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Bharat Bhushan Sahu
Department of Life Science, Shri Rawatpura Sarker University, Raipur, Chhattisgarh, India

Ayantika Pal
Department of Life Science, Shri Rawatpura Sarker University, Raipur, Chhattisgarh, India

Anil Kumar Dubey
Indira Gandhi Agricultural University, Raipur, Chhattisgarh, India

Surendra Kumar Gautam
Department of Life Science, Shri Rawatpura Sarker University, Raipur, Chhattisgarh, India

Corresponding Author:
Bharat Bhushan Sahu
Department of Life Science, Shri Rawatpura Sarker University, Raipur, Chhattisgarh, India

Regional variability in perceptions of feed supplementation on milk production of Kosali Cows in Chhattisgarh

Bharat Bhushan Sahu, Ayantika Pal, Anil Kumar Dubey and Surendra Kumar Gautam

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Abstract
Kosali cattle, which are indigenous to Chhattisgarh, are a key component of rural livelihoods and milk supply. But farmers' perceptions of feed supplementation, a determining factor in terms of productivity and quality, are not well understood in various regions. This research was intended to determine variability within and among regions for farmers' perceptions regarding feed supplementation affecting milk yield, quality, and sustainability of Kosali cows.
The study was carried out in five districts of Chhattisgarh; Dhamtari, Baloda Bazar, Raipur, Gariyaband, and Mahasamund. 200 respondents (40 from each district) were interviewed with the help of a 12-item Likert scale questionnaire. Data were analyzed in terms of descriptive statistics, coefficient of variation, and t-tests for assessment of district-wise difference.
Perceptions differed significantly across districts. Raipur farmers had high awareness, associating supplementation with yield, quality, and sustainability, while Mahasamund respondents had limited awareness, with a preoccupation with production and subsidy. Dhamtari and Baloda Bazar had moderate perceptions, while Gariyaband highlighted nutritional advantages. The findings suggest that socio-economic setting, exposure to extension, and policy awareness significantly influenced perceptions, resulting in marked regional variation.
Region-specific, targeted interventions are required to enhance adoption of supplementation strategies. Local knowledge-integrated policies combined with scientific feeding practices can improve Kosali cow productivity and enhance Chhattisgarh dairy development programs.

Keywords: Kosali cattle, feed supplementation, milk production, farmer perceptions, regional variability, Chhattisgarh

1. Introduction

1.1 Importance of Kosali Cows in Chhattisgarh Rural Economy

Indigenous cow breeds are critical to supporting the livelihoods of rural families in India, particularly in places such as Chhattisgarh where dairying is highly entrenched in traditional farming systems. Of these, the Kosali cow has special significance for smallholder farmers because of its tolerance for the stressful agro-climatic conditions, resistance to diseases, and role in improving household nutrition through milk availability (Jain *et al*., 2017) [21]. In contrast to exotic and crossbred cows, which require intensive management, Kosali cows perform well with low-input systems and are thus compatible with resource-poor tribal and rural communities (Sahu *et al*., 2018) [36].

Kosali cow milk, even though in smaller quantity than exotic breeds, is prized for its quality such as increased fat and protein content, which renders greater nutritional advantages to rural households (Chand *et al*., 2018) [9]. Furthermore, milk from Kosali cows is also economically and culturally important because it not only constitutes a basic diet but also generates income through local market channels (Bhagat *et al*., 2021) [5]. Dairy farming thus complements crop-based livelihoods and serves as a hedge against agrarian risks in rainfed Chhattisgarh.

Even though Kosali cows play a significant role, they are often kept with low inputs based on

crop residues and naturally occurring fodders. Research on Chhattisgarh's feed resource base reveals that macro and micro minerals are lacking in the state's fodder base, which will have direct implications for animal health and productivity (Goswami *et al*., 2017) [17]. This has led to a farmer perception that Kosali cows are genetically low milk yielders, without addressing the scope for productivity improvement through nutritional interventions. This is important to address in order to enhance the socio-economic status of smallholder households without compromising indigenous cattle germplasm.

1.2 Role of Feed Supplementation in Improving Indigenous Cattle Productivity

The scientific fraternity has always prioritized feed supplementation in accelerating milk output, content, and general animal performance. Supplementation fills gaps in basal diets, especially when animals rely on crop residues, poor-quality grasses, or forages lacking minerals (Bhanderi *et al*., 2016; Pandey *et al*., 2018) [6, 33]. Research has proven that strategic supplementation with concentrates, mineral mixtures, and non-traditional feed sources results in remarkable increases in milk productivity in various breeds (Singh *et al*., 2016; Shinde, 2021) [39, 37].

