Feeding practices and nutritional gap in lactating buffaloes of Tehri and Pithoragarh Districts in Uttarakhand

Jarial Sapna[1] and Anilkumar[2]
(with analytical inputs from V Padmakumar[3])

Nutrition, in general, remains the most critical constraint to increased animal productivity with the perpetual gap between demand and supply of digestible crude protein and total digestible nutrients (ILRI, 1995). Difference between availability and quality of feedstuffs in various seasons in different locations is one of the reasons leading to nutrient shortages or surpluses. In a state like Uttarakhand, the issue is far graver in the hills as feed and fodder markets are mainly concentrated in the plains. However, farmers, depending on their economic condition, can bridge the nutrient gap by (1) better use of available feed resources (2) produce more and (3) import. But to enable this clear understanding of the nutritional gap is required. The current information available in Uttarakhand for different locations in different seasons is very scanty. The present study was therefore undertaken to assess season-wise availability, requirement and nutritional gap of lactating buffaloes in Tehri and Pithoragarh districts of Uttarakhand.

Methodology

The present research was conducted in two blocks namely, Jhakhanidhar (altitude 1500-1700 AMSL) and Gangolihat (altitude 1600-1750 AMSL) of districts Tehri and Pithoragarh respectively and was confined to (lactating) buffaloes considering their prevalence in the area. Relevant information was collected from 20 farmers (10 from block Jhakhanidhar and 10 from Gangolihaat). Body weight, feed intake, and milk yield were recorded for individual animals of the 20 farmers during the study. Body weight was estimated using Shaeffer's formula. The observations recorded (one day per season) were repeated in three consecutive seasons (summer, rainy and winter). Feed samples were collected, pooled and chemically analysed for proximate principles as per Association of Official Analytical Chemists (AOAC, 1995). Daily intake of dry matter (DM), crude protein (CP) and metabolisable energy (ME) was calculated from the analysed results. Nutritional gap in terms of the above was arrived by finding the difference between the nutritional availability and requirement (requirement as per Ranjan, 1998 was calculated for the same breed of buffaloes found in the same environment but under optimum feeding). The data were statistically analyzed using mean and standard error as per standard procedure (Snecdecor and Cochran 1994) to draw meaningful conclusions.

Findings:

1. Socio-economic status and milk production

Majority of the farmers' families in Uttarakhand are nuclear with a family size of 6.1 in Jakhanidhar and 5.2 in Gangolihat blocks. Families in these regions keep buffalo to meet their daily needs. Women keep themselves meaningfully engaged in livestock rearing as men folk migrate to the plains for employment. As evident from Table 1, the Tehri farmers have more land (0.58 ha /family) but less livestock (4.7 /family) in comparison to Pithoragarh farmers whose land holding is less (0.16 ha /family) but livestock number is more (5.6 /family). The human and livestock numbers per family are almost same in both the

[1] *Special Project Scientist, International Livestock Research Institute*
[2] *Scientist, Pant Nagar Agricultural University*
[3] *Senior Scientist, International Livestock Research Institute*

districts. In these study sites majority of the farmers keep non-descript breeds of buffalo. Average body weight of the lactating buffaloes varied slightly from season to season in both the districts. In district Tehri during summer the body weight of the animal was 305 kg, followed by 306 kg in rainy season and 308 kg in winter. Whereas in district Pithoragarh the average body weight was 313 kg in summer, 311 kg in rainy season and 307 kg in winter (Table 1).

