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ASSESSMENT OF REPRODUCTIVE PERFORMANCE AND NUTRITIONAL STATUS OF BINJHARPURI CATTLE IN THEIR NATIVE TRACT

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ABSTRACT

The present study was undertaken to assess the reproductive performance and nutritional status of Binjharpuri cattle in their native tract and to evaluate the effect of nutritional supplementation on growth and reproductive performance. A field survey was conducted among 200 female Binjharpuri cattle, comprising 111 cows and 89 heifers, in four villages of Jajpur district, Odisha, from January to May 2021. Reproductive disorders were recorded in 115 animals, representing an overall prevalence of 57.50%. The prevalence was higher in cows (66.67%) than in heifers (46.06%). Based on the survey findings, 60 anoestrous animals, comprising 30 heifers and 30 postpartum anoestrous cows, were selected for a 60-day supplementation trial. The animals were divided into five treatment groups, each comprising six heifers and six cows. The groups received farmers' existing feeding practices (Group I), farmers' practice plus area-specific mineral mixture (ASSM) at 50 g/day (Group II), ASSM plus bypass protein at 100 g/day (Group III), ASSM plus bypass fat at 100 g/day (Group IV), and ASSM plus bypass protein and bypass fat at 50 g/day each (Group V). Body weight and average daily gain (ADG) were recorded, while reproductive performance was assessed through oestrus response and conception rate. The highest ADG was recorded in Group V among both heifers (230.67 ± 6.93 g/day) and cows (132.33 ± 3.16 g/day). Among heifers, the highest oestrus response (83.33%) and conception rate (80.00%) were observed in Group V. Among cows, the highest oestrus response (66.67%) was recorded in Groups IV and V, while the highest reported conception rate (75.00%) was observed in both groups. The reported cost per conception in Group V was ₹1,500. The findings indicate that reproductive disorders are an important concern in the surveyed Binjharpuri cattle population and that combined nutritional supplementation may improve growth and reproductive performance under smallholder production conditions.

KEYWORDS: Binjharpuri cattle, reproductive disorders, anoestrus, area-specific mineral mixture, bypass protein, bypass fat, oestrus response, conception rate

1. INTRODUCTION

Indigenous cattle constitute an important component of livestock production systems in India. They contribute to milk production, draught power, manure production and livelihood security, particularly among small and marginal farmers. These animals are generally adapted to local climatic conditions and are maintained under low-input production systems. However, inadequate nutrition, poor-quality feed resources, improper breeding management and limited access to veterinary services may adversely affect their productive and reproductive efficiency.

Binjharpuri is an indigenous dual-purpose cattle breed of Odisha, predominantly distributed in Jajpur district. The breed is valued for its adaptability to local environmental conditions and its utility under traditional smallholder production systems. Nayak et al. (2023) evaluated the production performance of Binjharpuri cattle and documented variations in production traits associated with location, lactation order and season of calving. Their findings highlighted the importance of management and environmental factors in the performance of this indigenous breed.

Reproductive efficiency is an important determinant of the economic productivity of cattle. Reproductive disorders such as anoestrus, repeat breeding, delayed onset of oestrus and poor conception can increase the calving interval and reduce lifetime productivity. Nutritional inadequacy is one of the important factors associated with reproductive inefficiency. Insufficient energy and protein intake, along with imbalanced mineral supply, may affect ovarian activity, oestrus expression and conception.

Minerals such as zinc, copper, manganese, cobalt and selenium are involved in several physiological processes associated with growth and reproduction. Their dietary requirements depend on the physiological status, age, production level and availability of minerals in the basal diet. Mohapatra et al. (2012) reported improved reproductive performance following supplementation of area-specific mineral mixture in cows. Agrawalla et al., (2017) also reported improvements in reproductive performance following area-specific mineral mixture supplementation in crossbred cattle in Odisha. Further studies have investigated mineral supplementation as a management approach for improving reproductive efficiency in cattle (Sahoo et al., 2016; Sethy et al., 2019; Muwel et al., 2020).

