



Farmer participatory assessment of nutritional interventions for productivity and profitability enhancement of dairy animals at small farms

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ABSTRACT

The present study was conducted across 18 districts falling under eight Agro-climatic zones in Uttar Pradesh functioning under aegis of ICAR-ATARI, Kanpur with the aim of assessment of nutritional interventions for productivity enhancement of dairy animals in the selected villages. Through Participatory Rural Appraisal (PRA) and Problem-Cause analysis (PCA) in the selected villages, issues of lower level of milk production and sub-optimal fertility potential were figured out to be topmost problems among the dairy animals of the selected area. The potential causes of the poor performance of dairy animals identified were lack of energy and micronutrients in the feed, suboptimal rumen health, imbalanced ration and feeding of poor-quality roughages. To overcome the prevailing problems of small and marginal dairy farmers, the innovative technologies related to nutritional intervention (bypass nutrients, rumen modifiers, mineral mixture etc.) for dairy animals, released from different ICAR institutes and state agricultural universities were subjected for On Farm Testings (OFTs) for assessing their field level appropriateness. The results of different OFTs conducted, confirmed significantly higher milk production, improved fertility, higher benefit:cost ratio in treatment groups with improved technologies over control groups with farmer's practice of feeding and positive reactions of the farmers for adoption of those technologies. The present study concluded that adoption of these tested technologies like daily feeding of mineral mixture, bypass nutrients, probiotics etc. may improve the productivity of dairy animals under the field conditions.

Keywords: Bypass nutrients, Mineral mixture, On farm testings (OFTs), Productivity enhancement, Rumen modifiers

Indian population with a score of 1.3 billion has already surpassed China. The mammoth population growth has overburdened our food production system with growing demands for milk, meat, eggs and other livestock-based products has opened the pathway to improve livelihood and nutritional security for small livestock holders (Alexandratos and Bruinsma 2012). The role of dairy sector cannot be ignored as it involves eight crore farmers directly and contributes to five percent in Indian economy as single largest agricultural commodity. India possesses the largest bovine population (303.76 million as reported in BAHS 2022) and ranks first in milk production (221.06 million tonnes) with 51.05% increase in production from past eight years (PIB 2023). Though India has highest milk production worldwide, the productivity of individual cattle/buffalo is low as compared to exotic breeds (Landes *et al.* 2017). With the available genetic potential for milk production, the productivity of our bovines can be improved by providing best livestock management practices which varies according to agro-climatic conditions of country

(Gupta *et al.* 2008). However, many bio-physical, systematic and socio-cultural problems limits the best livestock management practices to exploit their maximum genetic potential (Balehegn *et al.* 2020). Feed and fodder costs 70% of total expenditure in dairy and rises up to 90% in intensive system of production (Makkar 2016) and limited access to quality feed, fodder and nutrients (Brito *et al.* 2020) is considered as major constraint for improved productivity of livestock (Balehegn *et al.* 2020).

A number of nutritional interventions and technologies have been developed and tested by many ICAR institute and state agricultural universities (SAUs) as well as on-farm with farmer's participation to address the nutrition related constraints leading to poor bovine (cattle and buffaloes) productivity. These technologies include feeding of mineral mixture, vitamins, trace minerals, bypass nutrients, probiotics, mineral and nutrient block licks, improvement of nutritive value of poor-quality roughages, feed additives and supplements, balanced ration, etc. (Owen *et al.* 2012). This, however, leads to the research questions whether these available technologies are efficient in terms of fulfilling the gap between lower performance and expected productivity of Indian bovines at field level? Hence, the assessment of developed on-station feed management technologies and

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nutritional intervention at farmer's field becomes eminent. With these backgrounds, the present study, on farmer's participatory assessment of different recommended nutritional interventions for productivity and profitability enhancement of bovines at small dairy farms through On Farm Testings (OFTs) with active participation of Krishi Vigyan Kendras (KVKs) in the state of Uttar Pradesh (U.P.) were conducted.

