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Quantity and Value of Milk Losses Due to Technical Constraints - A Case of Crossbred Cows in North-Eastern States of India

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ABSTRACT

The crossbred cows occupy an important place in milk production system of North-Eastern States (N-E States). In majority of the states except Assam and Tripura, crossbred cows produced more than 50 per cent of the total milk (2007-08). However, milk production from crossbred animals in the region is affected by a number of technical constraints. The present study estimates the value of milk losses due to important constraints in order to quantify the loss and set priorities for their removal. Data for the study were collected from N-E States for crossbred cows. Based on the estimates, mineral deficiency appeared to be the most important constraint causing maximum economic losses, i.e., Rs. 55.28 crores followed by repeat breeding (Rs. 36.62 crores) and worms infestation (Rs. 12.91 crores). These three constraints account for 94 per cent of the total value of milk loss where mineral deficiency alone accounts for approximately 50 per cent losses. While, foot and mouth disease, mastitis, haemorrheric septicaemia, black quarter and milk fever placed in decreasing order in terms of their rank based on economic losses were found to be the minor constraints accounting for only six per cent of the total value of milk loss (Rs. 112.08 crores). All the constraints had lowered milk productivity of crossbred cows by 0.862 L/day. Tackling the constraints will increase milk production of the region by six per cent and will improve milk productivity and generate surpluses.

Keywords: Economic losses, Technical constraints, Priority, Crossbred milk production system, North-eastern states.

JEL: Q19, Q16, O13.

I

INTRODUCTION

Milk production system in North-Eastern States of India is affected by a number of constraints. Some of these constraints are physio-environmental and do not have solution in the near future until unless fundamental research is carried out in the area of genetics and breeding as well as in frontier areas of genetic engineering and biotechnology. The other constraints are of the socio-economic kind and require policy intervention to establish an efficient institutional arrangement in the area of

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The paper is based on part of the analysis done for M.Sc thesis of the first author. The thesis entitled 'Yield Gap Analysis and Priorisation of Constraints of Milk Production from Crossbred Cattle in North-Eastern States' was submitted in 2008 to National Dairy Research Institute (Deemed University), Karnal. The authors are thankful to the deemed university for supporting and allowing publication of paper out of research. However, the views expressed in the paper are strictly that of the authors and does not bear upon the Institute in any way.

credit and marketing, e.g., micro-finance, co-operatives etc., to overcome the resource crunch of the dairy farmers of the region and reduce transaction cost to realise the benefits of market economy. Last but not the least the group of constraints are technical in nature for which either the technology already exist or the existing technology could be refined in comparatively shorter period to overcome the problem. These constraints are related with the availability of feed and fodder, control of diseases and other management deficiencies. The last category of constraints accounts for much of the low productivity of animals, yield gaps in milk production and milk deficiency in the region. The yield gap attributable to these constraints was estimated to be about 66 per cent in N-E States (Paul and Chandel, 2010). The milk productivity of bovine species in the region is as low as 1.46 L/day/animal which is a weighted average of milk productivity of non-descriptive crossbred cattle and buffalo which were recorded 1.0, 4.73 and 2.14 L/day, respectively, of lactating animals in 2007-08 survey.

The major technical constraints in N-E States observed were mineral deficiency, repeat breeding, worms infestation and various diseases. One of the factors responsible for severity of these constraints is hot and humid climate of the region. Thus, the incidences of diseases are high in the States as compared to the rest of the country. The quality green fodder is not available round the year. Due to high price of concentrates and poor quality of dry fodder, the farmers are not able to meet the body requirement of their animals especially that of high yielding animals (crossbred), which results into mineral deficiency. Repeat breeding is also one of the major reasons of milk production losses which delays the calving period and extend the dry period. It may be due to mineral deficiency or physio-ovarian disorders or faulty artificial insemination. Likewise, worms Infestation occurs due to poor management practices followed by the farmers like unhygienic housing and feeding practices, poor quality drinking water and lack of cleanliness. The researchers have identified a number of constraints related to milk production (Acharya, 1984) what is not known is the quantum of economic losses caused by these constraints and their priorities.

Thus, the present study has two major objectives: (1) To estimate the quantity and value of milk losses due to technical constraints in crossbred milk production system and (2) prioritization of constraints to ensure higher returns to the public investments in research, development and extension services. There are a number of studies in agriculture directed at estimating the economic losses due to constraints but cases are few in livestock or dairy sector (Joshi *et al.,* 2003; Prabu *et al.,* 2004, Chauhan *et al.,* 1994).

