International Journal of Environmental & Agriculture Research (IJOEAR)
ISSN: [2454-1850]
[Vol-12, Issue-2, February- 2026]
Website: www.ijoear.com
Journal DOI: 10.25125/agriculture-journal

Effect of Feeding Fodder-based Balanced Ration on Animal's Productivity, Fertility and Economics of Dairying in Field Conditions

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Received:- 01 February 2026/ Revised:- 13 February 2026/ Accepted:- 19 February 2026/ Published: 28-02-2026

Abstract— *The present study evaluated the impact of green fodder–based ration balancing on milk productivity, fertility, and economics of dairy buffaloes under on-farm conditions. On-farm trials were conducted during 2018–19 to 2020–21 in the* rabi *season, involving five trials per year with 15 buffaloes per treatment, comparing balanced ration feeding (T2) with farmers' practice (T1). Results revealed that buffaloes under T2 recorded consistently higher average daily milk yield (6.85 ± 0.31 to 7.21 ± 0.34 L/day) with an increase of 7.0–8.91% over T1. Fertility performance improved markedly under T2, with conception rate increasing from 13.3 to 20.0% compared to 6.67–13.3% under T1. Economic analysis showed higher net returns (₹16.35 ± 0.71 to 18.28 ± 0.80 per litre of milk) and improved benefit–cost ratio (1.69–1.71) under balanced ration feeding as against 1.57–1.59 in farmers' practice. The study demonstrated that ration balancing using green fodder enhances feed utilization efficiency, improves reproductive performance, and increases profitability. Adoption of fodder-based balanced feeding can therefore serve as a cost-effective and sustainable strategy for improving dairy buffalo productivity under field conditions.*

Keywords— Balanced ration, Economics, Fertility, Green fodder, Milk production, On-farm trial.

I. INTRODUCTION

Ration balancing is the process of balancing the levels of various nutrients in the ration from available feed resources to optimize feed utilization and meet nutrient requirements for different physiological stages of animals, i.e., maintenance, production, and reproduction (FAO, 2012). A well-balanced ration plays a crucial role in enhancing animal productivity, improving fertility, and ensuring the economic sustainability of dairy farming (NRC, 2001). Animal feedstuffs are broadly classified into four groups: fodder, concentrate mixtures, feed supplements, and feed additives (Banerjee, 2018). Animals are fed two types of fodder: green and dry. Among these, green fodder is vital for maximizing fertility and production because it supplies vital minerals, vitamins, protein, and energy that promote optimal milk production, reproductive efficiency, and overall animal health (Ranjhan, 1998). Feeding a green fodder–based balanced ration improves digestion, increases milk production and quality, and reduces reliance on costly concentrate feeds. Therefore, a fodder-based dairy farming system is not only economical but also supports sustainable livestock management (Kearl, 1982).

Cultivated green fodder is broadly classified into carbonaceous and leguminous fodder. Carbonaceous fodder (e.g., maize, sorghum, bajra, oat) is rich in carbohydrates but low in protein (1.5–3% DCP, 55–65% TDN). Leguminous fodder (e.g.,

berseem, lucerne, cowpea, clover) is high in protein (12–20% DCP, 55–65% TDN) and crucial for enhancing milk production and growth (Ranjhan, 1998; Banerjee, 2018). A balanced combination of both ensures optimal nutrient supply, promoting better productivity, fertility, and overall health in dairy animals.

For low to moderate milk producers (up to 8 L/day), a well-balanced diet of dry and green fodder can satisfy nutritional needs without concentrate supplementation (Ranjhan, 1998; NRC, 2001). High-quality green fodder (35 kg) and dry fodder (2–3 kg) can sustain milk production of 5–8 L/day. For higher producers (>8–10 L/day), concentrate supplementation becomes necessary. From an economic standpoint, fodder-based feeding is more cost-effective than concentrate-heavy diets, as it reduces feeding costs while maintaining or improving productivity. The use of locally available green fodder minimizes input costs, enhances feed efficiency, and contributes to profitability under field conditions (Garg et al., 2013; Sherasia et al., 2017).

Therefore, the present study was designed to balance the ration of dairy buffaloes with green fodder and to assess its effect on animal productivity, fertility, and economics of dairying in field conditions

II. MATERIALS AND METHODS

2.1 Study Area and Period:

On-farm trials were conducted during the *rabi* seasons from 2018–19 to 2020–21 in two villages (Dhikoli and Padri) of Jhansi district, Uttar Pradesh, India. The study followed a participatory approach involving local dairy farmers.