MATERIALS AND METHODS

This study includes farmer participatory OFTs related to nutritional interventions conducted by different KVKs during the years 2016-2023 in 18 districts of U.P. namely Banda (2022-23), Mau (2021-22, 2018-19), Lucknow (2018-19), Basti (2021-22), Barabanki (2022-23), Saharanpur (2018-19), Balrampur (2018-19), Rampur (2018-19), Jaunpur-II (2017-18), Fatehpur (2017-18), Firozabad (2017-18), Hathras (2015-16), Gorakhpur-I (2015-16), Unnao (2018-19) and Farrukhabad (2016-17) across eight agro-climatic zones of Uttar Pradesh. All the OFTs were performed as per the standard protocols. Firstly, the participatory rural appraisal (PRA) exercise was done in the selected villages and thereafter, real situation of dairy farming in that particular village was analyzed. After face-to-face interaction with farmers, all problems related to management of dairy (cattle and buffaloes) animals were listed and ranked on the basis of severity of problem. After finding the most severe problem, the list of causes pertaining to low productivity was made, using problem-cause analysis (PCA). The dairy farming situation and problem-cause analysis are narrated in the results and discussion part of this paper. After selection of suitable technologies (related to nutritional/feeding management), farmer's practice (control group= T_1) and corresponding interventions (treatment group= T_2) were compared in the form of experimental trial on farmer's dairy animals in farmers' field. The nutritional interventions included in the study in three different classes namely rumen modifiers and bypass nutrients, energy and micronutrient supplement, and straw enrichment and unconventional feed. For each class in different district the farmer's practices were compared with treatment in view of which feeding intervention is better for each district(s) as compared to farmer's practice.

This on-farm research being farmer participating in nature, all the expenses were met by the targeted farmers except for cost of interventions. Also, all the conditions related to trial were kept homogenous for control and treatment groups except the intervention. The source of technologies which were taken for OFTs belonged to ICAR-IVRI (Izatnagar), ICAR-NDRI (Karnal) and ANDUAT (Ayodhya). The data for productivity was collected daily for the whole experimental period (90-120 days). Technical indicators (Average milk production and conception rate), economic analysis (B:C ratio) for each district (each intervention for two years) and farmer's reaction (technology affordability, availability, social compatibility and ease of use) were recorded at various stages of the

experiment. The B:C ratio was computed using the gross cost (Rs./animal) for all the operational cost and gross return (Rs./animal) by sale of milk during the entire trial period incurred by bovine keepers. For cost effectiveness of recommended technologies, incremental B:C ratio was also calculated by utilizing the cost involved in the feeding intervention only and the net return (Rs.) obtained. Then the value of net return over single unit of investment was worked out. The cost considered for the analysis was at the current price of respective year.

The data were analyzed by using SPSS 20. The means of control and treatments were compared using student's t test and significance level was set at 95%. Farmer's perception of the assessed technologies was also ascertained on the indicators of affordability, ease of application, availability and compatibility on the score of 5 (most liked score) and 1 (least liked score).

RESULTS AND DISCUSSION

Existing dairy farming situation and problem cause analysis: In most of the districts the existing dairy farming situation among the participating farmers was intensive system (stall fed) of production except for district Rampur, Fatehpur and Kaushambi, where they followed semi-intensive (stall fed as well some hours provided for grazing) dairy farming. The prevailing bovine breeds were Murrah buffalo, non-descript buffalo, crossbred cows and non-descript cows (Fig. 1) and their average production performance (liters/day) ranged between 4.5-8.0, 3-3.5, 5.2-9.8 and 1.6, respectively whereas their conception rate (%) varies as 30, 10, 40 and 10, respectively. The major problems experienced by the bovine owners in targeted villages were low milk yield and infertility (anoestrous, repeat breeding and silent heat) (Fig 2, 3). The major causes emerged for existing problems of dairy animals were deficiency of micronutrients in the livestock feed and imbalanced ration (rank-1), lack of energy source in the feed (rank-1), suboptimal rumen health (rank-2), and poor-quality roughage feeding (rank-2). Therefore, the interventions identified for assessment, across the prevailing causes included bypass fat and protein, probiotic supplementations, urea-molasses-mineral blocks, mineral mixture supplementation, nutrient enrichment of poor-quality roughage and azolla feeding.