Table 1: Socio-economic status and seasonal milk production in district Tehri and Pithoragarh

Parameter	Block Jakhnidhar (District Tehri)	Block Gangolihat (District Pithoragarh)
Family size(Numbers)	6.1±0.67	5.2±0.44
Landholding(ha/family)	0.58±0.79	0.168±0.02
Livestock holding(number/family)	4.7±0.63	5.6±0.63
Lactation length (months)	11.2±1.03	12.2±0.86
Summer Season(May)		
Body Weight (Kgs)	305±9.12	313±16.92
Milk Production(l/day/animal)	3.05±0.28	3.0±0.33
Milk production potential under optimum feeding*	3.81	3.75
Rainy Season (September)		
Body Weight (Kgs)	306±9.44	311.7±16.02
Milk Production (l/day/animal)	1.8±0.08	2.35±0.15
Potential milk production under optimum feeding*	2.25	2.35
Winter Season (December)		
Body Weight (Kgs)	308±9.98	307.53±16.69
Milk production in winter season(l/day/animal)*	1.7±0.08	1.9±0.26
Potential milk production under optimum feeding	2.13	2.38

** Milk production potential is calculated as 25% more than the current level of production as was observed in animals of the same breed in the same environment but under optimum feeding situation*

It was found that in block Jakhanidhar, milk production per day per animal was 3.05 kg (in summer), 1.8 kg (rainy season) and 1.7 kg (winter). In Gangolihat the figures were 3 kg (summer), 2.35 kg (rainy season) and 1.9 kg (winter).

Buffalo milk market is locally developed in both the study sites as there is high demand in the villages as well as in the nearby small towns like Pokhal Molno in district Tehri and Gangolihat in Pithoragarh. Generally, farmers in both the areas sell milk to the local market, neighbours, (Anchal) milk union and community owned milk federations. At the time of survey the community owned federations paid farmers @Rs 17 /litre in Jakahanidhar block and Rs 22 /litre in block Gangolihat. Quality is judged based on lactometer reading and payment is made accordingly.

2. Existing feeding practices in block Jakhanidhar (District Tehri)

The livestock owners of Tehri district used to feed a wide range of feeds and fodders like: wheat straw (*Triticum aestivum),* paddy straw (*Oryza sativa*), barnyard millet straw (*Echinochloa frumentacea*), timila leaves (*Ficus roxburghii*), khadik leaves (*Celtis spp*), denkan leaves (*Melia spp*), dry grass (*Heteropogon contortus*), green grass (*Heteropogon contortus*) and bhimal (*Grewia spp*.). The tree leaves and grasses (collected from own farms and forests) form the major source of roughage in the hills. Crop residues and dry grasses are stored and fed to animals during lean period stretching from November to May (acute shortage is from January – April). Yadava (2003) estimated that in the Central Himalayas nearly 66% of the fodder requirement is met by pasture and tree leaves. Generally, the farmers do not cultivate fodder crops in the arable land. Home based concentrate mixture (consisting of cooked wheat and rice) and kitchen waste are also used for feeding animals. Balanced feeds and mineral mixture supplements were not at all considered in feeding in the area due to lack of knowledge and/ or low

purchasing power. But it was observed that some the farmers in Gangolihat offered commercial feed pellets to their lactating animals.

2.1 Nutritional evaluation of feeds and fodders of Tehri District:

The chemical composition of feeds and fodders (on dry matter basis) available in summer, rainy and winter seasons for district Tehri based on laboratory analysis of samples is presented in Table 2.

Table 2: Chemical composition of feeds /fodder of district Tehri

Sl	Feeds/Fodder	DM (%)	EE (%)	CP (%)	CF (%)	AIA (%)	TDN (kg/kg DM)	ME (MJ/kg DM)
	Summer (April-June; recorded in May)							
1	Home based concentrate	89.1	2.52	9.82	12.85	0.55	0.91	13.77
2	Wheat straw (*Triticum aestivum)*	92.48	1.08	2.56	35.75	2.88	0.44	06.66
3	Paddy straw (*Oryza sativa*)	92.15	0.71	1.85	38.22	13.34	0.42	06.35
4	Jhangora straw (*Barnyard Millet*)	92.27	0.72	4.1	35.44	2.16	0.47	07.11
5	Timila Leaves (*Ficus roxburghii*)	64.46	8.50	12.34	29.8	0.80	0.60	09.08
6	Khadik Leaves (*Celtis spp*)	90.1	2.02	12.00	28.35	3.53	0.54	08.17
7	Denkan Leaves (*Melia spp*)	66.04	5.10	16.65	28.75	0.001	0.75	11.35
8	Dry grass (*Heteropogon contortus*)	87.23	1.37	4.64	28.76	2.87	0.44	06.66
	Rainy Season(July-Oct; recorded in Sept)							
9	Green grass (*Heteropogon contortus*)	28.06	1.84	7.64	10.76	2.49	0.50	07.57
10	Wheat straw (*Triticum aestivum)*	92.48	1.08	2.56	35.75	2.88	0.44	06.66
11	Home based concentrate	89.1	2.52	9.82	12.85	0.55	0.77	11.65
	Winter (Nov-March; recorded in Dec)							
12	Bhimal (*Grewia spp*.)	47.71	1.80	9.23	28.6	0.40	0.47	07.11
13	Dry grass (*Heteropogon contortus*)	87.23	1.37	4.64	28.76	2.87	0.44	06.66
14	Home based concentrate	89.1	2.52	9.82	12.85	0.55	0.91	13.77

