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Effect of area-specific mineral mixture on productivity of buffaloes and crossbred cows in adopted villages of KVK, Utukur, Andhra Pradesh

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Abstract
Mineral nutrition plays a critical role in dairy productivity, reproduction, and health. Imbalances and deficiencies are common in crop-residue-based feeding systems, particularly in semi-arid regions of Andhra Pradesh. A Frontline Demonstration (FLD) was conducted in 2023 by Krishi Vigyan Kendra (KVK), Utukur, Kadapa district, to evaluate the effect of area-specific mineral mixture (ASMM) supplementation in lactating buffaloes and crossbred (CB) cows in the adopted villages of Khajipeta and CK Dinne mandals. Thirty animals (20 buffaloes and 10 CB cows) were divided into control and treatment groups. Treatment animals were supplemented with ASMM @ 50 g/day/animal for 90 days in addition to farmers' normal ration. Milk yield, milk composition, reproductive performance, and health were monitored. Results showed that ASMM supplementation significantly improved milk yield (+0.9-1.0 L/day), milk fat (+0.4%), and shortened post-partum estrus interval by ~23 days. Conception rate increased from 33% (control) to 60% (treatment). Farmers also reported better body condition and adopted ASMM use independently after witnessing benefits. The study confirms that ASMM is a sustainable, low-cost intervention for enhancing dairy productivity under smallholder conditions.

Keywords: KVK Utukur, Area-specific mineral mixture, Buffalo, Crossbred cows, Milk yield, Reproduction, Farmer adoption

Introduction
Dairying is a cornerstone of rural livelihoods in Andhra Pradesh, especially in Kadapa district where buffaloes and crossbred (CB) cows are predominant dairy animals. Buffaloes are prized for their high-fat milk, while CB cows contribute higher overall yields. Despite this potential, productivity is constrained by imbalanced feeding practices. Farmers largely depend on paddy straw, sorghum stover, and groundnut haulms with limited concentrate feeding.
Such crop residues are poor in essential minerals, notably calcium (Ca), phosphorus (P), zinc (Zn), copper (Cu), manganese (Mn), and iodine (I). These deficiencies lead to:

- Reduced milk yield and fat synthesis (Ca, P, Zn involved in energy metabolism),
- Reproductive disorders such as delayed estrus and repeat breeding (Cu, Mn, I in hormone regulation),
- Weak immunity and higher susceptibility to mastitis (Zn, Cu, vitamins A & E as antioxidants).

Scientific studies have shown that chelated or area-specific mineral supplementation improves milk yield, fat percentage, reproductive efficiency, and immune status. Recognizing this, ICAR promotes area-specific mineral mixtures (ASMM) tailored to local deficiencies.
To validate the impact in real farm conditions, KVK, Utukur conducted a Frontline Demonstration (FLD) in 2023 in its adopted villages, focusing on buffaloes and CB cows, and evaluated production, reproduction, and farmer responses.

Methodology
Study Area
- **Villages:** Khajipeta and CK Dinne mandals, Kadapa district (semi-arid region).

- **Common feed resources:** Sorghum stover, paddy straw, groundnut haulms, cottonseed cake, occasional green fodder.

Experimental Design
- **Year:** 2023 (KVK Frontline Demonstration).
- **Animals:** 30 lactating dairy animals (20 buffaloes, 10 CB cows), 2nd-4th lactation, 2-6 months postpartum.

Groups
- **Control group (N=15):** Farmers' normal feeding.
- **Treatment group (N=15):** Farmers' normal feeding + ASMM @ 50 g/day/animal.
- **Duration:** 90 days.
- **ASMM formulation:** Procured from SVVU Tirupati.

Parameters Recorded
- **Milk yield (L/day):** Measured daily.
- **Milk composition:** Fat, SNF, protein, lactose (fortnightly analysis).
- **Reproductive traits:** Post-partum estrus interval, conception rate, silent estrus.
- **Body condition score (BCS):** Visual scale (1-5).
- **Farmer feedback:** Perceptions on animal health, adoption, and economics.