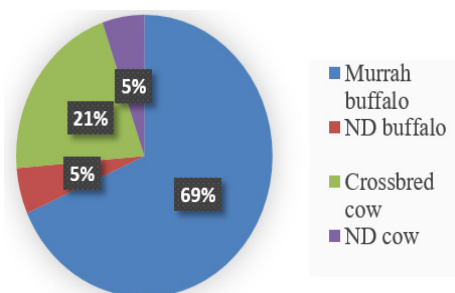


Fig. 1. Distribution of dairy animals' possession by dairy farmers

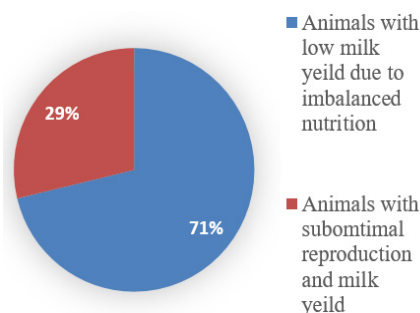


Fig. 2. Major Problems faced by the dairy animals in field conditions

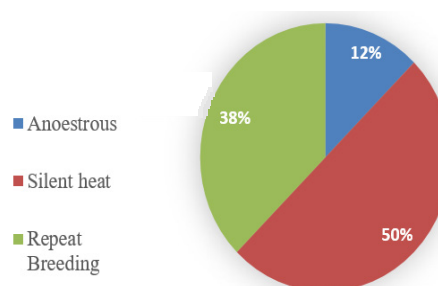


Fig. 3. Major infertility issues faced by dairy animals at field condition

Effect of rumen modifiers and bypass nutrients on productivity of dairy animals: The table 1 shows the result of OFTs conducted in the different districts of U.P. on feeding of probiotics and bypass nutrients in different years. The results from districts Banda and Barabanki revealed significantly higher ($p=0.000$) milk yield in bypass fat supplementation treatment groups (17.9% and 8.75%, respectively) than the control. The incremental B:C ratio for those OFTs also indicated that for every paisa investment in bypass fat feeding, there was corresponding increase of 40 and 33 paisa gain in profitability. This increase may be due to the feeding of bypass fat in early lactation of Murrah buffaloes. During physiological pressure (pregnancy, transition period and lactation), the body of dairy animals requires energy to execute body functions and this energy can be provided by the bypass fat as it bypasses ruminal degradation and is available for true digestion in the abomasum (Sarkar *et al.* 2022). The present findings are in agreement with the results of Tyagi *et al.* 2009, Thakur and Shelke 2010, Rohila *et al.* 2016 and Wadhwa *et al.* 2012, who had also reported that bypass fat feeding ensured the increase of 5.5 to 24% in milk yield. Inclusion of bypass fat for improved milk production is an old technology, albeit improvised many times by many researchers to get enhanced milk production. Parnerkar *et al.* 2011 reported that in Indian condition, feeding of bypass fat @ 20g/ kg of milk production in buffaloes have beneficial effects on improved productivity in terms of quantity and quality of milk production. In contrast to the present study, many authors quoted that supplementation of bypass fat did not show any effect on milk yield until the animal is in positive energy balance (Castaneda-Gutierrez *et al.* 2005, Davison *et al.* 1991). The results of feeding bypass protein in the districts of Lucknow (on crossbred cattle) and Mau (on Murrah buffaloes) resulted in 10.4% and 11.11% increase ($P=0.000$) in milk yield respectively in treatment group over control group (Table 1) and this is also in similar trend with the study of Kumar *et al.* (2005) who reported an increase of 13.65% in milk production of crossbred cows by feeding of degradable dietary protein (UDP). This enhanced milk yield may be attributed to presence of quality protein and amino acids which escaped ruminal fermentation and were available to animal body

for expression of improved performance. The study of Thapa *et al.* (2019) on feeding of rumen protected protein in crossbred cows also suggested the beneficial effect of enhanced milk yield.