DM=dry matter, EE=ether extract, CP=crude protein, CF=crude fibre, AIA=acid insoluble ash, TDN=total digestible nutrients, ME=metabolisable energy. Values are on DM basis except for dry matter

It is worth mentioning that the tree leaves fed to animals by the farmers are found to contain a higher levels of crude protein (Denkan-16.65%, Timila-12.34%, Khadik-12%, Bhimal-9.23%). This finding is in close agreement with those reported by Shukla et al (2007).

2.2 Dry matter intake (Tehri)

The following Tables (Table 3-5) show quantity of different feed stuffs fed to animals (on dry matter basis) by the Jakhanidhar farmers in the three seasons (it is to be noted that the type of feed given and the quantity recorded is only for one day in each season and that figure is taken as the average for the entire season):

Table 3: DMI /animal /day in SUMMER (Tehri)

Feedsuff	Buffalo 1	Buffalo 2	Buffalo 3	Buffalo 4	Buffalo 5	Buffalo 6	Buffalo 7	Buffalo 8	Buffalo 9	Buffalo 10	Total
Wheat straw	3.69	2.77	3.88	3.24	3.70	4.16	3.7		5.55	4.62	35.31
Paddy straw				0.74		1.11		5.53			7.38
Jhangora straw			0.46								0.46
Timila tree leaves	1.29	2.58		1.80	0.64					0.32	6.63
Khadik tree leaves		0.90		0.18	0.90	0.90	0.90			1.26	5.04
Denkan tree leaves							0.66	1.32			1.98
Home-based concentrate (cooked wheat & rice)		0.89	0.89	0.18	0.18	0.45	0.45		0.09	0.18	3.31
Total	4.98	7.14	5.23	6.14	5.42	6.62	5.71	6.85	5.64	6.38	60.11

Table 4: DMI /animal /day in RAINY season (Tehri)

Feedstuff	Buffalo 1	Buffalo 2	Buffalo 3	Buffalo 4	Buffalo 5	Buffalo 6	Buffalo 7	Buffalo 8	Buffalo 9	Buffalo 10	Total
Wheat straw	**3.7**	**3.7**	**2.77**	**3.7**	**2.77**	**1.85**	**1.85**	**2.77**	**2.77**	**4.16**	**30.04**
Green grass	2.29	2.86	2.86	2.29	2.86	3.43	2.86	2.57	2	2.63	**26.65**
Home-based concentrate (cooked wheat & rice)		0.18									**0.18**
Total	**5.99**	**6.74**	**5.63**	**5.99**	**5.63**	**5.28**	**4.71**	**5.34**	**4.77**	**6.79**	**56.87**

Table 5: DMI /animal /day in WINTER (Tehri)