Worldwide, evidence indicates high correlations between feeding supplementation and performance of milk. Supplementation with concentrates or fiber-rich feed ingredients, for instance, has improved milk yield and quality in pasture-based dairy systems (Auldist *et al*., 2013; 2016) [3, 4]. Similarly, new supplement strategies like polyherbal additives, grape pomace, hydroponic fodders, and oilseeds have been reported to not only enhance milk yield but also mitigate methane emissions and enhance environmental sustainability (Akter *et al*., 2024; Muñoz *et al*., 2021; Wu *et al*., 2024) [2, 31, 40]. In India, research with Azolla, plant feed additives such as Shatavari, and peptide additives have shown encouraging outcomes for crossbred as well as native cattle (Kumar, 2020; Muwal *et al*., 2020; Jagadeesh *et al*., 2025) [24, 26, 32, 20].

For Kosali cows of Chhattisgarh, supplementing can be a major intervention to fill the production gap. Feeding experiments in comparable situations emphasize that region-specific mineral supplements, cereal-supplemented feedingstuffs, and compound rations appreciably improve milk production and reproduction performance (Rajpoot *et al*., 2020; Singh *et al*., 2024) [34, 38]. The advantage goes beyond yield improvement to encompass enhanced milk quality characteristics like fat percentage, protein percentage, and processing characteristics (Bulgakov *et al*., 2021) [8]. Therefore, feed supplementation serves a twin purpose: enhancing farmer earnings through higher output and enhancing consumer nutrition through improved milk quality.

1.3 Research Gap

1.3.1 Non-availability of Comparative Perception-Based Studies Across Districts

Whereas the biological and nutritional effects of supplementation through feed have been extensively researched, there is sparse literature on how farmers view such interventions, particularly among indigenous breeds such as the Kosali cow. Perception determines adoption behavior, and without farmer belief in supplementation efficacy, scientifically proven practices can suffer poor implementation (Mooventhan *et al*., 2016) [30].

The majority of current research on Chhattisgarh cattle feeding is descriptive analyses of management practices or experimental supplementation trials (Bhagat *et al*., 2021; Jain *et al*., 2017) [5, 21]. For example, studies point out mineral content deficiencies of local fodders (Goswami *et al*., 2017) [17] and provide information on the profitability of dairying in tribal areas (Chand *et al*., 2018) [9], but there is no systematic evidence available on what farmers across districts understand about the role of supplementation in increasing Kosali milk production.

Also, studies of supplementation focus mainly on crossbred or high-yielding dairy cows (Akinlade *et al*., 2021; Dineen *et al*., 2021; Dida *et al*., 2024) [1, 12], and indigenous breeds are given less consideration. Even when Kosali cows are considered, productivity impact is of focus over farmer perception. This is concerning since perceptions may be very variable across regions due to variations in socio-economic status, availability of feed resources, and extension support systems. With no comparative perception-based research across districts, policymakers and extension workers are likely to apply blanket interventions that can fail in heterogeneous rural contexts.

1.3.2 Regional Variation in Perceived Advantage of Feed Supplementation

Against this background, the current research intends to examine regional differences in farmer perceptions of feed supplementation on milk production among Chhattisgarh's Kosali cows. Through comparisons of farmer perceptions across various districts, the research intends to identify variations in awareness, adoption, and perceived advantage of supplementation practices. These perspectives are important for designing extension programs and feed interventions at the local level.

The objectives are fourfold

1. To record existing feeding behaviors and awareness about supplementation among Kosali cow farmers.
2. To compare farmers' beliefs on the impact of feeding supplementation on milk production and quality.
3. To examine differences in perceptions between districts and show the role of socio-economic and ecological factors.
4. To make region-specific feeding recommendations backed by evidence to enhance Kosali cattle productivity.

Through this, the research helps bridge the research gap by going beyond controlled trials of supplementation to learn about farmer-led perceptions. Integrating scientific knowledge with indigenous views, this research hopes to help develop more effective and culturally suitable interventions that can enhance Kosali cow's role in Chhattisgarh's rural economy.

2. Materials and Methods

2.1 Study Area

The research was carried out in five districts of Chhattisgarh; Dhamtari, Baloda Bazar, Raipur, Gariyaband, and Mahasamund; that are famous for having extensive numbers of Kosali cattle and reliance on mixed crop-livestock farming systems. The districts are representative of varied agro-climatic settings and socio-economic situations, thus providing a glimpse into regional heterogeneity in perceptions about feed supplementation. The locations were chosen intentionally, as they represent variation in conventional management, availability of fodder, and supplementation practice uptake reported earlier in the same studies (Bhagat *et al*., 2021; Jain *et al*., 2017; Chand *et al*., 2018) [5, 31, 9].

2.2 Sample Size and Respondent Selection

200 respondents were surveyed, of which 40 respondents were randomly selected from each district through purposive random sampling for sufficient representation of households

rearing Kosali cows. Respondents were mainly small and medium-scale dairy farmers with hands-on experience in feeding and caring for cattle. The sample size was fixed based on guidelines for ensuring adequate statistical power for perception-based studies, similar to other livestock study designs (Mooventhan *et al*., 2016; Akinlade *et al*., 2021) [30, 1].