Energy supplementation is also important in anoestrous and postpartum animals, particularly where the basal diet does not meet their nutritional requirements. Bypass fat provides a concentrated source of energy, while bypass protein contributes to the supply of protein that escapes ruminal degradation. Tyagi et al., (2010) investigated the effect of bypass fat supplementation on productive and reproductive performance in crossbred cows. Sahoo et al., (2016) evaluated the combined supplementation of mineral mixture and bypass fat in reproductive-disordered cattle. Satapathy et al., (2019) also reported beneficial effects of nutritional interventions in anoestrous cattle under field conditions in Odisha. More recently, bypass fat supplementation has been investigated for improving reproductive performance and economic efficiency in dairy cattle (Sihag et al., 2020; Lunagariya et al., 2022; Sethy et al., 2022; Sarkar et al., 2025).

Balanced mineral nutrition is important for normal reproductive functions in female cattle. Recent reviews have further discussed the role of essential trace minerals in ovarian activity, conception and pregnancy maintenance (Molefe and Mulunda, 2025; Wang et al., 2026). However, information regarding the reproductive status and feeding practices of Binjharpuri cattle under field conditions remains limited.

Therefore, the present study was undertaken to assess the reproductive performance and nutritional status of Binjharpuri cattle in their native tract and to evaluate the effect of area-specific mineral mixture, bypass protein and bypass fat supplementation on growth and reproductive performance.

2. MATERIALS AND METHODS

2.1 Study area and survey

The study was conducted in four villages, namely Badakujhala, Banapur, Chattis Debil and Thiar Debil, located in Jajpur Sadar and Binjharpur blocks of Jajpur district, Odisha. The field survey was carried out from January to May 2021 in collaboration with the All India Coordinated Research Project on Nutritional and Physiological Approaches for Enhancement of Reproductive Performance in Animals (NPAERPA), Department of Animal Reproduction, Gynaecology and Obstetrics, College of Veterinary Science and Animal Husbandry, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar. A total of 200 female Binjharpuri cattle, comprising 111 cows and 89 heifers, were included in the survey. Information regarding reproductive history, occurrence of reproductive disorders and prevailing feeding and management practices was collected from the farmers.

2.2 Assessment of nutritional status and feeding practices

The prevailing feeding practices of Binjharpuri cattle were assessed through field observations and interaction with livestock owners. The feeding system was predominantly traditional and based on locally available feed resources. Animals were generally allowed to graze wherever grazing resources were available. Paddy straw was commonly offered as dry roughage, while green fodder availability varied according to season and local resources. Rice bran, rice gruel and small quantities of concentrate were occasionally provided. Drinking water was generally offered two to three times daily.

The assessment focused on the feeding resources and management practices followed by farmers. Individual dry matter intake, nutrient digestibility and chemical composition of feed were not quantified.

2.3 Selection of experimental animals

Based on the survey findings, 60 anoestrous animals were selected for the supplementation trial. These included 30 heifers and 30 postpartum anoestrous cows. The animals were clinically examined and selected animals were apparently free from infectious and contagious diseases.

All selected animals were dewormed seven days before the commencement of the experiment using fenbendazole at 10 mg/kg body weight. Necessary supportive medication was provided wherever required.

2.4 Experimental design and nutritional treatments

The selected animals were divided into five treatment groups, each comprising six heifers and six cows. The supplementation trial was conducted for 60 days.

- **Group I:** Farmers' existing feeding practices (control).
- **Group II:** Farmers' practice + area-specific mineral mixture (ASSM) at 50 g/animal/day.
- **Group III:** Farmers' practice + ASSM at 50 g + bypass protein at 100 g/animal/day.
- **Group IV:** Farmers' practice + ASSM at 50 g + bypass fat at 100 g/animal/day.
- **Group V:** Farmers' practice + ASSM at 50 g + bypass protein at 50 g + bypass fat at 50 g/animal/day.

The area-specific mineral mixture was prepared at OUAT following the formulation described by Mohapatra (2011). The composition per kilogram of mixture was as follows:

Table 1. Composition of area-specific mineral mixture

Ingredient	Quantity (g/kg)
Dicalcium phosphate (DCP)	850.62
Zinc sulphate	55.00
Manganese sulphate	45.00
Copper sulphate	26.00
Potassium sulphate	15.00
Cobalt chloride	5.68
Selenium-containing ingredient	2.70

Bypass protein supplementation was provided using Biobloom, procured from Zydus AHL, while bypass fat supplementation was provided using Fatomax, procured from INTAS Pharmaceuticals Ltd.