Feedstuff	Buffalo 1	Buffalo 2	Buffalo 3	Buffalo 4	Buffalo 5	Buffalo 6	Buffalo 7	Buffalo 8	Buffalo 9	Buffalo 10	Total
Dry grass	3.49	5.23	4.19	4.19	4.36	5.23	4.36	3.93	4.45	4.36	**43.79**
Timila tree leaves					0.64	0.32					**0.96**
Bhimal tree leaves	0.95	0.95	0.62	0.62	0.48	0.48	0.95	0.62		0.95	**6.62**
Home-based concentrate (cooked wheat & rice)	0.18	0.22	0.45	0.45	0.22	0.22		0.22	0.22		**2.18**
Total	**4.62**	**6.4**	**5.26**	**5.26**	**5.7**	**6.25**	**5.31**	**4.77**	**4.67**	**5.31**	**53.55**

2.3 Diet composition in Tehri

The following Figures (Figures 1-3) indicate the percentage composition of diet in the three seasons in Tehri:

Figure 1: Diet composition in Summer (%)

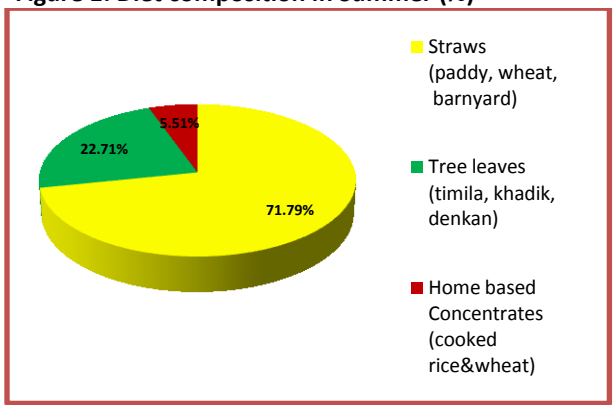


Figure 2: Diet composition in rainy season (%)

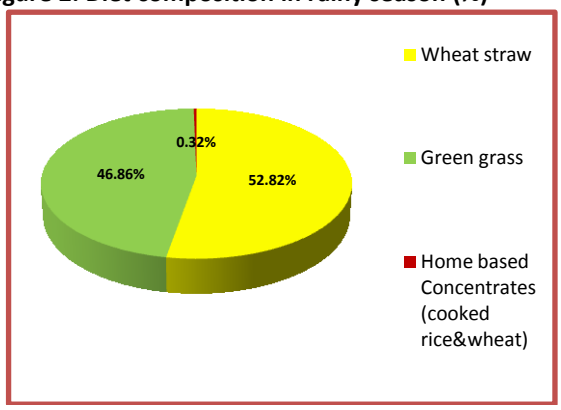
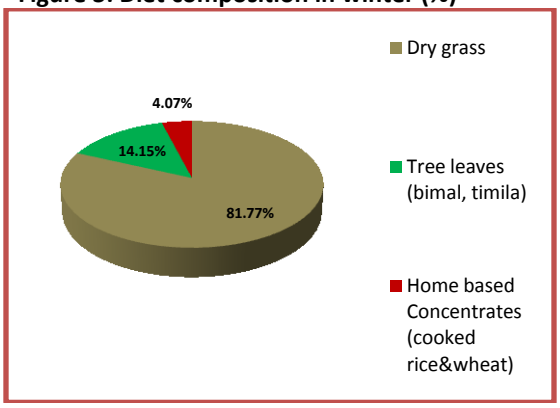


Figure 3: Diet composition in winter (%)



3. Existing feeding practices in block Gangolihat (District Pithoragarh):

Buffalo rearers in Gangolihat fed their animals with: wheat straw (*Triticum aestivum), gajjyo*or mixed dry grass (*Heteropogon contortus*), baanj tree leaves (*Quercus leucotrichophora*), bhimal tree leaves (*Grewia spp*.). and green grass (*Heteropogon contortus*). The grasses and tree leaves were collected from their farms and forest. Some farmers also give home based concentrates, commercial pellets and wheat bran purchased from market. The home based concentrate mainly consists of wheat (*Triticum aestivum)*, mandua /finger millet (Eleusine coracana) and rice flour (*Oryza sativa*). Wheat straw is the common dry fodder across the three seasons along with gajjyo (mixed dry grass). Baanj (*Quercus leucotrichophora) leaves,* which are available in plenty in the nearby forest, is mostly fed during summer and in some cases during winter when bhimal (*Grewia spp*.) leaves are not available. Farmers prefer to feed bhimal (*Grewia spp*.) leaves in the winter season and green grass during rainy period. It was interesting to note that the buffalo rearers have different opinion about feeding of baanj (*Quercus leucotrichophora*). Some believe that it makes the cream and curd thick while others say that feeding baanj (*Quercus leucotrichophora*) leaves are detrimental to pregnant buffaloes.

