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Research Article

FEED QUANTITY OPTIMIZATION FOR SMALL DAIRY FARMERS OF ANAND DISTRICT OF GUJARAT

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Abstract- Dairy farmers are feeding locally available green and dry fodder along with concentrate to the animals. The availability of these feed and fodder varies with season and region. Farmers feed the animals whatever is available with them or in the market without considering the nutritive value and end up spending more money or feeding imbalanced feed to the animals. The study was undertaken in Anand district of Gujarat in India to find out the lowest possible combination of feed and fodder to be fed to buffalo yielding 6 liters or more milk per day and are in early lactation. The area is dominated by buffalo among the dairy animal population in the study area which formed the basis for selection. Simple method of linear programming was used to arrive at the least cost combination using Excel solver. The study indicated that for a buffalo weighing 450 kg and yielding 10 litres of milk in a daywith 6% fat can be fed with 14.32 Kg of green maize fodder, 2.03 kg of paddy straw, 11.81 kg of soyabean straw and 4.82 kg of cotton seed cake, for which the feed cost per litre milk production comes out to be Rs. 21.23, besides meeting all the nutrient requirements.

Keywords- Linear Programming, Least Cost Ration Formulation, Dairy, Feed Optimization

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Introduction

For profitable dairying, farmers must focus on feeding, breeding and management. Among these, the importance of feed can be visualized from the fact that feed accounts for 55-60% of total cost of milk production [1]. During lactation, dairy animals have very high nutritional requirements relative to most other species. Meeting these requirements, especially for energy and protein, is challenging. Diets must have sufficient nutrient concentrations to support production and metabolic health, while also supporting rumen health and the efficiency of fermentative digestion [2]. The feed comprises of roughages and concentrates. Roughages include green and dry fodder. The availability of these fodders, particularly the green fodder varies with season and region. The concentrates include energy and protein rich components of animal feed, which are less in fiber. These days feed formulations are available in the market known as balanced compound feed which are considered to have the required nutrients in desired proportion. As different feed and fodders have different levels of nutrients, it is a big challenge for the farmers to formulate a ration which is balanced i.e., all the required nutrients are fed to the animals in appropriate quantity. Imbalanced nutrition is a major factor responsible for low livestock productivity [3]. Balanced nutrition contributes to improved animal output as well as reduces both the cost of production and greenhouse gases emission per unit of animal product [3]. Additionally, these feed and fodder have different prices. So, it becomes imperative for the farmers to feed the animal a balanced ration with minimum cost incurred in feed. To maximize the profitability from dairying, it is essential that the animals are fed desired nutrients to produce milk as per their genetic potential through a least cost balanced ration [4]. Cost can be minimized by 19 to 23% in local and cross-bred cows if fed using least cost feeding plan [5].

Anand district of Gujarat also known as the Charotar region has around 7 lakhs of milch animals, in which buffalo accounts for approximately 4.9 lakhs. 87.4% of the total farmers in the district are of small and marginal farmers category.[6] Agriculture with dairying is predominant. Most of the small farmers possess one or two cows along with 2-3 buffaloes. Farmers having land cultivate fodder crops in small plot to feed their animals, while other purchase from the market. Out of the total agricultural area covered under different crops in the district rice, wheat and bajra are grown in 58.5% of the area. 4.2% of the total cropped area is used for forage crops [6]. The straws of these food grain cereals are used as dry fodder. Concentrates are fed in very less quantity. Feeding in non-proportionate quantities of various feed and fodder does not provide balanced nutrition to the animals. Along with this, farmers also fail to achieve the lowest possible cost in feeding. With this background the following objectives were formulated and studied.

a) To estimate the existing cost of feed for high yielding Buffalo in early lactation stage in the study area; and
b) To find out the least cost combination among locally available feed for high yielding Buffalo in early lactation stage in the study area.

