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Production performance indicators used at Nili Ravi buffalo farm of ICAR-CIRB, Sub Campus, Bir Dosanjh, Nabha (Punjab) since its inception

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Abstract
The various production performance indicators like total lactation milk yield, standard lactation milk yield, wet average, herd average, age at first calving, service period, calving interval, dry period, conception rate and total milk production since the inception of the Nili Ravi buffalo farm at Nabha (Punjab) are presented in this communication. Considerable improvement was reported in the total lactation milk yield and standard lactation milk yield of the Nili Ravi herd. The wet average was the lowest (4.55 Kg) in the first year of establishment of the farm i.e., 1988-89 and the highest (8.52Kg) in the year 2017-18. The herd average was the lowest (2.81 Kg) in the second year of establishment of the farm i.e., 1989-90 and the highest (6.22 Kg) in the year 2015-16. The wet average and herd average have almost doubled since the inception of the farm. The highest service period of 312 d was recorded in the year 1991-92 and the lowest service period of 112 d was observed in the year of 2014-15 with an overall average service period 178 d. Inconsistent results were reported in the AFC as the improvement in the AFC seems to be non-significant. The longest calving interval of 622 d was reported in the year 1991-92 and the shortest calving interval of 420 d was recorded in the year of 2014-15 with an overall average CI of 484 d. The highest dry period of 243 d in the year 1991-92 and the lowest dry period of 131 d in the year 2000-01 with overall average dry period of 165 d was reported. It was concluded that there was considerable improvement in the production performance indicators (total lactation milk yield, standard lactation milk yield, wet average, herd average, service period, calving interval, dry period and total milk production) during 1988-89 to 2017-18. The wet average, herd average and total milk production has almost doubled since the establishment of the farm at CIRB, sub campus, Nabha. The conception rate remained almost poor during the entire period.

Keywords: Carcass characteristics, weaner pigs, meat quality, palm kernel cake

1. Introduction
India is the world's largest producer of milk but unlike other milk producing nations, the milk is produced by a large number of farmers (about 70 million) located in some 500000 remote villages. The families of the milk-producing farmers are mostly poor and under-privileged. Therefore, the additional income every year through the sale of surplus milk is vital to their well-being and economic security (Manorama India Yearbook, 1998) [15]. World milk production has doubled in the last few decades and it is noteworthy that in the last few years, buffalo have supplied about 12% of the total world milk production. India and Pakistan have produced respectively 60 and 30% of the world's buffalo milk. In India buffalo milk contributes 55%, and in Pakistan 75%, of their total milk production (FAO, 2004) [11]. Riverine breeds of the Indian sub-continent are mainly raised for milk production. Their milk yield is about six to seven litres per day. Twelve of the 18 major breeds of buffalo are kept primarily for milk production. The main milk breeds of India and Pakistan are the Murrah, Nili-Ravi, Surti, Mehsana, Nagpuri and Jaffrabadi (Chantalakhana and Falvey, 1999) [8]. The first major issue is the lower growth rate of calves during early months of their age. Lower growth rate in the early life of the calves is either due to underfeeding or imbalanced feeding. This lower growth rate results in higher age at puberty and thus higher age at first calving in heifers. Average age of puberty in buffalo and cow heifers is 37 and 34 months, respectively (Bashir, 2006; Rehman, 2006) [6, 20].

Age at calving in Nili-Ravi buffaloes, Sahiwal and Holstein cows is 55, 46 and 29 months, respectively (Moore, *et al*., 1990; Bashir, 2006; Rehman, 2006) [17, 6, 20]. In buffalo calves given calf starter ration containing CP% and TDN%, 17, 78 and 16, 72, respectively, a higher daily growth rate (471 vs 336 gm) has been observed on higher protein and energy ration (Ahmad and Jabbar, 2000) [2].

In order to enhance productivity of a dairy animal, it is necessary to develop an understanding of *the production performance indicators used for measuring performance of the dairy herd.* Milk yield and lactation length, two important parameters in dairy animals, depend on both genetic and non-genetic factors. The *non-genetic factors* such as management, amount and quality of feed, season etc. also influence milk yield and lactation length, and need to be assessed properly. For example, milk yield is affected by service period. Milk yield of the animals conceiving within 300 days after calving did not differ from each other. However, milk yield of the animals conceiving > 300 days after calving was significantly higher than the animals conceiving within 31-100 days after calving. The milk yield did not differ among animals conceiving 101-200, 201-300 and > 300 days after calving. Lactation length of these four groups did not differ from each other (Afzal *et al*., 2007) [1]. Analysis of long term data of Nili-Ravi buffaloes maintained at experimental stations in the home tract of the breed has shown that factors affecting milk yield in buffaloes are almost similar to those of cattle including: year, season, herd, parity, days in milk, days open, age and sire (Cady *et al*., 1983) [7].