2.3 Questionnaire Design

A 12-item structured questionnaire was crafted to elicit farmers' beliefs regarding feed supplementation and its effects on Kosali cow milk quantity and quality. The tool used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) to measure important areas like perceived effect on productivity, milk quality, animal health, and affordability. Questionnaire items were constructed based on themes identified in supplementation research (Auldist *et al*., 2013; Bipate & Misra, 2020; Dida *et al*., 2024) [3, 7, 12]. The questionnaire was pre-tested among a small number of respondents before final deployment to check for clarity, cultural sensitivity, and reliability.

Personal interviews were undertaken with respondents between March and June 2024. Local language (Hindi/Chhattisgarhi) was employed for ensuring proper understanding. Interviews were complemented with field observations regarding feeding habits, available fodder resources, and access to extension or veterinary services. Comparable triangulation approaches have been used in previous livestock supplementation research for cross-checking farmer-reported data (Goswami *et al*., 2017; Hassen *et al*., 2022) [17, 18].

2.4 Statistical Analysis

The coded responses were analyzed using descriptive and inferential statistics. Descriptive statistics employed included mean, standard deviation (SD), and coefficient of variation (CV) to describe central tendencies and variability. Independent sample t-tests were done to establish significant differences in perceptions between districts, with p-values less than 0.05 taken to signify statistical significance. This method is similar to analytical frameworks utilized in previous supplementation and perception research (Auldist *et al*., 2016; Bulgakov *et al*., 2021; Dineen *et al*., 2021) [4, 8]. All the analyses were performed using Microsoft Excel.

2.5 Ethical Considerations

Voluntary participation was ensured, with informed consent from all the respondents. Respondents were guaranteed confidentiality, and data were solely utilized for research purposes. Ethical standards followed general guidelines generally adopted in animal husbandry and participatory farmer studies (Kholif *et al*., 2021; Muwal *et al*., 2020) [23, 32].

3. Results and Discussion

3.1 Demographic Profile of Respondents in Raipur Division

The demographic profile of respondents in the five districts of Raipur Division, namely Dhamtari, Baloda Bazar, Raipur, Gariyaband, and Mahasamund, yields significant information on the socio-economic profile underlying perceptions of feed supplementation.

3.1.1 Age Distribution and Gender Pattern

The information showed in Table 1 and Figure 1, that most of the participants were middle-aged with a high concentration in the 45-54 years (20-50%) and 55-64 years (20-32.5%) age groups in districts. Farmers aged 18-34 years made up a low percentage (<10%), pointing to low youth participation in Kosali cattle rearing. This age structure indicates traditional practice continuity among senior farmers and low generational transfer, as observed in indigenous cattle rearing in central India (Jain *et al*., 2017) [21].

Table 1: Respondents Age Distribution and Frequency from Raipur Division

Percent Frequency District wise					
Age Groups	**Dhamtari**	**Baloda bazar**	**Raipur**	**Gariyaband**	**Mahasamund**
18-24 years	2.5	0.0	2.5	0.0	0.0
25-34 years	2.5	5.0	2.5	27.5	5.0
35-44 years	12.5	25.0	22.5	20.0	17.5
45-54 years	30.0	35.0	42.5	20.0	35.0
55-64 years	32.5	20.0	17.5	27.5	22.5
65 years or older	20.0	15.0	12.5	5.0	20.0
Total	100	100	100	100	100

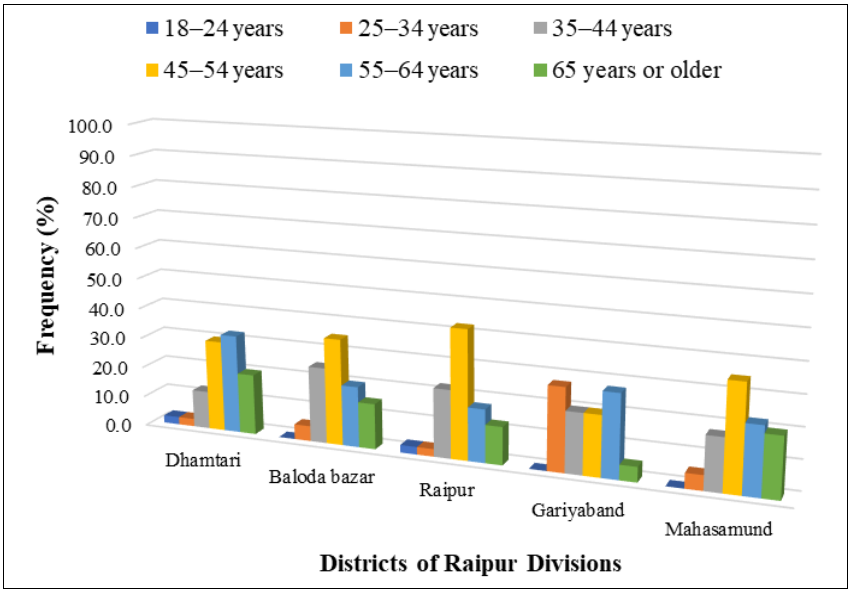

Fig 1: Graphical view Age Distribution and Percent Frequency of Respondents from Raipur Divisions

Table 2: Gender of Respondents from Raipur Divisions

Gender	Frequency	Percentage
Male	40	100%
Female	0	0%

Table 2 showed that all the respondents were men (100%), indicating a sampling constraint or more likely, the prevalence of men in structured decision-making around cattle feeding and farm finances. The same gendered patterns of participation have been reported in livestock production systems in South Asia (Bhagat *et al*., 2021) [5].