2.5 Body weight and average daily gain

The body weight of each experimental animal was recorded at the beginning (Day 0) and end (Day 60) of the experiment. Body weight was estimated using the formula described by Johnson (1940). Average daily gain was calculated using the following formula: ADG (g/day) = [(Final body weight − Initial body weight) × 1000] / Experimental period (days)

2.6 Monitoring of oestrus and reproductive performance

Experimental animals were monitored regularly for signs of oestrus, including vulval swelling, bellowing, restlessness and the presence of characteristic ropy vaginal discharge. Animals exhibiting oestrus were bred either by natural service or artificial insemination, depending on availability and management conditions. Pregnancy diagnosis was carried out by per rectal examination approximately 60 days after breeding.

The following reproductive parameters were calculated:

Oestrus response (%) = (Number of animals exhibiting oestrus / Total number of animals treated) × 100

Conception rate (%) = (Number of animals conceived / Number of animals bred) × 100

2.7 Statistical analysis

The data were analysed using appropriate statistical procedures, including analysis of variance (ANOVA), Student's t-test and chi-square test, wherever applicable. Differences were considered statistically significant at $P<0.05$.

3. RESULTS

3.1 Prevalence of reproductive disorders

Among the 200 female Binjharpuri cattle surveyed, reproductive disorders were recorded in 115 animals, representing an overall prevalence of 57.50%. The prevalence was higher among cows than heifers.

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Table 2. Prevalence of reproductive disorders among surveyed Binjharpuri cattle

Category	Animals surveyed	Animals with reproductive disorders	Prevalence (%)
Cows	111	74	66.7%
Heifers	89	41	46.06%
Total	200	115	57.50%

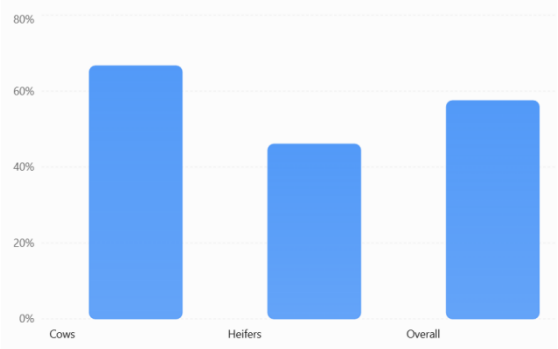


Figure 1. Prevalence of reproductive disorders among surveyed Binjharpuri cattle.

3.2 Body weight and average daily gain in heifers

The initial and final body weights of heifers were statistically comparable among the five treatment groups. Initial body weight ranged from 135.33 ± 5.46 to 137.58 ± 5.15 kg, while final body weight ranged from 148.36 ± 5.44 to 151.09 ± 5.61 kg. The average daily gain differed significantly among treatment groups ($P=0.018$). The highest

ADG was recorded in Group V (230.67 ± 6.93 g/day), followed by Group III (219.00 ± 5.12 g/day), Group IV (217.17 ± 6.60 g/day) and Group II (215.00 ± 5.38 g/day). The lowest ADG was observed in the control group (200.33 ± 3.85 g/day).

Table 3. Effect of nutritional supplementation on body weight and average daily gain in Binjharpuri heifers

Parameter	Group I	Group II	Group III	Group IV	Group V	P-value
Initial body weight (kg)	137.08 ± 5.94	137.42 ± 4.60	137.58 ± 5.15	135.33 ± 5.46	137.25 ± 5.46	0.998
Final body weight (kg)	149.10 ± 6.01	150.32 ± 4.33	150.72 ± 5.00	148.36 ± 5.44	151.09 ± 5.61	0.996
ADG (g/day)	200.33^{a} ± 3.85	215.00^{ab} ± 5.38	219.00^{b} ± 5.12	217.17^{ab} ± 6.60	230.67^{b} ± 6.93	0.018

Values are mean ± standard error; n=6 per group. Different superscripts within a row indicate significant differences.