2.2 Experimental Design and Animals:

Each year, 30 healthy lactating buffaloes in early lactation (10–60 days postpartum) with parity of 2–4 and average body weight of 425 kg were selected from farmers' herds. Animals were divided into two treatment groups using a stratified random sampling method based on initial milk yield:

- **T1 (Control, n=15):** Buffaloes maintained under farmers' existing feeding and management practices.
- **T2 (Treatment, n=15):** Buffaloes fed a green fodder–based balanced ration.

The study followed a completely randomized design with five replicates (farms) per treatment, each farm contributing 3 animals per treatment group annually.

TABLE 1
PREPARATION OF CONCENTRATE MIXTURE BASED ON NUTRITIVE VALUE (DM BASIS) OF COMMON FEED INGREDIENTS

Ingredients	Quantity (kg)	DCP (kg)	TDN (kg)
Barley	52	3.64	41.6
Wheat bran	26	2.6	16.9
Mustard Seed Cake	22	8.8	16.5
Total	**100**	**15.04**	**75**

In 100 kg of concentrate mixture, 2 kg mineral mixture and 1 kg salt were added.

2.3 Dietary Treatments:

T1 (Farmers' Practice): Animals were fed according to individual farmers' practices, typically consisting of locally available dry fodder (wheat straw) with variable amounts of green fodder and concentrate.

T2 (Balanced Ration): Farmers in this group were provided with high-quality seeds of berseem (variety Vardan) and oat (variety Kent) for cultivation. Buffaloes received a formulated balanced ration comprising:

- Dry fodder (wheat straw)
- Green fodder (berseem and oat in 1:1 ratio)
- Concentrate mixture (20% CP, 75% TDN) formulated from locally available ingredients: wheat bran, cereals, oilseed cakes, pulses, mineral mix (2%), and salt (1%)
- Mineral supplements

The first cut of green fodder was taken 50–60 days after sowing. Ration formulation followed thumb rules based on nutrient requirements for maintenance and milk production.

TABLE 2
FORMULATION OF BALANCED RATION FOR BUFFALOES IN TREATMENT GROUP (T2)

Animal Type	Dry Fodder (kg/d/animal)	Barseem + Oat Green Fodder (1:1) (kg/d/animal)	Concentrate Ration (kg/d/animal)
Buffalo with milk yield 5–10 L/day (425 kg BW)	6	20	4

2.4 Data Collection:

- **Milk Yield:** Daily milk yield was recorded for 90 days for each animal.
- **Fertility Parameters:** Reproductive performance was assessed through conception rate, calculated as the percentage of buffaloes that conceived during the trial period. Estrus detection was based on behavioral signs (bellowing, mounting, decreased feed intake) and physical indicators (vaginal discharge).
- **Economic Analysis:** Costs included feed inputs (fodder cultivation, concentrate ingredients), labor, and miscellaneous expenses. Returns were calculated based on milk sales at prevailing market rates.

2.5 Statistical Analysis:

Data were analyzed using analysis of variance (ANOVA) appropriate for completely randomized design (Snedecor and Cochran, 1989). Treatment means were compared using Duncan's Multiple Range Test (Duncan, 1995) at $p<0.05$ significance level. All analyses were performed using SAS 9.4 software.

III. RESULTS

3.1 Milk Production Performance:

Balanced ration feeding (T2) significantly improved milk production across all three study years (Table 3). Average daily milk yield under T2 ranged from 6.85 ± 0.31 to 7.21 ± 0.34 L/day (with 7.15 ± 0.33 L/day in 2019-20), representing a 7.00–8.91% increase over T1 (6.40 ± 0.22 to 6.62 ± 0.28 L/day). The differences were statistically significant ($p<0.05$) during 2019–20 and 2020–21.

3.2 Reproductive Performance

Balanced nutrition markedly enhanced fertility parameters (Table 3). Conception rate under T2 ranged from 13.3 to 20.0%, compared to 6.67–13.3% under T1. The improvement represented a two- to three-fold increase in conception success, with most pronounced benefits observed in later study years.

3.3 Economic Analysis

Balanced ration feeding improved economic returns significantly (Table 3). Net return per litre of milk under T2 (₹16.35 ± 0.71 to ₹18.28 ± 0.80) was consistently higher than T1 (₹14.54 ± 0.66 to ₹14.80 ± 0.69). The benefit–cost ratio ranged from 1.69–1.71 for T2 compared to 1.57–1.59 for T1.

