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Assessment of Production and Reproductive Traits of Murrah Buffaloes in Jaipur District, Rajasthan, India

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A B S T R A C T

Despite their substantial contribution to the dairy sector, detailed insights into the productive and reproductive performance of Murrah buffaloes remain limited and insufficiently explored. To address this research gap, a comprehensive study was conducted during 2023–24 in the Jaipur and Sikar districts of Rajasthan to assess key performance parameters of Murrah buffaloes. Data were systematically gathered from 480 buffaloes (240 each from Jaipur and Sikar) through structured interviews with 180 dairy farmers across eighteen purposively selected villages, utilizing a pre-tested and well-designed interview schedule. Results revealed significant regional variations in key performance parameters. The average daily milk yield was higher in Jaipur (9.31 ± 0.09 litres) than in Sikar (8.27 ± 0.26 litres), showing a significant difference of 1.04 litres ($P < 0.01$). Similarly, lactation milk yield and peak yield were also significantly higher in Jaipur (2769.63 ± 19.90 litres and 12.34 ± 0.08 litres, respectively) than in Sikar (2415.34 ± 72.87 litres and 11.54 ± 0.24 litres), indicating superior productivity in Jaipur. The lactation length was slightly but significantly longer in Jaipur by 1.61 days ($P = 0.011$). Reproductive performance indicators further demonstrated Jaipur's advantage. The dry period was shorter (104.81 ± 1.13 vs. 108.40 ± 2.64 days), age at first calving was earlier (1276.73 ± 10.61 vs. 1384.40 ± 0.34 days), service period was shorter (114.49 ± 1.87 vs. 131.40 ± 4.96 days), and fewer services per conception were required (1.79 ± 0.05 vs. 1.92 ± 0.15), all with statistically significant differences. Additionally, calving intervals were shorter in Jaipur (426.24 ± 2.22 days) than in Sikar (440.70 ± 5.21 days), indicating better reproductive efficiency. These findings underscore the superior management practices and productive-reproductive performance of Murrah buffaloes in Jaipur district compared to Sikar, highlighting the need for targeted interventions to enhance dairy efficiency across regions.

Introduction

Buffaloes have long been the cornerstone of India's dairy industry, significantly contributing to rural livelihoods, nutritional security, and national milk production. With a total buffalo population of 109.85 million, India remains the global leader in buffalo husbandry. Among Indian states, Rajasthan has emerged as a major contributor with 13.69 million buffaloes, according to the 20th Livestock Census. The Murrah buffalo, renowned for its superior

milk yield, reproductive performance, and adaptability, has gained widespread acceptance among dairy farmers in Jaipur due to its economic advantages and genetic potential. Modern breeding practices, particularly the use of artificial insemination (AI) with high-quality Murrah bull semen, have significantly improved the genetic quality and reproductive efficiency of the buffalo population in the region.

AI has also helped in reducing the cost of breeding and in controlling the spread of reproductive diseases, thereby enhancing herd productivity. In the year 2023–24, India's total milk production reached 239.30 million tonnes, with Rajasthan contributing 14.51 percent, securing the second position nationally. The per capita availability of milk in India rose to 471 grams per day, while Rajasthan reported 1,171 grams per day in 2024, marking a remarkable increase from 509 grams per day in 2009–10.

This growth reflects improved herd management, better nutrition, and enhanced breeding interventions. The Saras Dairy Cooperative, under RCDF, supports rural milk producers by ensuring fair prices, veterinary care, and essential inputs like AI and feed. This strengthens the rural-urban dairy link and boosts farmer incomes. Given the importance of Murrah buffaloes in milk production, a focused study on their performance in Jaipur and Sikar is vital for improving management practices and promoting sustainable dairy development.

Average daily milk yield

The average daily milk yield of Murrah buffaloes was significantly higher in Jaipur (9.31 ± 0.09 litres) than in Sikar (8.27 ± 0.26 litres), with a statistically significant mean difference of 1.04 litres ($t = 13.809$, $P < 0.01$). This marked difference reflects a significant regional variation in production performance, likely influenced by factors such as management practices, feeding, and environmental conditions. The milk yield recorded in both districts notably exceeds values reported in earlier studies. For example, Khatke *et al.,* (2023) observed a yield of 6.48 ± 0.34 litres in non-descript buffaloes in the Konkan region, while Meena *et al.,* (2016) and Sachan *et al.,* (2015) reported average yields of 5.75 ± 0.65 litres and 5.36 ± 1.2 litres, respectively, under typical rural farming conditions. The significantly higher milk yield observed in the present study underscores the superior genetic potential and improved management practices associated with Murrah buffaloes, particularly in Jaipur district.