Materials & Methods

The study was undertaken in Anand District of Gujarat and the study period was from November 2014 to February 2015. For the purpose data were collected from both primary as well as secondary sources. Survey method was adopted for primary data collection and 30 farmers were interviewed using pre-structured survey schedule using Multistage Sampling. In this, 3 talukas were selected randomly and from each taluka 2 villages were again selected randomly. From each selected village 5 respondents were selected purposively i.e., those farmers

who have buffalo yielding 6 litres or more per day and are in early stage of lactation.

Table-1 *Sampling Design*

Anand district	Anand	Bedva	5 Dairy farmer having buffalo yielding 6 lts or more per day and are in early lactation stage from each village
		Gopalpura	
	Petlad	Israma	
		Pandoli	
	Khambhat	Jalsan	
		Bamanva	

For nutritional composition of various feed items & nutritional requirements for the animal following secondary sources were used.

a) Nutrient composition of Indian feed and fodder published by ICAR
b) Nutrient requirements of cattle and buffalo published by ICAR
c) Feedipedia, an online resource for nutrient composition of various feed and fodder.
d) Nutritive value of commonly available feeds and fodders in India published by NDDB.

Technique used

Linear Programming model was used with Objective of cost minimization Subject to various constraints of nutritional requirements. Waugh (1950) and Tozer (2000) used linear programming to formulate least cost ration for dairy animals [7-9]. Linear Programming technique has also been used for least-cost broiler ration formulation [10]. Excel solver in Microsoft office 2010 was used to run the linear programming model.

Linear Programming model: The cost minimizing model used in the study was of the following form:

$$Minimize\ Z\ =\ \sum_{j=1}^{n} c_j\ x_j \qquad \text{[Eq-1]}$$

Subject to the constraints:

$$\sum_{j=1}^{n} a_{ij} x_j\ \geq b_i \qquad \text{[Eq-2]}$$

And Non Negativity Constraints: $x_j \geq 0$ [Eq-3]

Where,

Z = Total cost of the ration
c_j = Per Kg Dry Matter Cost of Ingredient
x_j = Ingredient Quantity
a_{ij} = Amount of i^{th} nutrient available per Kg DM of ^{ith} feed material
b_i = Required level of nutrients required by the animal

So, following nutrient constraints were formulated:

1. Dry Matter constraint, DM (Kg)
2. Crude Protein constraint, CP (Kg)
3. Crude fiber constraint, CF (Kg)
4. Metabolizable Energy constraint (M cal/kg)
5. Total Digestible Energy Constraint TDN (Kg)
6. Calcium, Ca (g)
7. Phosphorus, P (g)
8. Magnesium, Mg (g)
9. Potassium, K (g)
10. Sodium, Na (g)

The above are greater than or equal to constraints and vary with the animal body weight, Milk yield and milk fat percentage.

11. Ether Extract, EE ≥ 6% of total DM intake
12. Dry Matter from Conc. DM (Conc.) < 60% of total DM
13. CF (Kg) – 35-50% of total DM
14. Green fodder = 1/4 th of total roughage DMI
15. Dry fodder = 3/4th of total roughage DMI

Body Weight Calculation:

Body Weight of the animal was calculated using Aggarwal's Modified Shaeffers Formula [11].

$$Body\ weight\ (Seer) = \frac{girth(inches) \times length(inches)}{Y} \qquad \text{[Eq-4]}$$

1 Seer = 0.933 Kg
Y = 9 if girth is less than 65"
Y = 8.5 if girth is 65- 80"
Y = 8 if girth is over 80"

Results & Discussion

Dairy farmers in the study area, particularly the small farmers owning up to 5 milch animal with one in-milk buffalo yielding 6 liters or more milk per day were interviewed to enquire about the feed and fodder they feed to the animals, along with price at which these are being purchased. Those having land were growing green fodder like sorghum, maize fodder in small piece of land while rest were purchasing from the traders. It is worth mentioning here that the fodders are fed to the animals by giving these to the animals on the ground without chaffing. In no case fodder chaffing machine was present.