3.1.2 Education Level, Occupation, Location, and Farming Experience

Most (60-75%) of the respondents in the districts had education below high school, and few reached higher secondary or diploma/certificate levels. Less than 5% had education at college level. Low formal education levels may limit adoption of scientific feed management, as literacy was reported to correlate with awareness of nutritional technologies in dairy cattle production (Hassen *et al*., 2022) [18].

Table 3: Education Level of Respondents from Raipur Divisions

Percent Frequency District wise					
Education Level	**Dhamtari**	**Baloda bazar**	**Raipur**	**Gariyaband**	**Mahasamund**
Less than High School	75.0	70.0	70.0	70.0	60.0
High School Graduate	25.0	27.5	30.0	27.5	32.5
Diploma/Certificate	0.0	2.5	0.0	2.5	5.0
College/Bachelor's Degree	0.0	0.0	0.0	2.5	2.5
Total	100	100	100	100	100

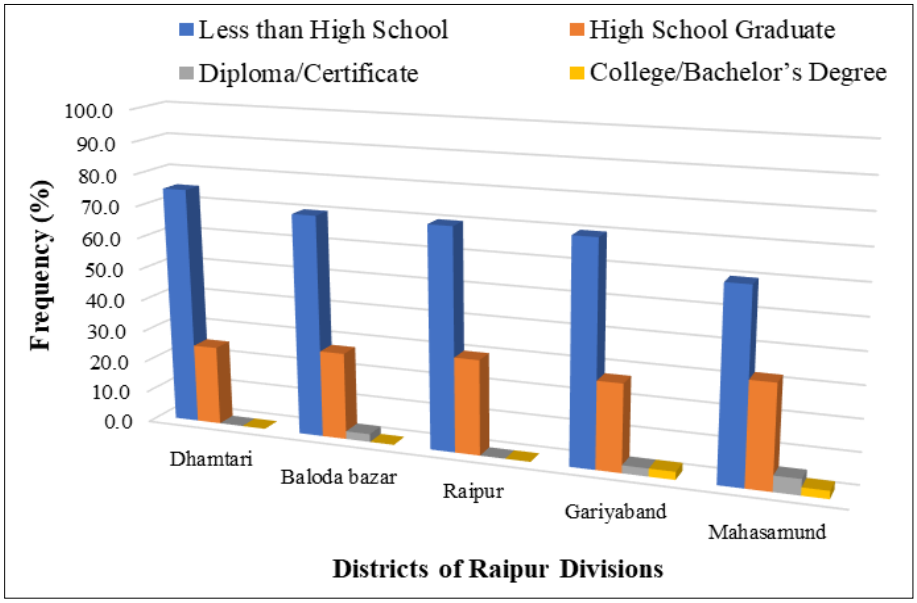

Fig 2: Graphical view of Respondents Education Level from Raipur Divisions

Table 4: Occupation, Location and Farming Experience of Respondents from Raipur Divisions

Percent Frequency District wise					
Occupation	**Percentage**	**Location**	**Percentage**	**Experience Level**	**Percentage**
Farmer	100%	Rural Area	100%	More than 10 years	100%

All the interviewees were farmers from rural backgrounds with more than 10 years of experience in farming, emphasizing their extensive knowledge of local cattle rearing. Although such an experience strengthens indigenous practices, it can also enhance resistance to change without specific training and extension (Mooventhan *et al*., 2016) [30].

3.2 District-Wise Results on the Impact of Feed

3.2 Supplementation in Raipur Divisions

3.2.1 Dhamtari District

Dhamtari analysis showed four key factors affecting attitudes toward feed supplementation: perceived impact on milk yield (Q1, $p < 0.001$), feed management role (Q3, $p < 0.001$), cost-benefit (Q5, $p = 0.04$), and knowledge of government assistance (Q12, $p = 0.01$).

Table 5: Impact of feed supplementation on milk production in Dhamtari District.