II

VETERINARY INFRASTRUCTURE AND PRODUCTIVITY STATUS

In N-E States, it is mainly the cattle-based milk production system. Cow milk constituted about 89 per cent of the total milk production of 1139 thousand tonnes in

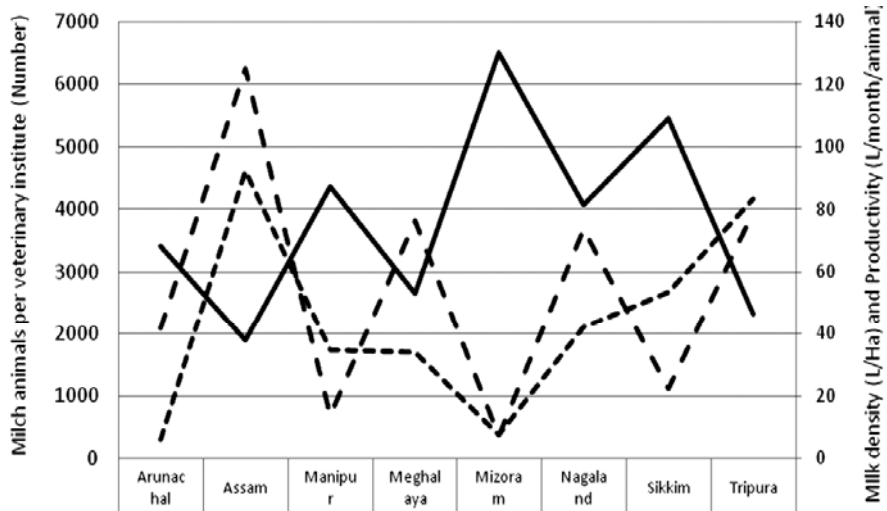
2007-08 from bovine species. In this, 12 per cent of the crossbred in-milk produced 39 per cent of the cow milk (Table 1). In majority of the states except Assam and Tripura, crossbred animals produces more than 50 per cent of the total milk. The milk productivity from crossbred cattle ranges from 3.36 L/day in Assam to 10 L/day in Arunachal Pradesh. Since, Assam accounts for more than fifty per cent of the crossbred cattle in the region, milk productivity of crossbred cattle in this state could be taken as the mode value. Most of the available crossbred cattle are the upgraded local breed to Jersey and Holstein Friesian types.

TABLE 1: STATE-WISE MILK PRODUCTION, PRODUCTIVITY AND VETERINARY INSTITUTIONS IN N-E STATES - 2007-08

States	Milk production (thousand tonnes)			Productivity (l/day)			Milch animal per vet. institute	Milk density
	Crossbred	Cattle	Total	Crossbred	Cattle	Total	(Number)	(L/Ha.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Arunachal Pradesh	25.5 (52.78)	48.35 (100.00)	48.3 (100.00)	9.988	2.208	2.196	2095	5.774
Assam	165.37 (22.79)	625.83 (86.26)	725.47 (100.00)	3.356	1.186	1.261	6243	92.490
Manipur	39.06 (50.47)	63.12 (81.55)	77.40 (100.00)	7.644	2.882	2.905	688	34.667
Meghalaya	45.83 (60.26)	74.03 (97.34)	76.05 (100.00)	8.969	1.764	1.766	3811	33.907
Mizoram	12.30 (77.80)	15.17 (95.95)	15.81 (100.00)	8.425	4.618	4.331	364	7.498
Nagaland	41.42 (59.14)	68.45 (97.73)	70.04 (100.00)	4.934	2.767	2.711	3684	42.246
Sikkim	38.00 (100.00)	38.00 (100.00)	38.00 (100.00)	6.369	3.644	3.637	1115	53.551
Tripura	30.64 (30.64)	86.17 (86.17)	87.73 (100.00)	4.418	1.533	1.541	3957	83.664
Overall/ Total	398.14 (34.96)	1019.12 (89.49)	1138.85 (100.00)	4.695	1.440	1.491	4106	43.467
Rest of India	21316.55 (21.75)	42379.10 (43.24)	98017.90 (100.00)	6.593	3.271	3.852	4392	328.188

Figures in parentheses are the percentage of total.