Table-2 *Feed and fodder fed to the animals in the study area*

Green fodder	Doob grass
	Maize fodder green
	Sorghum fodder
	Sugarcane top
Dry fodder	Paddy straw
	Bajra straw
	Sorghum straw
	Soyabean straw
	Groundnut stover
Concentrate	Maize cake
	Cotton seed cake/expeller
	Amul compound feed
	Wheat bran
	Arhar chuni

The above table shows the various green and dry fodder and concentrate fed to the dairy animals. This is the exhaustive list of feed and fodder fed to the animals by the sampled dairy farmers in the study area.

Few farmers reported to be using soyabean straw and groundnut stover, which they purchase from traders who procure from Madhya Pradesh and Saurastra region respectively. This list is further used to find out the least cost combination, which may be used by the farmers in the study area. These feed and fodders are considered to be available in the study area in the month of November- February for the purpose of arriving at the least cost combinations.

In order to find out the nutritional composition of the feed and fodder available in the study area, various secondary sources were used and are presented in the [Table-3]. The Dry matter (DM), Crude protein (CP), Crude Fibre (CF), Metabolizable Energy (ME), Total Digestible Nutrients (TDN) details along with Calcium (Ca), Phosphorus (P), Magnesium (Mg), Potassium (K), Sodium (Na) and Ether Extract (EE) content are presented. All the values presented above are on dry matter basis. The nutritional compositions of the feed and fodder are collected from the published source of ICAR, NRC and Feedipedia.

The [Table-4] shows the nutrient requirements by various weight categories of buffalo for maintenance. The nutrient requirement for maintenance vary with weight. The requirements are for body weights ranging from 200 Kg to 800 Kg in steps of 50. The various nutrient parameters are Dry Matter (DM), Total Digestible Nutrients (TDN), Metabolizable Energy (ME), Metabolizable Protein (MP), Rumen Degradable Protein (RDP), Crude Protein (CP), Calcium (Ca), Phosphorus (P), Sodium (Na), Chloride (Cl), Potassium (K), Magnesium (Mg) and Sulphur (S).

As the nutrient requirement for production varies with fat percentage, the above table depicts the nutrient requirement at various levels of fat percentage. The nutrient parameters are depicted for fat percentage ranging from 4% to 10%.

Table-3 *Nutritional composition of feed and Fodder (Per kg of feed and fodder on dry matter basis)[12-14]*

Feed	Category	DM (Kg)	CP (Kg)	CF (Kg)	ME (M cal/kg)	TDN (Kg)	Ca (g)	P (g)	Mg (g)	K (g)	Na (g)	EE (Kg)
Doob grass	Green fodder	0.313	0.098	0.313	1.769	0.529	4.500	2.200	1.800	15.700	0.400	0.019
Maize fodder green	Green fodder	0.289	0.069	0.301	2.222	0.600	3.700	2.000	2.600	18.700	3.000	0.012
Sorghum fodder	Green fodder	0.281	0.082	0.336	2.103	0.560	4.100	2.000	2.200	19.300	2.500	0.019
Sugarcane top	Green fodder	0.268	0.049	0.340	1.912	0.450	2.800	1.200	1.600	18.700	0.030	0.015
Paddy straw	Dry fodder	0.928	0.042	0.351	1.386	0.400	2.900	0.900	1.900	18.000	2.700	0.014
Bajra straw	Dry fodder	0.931	0.052	0.418	1.506	0.500	2.500	1.500	3.800	23.800	0.200	0.007
Sorghum straw	Dry fodder	0.930	0.037	0.395	1.746	0.600	3.100	0.700	2.500	12.900	0.200	0.012
Soyabean stover	Dry fodder	0.891	0.069	0.442	1.793	0.500	9.110	0.690	1.610	0.420	0.300	0.035
Groundnut stover	Dry fodder	0.913	0.112	0.336	1.888	0.430	11.000	1.500	6.100	11.200	0.400	0.016
Maize cake	Concentrate	0.956	0.256	0.104	3.131	0.844	0.700	5.500	2.000	2.300	0.400	0.081
Cotton seed cake	Concentrate	0.922	0.450	0.106	3.155	0.690	2.000	12.400	6.300	16.600	0.300	0.089
Amul compound feed	Concentrate	0.890	0.210	0.110	3.000	0.710	0.800	0.500	2.5	10.000	1.500	0.030
Wheat bran	Concentrate	0.870	0.173	0.104	2.629	0.715	1.400	11.100	4.600	13.700	0.100	0.039
Arhar chuni	Concentrate	0.930	0.067	0.380	2.079	0.610	9.700	1.800	3.000	12.000	0.100	0.003
Lucerne	Green fodder	0.199	0.206	0.267	2.247	0.650	19.400	2.500	2.800	22.400	0.500	0.029