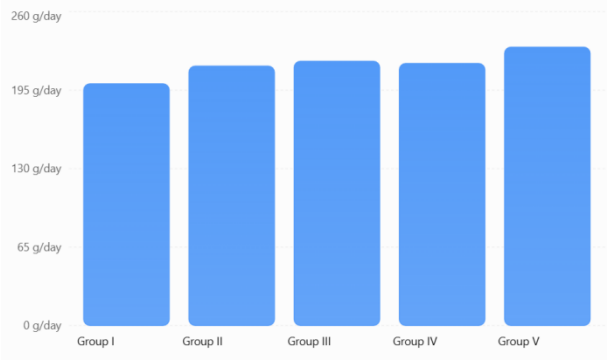


Figure 2. Effect of nutritional supplementation on average daily gain in Binjharpuri heifers.

3.3 Body weight and average daily gain in cows

The initial and final body weights of cows did not differ significantly among the five treatment groups. Initial body weight ranged from 197.08 ± 4.14 to 202.75 ± 3.48 kg, whereas final body weight ranged from 205.02 ± 4.08 to 209.81 ± 3.56 kg. A significant difference in ADG was observed among treatment groups ($P<0.01$). Group V showed the highest ADG (132.33 ± 3.16 g/day), followed by Group III (125.83 ± 3.57 g/day), Group IV (119.50 ± 4.21 g/day) and Group II (117.67 ± 4.53 g/day). The lowest ADG was recorded in the control group (105.00 ± 1.77 g/day).

Table 4. Effect of nutritional supplementation on body weight and average daily gain in Binjharpuri cows

Parameter	Group I	Group II	Group III	Group IV	Group V	P-value
Initial body weight (kg)	200.33 ± 3.59	202.75 ± 3.48	198.58 ± 3.68	199.92 ± 4.08	197.08 ± 4.14	0.870
Final body weight (kg)	206.63 ± 3.64	209.81 ± 3.56	206.13 ± 3.56	207.09 ± 3.96	205.02 ± 4.08	0.923
ADG (g/day)	105.00^{a} ± 1.77	117.67^{b} ± 4.53	125.83^{b} ± 3.57	119.50^{b} ± 4.21	132.33^{c} ± 3.16	<0.01

Values are mean ± standard error; n=6 per group. Different superscripts within a row indicate significant differences.

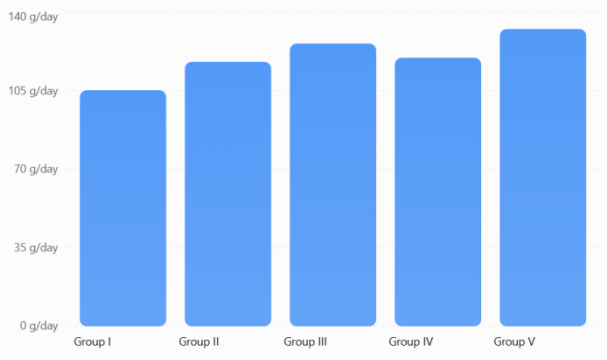


Figure 3. Effect of nutritional supplementation on average daily gain in Binjharpuri cows.

3.4 Reproductive performance in heifers

The oestrus response varied among the treatment groups. The highest oestrus response was recorded in Group V (83.33%), followed by Group III (66.67%) and Group IV (50.00%). The highest reported conception rate was also observed in Group V (80.00%), followed by Group IV (66.67%) and Group III (50.00%).

Table 5. Oestrus response and conception rate in Binjharpuri heifers following nutritional supplementation

Treatment group	Oestrus response (%)	Conception rate (%)
Group I	Not available	Not available
Group II	Not available	Not available
Group III	66.67	50.00
Group IV	50.00	66.67
Group V	83.33	80.00

Exact reproductive percentages for Groups I and II were not available in the supplied study data and should be inserted from the original experimental records before submission.

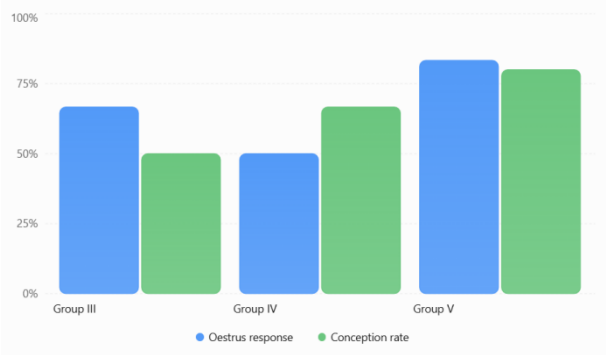


Figure 4. Oestrus response and conception rate in Binjharpuri heifers following nutritional supplementation.