Lactation length

The average lactation length of Murrah buffaloes was significantly longer in Jaipur (296.61 ± 0.83 days) as compared to Sikar (295.00 ± 1.99 days), with a statistically significant difference of 1.61 days ($t = 2.560$, $P = 0.011$). Although the numerical difference appears modest, it indicates a meaningful variation in lactation duration between the two districts. The observed lactation lengths in both regions are consistent with previously reported values. Thiruvenkadan *et al.,* (2014) and Boro *et al.,* (2020) recorded similar averages of 297.8 ± 1.9 days, while Khatke *et al.,* (2023) reported a slightly higher value of 302.87 ± 2.47 days. In contrast, Kushwaha *et al.,* (2013) and Sachan *et al.,* (2015) reported shorter lactation lengths of 291.4 ± 4.9 and 293.5 ± 27.1 days, respectively. The present findings suggest that Murrah buffaloes in both Jaipur and Sikar maintain a stable and desirable lactation period, reflecting sound reproductive and nutritional management in these regions.

Lactation milk yield

The average lactation milk yield of Murrah buffaloes was significantly higher in Jaipur (2769.63 ± 19.90 litres) in comparison to Sikar (2415.34 ± 72.87 litres), with a highly significant difference of 354.29 litres ($t = 18.860$, $P < 0.01$). This substantial yield gap highlights the superior milk productivity of buffaloes in Jaipur, which may be attributed to better feeding practices, improved healthcare, and overall superior herd management. The yields reported in this study are notably higher than those documented in previous research.

Thiruvenkadan *et al.,* (2014) and Boro *et al.,* (2020) reported mean 305-day yields of 1804.9 ± 14.7 kg and 2147.6 ± 87.06 kg, respectively, while Khatke *et al.,* (2023) observed 1964.57 ± 101.58 litres in non-descript buffaloes. Similarly, Dhakad *et al.,* (2024) recorded an average yield of 1765.55 ± 28.61 litres in Mehsana buffaloes. These comparisons underscore the enhanced genetic potential and productive efficiency of Murrah buffaloes in Jaipur, particularly under effective and modern management systems.

Peak yield

The average peak milk yield of Murrah buffaloes was significantly higher in Jaipur (12.34 ± 0.08 litres) than in

Sikar (11.54 ± 0.24 litres), with a notable and statistically significant difference of 0.80 litres (t = 11.530, P < 0.01). The peak yields recorded in this study are considerably higher than those reported in earlier literature.

Meena *et al.,* (2016) reported a peak yield of 8.56 ± 0.85 litres under field conditions, while Boro *et al.,* (2020) and Sangwan *et al.,* (2021) documented peak yields for Murrah buffaloes ranging between 8.87 ± 0.05 and 10.55 ± 0.25 kg/day. In contrast, Khatke *et al.,* (2023) observed a lower peak yield of 6.80 ± 0.24 litres in non-descript buffaloes, and Sachan *et al.,* (2015) reported 8.1 ± 1.9 litres/day.

Dry period

The average dry period of Murrah buffaloes was significantly shorter in Jaipur (104.81 ± 1.13 days) relative to Sikar (108.40 ± 2.64 days), with a statistically significant difference of -3.59 days (t = -4.246, P < 0.01). A shorter dry period, as observed in Jaipur. For instance, Boro *et al.,* (2020) reported a slightly longer dry period of 110.66 ± 6.62 days. Khatke *et al.,* (2023) found an average of 138.14 ± 2.41 days, while Sachan *et al.,* (2015) documented an even longer dry period of 156.4 ± 39.6 days.

These comparisons highlight that the Murrah buffaloes in Jaipur, in particular, are managed more effectively to achieve shorter dry periods, thereby enhancing their productivity and reproductive performance.

Age at first calving

The average age at first calving (AFC) of Murrah buffaloes was significantly lower in Jaipur (1276.73 ± 10.61 days) compared to Sikar (1384.40 ± 0.34 days), with a substantial difference of -107.67 days (t = -12.685, P < 0.01). This statistically significant variation indicates earlier attainment of reproductive maturity and more effective heifer management practices in Jaipur.

A lower AFC is economically beneficial, as it reduces the unproductive growth period, allows earlier onset of milk production, and improves lifetime productivity. For instance, Boro *et al.,* (2020) recorded an AFC of 43.69 ± 0.46 months, while Sachan *et al.,* (2015) reported 1482 ± 162 days (~48.7 months). Jadhao *et al.,* (2022) observed a much higher AFC of 1778.55 ± 28.26 days (~58.8 months) in Murrah buffaloes. Similarly, Khatke *et al.,* (2023) and Kabir *et al.,* (2017) reported delayed first calving at 51.65 and 49.84 months, respectively.