The establishment of veterinary institutions and knowledge dissemination centres are the major interventions to overcome the technical constraints. In this section, we try to analyse the relationship among veterinary institutions, density of milk production and milk productivity in N-E States (Figure 1) and infer that investment in these institutions is beneficial in the long run to avoid economic losses to the economy. In order to highlight the point, three series were constructed that of number of milch animals per veterinary institution, milk produced per hectare of geographical area and milk productivity. To make it comparable across states, veterinary institutions include only veterinary hospitals and dispensaries. The milk productivity was calculated per month in order to draw series on same scale of the graph.



	Arunachal	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura
Vet. Institutions (Milch animal/institute)	2094.63	6242.58	687.62	3811.40	363.63	3684.20	1114.55	3956.52
Productivity (L/month)	68.13	37.83	87.15	52.97	129.95	81.34	109.13	46.22
Milk density (L/ha)	5.77	92.49	34.67	33.91	7.50	42.25	53.55	83.66

Figure 1. Relationship among Veterinary Infrastructure, Milk Density and Milk Productivity in N-E States

A perusal of the graph shows that among N-E States, the number of milch animals per veterinary institution moved along with milk density and inversely with milk productivity. This clearly indicates that milk production in N-E States was a function of more number of animals in-milk. However, the milk productivity was low when more milch animals were served per unit of veterinary institution or the number of veterinary institutions is less with respect to the population of milch animals. This clearly indicated that increasing the number of veterinary institutions will reduce the technical constraints and economic losses, and enhance milk productivity.

III

MATERIALS AND METHOD

The Sample

The data for the study were collected from three states, namely, Assam, Tripura and Manipur. The basis of selecting these states was the highest milk production. Subsequently, one district and one block were selected on the basis of highest number of milch cattle in the absence of information on milk production at the district and block levels. From each block, two villages were selected on the basis of highest

crossbred milch animals in consultation with officers of the Department of Animal Husbandry of the respective states. A complete list of dairy farmers having at least one crossbred cow in-milk was prepared from these villages by noting down their general information including the herd size. These dairy farmers were then stratified into small (1-2 crossbred cattle), medium (3-8 crossbred cattle) and large (9-20 crossbred cattle) categories and ultimately, a sample of 90 households was randomly selected by probability proportion allocation among villages and the strata which comprised 50 small, 31 medium and 9 large households.

Quantification of Economic Losses

Data on the following aspects were collected using pre-tested schedules based on the memories of the farmers for the year 2007-08.

Name of technical constraints and milk yield loss due to i-th constraint in L/day/animal = l_i

Duration of the year in months for which an animal suffered from i-th disease/ constraint = d_i

Probability of occurrence (per cent) of the i-th constraint per year= p_i

Farm gate prices of milk (Rs/L)= P_m

The above information was supplemented by the collecting following data direct from the Official of the State Departments of Animal Husbandry and Veterinary Doctors.

Proportion of crossbred animals in-milk affected by i-th constraint = n_i

Population of crossbred animal in-milk = N

Using the above information, quantity and value of milk losses were estimated as following:

Expected quantity of milk loss/annum/animal due to i-th constraint (E_{qi}) = $l_i*p_i*d_i$

Total milk loss in N-E states due to i-th constraint (T_{qi})= $E_{qi}*N*n_i$

Total value of milk loss (Economic Loss) due to i-th constraint = $T_{qi}*Pm$.

IV

RESULTS AND DISCUSSION

In total, eight major technical constraints were identified causing tangible milk yield losses in the area. These were namely foot and mouth disease (FMD), mastitis, mineral deficiency, worms infestation, repeat breeding, milk fever, black quarter disease and hemorrhagic septicaemia. The incidence of their occurrence, proportion of animal infected, yield loss and duration for which animal suffered from particular constraints have been discussed in this section. The constraints were felt important because of their regular occurrence and the proportion of animal suffering. It was observed that the probability of their occurrence was 100 per cent, i.e., occurring

every year and hence, it was taken same for all the constraints with varying durability, animals affected and the yield loss. The latter information has been given separately in tabular form while discussing each constraint. The last part of the section, quantify the economic losses from each constraint and set the priorities for line of action.