The objective of the present study was to record production performance indicators (*like total lactation milk yield, standard lactation milk yield, wet average, herd average, age at first calving, service period, calving interval, dry period, conception rate and total milk production*) used at Nili Ravi buffalo farm of ICAR-CIRB, sub campus, Nabha (Punjab) since the inception of this Nili Ravi Farm.

2. Materials and Methods

The Nili-Ravi is one of the important buffalo breeds of India with its home tract in Gurdaspur, Amritsar and Ferozepur districts of Punjab i.e. along with the international border of Pakistan. Due to the non-availability of pure and superior breeding bulls in the tract, farmers face constraint in breeding their Buffaloes. To preserve the important germplasm of Nili-Ravi buffalo in India, Sub-campus of Central Institute for Research on Buffaloes was established on 1st December, 1987 at Bir Dosanjh, Nabha in Punjab by acquiring land and other facilities from the Government of Punjab for research on improvement of Nili-Ravi buffalo. The CIRB, sub campus, Nabha was identified as one of the centers for research work under the Network Programme on buffaloes for Nili-Ravi breed. As the only organized farm of Nili-Ravi breed in India, Central Institute for Research on Buffaloes, sub-Campus, Nabha is contributing to conservation and improvement of this fine breed of buffalo. The farm has a herd of about 500 herds of Nili Ravi breed of buffaloes. The sick animals were treated by an experienced veterinarian employed at ICAR-CIRB, Sub campus, Nabha. All animals were fed in groups since the inception of the farm. Fresh water was made available to every animal round the clock. Troughs were cleaned and maintained regularly. The various production performance indicators like total lactation milk yield, standard lactation milk yield, wet average, herd average, age at first calving, service period, calving interval, dry period, conception rate and total milk production recorded are presented in this communication since the inception of the farm.

3. Results and Discussion

3.1 Production Performance Indicators

The data pertaining to various production performance indicators at Nili-Ravi farm, Nabha *viz*. total lactation milk yield, standard lactation milk yield, wet average, herd average, age at first calving, service period, calving interval, dry period, conception rate and total milk production as recorded in various years since the inception of the project is presented in Table 1.

3.1.1 Total lactation milk yield (TLMY)

Milk yield of buffalo is an important factor of management strategies in dairy farming. The quantity of milk produced in a complete lactation is known as total lactation milk yield. The highest TLMY of 2564 Kg and the lowest TLMY of 1724 Kg was recorded during the year 2015-2016 and 1988-98, respectively. The average TMLY during the entire period under study was 2057.7 Kg. In the present study, the lowest TLMY was reported in the first year of the establishment of the farm. After that there was increase in the TLMY, however, the increase in TLMY was not consistent as the TLMY is influenced by several factors. By and large the TLMY was increased with increasing number of years. *Milk yield directly relates to farm revenues* (Santschi *et al*., 2011c) [23], *and environmental impacts per kilogram of milk often decrease when milk yield levels increase* (Wall *et al*., 2010; Van Middelaar *et al*., 2014) [28, 27].

3.1.2 Standard Lactation Milk Yield (SLMY)

To compare milk yields between animals, lactations are traditionally standardized to 305-d yields (Patton *et al*., 2006; Windig *et al*., 2006) [18, 30]. Quantity of milk produced during 305 or less days is known as standard lactation milk yield. The highest SLMY of 2471 Kg and the lowest SLMY of 1465 Kg were recorded during the year 2015-16 and 1988-89, respectively. The *average SLMY of 1947 Kg was recorded during the period 1988-89 to 2017-18.* In the present study, the SLMY has increased considerably (almost 1.7 times) since the establishment of the Nili Ravi farm at Nabha.

3.1.3 Wet average (WA)

Wet average is quantity of milk produced on a weekly test day divided by number of lactating animals. The wet average was the lowest (4.55 Kg) in the first year of establishment of the farm i.e., 1988-89 and the highest (8.52Kg) in the year 2017-18. The average wet average during the study period under report was 6.70 Kg. The wet average increased with the increasing number of years. The wet average has almost doubled since the inception of the farm.