Service period

The average service period of Murrah buffaloes was significantly shorter in Jaipur (114.49 ± 1.87 days) was significantly shorter than that in Sikar (131.40 ± 4.96 days), with a notable and statistically significant difference of -16.91 days (t = -11.421, P < 0.01).

This substantial reduction reflects more effective reproductive management in Jaipur, including timely heat detection, proper estrus synchronization, and efficient insemination practices. The present findings are more favorable compared to earlier reports. For instance, Khatke *et al.,* (2023) recorded an average service period of 128.62 ± 2.04 days, while Boro *et al.,* (2020) reported a longer interval of 139.91 ± 2.96 days.

Service per conception

The average number of services per conception in Murrah buffaloes was significantly lower in Jaipur (1.79 ± 0.05) compared to Sikar (1.92 ± 0.15), with a statistically significant difference of -0.13 (t = -2.998, P = 0.003). This indicates a higher conception efficiency in Jaipur, likely attributable to timely detection of estrus, better semen quality, and more effective breeding management practices.

The values reported in this study are more favorable than those of Dhaka *et al.,* (2017) and Kabir *et al.,* (2017), who observed averages of 2.20 and 2.23 services per conception, respectively suggesting suboptimal breeding efficiency in those contexts. Conversely, Boro *et al.,* (2020) reported an even lower average of 1.17 ± 0.03, reflecting exceptional reproductive management.

Calving interval

The average calving interval of Murrah buffaloes was significantly shorter in Jaipur (426.24 ± 2.22 days) compared to those in Sikar (440.70 ± 5.21 days), with a mean difference of -14.46 days (t = -8.685, P < 0.01). This highly significant difference reflects superior reproductive efficiency and more effective postpartum breeding management in Jaipur. A shorter calving interval is desirable as it enhances the number of productive lactations over an animal's lifetime, thereby improving overall herd productivity.

Table.1 Production and reproduction performance of Murrah buffalo

S.No.	Parameter	Jaipur	Mean± SE	SD	Sikar	Mean± SE	SD	Difference	SEd	t-value	df	P-value
1	Average daily milk yield (lit.)	240	9.31± 0.09	0.82	240	8.27± 0.26	0.83	1.04	0.075	13.809	480	0.000
2	Lactation length (days)	240	296.61± 0.83	7.45	240	295.00± 1.99	6.28	1.61	0.629	2.560	480	0.011
3	Lactation milk yield (lit.)	240	2769.63± 19.90	177.76	240	2415.34± 72.87	230.43	354.29	18.786	18.860	480	0.000
4	Peak yield (lit.)	240	12.34± 0.08	0.75	240	11.54± 0.24	0.77	0.80	0.069	11.530	480	0.000
5	Dry period (days)	240	104.81± 1.13	10.10	240	108.40± 2.64	8.34	-3.59	0.845	-4.246	480	0.000
6	Age at first calving (days)	240	1276.73± 10.61	94.86	240	1384.40± 0.34	91.07	-107.67	8.488	-12.685	480	0.000
7	Service period (days)	240	114.49± 1.87	16.74	240	131.40± 4.96	15.68	-16.91	1.481	-11.421	480	0.000
8	Service per conception (No.)	240	1.79± 0.05	0.47	240	1.92 ± 0.15	0.48	-0.13	0.043	-2.998	480	0.003
9	Calving interval (days)	240	426.24± 2.22	19.84	240	440.70 ± 5.21	16.48	-14.46	1.665	-8.685	480	0.000

The calving intervals recorded in the present study are favorable when compared to earlier research. Kushwaha *et al.,* (2013) and Kabir *et al.,* (2017) reported much longer averages of 522.1 ± 12.1 and 545.37 ± 39.11 days, respectively, indicating lower reproductive efficiency. Similarly, Sachan *et al.,* (2015) observed an interval of 450.2 ± 35.1 days, while Khatke *et al.,* (2023) reported a mean of 433.06 ± 4.03 days.

The study clearly indicates that Murrah buffaloes in Jaipur outperform those in Sikar in both production and reproduction parameters, such as higher average daily milk yield, peak yield, and shorter service period, calving interval, and age at first calving.

These statistically significant differences suggest better animal husbandry practices, nutrition, and healthcare management in Jaipur. To enhance buffalo performance in Sikar, it is recommended to adopt improved breeding strategies, nutritional supplementation, and farmer capacity-building programs. Focused extension services and knowledge transfer from high-performing regions like Jaipur can play a transformative role in uplifting buffalo productivity in underperforming areas.

Author Contributions

L. N. Verma: Investigation, formal analysis, writing—original draft.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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