Foot & Mouth Disease (FMD): FMD is highly contagious viral disease-affecting cattle and causes irrecoverable economic losses to the farming community. The economic losses caused by the disease were mainly due to the reduction in milk production, market price of animal as well as hide and skin (Prabu *et al.*, 2004). In addition, the milk and milk products were not accepted by the countries free from this disease, resulting in severe reduction in the export potential of livestock industry of India.

TABLE 2. ESTIMATION OF PARAMETERS OF FMD IN SAMPLE STATES AND N-E STATES

States (1)	Lactating animal affected (proportion) (2)	Average yield loss (l/day) (3)	Duration of effect (days) (4)
Assam	0.20	3.72	20.00
Manipur	0.30	3.15	15.00
Tripura	0.10	3.20	20.00
N-E states	0.11	3.60	19.63

A perusal of Table 2 shows that the proportion of animals affected was 11 per cent but the incidences were very high in Manipur (30 per cent crossbred animals affected) followed by Assam (20 per cent). The disease occurred mainly during rainy seasons. The average duration was found to be about 20 days causing average milk loss of 3.35 L/ day during infection. As mentioned above, the disease was occurring every year like any other constraint and hence, the probability of occurrence was taken as 100 per cent.

Mastitis: The disease was reported from all the N-E States, causing major economic loss in dairy animals. The disease was not fatal but led to milk yield reduction from 15 per cent to 100 per cent. The average yield loss was estimated to be 4.29 L/day. This was higher in Assam and Manipur in comparison to Tripura. Higher yielders were suffering more and hence, the crossbred were affected the most.

TABLE 3. ESTIMATION OF PARAMETERS OF MASTITIS IN SAMPLE STATES AND N-E STATES

States (1)	Lactating animal affected (proportion) (2)	Average yield loss (l /day) (3)	Duration of effect (days) (4)
Assam	0.20	4.18	10.00
Manipur	0.20	5.67	10.00
Tripura	0.12	4.10	7.00
N-E states	0.20	4.29	9.64

Mineral Deficiency: Due to lack of availability of green fodder and high cost of concentrates, most of the times, farmers were feeding their animals with dry fodder,

i.e., paddy straw. Low nutritive value of paddy straw and less of green fodder and concentrate were the major reasons for mineral deficiency in high yielder like the crossbred. The deficiency caused loss of appetite and body weight leading to decrease in milk yield in crossbreed animals. About 69 per cent crossbreed animals in this region were suffering from mineral deficiency. It was, also, considered as one of the factors responsible for repeat breeding.

TABLE 4. ESTIMATION OF PARAMETERS OF MINERAL DEFICIENCY IN SAMPLE STATES AND N-E STATES

States (1)	Lactating animal affected (proportion) (2)	Average yield loss (l /day) (3)	Duration of effect (days) (4)
Assam	0.70	0.93	270
Manipur	0.60	1.26	180
Tripura	0.70	0.91	270
N-E states	0.69	0.96	263

The average duration of the problem was 263 days in a year causing a milk loss of 0.96 L/day.

Worms Infestation: The physical, environmental and biological conditions of N-E States are suitable for worms infestation. Worms infested nearly 48 per cent of crossbreed animals in the region (Table 5).

TABLE 5. ESTIMATION OF PARAMETERS OF WORMS INFESTATION IN SAMPLE STATES AND N-E STATES

States (1)	Lactating animal affected (proportion) (2)	Average yield loss (l /day) (3)	Duration of effect (days) (4)
Assam	0.50	0.91	90
Manipur	0.40	1.26	90
Tripura	0.40	0.93	90
N-E states	0.48	0.94	90

Poor management and unhygienic housing and feeding conditions were the major reasons for worms infestation. The infested animal loses weight and have reduced physiological functions which ultimately result into low milk yield. On an average, an animal remain infested for three months a year during which the farmer tries his own indigenous technical knowledge (ITK) as well as approaches the veterinary hospitals for treatment.

Repeat Breeding: Repeat breeding accounted for a considerable financial losses and economic setback to dairy farmers, whereby, it delays in calving period and increases dry period causing low milk production per lactation. In N-E States also, the proportion of animals suffering from repeat breeding were quite similar to national average. In the region, near 35 per cent of crossbreed animals were repeat breeder (Table 6).

A crossbred animal with normal cycling female and normal genitalia was considered repeat breeder if she fails to settle to service or insemination during 3 or

more consecutive oestrus periods. In this way, it was observed that dry period of repeat breeder was got extended by about 69 days on an average and the yield loss was taken as the average productivity of the animal in the region.