3.1 Nutritional evaluation of feeds and fodder of Pithoragarh district:

Chemical composition of different feeds and fodder available during summer, rainy and winter seasons in district Pithoragarh based on laboratory analysis is presented in Table 6.

Table 6: Chemical composition of feeds/fodder of district Pithoragarh

Sl	Feeds/Fodder	DM (%)	EE (%)	CP (%)	CF (%)	AIA (%)	TDN (kg/kg DM)	ME (MJ/Kg DM)
	Summer (April-June; recorded in May)							
1	Home based concentrate	88.73	4.36	12.33	12.65	0.32	0.91	13.77
2	Wheat straw (*Triticum aestivum*)	87.96	1.39	1.85	33.15	3.83	0.44	06.66
3	Gajjyo/Mixed dry grass	88.73	0.82	5.91	28.35	3.34	0.55	08.32
4	Baanj (*Quercus leucotrichophora)*	57.18	11.75	18.23	27.54	0.003	0.55	08.32
5	Pellet	89.21	1.84	18.25	12.66	3.83	0.89	13.47
6	Wheat bran	88.44	2.86	13.84	11.88	0.11	0.88	13.31
	Rainy Season (July-Oct; recorded in Sept)							
7	Green grass	23.57	2.00	4.33	27.33	1.70	0.56	08.47
8	Home based concentrate	88.73	4.36	12.33	12.65	0.32	0.91	13.77
9	Wheat straw (*Triticum aestivum*)	87.96	1.39	1.85	33.15	3.83	0.44	06.66
	Winter (Nov-March; recorded in Dec)							
10	Bhimal (*Grewia oppositifolia*)	53.84	1.33	7.10	26.80	0.30	0.69	10.44
11	Baanj (*Quercus leucotrichophora)*	57.18	11.75	18.23	27.54	0.003	0.86	13.01
12	Gajjyo/Mixed dry grass	88.73	0.82	5.91	28.35	3.34	0.55	08.32
13	Wheat straw (*Triticum aestivum*)	87.96	1.39	1.85	33.15	3.83	0.44	06.66

DM=dry matter, EE=ether extract, CP=crude protein, CF=crude fibre, AIA=acid insoluble ash, TDN=total digestible nutrients, ME=metabolisable energy. Values are on DM basis except for dry matter

It can be seen that the crude protein content in baanj tree leaves (18.23%) is relatively higher. It is noticed that while crude protein value of bhimal tree leaves in Pithoragarh is 7.1%, the value for the same is higher in Tehri (9.23%). This variation, as reported by Pal et al (1979), is because of factors like season, soil, environment and stage of harvest.

3.2 DMI in Pithoragrah

The following Tables (Table 7-9) show quantity of different feed stuffs (on DM basis) fed to animals by the Pithoragarh farmers in the three seasons (the type of feed given and the quantity recorded is only for one day in each season and the figure is taken as the average for the entire season):

Table 7: DMI /animal /day in SUMMER (Pithoragarh)

Feedstuff	Buffalo 1	Buffalo 2	Buffalo 3	Buffalo 4	Buffalo 5	Buffalo 6	Buffalo 7	Buffalo 8	Buffalo 9	Buffalo 10	Total
Wheat straw	3.78	4.4	3.69	3.69	4.57	5.28	3.78		3.69	5.1	**37.98**
Dry grass			0.44		0.44			5.32	0.44		**6.64**
Baanj tree leaves	1.94	1.26	0.69	1.43	0.69	1.37	1.94		0.69	0.69	**10.7**
Home based concentrate (cooked wheat & rice)		0.44	0.18	0.18	0.18	0.44			0.18	0.18	**1.78**
Pellet feed									0.09		**0.09**
Wheat bran		0.18		0.18		0.18					**0.54**
Total	**5.72**	**6.28**	**5.00**	**5.48**	**5.88**	**7.27**	**5.72**	**5.32**	**5.09**	**5.97**	**57.73**