3.5 Reproductive performance in cows

Among the postpartum anoestrous cows, the highest oestrus response was recorded in Groups IV and V (66.67% each). Groups II and III showed an oestrus response of 50.00% each, while the control group showed the lowest response (16.67%). The highest reported conception rate was recorded in Groups IV and V (75.00% each), followed by Group III (50.00%).

Table 6. Oestrus response and conception rate in postpartum anoestrous Binjharpuri cows

Treatment group	Oestrus response (%)	Conception rate (%)
Group I	16.67	Not available
Group II	50.00	Not available
Group III	50.00	50.00
Group IV	66.67	75.00
Group V	66.67	75.00

Exact conception percentages for Groups I and II were not available in the supplied study data and should be confirmed from the original experimental records.

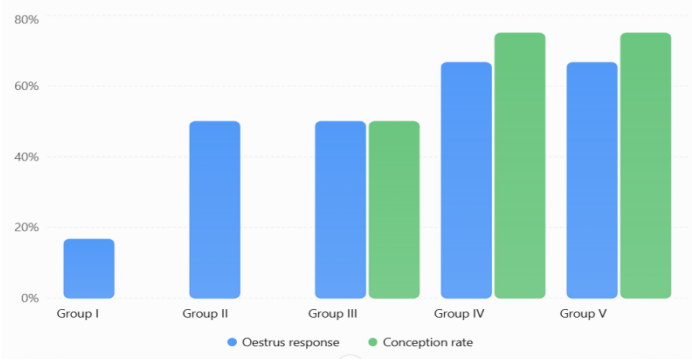


Figure 5. Oestrus response and conception rate in postpartum anoestrous Binjharpuri cows following nutritional supplementation.

3.6 Cost per conception

The reported cost per conception in Group V was ₹1,500. This finding indicates the potential economic relevance of combined supplementation. However, a complete economic comparison among all treatment groups would require the corresponding supplementation costs and conception records for each group.

4. DISCUSSION

4.1 Prevalence of reproductive disorders

The present survey revealed an overall reproductive disorder prevalence of 57.50% among the studied Binjharpuri cattle population. The prevalence was higher in cows (66.67%) than in heifers (46.06%). This difference may be associated with the additional reproductive and physiological demands experienced by cows during pregnancy, calving and lactation. Postpartum reproductive recovery may also be influenced by feeding management, body condition, suckling practices and the availability of adequate nutrients.

The prevalence observed in the present study indicates the need for improved reproductive healthcare and nutritional management in the native tract of Binjharpuri cattle. However, the findings should be interpreted in relation to the selected villages, study period and diagnostic criteria used. The prevalence cannot be considered representative of the entire breed population without a larger and more geographically extensive survey. Nayak et al. (2023) documented variations in production performance among Binjharpuri cattle associated with location, lactation order and season of calving. These findings emphasize the influence of management and environmental factors on the performance of this indigenous breed.

4.2 Feeding practices and nutritional status

The field assessment indicated that Binjharpuri cattle were predominantly maintained under traditional smallholder production systems. Paddy straw was the major dry roughage, while green fodder availability varied according to season and location. Rice bran, rice gruel and small quantities of concentrate were provided occasionally. Such feeding practices may not consistently fulfil the nutritional requirements of animals at different physiological stages, particularly during growth, late pregnancy and the postpartum period.

Jajpur district is susceptible to seasonal flooding, which may affect fodder availability and the continuity of livestock feeding resources. Under such conditions, the availability of balanced feed and mineral supplements becomes important. Nevertheless, the present study did not include detailed feed analysis, individual feed intake measurements or nutrient balance calculations. Therefore, specific nutrient deficiencies cannot be confirmed from the feeding survey alone.

4.3 Effect of supplementation on growth performance

The average daily gain differed significantly among treatment groups in both heifers and cows. In heifers, the highest ADG was recorded in Group V (230.67 ± 6.93 g/day), while the lowest was observed in the control group (200.33 ± 3.85 g/day). Similarly, among cows, Group V showed the highest ADG (132.33 ± 3.16 g/day), compared with 105.00 ± 1.77 g/day in the control group.