TABLE 6. ESTIMATION OF PARAMETERS OF REPEAT BREEDING IN SAMPLE STATES AND N-E STATES

States (1)	Lactating animal affected (proportion) (2)	Average yield loss (L /day) (3)	Duration of effect (days) (4)
Assam	0.35	4.65	70.00
Manipur	0.30	6.30	66.00
Tripura	0.35	4.57	64.00
N-E states	0.35	4.78	69.00

Milk Fever: Milk fever, also known as 'parturient paresis' is a complex metabolic disease of dairy cattle. It occurs commonly within 48 hours after parturition. In N-E States, nearly 11 per cent animals were suffering from this disease and this lead to loss in milk yield (Table 7). The prevalence of disease in the region was similar to the situation in Tamil Nadu. Thirunavukkarasu *et al.* (2010) found that 13.67 per cent of cows and 11.99 per cent of buffalo in the study area of Tamil Nadu were affected by milk fever.

TABLE 7. ESTIMATE OF PARAMETERS OF MILK FEVER IN SAMPLE STATES AND N-E STATES

States (1)	Lactating animal affected (proportion) (2)	Average yield loss (L /day) (3)	Duration of effect (days) (4)
Assam	0.10	2.32	1.00
Manipur	0.10	3.15	1.00
Tripura	0.15	2.28	1.00
N-E states	0.11	2.39	1.00

The duration of effect lasted for one day on an average in the region.

Black Quarter (BQ) and Hemorrhagic Septicaemia (HS): These two diseases were prevalent in the region with the onset of rainy season. In both the cases, the animal suffered from high fever. Due to specific symptoms, the farmers were not able to differentiate between them and hence, the estimates could not be generated separately state wise and constraint wise. It was in consultation with veterinary doctors and official of animal husbandry who told that 5 to 10 per cent of the crossbred animals suffer from both these diseases every year and the probability of occurrence is 100 per cent. On an average, an animal remains affected for 3 to 5 days causing reduction in milk yield to the extent of 3.716 L/ day during the infection.

IV

VALUE OF MILK LOST DUE TO TECHNICAL CONSTRAINTS

Table 8 presents the estimates of expected losses in milk production in terms of quantity and value due to the above described technical constraints in N-E States as a

whole. As is clear from the table, mineral deficiency causes maximum economic losses, i.e., Rs. 55.28 crores followed by repeat breeding (Rs. 36.62 crores) and worms infestation (Rs. 12.91 crores). All these three constraints account for 94 per cent of the value of milk loss where mineral deficiency alone accounts for approximately 50 per cent losses. FMD, Mastitis, HS, BQ, and milk fever placed in decreasing sequence in terms of their rank based on economic losses, were found to be the minor constraints. The value of milk loss from FMD, Mastitis, HS, BQ and milk fever were Rs. 4.19, Rs 2.25, Rs. 0.16, Rs. 0.12 and Rs. 0.08 crores, respectively accounting for six per cent of the total value of losses (Rs. 112.08 crores). The value of loss in their decreasing order set the priority for action to tackle the constraints. Overcoming the problem of mineral deficiency among lactating crossbred cows will alone reduce fifty per cent of the losses and any such effort is going to have the highest benefit-cost ratio.

TABLE 8. ESTIMATED QUANTITY AND VALUE OF MILK LOSSES DUE TO TECHNICAL CONSTRAINTS IN N-E STATES

Sl. No. (1)	Name of the constraints (2)	Expected milk loss (L/animal/ year) (3)	Total milk loss (thousand tonnes) (4)	Value of loss (Rs. in crores) (5)	Priority (6)
1.	Mineral deficiency	252.55	36.059	55.28	I
		(31.27)	(49.32)	(49.32)	
2.	Repeat breeding	329.82	23.887	36.62	II
		(40.84)	(32.67)	(32.67)	
3.	Worms infestation	84.77	8.419	12.91	III
		(10.50)	(11.52)	(11.52)	
4.	Foot and mouth disease	70.67	2.924	4.48	IV
		(8.75)	(4.00)	(4.00)	
5.	Mastitis	41.35	1.626	2.49	V
		(5.13)	(2.22)	(2.22)	
6.	Haemorrheric septicaemia	14.88	0.082	0.13	VI
		(1.84)	(0.12)	(0.12)	
7.	Black quarter	11.10	0.061	0.09	VII
		(1.38)	(0.08)	(0.08)	
8.	Milk fever	2.39	0.054	0.08	VIII
		(0.29)	(0.07)	(0.07)	
	Total	807.53	73.112	112.08	
		(100.00)	(100.00)	(100.00)	

Figures in parentheses are the percentage of the total.

