high genomic potential of our Nili Ravi buffaloes. This indicate that Nili Ravi buffaloes have greater capacity to reproduce in herd life. Among the reproductive traits, breeding efficiency appears to be better trait for measuring the reproductive efficiency of buffaloes.

Productive Parameters: Studies on the Nili Ravi buffaloes revealed that average 305-day milk yield was 2211.05 ± 20.06 liters in this study, but Naqvi and Shami (1999) found that the average milk yield in the early maturing group buffaloes was 1912.00 ± 12.00 liters and late maturing group buffaloes was 1833.78 ± 16.44 liters, which is comparatively lower with the values found in Buffalo Research Institute, Pattoki, District Kasur in this study. One comparative study of Egyptian buffaloes, their crossing with 1/2 Pakistani buffaloes and their crossing with 3/4 Pakistani buffaloes reported by Fooda *et al*. (2011a) found lower milk yield of 1502 ± 344 kg, 1357 ± 394 kg and 1383 ± 372 kg, respectively, which is low comparatively than present study. This difference might be due to better nutritional, availability of green fodder and good management. The data analysis of Nili Ravi buffaloes revealed that average lactation length in this study which was comparatively same the values (266.6 ± 15 days) presented by Khan and Chaudhry (2000) in Nili Ravi buffaloes maintained at Livestock Experiment Station, Bahadurnagar, Okara. Studies on the Nili Ravi buffalos at Buffalo Research Institute, Pattoki, District Kasur revealed that average dry period in this study was 279.47 ± 5.19 days, but Naqvi and Shami (1999) found that the average dry period in the early maturing group buffaloes was 241.59 ± 4.18 days and late maturing group buffaloes was 306.39 ± 8.78, which is comparatively lower in the early maturing group buffaloes and higher in late maturing group buffaloes with the values found in this study. One comparative study of Egyptian buffaloes reported by Aziz *et al*. (2001) revealing higher dry period of 307.3 ± 51.30 days, which was high comparatively than present study. The reason behind longer dry period might be due managemental factors and poor lactation yield.

Conclusion: It was concluded that improvement in productive and reproductive traits in Nili Ravi buffaloes can be achieved by breeding the animals with the semen of genetically superior sire, effective heat detection program, good artificial insemination, better management practices, improve nutrition, use of new reproductive technology, preventive measures, elevating the nutrition level through making silage, upgrading sanitation and ventilation system, provision of pond during summer season and providing full comfort to animal. Improved management of heifers may reduce age at maturity and age at first calving. Culling on the basis of production performance may improve productivity of buffalo in future.

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