3.1.4 Herd average (HA)

Herd average is quantity of milk produced on a weekly test day divided by number of breedable buffaloes in herd (both lactating and dry buffaloes). The herd average was the lowest (2.81 Kg) in the second year of establishment of the farm i.e., 1989-90 and the highest (6.22 Kg) in the year 2015-16. Like, wet average, the herd average also has almost doubled since the inception of the farm.

3.1.5 Age at first calving (AFC)

The age of the animal at first calving is very important for high life time production. The *desirable age at first calving in Indian cattle breeds is 3 years, 2 year for cross bred cattle and 3 ½ year in buffaloes.* Prolonged age at first calving will have high production in the first lactation, but the life time production will be decreased due to less number of calving. If the age at first calving is below optimum, the calves born are weak, difficulty in calving and less milk production in first lactation. In the present study, the highest AFC was 1529 d in the year 1995-96 and the lowest AFC was 1197 d in the year 1999-00. With regard to AFC, inconsistent results were reported during the period under report as the improvement in the AFC seems to be non-significant. The average of AFC during the period under report was 1283 d which was 10 d higher than the AFC in inception year of 1988-89. *Balanced feeding, improved management and minimum disease prevalence can be helpful in reducing the age at first calving* (Heinrichs *et al*, 2005) [13]. Chaudhry *et al*. (1991) [9] reported that age at puberty could be reduced by one month through additional concentrate feeding for a few months before the onset of puberty in Nili-Ravi buffalo heifers. However, mineral supplementation in this study did not reduce the age at puberty in buffalo heifers.

Table 1: Production performance indicators used since inception of the network project

Year	TLMY (Kg)	SLMY (Kg)	Wet Av. (Kg)	Herd Av. (Kg)	AFC (d)	SP (d)	CI (d)	DP (d)	CR (%)	% of milk animals	Total milk production (Kg)
1988-89	1724	1465	4.55	3.17	1273	205	517	211	20.17	74	178993
1989-90	2080	1706	5.20	2.81	1301	186	511	177	31.23	59	165699
1990-91	1859	1717	5.76	3.90	1297	276	517	197	18.30	72	202019
1991-92	2017	1813	5.82	3.33	1411	312	622	243	67.31	63	178940
1992-93	1974	1921	5.86	3.42	1438	207	490	180	30.32	64	189608
1993-94	1776	1744	6.75	3.39	1356	211	513	176	31.39	58	172021
1994-95	2043	1944	6.01	4.18	1476	232	527	207	20.07	67	205959
1995-96	2049	1894	5.61	3.99	1529	243	539	199	36.76	71	177998
1996-97	2092	1807	5.71	3.49	1371	260	561	176	28.21	61	170971
1997-98	2126	2056	6.03	4.45	1262	246	550	183	32.66	74	247851
1998-99	2153	2056	6.13	4.26	1230	170	481	150	38.01	72	233780
1999-00	1968	1874	6.01	4.23	1197	134	467	134	56.79	68	190088
2000-01	1890	1812	6.31	4.69	1213	143	443	131	60.85	74	220319
2001-02	1926	1885	6.85	4.82	1266	137	445	133	49.10	69	219062
2002-03	2007	1941	6.55	4.83	1277	132	440	132	47.96	73	253980
2003-04	1968	1895	6.35	4.70	1266	138	443	136	48.91	73	247611
2004-05	1974	1848	6.86	4.65	1306	155	463	146	46.24	67	252362
2005-06	2190	2090	6.85	4.84	1294	167	474	157	43.21	71	284709
2006-07	1921	1795	6.20	4.40	1214	165	478	160	41.60	71	270368
2007-08	1787	1629	6.73	4.46	1241	165	458	150	49.60	65	253844
2008-09	2036	1929	6.91	5.03	1206	172	489	172	48.21	73	305024
2009-10	1927	1822	7.00	4.66	1246	170	478	163	46.70	65	281219
2010-11	2042	1972	7.11	4.93	1250	191	500	170	38.12	70	253438
2011-12	2045	1998	7.74	5.30	1207	136	464	150	38.30	68	239816
2012-13	2048	2017	8.26	5.34	1205	126	436	151	40.00	65	273133
2013-14	2297	2241	8.25	5.32	1210	127	446	159	34.16	64	284577
2014-15	2433	2362	8.48	5.98	1212	112	420	138	39.39	71	305602
2015-16	2564	2471	8.51	6.22	1217	145	453	150	37.59	72	345780
2016-17	2452	2377	7.96	5.23	1260	140	447	147	46.94	65	299410
2017-18	2363	2321	8.52	5.84	1250	135	444	157	39.75	68	307248
Average	2058	1947	6.70	4.53	1283	178	484	165	39.66	68	240381