Table-4 *Nutrient Requirement for Buffalo (For Maintenance) [15]*

BW(Kg)	DM(Kg)	TDN(Kg)	ME(Mcal)	MP(g)	RDP(g)	CP(g)	Ca (g)	P (g)	Na (g)	Cl (g)	K (g)	Mg (g)	S (g)
200	4.32	1.92	6.94	141	220	259	9	4	7	20	36	4	1
250	5.4	2.28	8.24	167	260	306	11	5	9	25	44	5	1
300	6.48	2.62	9.47	191	298	351	14	6	10	30	53	6	1
350	7.56	2.95	10.67	214	335	394	16	7	12	35	62	7	1
400	8.64	3.27	11.82	237	370	436	18	8	14	40	71	8	2
450	9.72	3.58	12.94	259	405	476	20	9	15	45	80	8	2
500	10.8	3.88	14.04	280	438	515	23	10	17	50	89	9	2
550	11.88	4.18	15.1	301	470	553	25	11	19	55	98	10	2
600	12.96	4.47	16.15	321	502	591	27	12	21	60	107	11	2
650	14.04	4.75	17.18	341	533	627	30	13	22	65	116	12	3
700	15.12	5.03	18.19	361	563	663	32	14	24	70	124	13	3
750	16.2	5.31	19.19	380	593	698	34	15	26	75	133	14	3
800	17.28	5.58	20.17	399	623	733	36	16	27	80	142	15	3

Table-5 *Nutrient Requirement for Buffalo-Production requirement (per kg milk production) [15]*

Fat (%)	DM(Kg)	TDN(Kg)	ME(Mcal)	MP(g)	RDP(g)	RUP(g)	CP(g)	Ca (g)	P (g)	Na (g)	Cl (g)	K (g)	Mg (g)
4	0.55	0.36	1.29	66	54	60	124	4.8	1.8	0.7	1.3	1.7	0.7
5	0.61	0.4	1.43	66	60	53	124	4.8	1.8	0.7	1.3	1.7	0.7
6	0.67	0.44	1.58	66	66	46	124	4.8	1.8	0.7	1.3	1.7	0.7
7	0.74	0.48	1.73	66	72	39	124	4.8	1.8	0.7	1.3	1.7	0.7
8	0.8	0.52	1.88	66	78	31	124	4.8	1.8	0.7	1.3	1.7	0.7
9	0.86	0.56	2.02	66	85	24	124	4.8	1.8	0.7	1.3	1.7	0.7
10	0.93	0.6	2.17	66	91	17	124	4.8	1.8	0.7	1.3	1.7	0.7