Table 8: DMI /animal /day in RAINY SEASON (Pithoragarh)

Feedstuff	Buffalo 1	Buffalo 2	Buffalo 3	Buffalo 4	Buffalo 5	Buffalo 6	Buffalo 7	Buffalo 8	Buffalo 9	Buffalo 10	Total
Wheat straw	1.76	1.76	3.51		3.52	2.64	1.76	3.52	1.06	2.99	22.52
Green Grass	2.83	3.16	1.89	4.24	2.36	4.71	4.38	1.65	3.02	3.54	31.78
Home based concentrate (cooked wheat & rice)				0.44							0.44
Total	4.59	4.92	5.4	4.68	5.88	7.35	6.14	5.17	4.08	6.53	54.74

Table 9: DMI /animal /day in WINTER (Pithoragarh)

Feedstuff	Buffalo 1	Buffalo 2	Buffalo 3	Buffalo 4	Buffalo 5	Buffalo 6	Buffalo 7	Buffalo 8	Buffalo 9	Buffalo 10	Total
Wheat straw	3.78	3.96	3.96	3.96	3.96	3.96	3.96	2.64	3.96	3.96	38.1
Dry grass						1.06					1.06
Baanj tree leaves	0.69		0.69					0.69		0.69	2.76
Bhimal tree leaves		2.64		1.35	1.83	2.15	1.24	1.24	1.35		11.8
Home based concentrate (cooked wheat & rice)				0.22	0.22		0.18				0.62
Pellet feed		0.18								0.18	0.36
Total	4.47	6.78	4.65	5.53	6.01	7.17	5.38	4.57	5.31	4.83	54.7

3.3 Diet composition in Pithoraghar (%)

The following Figures (Fig. 4-6) indicate the composition of diet (%) in the three seasons:

Figure 4: Composition of diet in SUMMER (%)

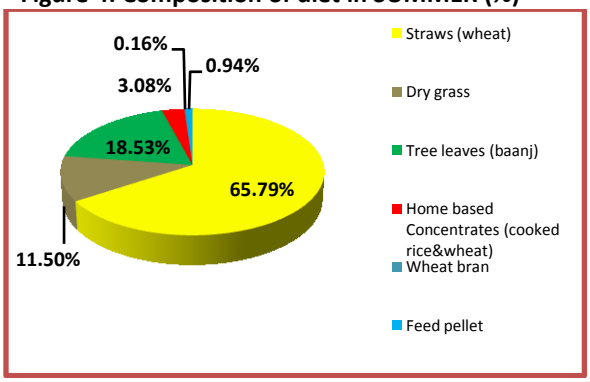


Figure 5: Composition of diet in RAINY SEASON (%)

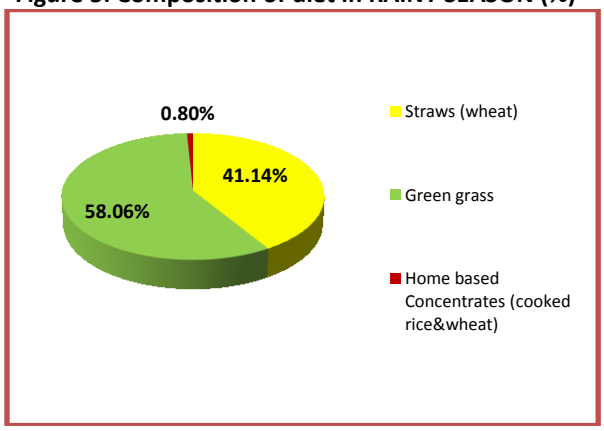
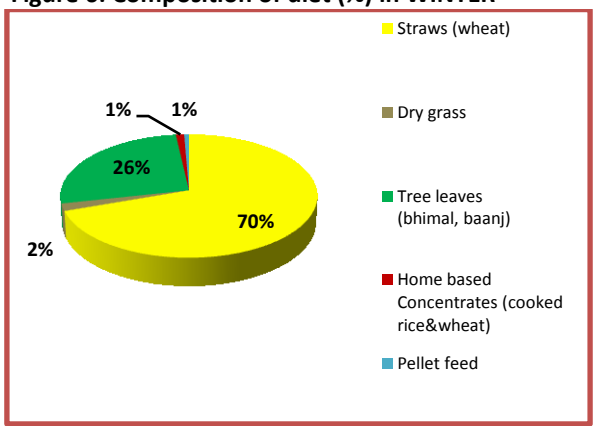