Question No.	Description	Mean Score	SD	CV	t-value	p-value two tailed	Significance
Q1	Perceived Effect of Feed Supplementation on Milk Production	2.28	0.72	0.32	-6.41	0.00	Yes
Q2	Feed Supplementation and Nutritional Quality of Milk	2.95	0.82	0.28	-0.39	1.05	No
Q3	Role of Feed Management in Increasing Milk Yield	1.93	0.73	0.38	-9.32	0.00	Yes
Q4	Impact on Cow Health and Body Condition	2.98	0.70	0.23	-0.23	1.23	No
Q5	Cost-effectiveness of Feed Supplementation	2.63	1.01	0.38	-2.36	0.04	Yes
Q6	Importance of Timing and Composition of Supplementation	3.15	0.92	0.29	1.03	0.46	No

Q7	Observable Increase in Milk Output Due to Supplementation	2.75	0.93	0.34	-1.71	0.14	No
Q8	Contribution to Dairy Sector Sustainability	3.23	0.92	0.29	1.55	0.20	No
Q9	Customization of Feed According to Individual Cow Needs	2.80	0.94	0.34	-1.35	0.28	No
Q10	Influence of High-Quality Feed Supplements on Milk Composition	2.90	0.87	0.30	-0.73	0.71	No
Q11	Availability and Effectiveness of Training on Feed Supplementation	3.05	0.90	0.30	0.35	1.09	No
Q12	Awareness of Government Support/Incentives for Feed Supplementation	2.55	0.96	0.38	-2.97	0.01	Yes

SD=Standard Deviation, CV=Coefficient of Variance; Significance level ($p < 0.05$)

Although respondents accepted the economic as well as production advantages, they were ambivalent regarding supplementation's effect on nutritional quality (Q2), health of the cow (Q4), and sustainability (Q8). This partial acceptance reflects a lack of insight into feed-milk quality relationships, something echoed by Bipate and Misra (2020) [7] as part of their study of indigenous cattle feeding systems.

3.2.2 Baloda Bazar District

Five of 12 items were significant at Baloda Bazar, including milk production (Q1), feed management (Q3), cow health (Q4), visible milk output (Q7), and government support (Q12).

Table 6: Impact of feed supplementation on milk production in Baloda Bazar District.

Question No.	Description	Mean Score	SD	CV	t-value	p-value two tailed	Significance
Q1	Perceived Effect of Feed Supplementation on Milk Production	2.33	1.35	0.58	-3.17	0.00	Yes
Q2	Feed Supplementation and Nutritional Quality of Milk	2.75	1.21	0.44	-1.30	0.30	No
Q3	Role of Feed Management in Increasing Milk Yield	2.03	0.97	0.48	-6.33	0.00	Yes
Q4	Impact on Cow Health and Body Condition	2.48	1.06	0.43	-3.13	0.01	Yes
Q5	Cost-effectiveness of Feed Supplementation	3.00	1.04	0.35	0.00	1.50	No
Q6	Importance of Timing and Composition of Supplementation	2.75	1.17	0.43	-1.35	0.28	No
Q7	Observable Increase in Milk Output Due to Supplementation	3.45	1.24	0.36	2.30	0.04	Yes
Q8	Contribution to Dairy Sector Sustainability	2.83	1.01	0.36	-1.10	0.42	No
Q9	Customization of Feed According to Individual Cow Needs	2.83	1.22	0.43	-0.91	0.55	No
Q10	Influence of High-Quality Feed Supplements on Milk Composition	2.68	1.07	0.40	-1.92	0.09	No
Q11	Availability and Effectiveness of Training on Feed Supplementation	3.00	1.09	0.36	0.00	1.50	No
Q12	Awareness of Government Support/Incentives for Feed Supplementation	2.23	1.23	0.55	-3.99	0.00	Yes

SD=Standard Deviation, CV=Coefficient of Variance; Significance level ($p < 0.05$)

Farmers in this area demonstrated stronger acknowledgment of the role of supplementation in enhancing milk production and cow health in Dhamtari. Problems of sustainability (Q8) and composition of milk (Q10) were still non-significant, resonating with previous research that smallholder farmers focus more on yield rather than quality-related issues (Auldist *et al*., 2013) [3].

3.2.3 Raipur District

Raipur district showed the highest recognition with 10 out of 12 variables being statistically significant. Respondents overwhelmingly felt that feed supplementation enhanced milk production (Q1, $p< 0.001$), quality of nutrition (Q2, $p< 0.001$), feed management (Q3, $p < 0.001$), cow health (Q4, $p< 0.001$), cost-effectiveness (Q5, $p = 0.004$), and sustainability (Q8, $p = 0.003$). They were also aware of government incentives (Q12).

Table 7: Impact of feed supplementation on milk production in Raipur District.