The OFTs on probiotic supplementation in Mau district highlighte in 21.11% increase ($p=0.000$) in milk yield and 80% conception rate in treatment groups as compared to control. Similarly, in the district Basti, there was 9.60 % increase in milk production and 60% conception rate in treatment groups than control which was statistically significant ($p=0.000$), taking 2-tailed value. The incremental B:C ratio indicated a gain in profitability of 22 and 50 paisa over every paisa invested, respectively. This improved performance of dairy animals may be attributed to feeding of probiotics which helps in growth of beneficial gut microbes, inhibits disease causing microbes and improved overall health and performance of dairy animals. The present observation is also supported by the findings of Ayad *et al.* (2013), El-garhi *et al.* (2019) and Verma *et al.* (2022) on probiotics feeding.

Effect of energy and micronutrients supplementation on productivity of dairy animals: The results of OFTs on effect of feeding UMMB on performance of dairy animals and of mineral mixture on productivity of bovines in different districts has been presented in Table 2. The assessment of efficacy of UMMB on milk production of non-descript buffaloes, Murrah buffaloes and crossbred cattle illustrated enhanced ($p=0.000$) milk yield by 12-19% in treatment groups than control groups. Also, the supplementation of UMMB has increased conception rate 60-80% in non-descript and Murrah buffaloes. The incremental B:C ratio showed a profit in the range of Rs. 0.40-0.60 for every rupee invested. The positive effect on productivity and fertility may be attributed to supplementation of UMMB which is high in protein and energy concentrated feed with necessary amount of minerals and vitamins. It provides non protein nitrogen to the rumen microbes for synthesis of microbial protein without risk and ultimately providing necessary nutrients to animal's body. Supplementation of UMMB with straw based diet increases daily milk yield, longer lactation period and fertility in lactating animals. Prasad *et al.* (2001) has shown the positive effect on nutrient utilization and milk production in buffaloes by

Table 1. Assessment of efficacy of rumen modifiers and by-pass nutrients on productivity of dairy animals in the different districts of U.P

KVK	Farmer's practice (Control animal=T ₁)	Technology assessed(Treatment=T ₂)	Technical indicator = Milk production (liter/ day) and Conception rate(Mean)*	SD	SEM	Gross cost (Rs./trial period/animal)	Gross return(Rs./trial period /animal)	Economic analysis (B: C ratio)	Incremental B:C ratio
Banda (n=6)12 Murrah buffalo in 3 rd lactation	Straw + Green Fodder + concentrate	Bypass fat (calcium salt of long chain fatty acid) @150 gm /day/animal + Farmers Practice	T ₁ =6.62 *T ₂ =7.83	0.44	0.02	14963.01	32769.00	2.19	0.40
Mau (n=5) 10 Murrah buffalo in 2nd lactation	Ration + Gur feeding	Ration + Probiotic (bacteria base with vitamin and trace minerals)@50g/day/animal	T ₁ = 7.01 CR=20% *T ₂ =8.49	0.47	0.02	19923.15	37854.00	1.9	0.22
Lucknow (n=10) 20 Crossbred cows	Mixture of wheat straw with concentrate and green fodder	Formaldehyde treated by pass protein @ 100 gm/animal/day + farmer's practice	CR=80% T ₁ = 7.7 2 *T ₂ =8.50	0.95	0.04	21625.47	45846.00	2.12	
Basti (n=5) 10 Murrah buffalo in 2nd lactation	Wheat straw+ green fodder + grains + gur feeding	Probiotics supplementation + farmer's practice	T ₁ = 6.56 CR= 20% *T ₂ =7.19 CR=60%	0.32	0.01	29692.30	34740.00	1.17	0.30
Mau (n=8) 16 Murrah buffalo in 3rd lactation	Wheat straw + green fodder + choker and grains	Bypass protein supplement (lysine) @ 100 gm/animal/day + farmer's practice	T ₁ =6.71	0.55	0.03	18166.15	23616.00	1.3	0.50
Barabanki (n=5) 10 Murrah buffalo in 2nd lactation	Roughage + grains + choker + salt	Feeding of bypass fat (calcium salt of long chain fatty acid) @150 g /d / animal + farmer's practice	*T ₂ =7.50 T ₁ = 8.02 *T ₂ =8.77	0.89	0.04	21570.00	38826.00	1.8	
				0.30	0.01	19355.76	30195.00	1.56	0.23
				3.06	0.11	22625.69	40500.00	1.79	
				0.13	0.01	26932.83	36090.00	1.34	0.33
				0.54	0.03	28358.08383	47358.00	1.67	