TABLE 3
MILK YIELD, FERTILITY, AND ECONOMICS OF DAIRYING IN CONTROL (T1) AND TREATMENT (T2) GROUPS DURING STUDY PERIOD

Period	Treatment	No. of Trials	No. of Animals	Average Milk Yield (L/day) (Mean ± SE)*	Milk Yield Increase (%)	Conception Rate (%)	Net Return (₹/L milk)	B:C Ratio
2018-19	T1	5	15	6.40 ± 0.22	–	6.67	14.54 ± 0.66	1.57
	T2	5	15	6.85 ± 0.31	7	13.3	16.35 ± 0.71	1.69
2019-20	T1	5	15	6.6^{a} ± 0.28	–	6.67	14.76^{a} ± 0.68	1.59
	T2	5	15	7.15^{b} ± 0.33	8.33	20	17.28^{b} ± 0.74	1.71
2020-21	T1	5	15	6.62^{a} ± 0.28	–	13.3	14.80^{a} ± 0.69	1.59
	T2	5	15	7.21^{b} ± 0.34	8.91	20	18.28^{b} ± 0.80	1.71

Means bearing different superscripts differ significantly ($p<0.05$) within the same year.

IV. DISCUSSION

4.1 Enhanced Milk Production:

The consistent 7.0–8.91% increase in milk yield under balanced ration feeding (T2) aligns with previous reports demonstrating improved nutrient utilization and metabolic efficiency. Garg et al. (2013) documented similar yield improvements (6–10%) in field-scale ration balancing trials with dairy animals. The enhanced production can be attributed to optimal supply of digestible crude protein (DCP) and total digestible nutrients (TDN), which support sustained lactation without metabolic stress. The formulation using locally available berseem (high protein) and oat (high energy) created a complementary nutrient profile that likely improved rumen fermentation and nutrient partitioning toward milk synthesis.

4.2 Improved Reproductive Performance:

The two- to three-fold improvement in conception rate under T2 underscores the critical link between nutrition and reproduction. Energy–protein imbalance, common in traditional feeding systems, disrupts ovarian cyclicity and embryonic development (FAO, 2012). The balanced ration likely provided adequate micronutrients (zinc, copper, phosphorus) and vitamins essential for hormone synthesis and uterine health. Garg et al. (2013) similarly reported 15–20% improvement in conception rates through ration balancing. The cumulative benefits observed in later study years suggest that sustained nutritional correction gradually improves overall reproductive fitness.

4.3 Economic Viability:

Higher net returns (₹1.81–3.48 per litre more than T1) and improved B:C ratios (1.69–1.71 vs. 1.57–1.59) demonstrate the economic superiority of balanced feeding. This profitability stems from increased milk output without proportional increase in feed costs, as the system optimized use of farm-grown fodder. Sherasia et al. (2017) reported similar economic gains, with B:C ratios improving by 0.15–0.25 points through ration balancing interventions. The reduced dependence on purchased concentrates made the system more resilient to market price fluctuations.

4.4 Practical Implications and Adoption Potential:

The three-year consistency of results across multiple farms validates the technical feasibility and farmer acceptability of this approach. The visible improvements in milk yield and fertility within 90 days create strong incentives for adoption. However, successful implementation requires initial support with quality fodder seeds and basic training in ration formulation—investments that yield substantial long-term returns.

4.5 Study Limitations:

While demonstrating clear benefits, this study had certain limitations: individual farmer management variations, lack of milk composition data, and no measurement of body condition score changes. Future studies could incorporate these parameters and evaluate long-term effects over multiple lactations.

V. CONCLUSION

The findings clearly establish that green fodder–based ration balancing significantly improves milk yield (7.0–8.91% increase), fertility (two- to three-fold higher conception rate), and economic returns (B:C ratio 1.69–1.71) in dairy buffaloes under field

conditions. The intervention demonstrates that low to moderate milk-yielding buffaloes can be efficiently maintained on balanced green and dry fodder with minimal concentrate supplementation, reducing feeding costs while enhancing productivity and reproduction. The consistent performance across three consecutive years confirms the technical feasibility and economic viability of this approach. Wider dissemination through on-farm demonstrations and extension programs is recommended to enhance productivity, profitability, and sustainability of smallholder dairy farming systems in similar agro-ecological regions.

ACKNOWLEDGEMENT

The authors express sincere gratitude to the Director, ICAR–ATARI, Kanpur, Uttar Pradesh, and Hon'ble Vice Chancellor, BUAT, Banda, U.P. for providing financial and technical support. Special thanks to the participating farmers of Dhikoli and Padri villages for their cooperation and to field staff for assistance in data collection.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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