3.1.6 Service Period (SP)

It is the period between date of calving and date of successful conception. The optimum service period helps the animal to recover from the stress of calving and also to get the reproductive organs back to normal. For buffalo the optimum service period is 60 to 90 days. *If the service period is too prolonged the calving interval is also prolonged, less no. of calving will be obtained in her life time. If the service period is too short, the animal will become weak and persistency of milk production is poor due to immediate pregnancy.* In the present study, the highest service period of 312 d was recorded in the year 1991-92 and the lowest service period of 112 d was observed in the year of 2014-15. The average service period during the period under report was 178 d. The study reported considerable reduction in the service period which increased the profitability of the farm. However, the current service period of 135 d in the year 2017-18 is still higher than the optimum service period of 60 to 90 days.

3.1.7 Calving Interval: Calving Interval is the period between two successive calving's. It does not include the animals culled each year as open or as pregnant low producers. Calving Interval is a *very accurate indicator of what has happened in the past, but does not indicate current status*. Regularity in conception and a short calving interval are most important to achieve a high lifetime milk production. Calving interval in buffalo is highly dependent on management, climate and nutrition. It is therefore shorter in some regions and longer in others. In order to shorten the calving interval the female should be serviced again as soon as possible after calving, after providing a sufficient period of rest. Weaning of calves at birth has been shown to decrease the service period in comparison to unweaned buffalo. In the present study, the longest calving interval of 622 d was reported in the year 1991-92 and the shortest calving interval of 420 d was recorded in the year of 2014-15. The average calving interval of 484 during the period under report was

recorded. The calving interval has decreased with increasing number of years. The current calving interval of 444 d in the year 2017-18 is still higher compared to the set target. A shorter service period will lead to a shorter calving interval-a calving interval of less than 410 days is recommended (Thomas, 2008) [24]. The target calving interval for buffaloes should be 405 days, but the existing one is 520 days (Baithalu *et al*., 2014) [5]. *Calving Interval as a reproductive management figure is affected by two reproductive figures*: Days Open and Gestation Length. Obviously, gestation length cannot be altered. However, a dairy producer can control Calving Interval by changing any management component that affects Days Open.

3.1.8 Dry period

Exceptionally long or short dry periods will adversely affect the profitability of individual animal. A short dry period will not provide adequate rest and time for mammary regeneration, while long dry periods will result in higher feed costs with no income from milk production. Long dry periods can also result in fat animals that are more prone to problems with health and reproductive performance. The present investigation reported the highest dry period of 243 d in the year 1991-92 and the lowest dry period of 131 d was reported in the year 2000-01. The average dry period during the period under report was 165 d. Recently, shortening the dry period (DP) has been suggested as a management strategy to reduce the negative energy balance in early lactation and to increase fertility in dairy cattle (Andersen *et al*., 2005; Van Knegsel *et al*., 2013) [3, 26]. Shortening the DP results in additional milk yield before calving but reduced milk yield after calving (Annen *et al*., 2004; Santschi *et al*., 2011a; Van Knegsel *et al*., 2013, 2014) [4, 26, 21, 26, 25]. The additional milk yield before calving can be accredited to the choice of DP length. The 305-d yield does not include this additional milk yield, and, therefore, is less suitable for assessing the effect of DP length on milk yield. Shortening the DP may also improve fertility (Gumen *et al*., 2005; Watters *et al*., 2009; Chen *et al*., 2015) [12, 29, 10], although not all studies found this (Pezeshki *et al*., 2007; Santschi *et al*., 2011b) [19, 22]. Improved fertility can partly compensate for milk losses related to a shortened DP if the calving interval is shortened (Inchaisri *et al*., 2010) [14].