Figure 6: Composition of diet (%) in WINTER



4. Nutritional status of lactating buffaloes in Tehri and Pithoragarh districts:

The nutritional requirement (calculated as per Ranjan, 1998 for optimum production by the same breed of buffaloes found in the same environment under optimum feeding), present intake and gap of dry matter, CP and ME in different seasons of both the sites are presented in Table 8. As can be seen in the Table, the lactating buffaloes in both the sites exhibited negative balance for DM, CP and ME. The intake depends mainly on local availability of different feedstuffs. Farmers generally did not attempt to fill the gap by feeding supplementary feeds, reported to be due to low production capacity of the animals, low purchasing power and lack of knowledge.

Table 8: Daily average intake, requirement and balance of DM, CP and ME of lactating buffaloes of Tehri and Pithoragarh districts

Parameter	*District -Tehri*			*District -Pithoragarh*		
Seasons	*Summer*	*Rainy*	*Winter*	*Summer*	*Rainy*	*Winter*
Dry Matter						
Intake (kg)	6.01	5.68	5.36	5.77	5.47	5.47
Requirement (kg)	7.63	7.65	7.70	7.84	7.79	7.69
Balance (kg)	-1.62	-1.97	-2.34	-2.07	-2.32	-2.22
Crude Protein						
Intake (g)	313.8	282.3	286.77	335.41	286.61	224.70
Requirement (g)	428.15	341.3	333.10	429.30	383.05	348.00
Balance (g)	-114.35	-59.00	-46.33	-93.89	-96.44	-123.30
ME						
Intake (MJ)	48.72	40.55	38.13	43.42	41.30	39.49
Requirement (MJ)	54.32	47.81	46.90	54.77	52.05	47.51
Balance (MJ)	-5.60	-7.26	-8.78	-11.35	-10.74	-8.02

5. Results and discussion:

The results show that both in Tehri as well as in Pithoragarh, the animals are underfed in terms of quantity (DM) and quality (CP and ME). In Tehri, the shortage of dry matter is in the range of 21-30%, whereas protein shortage is 13-27% and energy deficit 10-19%. In Pithoragarh the shortages are in the range of 26-29% (DM), 21-35% (CP) and 17-21% (ME).

Deficit (Tehri)			
	Summer	Rainy	Winter
DM	21%	25%	30%
CP	27%	17%	13%
ME	10%	15%	19%

Season-wise analysis shows that in Tehri, in summer there is an acute shortage of protein (27%). There is also shortage of dry matter (21%). Major quantity of dry matter (72%) comes from straws (remaining tree leaves and home based concentrates). So here, the options available to fill the major gaps are: (1) improve the quality of straws (2) cultivate legume fodder trees in private /public waste lands to lop and feed as fodder (3) supplement present feeds with any of the locally available (de-oiled) cakes with higher protein content. In terms of quantity, about 2 kg of (enriched) straw (or 10 kg grass /weeds /tree leaves) and half kg of cake would be sufficient to fill the gap and produce 25% more milk (gap is calculated based on potential production under better feeding).

In winter (Tehri) the shortage of energy is higher (19%) besides the dry matter deficit of 30% (protein deficiency is low due to feeding of tree leaves rich in protein). So to fill this gap the quantity of dry roughage, presently supplied through dry grass, is to be enhanced and fed after enrichment (or supplemented) with concentrates having higher energy value such as crushed maize, molasses etc.