*p=0.000 (2-tailed t value)

Table 2. Assessment of efficacy of energy and micronutrients supplementation on performance of dairy animals by different KVKs of Uttar Pradesh

KVK	Farmer's practice (Control animal=T ₁)	Technology assessed (Treatment=T ₂)	Technical indicator = Milk production (liter/day) and Conception rate (Mean)*	SD	SEM	Gross cost (Rs./trial period / animal)	Gross return (Rs./ trial period /animal)	Economic analysis (B:C ratio)	Incremental B:C ratio
Saharanpur (n=10)	Roughage + concentrate + Salt	UMMB @ 1 brick for 7 days/animal + farmer's practice	T ₁ =2.32 CR=10% *T ₂ =3.92 CR=60%	0.72	0.03	8202.86	11484.00	1.4	0.5
Balrampur (n=5)	Roughage + concentrate+ Salt	Urea -molasses-mineral block (UMMB) @ 1 brick for 7 days/ animal + farmer's practice	T ₁ =4.57	0.42	0.02	12339.00	18508.50	1.5	0.6
8 Murrah Buffalo in 3rd lactation			*T ₂ =5.2	0.89	0.04	13371.43	28080.00	2.1	
Rampur (n=5)	Use of choker and common salt	UMMB supplementation (Licking) @ 300 g/day/animal+ farmer's practice	T ₁ =4.79 CR=20% *T ₂ =5.4 CR=80%	2.45	0.16	13956.47	19399.50	1.39	0.43
10 Murrah Buffalos in second lactation				2.49	0.14	16021.98	29160.00	1.82	
Jaunpur-2 (n=10)	Seasonal green fodder + crop	UMMB, 38 kg molasses + 10 kg Urea+2 kg mineral mixture + 40 kg wheat bran + 10 kg bentonide/cement/ lime + 1 kg common salt + 20g vitamin (Vetabland) + farmer's practice	T ₁ = 8.50	3.06	0.10	22144.74	42075.00	1.9	0.4
20 Crossbred cows in 3rd lactation	residue +wheat flour & Mustard cake		*T ₂ = 10.12	1.11	0.04	23760.00	54648.00	2.3	
Fatehpur (n=10)	Only grain, straw, green fodder and salt feeding	50g mineral mixture/d/animal + farmer's practice	T ₁ = 1.63 *T ₂ = 2.51	0.29	0.01	6770.77	8802.00	1.3	0.4
20 Non-descript cows				0.84	0.03	7972.94	13554.00	1.7	
Firozabad (n=5)	Only providing grains and roughages	Mineral mixture (Agrimin, 50 gm/head/day for 120 days) and dewormer (Lebrazole Tablet) 1st day and 7th day + farmer's practice	T ₁ CR=20%	NA	NA	10500.00	14700.00	1.4	0.7
10 Murrah buffalo heifers			*T ₂ CR=80%	NA	NA	15400.00	32340.00	2.1	
Hathras (n=5)	Straw (05 kg) + green fodder (10 kg) + concentrate /animal	Farmer's practice+ 50 g mineral mixture and deworming/animal	T ₁ = 6.16	0.41	0.02	33264.00	19567.06	1.7	0.22
10 Murrah buffalo			*T ₂ = 7.77	1.04	0.05	41958.00	21853.13	1.92	
Gorakhpur-1 (n=5)	Ration + only use of common salt	Use of mineral mixture @ 50g / day/animal + dewormer + farmer's practice	T ₁ = 5.22 *T ₂ = 6.44	0.21	0.01	28188.00	15660.00	1.8	0.3
10 Murrah buffalo in 2nd lactation				0.97	0.05	34776.00	16560.00	2.1	
Unnao (n=10)	Mustard cake, wheat bran and pigeon pea bran)	+ farmer's practice Mineral mixture supplement @ 50g /day/animal	T ₁ = 6.23 CR=20% *T ₂ = 8.53 CR= 70%	0.29	0.01	30838.50	23721.92	1.3	0.48
20 Murrah buffalo				1.62	0.06	46062.00	25877.53	1.78	
Farrukhabad (n=5)	No use of min. mix& improper green feeding	Agrininforte (mineral mix. @50gm/ day/animal+30gm Lauhari salt. + balanced ration	T ₁ = 5.24 *T ₂ =7.52	0.28	0.01	28296.00	21766.15	1.3	0.26
10 Crossbred cows in 3rd lactation				1.57	0.07	40608.00	26030.77	1.56	