Table-6 *Primary survey findings (Descriptive Statistics)*

	N	Range	Mean	Std. Deviation
Body weight (Kg)	30.00	131.00	451.57	41.63
Milk yield (Litres)	30.00	10.00	9.72	3.33
Milk Fat percentage (%)	30.00	1.70	6.24	0.43
Green fodder qty (Kg)	30.00	25.00	18.67	5.71
Dry fodder qty (Kg)	30.00	7.00	7.57	2.10
Concentrate qty (Kg)	30.00	4.00	5.77	1.43
Total feed qty (Kg)	30.00	25.00	32.00	7.48
Green fodder cost (Rs)	30.00	50.00	33.71	12.54
Dry fodder cost (Rs)	30.00	40.75	39.18	13.93
Concentrate cost (Rs)	30.00	114.00	118.48	38.99
Total feed cost (Rs)	30.00	180.75	191.36	57.20
Green fodder cost per litre (Rs)	30.00	8.00	3.85	1.83
Dry fodder cost per litre (Rs)	30.00	5.50	4.24	1.58
Concentrate cost per litre (Rs)	30.00	10.49	12.59	2.50
Total feed cost per litre (Rs)	30.00	20.31	20.69	5.05
Valid N (listwise)	30.00			

The average weight of the animal was found to be 451.57 Kg.

A measuring tape was used to measure the length and girth of the sampled animals. The length was recorded from the point of shoulder to the point of buttock, while girth was measured by passing the tape just behind the forelegs. Average milk fat percentage comes out to be 6.24%. The average quantity of green, dry fodder and concentrate fed to these buffaloes are 18.67 Kg, 7.57 Kg and 5.77 Kg on wet basis. The per litre cost of these feed are Rs. 3.85 for green fodder; Rs. 4.24 for Dry fodder; and Rs. 12.59 for concentrate with total cost of feed per litre of milk production coming out to Rs. 20.69.

A bivariate correlation was used to explore the relationship between Body weight, milk yield, quantity of dry, green and concentrate and total quantity and cost of these categories of feed per litre.

There was a weak positive correlation between body weight of buffalo and quantity of dry fodder fed, body weight and concentrate quantity, body weight and total quantity of feed. It shows that farmers are feeding more feed to heavier animals. There was moderate positive correlation between milk yield and quantity of dry fodder fed, milk yield and concentrate quantity, milk yield and total quantity of feed. It means farmers are feeding more dry fodder and concentrate for higher yielding buffaloes. There was weak negative correlation between milk yield and cost of green fodder per litre of milk, milk yield and cost of dry fodder per litre of milk, milk yield and cost of concentrate per litre of milk, milk yield and cost of total feed per litre of milk yield. This clearly indicates that if milk yield is high, a farmer is able to achieve lower cost of feed per litre of milk.

In order to arrive at the least-cost feed combination, the prices of various feed and fodder fed to the animals are collected, and the modal value of these feed and fodder are used for the purpose. The prices are on wet or as such basis, which are converted into Dry matter basis for all the identified feed

As the average milk fat percentage came out to be 6.24%, the nutrient requirements for buffaloes weighing 450 kg to 550 kg in steps of 50 and milk yield 6, 8 and 10 litres were computed and are presented in [Table-9]. These nutrient requirements are constructed as constraints for minimizing the cost of feed.

Table-7 *Correlation Matrix*

Correlations											
		Bodywt_cal	Milk_yield	Green_qty	Dry_qty	Conc_qty	Total_qty	Green_per_lt_cost	Dry_per_lt_cost	Conc_per_lt_cost	Total_per_lt_cost
Body wt.	Pearson Correlation	1	**.411***	.353	**.473****	**.496****	**.497****	-.003	.077	.155	.100
	Sig. (2-tailed)		.024	.056	.008	.005	.005	.987	.684	.413	.599
	N	30	30	30	30	30	30	30	30	30	30
Milk yield	Pearson Correlation	.411*	1	.342	**.783****	**.790****	**.632****	**-.585****	**-.381***	**-.423***	**-.541****
	Sig. (2-tailed)	.024		.064	.000	.000	.000	.001	.038	.020	.002
	N	30	30	30	30	30	30	30	30	30	30
*. Correlation is significant at the 0.05 level (2-tailed).											
**. Correlation is significant at the 0.01 level (2-tailed).											