Question No.	Description	Mean Score	SD	CV	t-value	p-value two tailed	Significance
Q1	Perceived Effect of Feed Supplementation on Milk Production	1.58	0.75	0.47	-12.06	0.00	Yes
Q2	Feed Supplementation and Nutritional Quality of Milk	2.43	0.55	0.23	-6.62	0.00	Yes
Q3	Role of Feed Management in Increasing Milk Yield	1.60	0.87	0.54	-10.16	0.00	Yes
Q4	Impact on Cow Health and Body Condition	2.43	0.84	0.35	-4.31	0.00	Yes
Q5	Cost-effectiveness of Feed Supplementation	2.35	1.27	0.54	-3.23	0.00	Yes
Q6	Importance of Timing and Composition of Supplementation	2.75	1.19	0.43	-1.33	0.29	No
Q7	Observable Increase in Milk Output Due to Supplementation	2.15	1.10	0.51	-4.89	0.00	Yes
Q8	Contribution to Dairy Sector Sustainability	2.43	1.11	0.46	-3.29	0.00	Yes
Q9	Customization of Feed According to Individual Cow Needs	2.15	1.03	0.48	-5.24	0.00	Yes
Q10	Influence of High-Quality Feed Supplements on Milk Composition	2.55	1.01	0.40	-2.81	0.01	Yes
Q11	Availability and Effectiveness of Training on Feed Supplementation	2.38	1.03	0.43	-3.84	0.00	Yes
Q12	Awareness of Government Support/Incentives for Feed Supplementation	2.53	1.04	0.41	-2.45	0.03	Yes

SD=Standard Deviation, CV=Coefficient of Variance; Significance level ($p < 0.05$)

This indicates comparatively greater exposure to extension and training programs within the district in agreement with previous research findings that urban-border districts have improved access to livestock development programs (Chand *et al*., 2018) [9]. The prevalent awareness of feed management skills is in agreement with Dida *et al*. (2024) [12], who stressed training as a significant factor for adoption of supplementation.

3.2.4 Gariyaband District

In Gariyaband, five alone were significant, *viz*., nutritional quality (Q2, $p = 0.01$), role of feed management (Q3, $p < 0.001$), cost-effectiveness (Q5, $p = 0.01$), sustainability (Q8, $p = 0.01$), and government support (Q12, $p = 0.03$). Though farmers understood supplementation's contribution toward milk quality and economic sustainability, they were not so sure regarding direct effects on milk production or cow health. This mixed view indicates limited uptake of good quality feed or inconsistency in supplementation practice. Such disparity mirrors findings by Goswami *et al*. (2017) [17], where local fodder availability influenced heterogeneous results in supplementation studies.

Table 8: Impact of feed supplementation on milk production in Gariyaband District.

Question No.	Description	Mean Score	SD	CV	t-value	p-value two tailed	Significance
Q1	Perceived Effect of Feed Supplementation on Milk Production	2.85	1.39	0.49	-0.68	0.75	No
Q2	Feed Supplementation and Nutritional Quality of Milk	3.63	1.37	0.38	2.88	0.01	Yes
Q3	Role of Feed Management in Increasing Milk Yield	1.93	1.07	0.56	-6.35	0.00	Yes
Q4	Impact on Cow Health and Body Condition	3.15	1.41	0.45	0.68	0.76	No
Q5	Cost-effectiveness of Feed Supplementation	2.48	1.18	0.48	-2.82	0.01	Yes
Q6	Importance of Timing and Composition of Supplementation	2.85	1.27	0.45	-0.75	0.69	No
Q7	Observable Increase in Milk Output Due to Supplementation	3.20	1.52	0.48	0.83	0.62	No
Q8	Contribution to Dairy Sector Sustainability	2.38	1.41	0.59	-2.81	0.01	Yes
Q9	Customization of Feed According to Individual Cow Needs	2.85	1.27	0.45	-0.75	0.69	No
Q10	Influence of High-Quality Feed Supplements on Milk Composition	2.58	1.30	0.50	-2.07	0.07	No
Q11	Availability and Effectiveness of Training on Feed Supplementation	3.25	1.61	0.50	0.98	0.50	No
Q12	Awareness of Government Support/Incentives for Feed Supplementation	2.68	0.83	0.31	-2.48	0.03	Yes

SD=Standard Deviation, CV=Coefficient of Variance; Significance level ($p < 0.05$)

3.2.5 Mahasamund District

Three major factors came out in Mahasamund: effect on milk production (Q1, $p< 0.001$), feeding management (Q3, $p< 0.001$), and government incentives (Q12, $p< 0.001$). All other variables; such as milk quality, health, cost-effectiveness, and sustainability- were non-significant.

Table 9: Impact of feed supplementation on milk production in Mahasamund District.