3.1.9 Conception rate (CR)

Conception rate is a measure of an animal's fertility at service. It is calculated by dividing the number of pregnant animals by the total number of inseminations. The buffalo to be inseminated should be restrained well; otherwise there is every chance to damage the uterus by Al gun and/or improper deposition of semen leading to poor CR. Before introducing the gun, perineum and vulval area of the animal has to be wiped properly to avoid infection carried through the gun. Insemination gun should be inserted at $30\text{-}45^0$ angle after opening vulval lips to avoid urethral opening. In the present study, the lowest CR of 18.30% was reported in the year 1990-91 and the highest CR of 67.31% was reported in the subsequent year of 1991-92. The overall average CR during the period under report was 39.66%, which was similar to the current CR (39.75) in the year 2017-18. The low CR at the farm could be due to the poor semen handling facilities available at the farm. In well managed herd practicing A.I., there should be a 50-60% conception rate (Mohanty *et al*., 2016) [16].

3.1.10 Total milk production:

The total milk production was the lowest (165699 Kg) in the year 1989-90 and the highest (345780 Kg) in year 2015-16. The average milk production during the period under report was 240381 Kg which was almost 1.34 times higher than the first year of farm establishment. The total milk production has almost doubled since the establishment of the farm at CIRB, sub campus, Nabha.

3.2.1 Green fodder, dry fodder, silage and grain production

The data pertaining to green fodder, dry fodder, silage and grain production from 2007-08 to 2017-18 at Nili Ravi buffalo farm of CIRB-sub campus, Nabha is presented in Table 2. The various crops grown included paddy, wheat, oats, barley, sarson, berseem and MP Chari. All possible efforts were made to maintain the availability of green fodder round the year. The silage preparation was not continuous. In some of the years, it was either not prepared or not recorded. Forage preservation as silage is a key component of high input systems. It has allowed producers to intensify the productivity of the land and the productivity of the cows independently from each other. As silage making allows storage and preservation of feed resources for months. By silage making, the animal producers can achieve two objectives: 1), to maximize yield of digestible nutrients (energy, protein, etc.) per hectare of land, 2) to maximize milk production per buffalo throughout the year. At CIRB sub campus, Nabha, the animals were fed on silage during lean period of green fodder availability, depending upon the silage availability.

Table 2: Green fodder, dry fodder, silage and grain production from 2007-08 to 2017-18

Year	Green Fodder (qtl)	Dry Fodder (qtl)	Silage (qtl)	Grain + Seed (qtl)
2007-08	40,288	1,271	-	Paddy=793, Wheat=1,607, Sarson=47, Oat=30, Total=2,477
2008-09	43,412	1,983	2,509	Paddy=954, Wheat=1,445, Barley=231, Sarson=3, Oat=37, Total=2,674
2009-10	35,151	2,507	2,276	Paddy=915, Wheat=1,419, Barley=779, Sarson=26, Oat=35, Barseem=6, Total=3,180
2010-11	38,454	1,317	3,195	Paddy=656, Wheat=997, Barley=537, Sarson=8, Oat=125, Total=2,323
2011-12	41,563	2,419	5,278	Paddy=786, Wheat=1,583, Barley=1,451, Sarson=49, Oat=200MP, Chari=23, Total=4,092
2012-13	42,899	2,478	-	Paddy=1,124, Wheat=1,890, Barley=1,972, Sarson=29, Oat=288, Total=5,303
2013-14	44,202	3,038	-	Paddy=1,097, Wheat=1,417, Barley=1,930, Sarson=62, Oat=317, Total=4,823
2014-15	39,542	3,487	3,603	Paddy=1,587, Wheat=2,117, Barley=2,332, Sarson=24, Oat=174, Barseem=19, Total=6,253
2015-16	48,900	3,487	3,943	Paddy=1,890, Wheat=2,123, Barley=2,048, Sarson=10, Oat=128, Total=6,199
2016-17	41,980	1,875	-	Paddy=1,243, Wheat=1,757, Barley=1,367, Sarson=24, Oat=125, Barseem=7, Total=4,523
2017-18	44,496	3,365	3,909	Paddy=1,193, Wheat=1,964, Barley=1,712, Sarson=51, Oat=58, Total=5,078

4. Conclusion

It was concluded that there was considerable improvement in the production performance indicators (total lactation milk yield, standard lactation milk yield, wet average, herd average, service period, calving interval, dry period and total milk production) during 1988-89 to 2017-18. The *wet*

average, herd average and total milk production has almost doubled since the establishment of the farm at CIRB, sub campus, Nabha. The conception rate remained almost poor during the entire period.

Conflict of Interest
Not available

Financial Support
Not available

5. Reference

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