Table-8 *Modal Price of Feed and Fodder available*

Feed	As such price (Kg)	Prices (per Kg D.M.)
Doob grass	2.00	6.39
Maize fodder green	1.50	5.19
Sorghum fodder	2.00	7.12
Sugarcane top	2.00	7.46
Paddy straw	4.00	4.31
Bajra straw	8.00	8.59
Sorghum straw	7.50	8.06
Soyabean straw	6.50	7.30
Groundnut straw	7.50	8.21
Maize cake	23.00	24.06
Cotton seed cake	22.00	23.86
Amul comp. feed	14.00	15.73
Wheat bran	15.00	17.24
Arhar chuni	17.00	18.28

Table-9 *Total Nutrient Requirement for buffalo for various combinations of body weight and milk yield at 6% fat*

	Maintenance requirement				Production requirement			Total Requirement											
								6 litre milk yield				8 litre milk yield				10 litre milk yield			
	400 kg	450 kg	500 kg	550 kg	6 lt	8 lt	10 lt	400kg	450kg	500kg	550kg	400kg	450kg	500kg	550kg	400kg	450kg	500kg	550kg
DM (Kg)	8.64	9.72	10.8	11.88	4.02	5.36	6.7	12.66	13.74	14.82	15.9	14	15.08	16.16	17.24	15.34	16.42	17.5	18.58
CP (Kg)	0.436	0.476	0.515	0.553	0.744	0.992	1.24	1.18	1.22	1.259	1.297	1.428	1.468	1.507	1.545	1.676	1.716	1.755	1.793
ME (M cal/kg)	11.82	12.94	14.04	15.1	9.48	12.64	15.8	21.3	22.42	23.52	24.58	24.46	25.58	26.68	27.74	27.62	28.74	29.84	30.9
TDN (Kg)	3.27	3.58	3.88	4.18	2.64	3.52	4.4	5.91	6.22	6.52	6.82	6.79	7.1	7.4	7.7	7.67	7.98	8.28	8.58
Ca (g)	18	20	23	25	28.8	38.4	48	46.8	48.8	51.8	53.8	56.4	58.4	61.4	63.4	66	68	71	73
P (g)	8	9	10	11	10.8	14.4	18	18.8	19.8	20.8	21.8	22.4	23.4	24.4	25.4	26	27	28	29
Mg (g)	8	8	9	10	4.2	5.6	7	12.2	12.2	13.2	14.2	13.6	13.6	14.6	15.6	15	15	16	17
K (g)	71	80	89	98	10.2	13.6	17	81.2	90.2	99.2	108.2	84.6	93.6	102.6	111.6	88	97	106	115
Na (g)	14	15	17	19	4.2	5.6	7	18.2	19.2	21.2	23.2	19.6	20.6	22.6	24.6	21	22	24	26

(Computed by Author)

Simple method of Linear Programming is used to arrive at the least cost feed combination for buffalo yielding 6 litres or more per day and are in early lactation. As the nutrient requirement varies with body weight of the animal along with the milk yield and the milk fat percentage, the least cost combination is calculated for various weights of the animal from 400 kg at the step of 50 kg upto 550 kg (as this was the body weight range of the sampled buffalo), milk yield 6, 8 and 10 litres, and 6% fat (average fat percentage of the sampled buffalo- 6.24%). The weight estimated using the Aggarwal's Modified Shaeffers Formula were rounded up or down to nearest 50s or 100s.

The nutrient composition of all the feed and fodder are on Dry matter basis. Hence the quantities arrived are converted into wet basis or as such basis using the information on DM (Kg) in [Table-3].

Feeding Maize green fodder, paddy straw, soya bean straw and cotton seed cake to these animals with the quantities as mentioned above will optimize the feed cost. The table also shows the total cost of feed and cost of these feed combinations per litre of milk production for various weight, milk yield and fat percentage categories of buffalo.