In rainy season (Tehri) about 47% of roughage comes through grasses and remaining 53% through straws. Here, there is considerable shortage of DM (25%), CP (17%) and ME (15%). The dry matter and protein gap can be filled by providing additional quantity of leguminous fodder (to be cultivated in the rainy season in own farms). This will also take care of ME shortage.

In Pithoragarh, there is no big difference in shortages among three seasons except protein shortage in winter, which is considerably higher (shortage 123 g /day) compared to all seasons and that in Tehri region. So in winter, the main feed (70% straws) is to be supplemented with a good, cheap and locally available protein source. Otherwise, the options suggested for the three seasons in Tehri are relevant here also and can be adopted in the same way.

Deficit (Pithoragarhi)			
	Summer	Rainy	Winter
DM	26%	29%	28%
CP	21%	25%	35%
ME	21%	21%	17%

6. Recommendation

Specific recommendations for the three seasons in the two regions are summarized in Table 9 below:

Table 9: Recommendation

	Summer	Rainy	Winter
Tehri	• Add (locally available or cultivated) leguminous fodder in the diet (cheapest option) • Supplement present feeds with any of the locally available protein sources such as oil cakes • Based on availability, use a combination of the above	• Increase quantity of fodder with good quality (a mixture of grasses and legumes)	• Increase quantity of dry grass in the diet • Increase quality of the dry grass through enrichment with energy sources such as molasses • Supplement present feeds with high energy concentrates like crushed maize

	Summer	Rainy	Winter
Pithoragarh	• Increase quantity of straws /dry grass • Supplement the dry roughages with energy and protein sources (use of Urea Molasses Mineral Blocks is an option to be tried)	• Increase quantity of green fodder • Supplement with energy (crushed maize) and protein (cakes) sources	• Increase quantity of straws • Supplement the main feed (70% straws) with a good, cheap and locally available protein source.

The impact of feeding additional quantity /quality of feeds suggested above will be seen only after a month as the animal will initially utilize the additional nutrients supplied to recoup its weak body condition, which was resulted due to short supply of nutrients. The additional feed requirements indicated above will increase further when the local buffaloes currently present in the region are upgraded to improved breeds. As improved animals can respond to improved feeding much more efficiently than the non-descript ones, one should also simultaneously work in the region for breed improvement. It is needless to say that in all the feed improvements suggested above, a least cost supplementation strategy shall be adopted to fulfill the requirement. The approach of 'utilize better' (improving the quality of present feed stuffs), 'produce more' (increasing biomass production) and 'import' (bringing nutrient supplements) could be resorted to fill the nutritional gap and optimize milk production in both the districts. Besides, farmers' awareness is also required to be raised on balance feeding practices using locally available feed resources.

References

AOAC.1995.Official Methods of Analysis.15th Edition. Association of official Analytical Chemists.Washington DC.

ILRI. 1995. Global agenda for livestock research. In: PR Gardiner and C Devendra (editors).Proceedings of consultation. International Livestock Research Institute, Nairobi, Kenya.

Pal R N Dogra KK, Singh L N Negi SS.1979. Chemical composition of some fodder trees in Himachal. Forage Research 5: 109-15.

Ranjan., S.K 1998 Nutrient Requirements of Livestock and Poultry. Indian Council of Agricultural Research. New Delhi.

Sendecor GW and Cochran W G. 1994.Statistical Methods. Iowa State University Press Ames, IOWA,USA.

Shukla Saraswati, Tiwari DP, Kumar Anil, Mondal BC, and Upadhayay AK. 2007. Animal husbandry practices in Pithoragarh district of Uttarakhand state. *Indian Journal of Animal Sciences 77(11):1201-1204.*

Yadav AK, Kumar Anil and Singh Vir. 2003. Nutritive evaluation of some native/ fodder plants in the hill and tarai region of Uttaranchal. *Indian Journal of Animal Sciences 73(7):793-797.*