Statistical Analysis
Data analyzed using independent t-test; $P < 0.05$ considered significant.

Results
- **Milk Yield**

Supplemented animals showed a consistent increase in daily yield compared to controls.

Table 1: Effect of ASMM on milk yield (L/day)

Species	Group	Initial yield	Final yield	Mean increase	% increase
Buffaloes (N=20)	Control	5.6±0.3	6.0±0.2	+0.4	7.1
	Treatment	5.7±0.4	6.6±0.3	+0.9	15.8
CB cows (N=10)	Control	7.4±0.2	7.8±0.3	+0.4	5.4
	Treatment	7.5±0.3	8.5±0.3	+1.0	13.3

→ ASMM supplementation doubled the yield increment compared to control.

- **Milk Composition**

ASMM improved fat % significantly, with minor, non-significant effects on SNF, protein, and lactose.

Table 2: Effect of ASMM on milk composition

Parameter	Buffalo Control	Buffalo Treatment	CB Cow Control	CB Cow Treatment
Fat (%)	6.6±0.2	7.0±0.3*	3.8±0.2	4.2±0.3*
SNF (%)	9.2±0.2	9.3±0.2 (NS)	8.6±0.2	8.7±0.2 (NS)
Protein (%)	3.7±0.1	3.8±0.1 (NS)	3.5±0.1	3.6±0.1 (NS)
Lactose (%)	4.9±0.1	5.0±0.1 (NS)	4.8±0.1	4.9±0.1 (NS)

$p<0.05$; NS = Not significant

Fat synthesis improved due to better Ca-P balance and trace mineral-mediated energy utilization.

- **Reproductive Performance**

Trace minerals (Zn, Cu, Mn, I) support ovarian activity, luteal function, and hormone synthesis, explaining earlier estrus and higher conception.

Table 3: Effect of ASMM on reproduction

Parameter	Control	Treatment	Improvement
Post-partum estrus (days)	95±5	72±4	-23 days
Conception rate (%)	33	60	+27%
Silent estrus incidence (%)	40	13	-27%

- **Body condition and farmer feedback**
  - BCS improved (2.9 in control vs. 3.5 in treatment).
  - Farmers observed shinier coats, better feed efficiency, and more vigorous calves.
  - After witnessing results, farmers began purchasing and supplementing ASMM on their own, showing strong technology adoption.
  - Economics: Extra milk (0.9-1 L/day) provided an additional ₹30-40/day, outweighing ASMM cost (₹5/day).

Discussion
The results reinforce earlier findings that mineral supplementation improves milk yield, fat percentage, and reproductive efficiency.
- Milk yield improvement was similar to chelated mineral trials in cows, suggesting buffaloes respond equally well.
- Reproductive benefits highlight the role of Zn, Cu, and Mn in follicular development and steroidogenesis.
- Farmer-led adoption demonstrates practicality and economic viability, ensuring sustainability beyond demonstrations.

Thus, ASMM bridges the gap between traditional crop-residue feeding and scientific nutrition management.

Summary and Conclusion
The 2023 Frontline Demonstration at KVK Utukur confirmed that ASMM supplementation (50 g/day/animal for 90 days) in buffaloes and crossbred cows:
- Increased milk yield (0.9-1.0 L/day),
- Improved milk fat content (+0.4%),
- Reduced post-partum estrus interval by ~23 days,
- Enhanced conception rate (60% vs. 33%),
- Improved body condition and overall health.

Importantly, farmers adopted ASMM supplementation independently after observing results, indicating strong potential for scaling up.

Conclusion
ASMM is a scientifically validated, low-cost, farmer-accepted intervention to enhance productivity and profitability of buffaloes and crossbred cows in Andhra Pradesh.

Conflict of Interest
Not available

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