*p=0.000 (2-tailed t value)

supplemental feeding of UMMB. Tanwar *et al.* (2013) in similar kind of experiment with UMMB on buffaloes under field condition quoted 13.21 to 18.55 % increase in milk production with BC ratio of 3.6 to 4.18. The improved conception rate in buffaloes may be attributed to improved nutritional status by UMMB supplementation leading to ovulation which was earlier hampered due to feeding of poor-quality roughages (negative energy balance and minerals and vitamin deficiency). Alam *et al.* (2006) and Khadda *et al.* (2014) also documented the positive effect of UMMB supplementation on reproductive performance of dairy animals and findings of the present study conform to these studies.

The OFTs on mineral mixture supplementation resulted in 23.37-54% increase ($p=0.000$) in milk production with higher economic returns and 70-80% conception rate with prominent heat symptoms in non-descript cows, crossbred cows and Murrah Buffaloes of treatment groups than in control groups. The maximum hike of 54% in milk production was found in non-descript cows (OFT in the district of Fatehpur). The reason for this improved performance may be because of the availability of vital micronutrients and vitamins supplied through mineral mixture thus enhancing the molecular mechanisms which exploited the non-descript cow to their maximum genetic potential for milk production. This OFT also showed that the simple addition of mineral supplementation in the feeding of non-descript cows can improve the productivity of Indian dairy animals. The study of Sahoo *et al.* (2017) also supported these findings on mineral mixture for improved productivity of dairy animal but the percentage increase in milk production was in the range of 9.5%. Gupta *et al.* (2017) also illustrated that mineral mixture feeding in crossbred cattle improved milk production 13.4% and conception rate 64 %.

Effect of unconventional feed straw enrichment on productivity of dairy animals: The result of OFT on azolla supplementation in Murrah buffaloes in Kaushambi district indicated statistically significant ($p=0.000$) increase (23.45 %) (Table 3) in milk production. The study advocated that azolla (unconventional feed) can be included in the Murrah buffaloes feeding @ rate of 20% for higher milk production with an added benefit of low cost of production. The reason behind this improved productivity of Murrah buffaloes may be due to azolla supplementation rich source of protein (28%) and other nutrients which is required by the dairy animals (Prabina and Kumar 2010). The added benefits of azolla feeding were its cost effectiveness, easy cultivation and ready supply the nutrients for improved productivity (Ahirwar and Leela 2012). The feed supplementation of azolla can be used as scarcity feed in lean season of fodder production. The present findings are also supported by Lavania *et al.* (2019) which showed that azolla supplementation can increase milk production @ 20%. Gowda *et al.* (2015) in a similar kind of study had also reported the improved milk yield with a marginal increase of 4.8%. In contrast to the present study, Mudgal

Table 3. Assessment of efficacy of straw enrichment & unconventional feed on performance of dairy animals by different KVKs of Uttar Pradesh