Question No.	Description	Mean Score	SD	CV	t-value	p-value two tailed	Significance
Q1	Perceived Effect of Feed Supplementation on Milk Production	2.28	0.85	0.37	-5.41	0.00	Yes
Q2	Feed Supplementation and Nutritional Quality of Milk	2.90	0.90	0.31	-0.70	0.73	No
Q3	Role of Feed Management in Increasing Milk Yield	2.15	0.74	0.34	-7.31	0.00	Yes
Q4	Impact on Cow Health and Body Condition	2.73	0.85	0.31	-2.05	0.07	No
Q5	Cost-effectiveness of Feed Supplementation	2.65	1.08	0.41	-2.06	0.07	No
Q6	Importance of Timing and Composition of Supplementation	3.13	0.88	0.28	0.90	0.56	No
Q7	Observable Increase in Milk Output Due to Supplementation	2.70	1.07	0.40	-1.78	0.13	No
Q8	Contribution to Dairy Sector Sustainability	2.73	1.04	0.38	-1.68	0.15	No
Q9	Customization of Feed According to Individual Cow Needs	2.93	1.05	0.36	-0.45	0.98	No
Q10	Influence of High-Quality Feed Supplements on Milk Composition	2.73	1.01	0.37	-1.72	0.14	No
Q11	Availability and Effectiveness of Training on Feed Supplementation	3.15	1.00	0.32	0.95	0.52	No
Q12	Awareness of Government Support/Incentives for Feed Supplementation	2.28	0.93	0.41	-4.91	0.00	Yes

SD=Standard Deviation, CV=Coefficient of Variance; Significance level ($p < 0.05$)

This suggests low awareness of supplementation benefits, perhaps because of traditional dependence on crop residues and poor-quality fodder. Other ethnographic research (Jain *et al*., 2017) [21] also reported poor supplementation in this district, notwithstanding its large number of Kosali cattle.

Table 10: Overall Mean Perception on the Impact of feed supplementation on milk production in Raipur Divisions

	Mean±SE				
Q.No.	**Dhamtari**	**Baloda Bazar**	**Raipur**	**Gariyaband**	**Mahasamund**
Q1	2.28±0.36	2.33±0.37	1.58±0.25	2.85±0.45	2.28±0.36
Q2	2.95±0.47	2.75±0.43	2.43±0.38	3.63±0.57	2.90±0.46
Q3	1.93±0.30	2.03±0.32	1.60±0.25	1.93±0.30	2.15±0.34
Q4	2.98±0.47	2.48±0.39	2.43±0.38	3.15±0.50	2.73±0.43
Q5	2.63±0.42	3.00±0.47	2.35±0.37	2.48±0.39	2.65±0.42
Q6	3.15±0.50	2.75±0.43	2.75±0.43	2.85±0.45	3.13±0.49
Q7	2.75±0.43	3.45±0.55	2.15±0.34	3.20±0.51	2.70±0.43
Q8	3.23±0.51	2.83±0.45	2.43±0.38	2.38±0.38	2.73±0.43
Q9	2.80±0.44	2.83±0.45	2.15±0.34	2.85±0.45	2.93±0.46
Q10	2.90±0.46	2.68±0.42	2.55±0.40	2.58±0.41	2.73±0.43
Q11	3.05±0.48	3.00±0.47	2.38±0.38	3.25±0.51	3.15±0.50
Q12	2.55±0.40	2.23±0.35	2.53±0.40	2.68±0.42	2.28±0.36
Average	2.76±0.44	2.69±0.43	2.28±0.36	2.82±0.45	2.69±0.43

SE= Standard Error

Table 6 and Figure 3 revealed that the research indicated considerable regional variation in perceptions regarding feed supplementation on Kosali cow milk production. Greatest average scores were registered in Gariyaband (2.82 ± 0.45) and Dhamtari (2.76 ± 0.44), whereas Raipur recorded lesser perceptions (2.28 ± 0.36). Constant SE values reflect consistent regional responses.

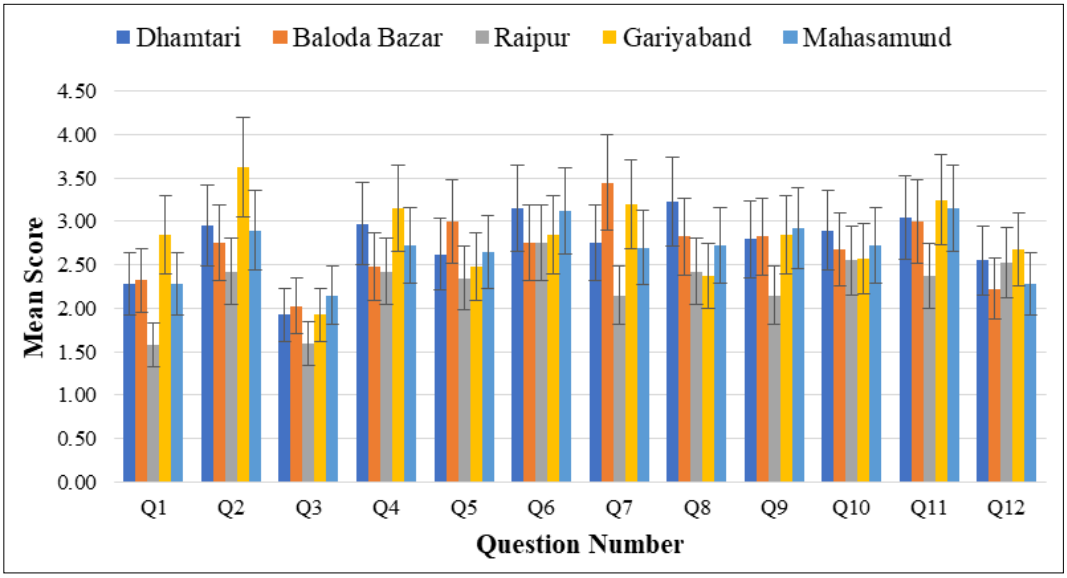

Fig 3: Graphical view of Overall Mean Perception on the Impact of feed supplementation on milk production in Raipur Divisions