Table-10 *Least cost combination of Feed*

	Doob grass	Maize fodder green	Sorghum fodder	Sugarcane top	Paddy straw	Bajra straw	Sorghum straw	Soyabean straw	Groundnut stover	Maize cake	Cotton seed cake	Amul feed	Wheat bran	Arhar chuni	Total cost	Cost Per Litre
400kg 6 lt 6% fat	0.00	**10.80**	0.00	0.00	**2.22**	0.00	0.00	**8.20**	0.00	0.00	**3.93**	0.00	0.00	0.00	**164.77**	**27.46**
450kg 6 lt 6% fat	0.00	**11.83**	0.00	0.00	**2.12**	0.00	0.00	**9.30**	0.00	0.00	**4.17**	0.00	0.00	0.00	**178.36**	**29.73**
500kg 6 lt 6% fat	0.00	**12.66**	0.00	0.00	**2.54**	0.00	0.00	**9.67**	0.00	0.00	**4.58**	0.00	0.00	0.00	**192.80**	**32.13**
550kg 6 lt 6% fat	0.00	**13.50**	0.00	0.00	**2.97**	0.00	0.00	**10.05**	0.00	0.00	**4.99**	0.00	0.00	0.00	**207.23**	**34.54**
400 kg 8 lt 6% fat	0.00	**12.05**	0.00	0.00	**2.18**	0.00	0.00	**9.45**	0.00	0.00	**4.25**	0.00	0.00	0.00	**181.76**	**22.72**
450 kg 8 lt 6% fat	0.00	**13.07**	0.00	0.00	**2.08**	0.00	0.00	**10.56**	0.00	0.00	**4.49**	0.00	0.00	0.00	**195.35**	**24.42**
500 kg 8 lt 6% fat	0.00	**13.91**	0.00	0.00	**2.50**	0.00	0.00	**10.93**	0.00	0.00	**4.90**	0.00	0.00	0.00	**209.79**	**26.22**
550 kg 8 lt 6% fat	0.00	**14.74**	0.00	0.00	**2.92**	0.00	0.00	**11.30**	0.00	0.00	**5.32**	0.00	0.00	0.00	**224.23**	**28.03**
total-400kg 10 lt 6% fat	0.00	**13.29**	0.00	0.00	**2.14**	0.00	0.00	**10.71**	0.00	0.00	**4.58**	0.00	0.00	0.00	**198.76**	**19.88**
total-450kg 10 lt 6% fat	0.00	**14.32**	0.00	0.00	**2.03**	0.00	0.00	**11.81**	0.00	0.00	**4.82**	0.00	0.00	0.00	**212.35**	**21.23**
total-500kg 10 lt 6% fat	0.00	**15.15**	0.00	0.00	**2.46**	0.00	0.00	**12.18**	0.00	0.00	**5.23**	0.00	0.00	0.00	**226.78**	**22.68**
total-550kg 10 lt 6% fat	0.00	**15.99**	0.00	0.00	**2.88**	0.00	0.00	**12.55**	0.00	0.00	**5.64**	0.00	0.00	0.00	**241.22**	**24.12**

The cost per litre for a buffalo weighing 450 kg and yielding 10 litres of milk with 6% fat comes out to Rs. 21.23 when fed with 14.32 Kg of green maize fodder, 2.03 kg of paddy straw, 11.81 kg of soyabean straw and 4.82 kg of cotton seed cake.

Conclusion

The existing cost of feed for buffalo yielding 6 litres or more milk and are in early lactation stage is Rs. 3.85, Rs. 4.24 and Rs. 12.59 per day for green fodder, dry fodder and concentrate respectively with overall cost of feed Rs. 20.69 per litre of milk production.

With a combination of Maize green fodder, paddy straw, soyabean straw and cotton seed cake in the quantity as estimated above for various combinations of animal's body weight, milk yield and fat percentage in milk, a farmer can achieve the lowest feed cost beside fulfilling the nutritional requirement.

Conflict of Interest: None declared

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