KVK	Farmer's practice (Control animal=T ₁)	Technology assessed (Treatment=T ₂)	Technical indicator = Milk production (liter/day) and Conception rate (Mean)*	SD	SEM	Gross cost (Rs./ trial period / animal)	Gross return (Rs./trial period /animal)	Economic analysis (B:C ratio)	Incremental B:C ratio
Kaushambi (n=10) 20 Murrah buffalo	Farmer's practice of ration feeding	Azolla green feed supplement taken (100-200 gm/day) + Farmer's practice	T ₁ = 7.00 *T ₂ = 8.61	0.17	0.01	18236.84	34650.00	1.9	0.4
Kannauj (n=10) 20 Murrah buffalos	feeding of poor quality dry roughage	Urea enrichment of straw	T ₁ = 7.84 *T ₂ = 9.60	0.41	0.01	19783.18	42336.00	2.14	0.30
Raebareilly-1 (n=10) 20 Crossbred cows	Wheat straw 10kg + conc. 2kg + 10kg green fodder	Wheat straw treated with urea and molasses 10kg + 2kg concentrate + 10kg green fodder.	T ₁ = 9.87 *T ₂ = 11.61	0.29	0.01	33840.00	35532.00	2.44	0.09
				1.21	0.04	36663.16	41796.00	1.14	

* $p=0.000$ (2-tailed t value)

Table 4. Farmer's perception of assessed technologies

Assessed technology	Perception indicator				Average score	Final rank
	Affordability (5 to 1)	Easy to use (5 to 1)	Availability (5 to 1)	Compatibility (5 to 1)		
Bypass nutrients	04	05	05	03	17	II
Rumen modifiers	03	04	02	03	12	III
UMMB	04	03	02	02	11	IV
Mineral mixture supplementation and balanced ration feeding	04	05	05	04	18	I
Azolla feeding	04	04	02	03	13	III
Straw enrichment	05	02	03	02	12	IV

et al. (2022) in their study of 10% inclusion of azolla feeding in buffaloes concluded no significant effect on milk production. The results of OFTs on urea enrichment of poor-quality straw in the district Kannauj and Raebareilly-1 indicated (Table 3) 22.45% and 17.63% increase ($p=0.000$) in milk production in Murrah buffaloes and crossbred cows respectively. This increased milk production may be attributed to feeding of urea treated straws as in our country generally dairy animals are fed with poor quality and lignified straw with less available nutrients. Straw enrichment not only provides nutrients but also improves feed intake by the dairy animals. In a similar study of urea enrichment of straw, researchers documented 24-26% increase in milk production and 42% more consumption than untreated straw fed animals (Shelke *et al.* 2018).

Farmers perception of the assessed technologies: After the successful technical outcome of the OFTs on nutritional interventions, the reactions of participating farmers were also recorded (Table 4). The cattle keepers found the technology of mineral mixture supplementation to be best and ranked it first among all the technologies. However, all the farmers accepted the fact that the assessed technologies have better advantages over their local practices. The technology of feeding UMMB and urea enrichment of straws was ranked last (IV) among all the assessed technologies. Also, these technologies are in tandem with social norm and culture. The out-scaling of the assessed technologies through OFTs was done by the frontline demonstration (FLD).

The productivity of Indian dairy bovines is relatively lower than their genetic production potential. Many factors govern the individual animal's productivity in which more than half of the reason may be attributed to poor feeding management. The results of the above nutritional interventions emanated the location specific (district wise) technological options for enhanced productivity of cattle and buffalo in Uttar Pradesh which are necessary means for newer technologies benchmarking for exploitation of maximum genetic potential of dairy animals. The OFTs conducted in Uttar Pradesh confirmed the scope of better performance of indigenous and non-descript bovines at field level if they are given the appropriate nutritional interventions especially mineral mixture supplementations

and by pass nutrients in high yielders. Further the higher production of dairy animals by using these technologies at field condition necessitates for their dissemination (frontline demonstrations and awareness about nutritional interventions) with more emphasis on daily feeding of mineral mixture with active participation of related stakeholders like district animal husbandry department, farmers association and input agencies.

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