Greater perception in certain areas could be an index of improved knowledge about supplementing benefits of feed, which is consistent with evidence that such supplements improve milk production and quality (Akinlade *et al*., 2021; Akter *et al*., 2024; Auldist *et al*., 2013, 2016) [2, 2, 3]. Regional differences are likely due to local feeding habits, mineral content, and extension services (Bhagat *et al*., 2021; Shinde, 2021; Sahu *et al*., 2018) [5, 37, 36], emphasizing the importance of targeted intervention.

3.3 Comparative Discussion Across Districts

There is evident regional heterogeneity in feed supplementation perceptions across Raipur Division.

- Raipur district farmers demonstrated the greatest awareness of supplementation gains in nearly all aspects, implying greater assimilation of scientific information and extension support.
- Baloda Bazar and Dhamtari farmers recognized production and economic gains but demonstrated weaker awareness of milk quality and sustainability dimensions.
- Gariyaband respondents emphasized nutritional and sustainability benefits but were not convinced regarding output effects.
- The farmers of Mahasamund exhibited the most incomplete perceptions, with understanding mostly limited to yield and government incentives.

This disparity is an indication of differences in schooling, training exposure, availability of fodder, and extension service access between districts. According to Hassen *et al*. (2022) [18], farmer attitudes towards supplementation are predominantly influenced by institutional support, awareness programs, and cost-feasibility.

3.4 Implications for Sustainable Dairy Development

The results highlight several important implications:

3.4.1 Targeted Awareness Programs: Extensive extension programs are needed in districts such as Mahasamund and Dhamtari to enhance supplementation's contribution to improving milk quality and animal health.

3.4.2 Policy Interventions: Government schemes need to be propagated effectively and tailored to local situations. The high level of government incentives' perception across the districts shows their impact, consistent with previous indicators of policy effectiveness in livestock development (Muwal *et al*., 2020) [32].

3.4.3 Training and Capacity Building: Raipur's success testifies to the potency of farmer training. Scaling such efforts would fill knowledge gaps in other districts.

3.4.4 Integration of Indigenous Practices: Local feeding habits ought to be synchronized with supplementation approaches in order to maximize acceptance, as proposed by Bipate and Misra (2020) [7].

The research indicates that although Kosali cattle farmers in Raipur Division recognize the possibility of feed supplementation, perception differs widely between districts. Raipur excels with high positive perceptions, while Mahasamund is behind with low awareness. These variations highlight the need for context-specific interventions, training for farmers, and policy assistance to achieve the best in supplementation for indigenous cattle systems.

4. Conclusion

4.1 Feed supplementation perceptions vary widely across districts

Findings indicate extensive regional difference in the perceptions of farmers on supplementation of Kosali cow milk production in Chhattisgarh. Whereas Raipur district respondents exhibited extensive awareness of supplementation benefits on milk yield, quality, animal health, and sustainability, Mahasamund farmers depicted limited awareness based primarily on production and government incentives. Dhamtari and Baloda Bazar showed moderate awareness, with a focus on yield and cost-effectiveness, whereas Gariyaband farmers highlighted nutritional quality and sustainability at the expense of direct productivity benefits. Such variation highlights how local socio-economic settings, levels of education, and exposure to extension activities influence perceptions.

4.2 Regionalized interventions required for successful adoption

Since uneven patterns of awareness are likely, one-size-fits-all approaches are bound to fail. District-based interventions that

link scientific training with traditional feeding practices are required to drive adoption higher. For example, awareness campaigns in Mahasamund must highlight the connection between supplementation and milk quality, while technical programs in Dhamtari could communicate about technical approaches to sustainability and long-run economic gain. The success seen in Raipur underscores the value of capacity-building programs, implying that replicated experience with similar training and demonstration programs across other districts may help fill knowledge gaps and enhance adoption rates.

4.3 Policy implications for dairy development programs

The results have significant policy implications for livestock development in Chhattisgarh. Firstly, higher visibility and access to government schemes are required, as awareness of incentives heavily impacted perceptions across districts. Secondly, policies need to promote public-private partnerships in feed supply chains to ensure supplementation affordability and access. Lastly, blending indigenous knowledge with contemporary supplementation methods will secure cultural acceptance and sustainability. By making dairy development schemes fit regional requirements, policymakers can increase milk productivity, improve smallholder farmers' livelihoods, and promote the conservation and use of Kosali cattle as an important indigenous genetic resource.

Conflict of Interest
Not available

Financial Support
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