The comparatively higher ADG in Group V suggests a favourable response to the combined supplementation of area-specific mineral mixture, bypass protein and bypass fat. The response may be related to improved nutrient availability through the additional supply of minerals, protein and energy. However, because the study did not measure nutrient intake or digestibility, the precise contribution of each supplement cannot be established.

Tyagi et al., (2010) evaluated bypass fat supplementation in crossbred cows and reported effects on productive and reproductive performance. Sahoo et al., (2016) also investigated combined mineral mixture and bypass fat supplementation in reproductive-disordered cattle. Similar nutritional interventions were studied by Satapathy et al., (2019) under field conditions in Odisha. These investigations provide relevant comparative evidence for the use of nutritional supplementation in cattle.

4.4 Effect of supplementation on reproductive performance in heifers

The highest oestrus response and conception rate among heifers were recorded in Group V, receiving ASSM, bypass protein and bypass fat. The oestrus response in this group was 83.33%, while the conception rate was 80.00%. The response was also encouraging in Group III, which received ASSM and bypass protein, and Group IV, which received ASSM and bypass fat.

Improved nutritional supply may support normal ovarian activity, follicular development and expression of oestrus. Balanced mineral supply is important for several reproductive processes, while adequate energy and protein are necessary for maintaining growth and reproductive development. Mohapatra et al., (2012) reported improved conception performance following area-specific mineral supplementation in cows. Agrawalla et al., (2017) also reported improvements in reproductive parameters following mineral supplementation in crossbred cattle in Odisha.

The findings of the present study are consistent with the general rationale for investigating bypass fat supplementation in anoestrous cattle. Sahoo et al., (2016) evaluated combined mineral mixture and bypass fat supplementation in reproductive-disordered cattle, while Sethy et al., (2022) investigated bypass fat in combination with hormonal protocols in crossbred cattle with reproductive disorders. Sarkar et al., (2025) also evaluated bypass fat supplementation as a nutritional intervention for advancing reproductive activity in anoestrous dairy cows.

4.5 Effect of supplementation on reproductive performance in cows

Among postpartum anoestrous cows, Groups IV and V showed the highest oestrus response (66.67% each). The highest reported conception rate was also observed in these groups (75.00% each). In contrast, the control group showed the lowest oestrus response (16.67%).

The comparatively better reproductive response in groups receiving bypass fat may be associated with the additional energy supplied through rumen-protected fat. Energy availability is particularly important in postpartum animals because inadequate energy intake may delay the resumption of ovarian activity. Tyagi et al., (2010) and Sihag et al., (2020) investigated the effects of bypass fat supplementation on productive and reproductive performance in crossbred cows. Lunagariya et al., (2022) also examined bypass fat supplementation in relation to production, reproduction and economic efficiency in dairy cows.

The importance of mineral supplementation in reproductive management has also been demonstrated by Mohapatra et al., (2012), Agrawalla et al., (2017) and Muwel et al., (2020). These studies provide supporting evidence for nutritional interventions in cattle maintained under different production systems. However, differences in breed, physiological status, basal diet and experimental design should be considered when comparing results among studies.

4.6 Economic implications

The reported cost per conception in Group V was ₹1,500. The combined supplementation strategy may have practical relevance under smallholder production systems if the reproductive benefits are maintained under field conditions. However, a reliable economic recommendation requires a comparison of total supplementation expenditure, additional management costs, conception outcomes and the economic value of improved reproductive performance across all treatment groups.

5. CONCLUSION

The present study revealed a considerable prevalence of reproductive disorders (57.50%) among the surveyed Binjharpuri cattle in their native tract, with a higher prevalence in cows than in heifers. The field assessment also indicated that animals were predominantly maintained under traditional feeding systems based on grazing, paddy straw and limited supplementary feed resources.

Nutritional supplementation significantly influenced average daily gain in both heifers and cows. The combined supplementation of area-specific mineral mixture, bypass protein and bypass fat (Group V) produced the highest average daily gain in both categories. Encouraging oestrus response and conception rates were also observed in supplemented groups, particularly Group V in heifers and Groups IV and V in cows.

The findings suggest that targeted nutritional supplementation may be a useful management approach for improving growth and reproductive performance in Binjharpuri cattle. Further studies involving larger animal populations, detailed feed and nutrient analysis, and complete economic evaluation are recommended to develop practical nutritional strategies for the sustainable improvement of this indigenous breed.

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