In case of expected milk loss per year per animal, repeat breeding causes more loss than mineral deficiency. While the total milk loss from the latter constraint is more than the former because the proportion of crossbred animals in-milk suffering from mineral deficiency are more, i.e., 69 per cent (Table 3) as against 35 per cent in case of repeat breeding (Table 5).

The total milk loss from all the constraints was estimated to be 73.112 thousand tonnes in which the mineral deficiency alone accounted for fifty per cent followed by repeat breeding (32.67 per cent) and worms infestation (11.52 per cent). The first

three ranked constraints accounted for 94 per cent of the total milk loss. Total milk loss follows the same priority as the value of milk loss since figures are multiple of constant value, i.e., the price of milk (Rs 15.33/L). Only 6 per cent of the loss in milk production is caused by rest of the constraints. Removal of all the constraints will increase the existing milk production from crossbred animals from 398.14 thousand tonnes to 471.252 thousand tonnes. Resultantly, the productivity of crossbred animals which is 4.695 L/day at present will increase to 5.557 L/day by about 19 per cent. This will increase total milk production of the region by six per cent from 1138.85 thousand tonnes to 1211.962 thousand tonnes.

Measures to Remove Constraints: The analysis clearly hints at that allocation of additional resources in dairying to remove the above mentioned constraints, in order of their priority, will increase milk production and generate surpluses to the society. One of the important measures to remove constraints is to increase the intensity of veterinary institutions which will improve accessability and veterinary health of dairy animals especially that of crossbred cows who need it more. Animal husbandary and dairy extension services to improve housing of dairy animals, educate the farmers about the symptoms of diseases and their treatment, and better feeding practices will help in prevention of mineral deficiency, worms infestation, FMD, BQ and HS. Keeping in view the extent of economic losses, a mission mode programmes in the region, if launched to remove the mineral deficiency and worms infection of the cost equal to or lesser than their value of milk loss, will still be an economically viable proposition.

IV

SUMMARY AND CONCLUSIONS

Milk production from crossbred animals in N-E States was affected by a number of technical constraints. Important one of these were mineral deficiency, repeat breeding, worms infestation and diseases namely Milk Fever, Foot and Mouth Disease, Haemorrhagic Septicaemia, Black Quarter and Mastitis. The quantum of losses caused by these constraints in milk production, both in physical and monetary terms, sets the priority for the course of action. The investments made to remove the constraints according to priorities also ensure better results and high returns to per rupee invested. In order to estimate the quantity and value of milk losses from these constraints, data was collected from N-E States for crossbred cows. The crossbred cows occupied an important place in milk production system of the region. Crossbreds were 12 per cent of the in-milk cattle which produced 39 per cent of the cow milk (2007-08). In majority of the states except Assam and Tripura, crossbred cow produced more than 50 per cent of the total milk.

The quantity of milk loss was estimated in terms of the expected milk loss (L/animal/year) and total milk loss. The value of milk loss is the monetary value of total milk loss (total milk loss x price of milk). The value of loss in their decreasing

order set the priority for action to tackle the constraints. Accordingly, mineral deficiency appeared to be the most important constraint causes maximum economic losses, i.e., Rs. 55.28 crores followed by repeat breeding (Rs 36.62 crores) and worms infestation (Rs 12.91 crores). These three constraints account for 94 per cent of the value of milk loss where mineral deficiency alone accounts for approximately 50 per cent losses. FMD, Mastitis, HS, BQ, and Milk fever were found to be the other miner constraints placed in decreasing order in terms of their rank based on economic losses. The removal of all the constraints will increase the productivity of crossbred animals by about 19 per cent from 4.695 L/day at present to 5.557 L/day. The total milk production of the region will increase by six per cent from 1138.85 thousand tonnes to 1211.962 thousand tonnes.

One of the important factors to remove constraints is to increase intensity of veterinary institutions with improved service quality and delivery mode. The latter could, very well be the future areas of research. At the same time, the mission mode programmes in the region to remove mineral deficiency and worms infection of the cost equal to or lesser than their value of milk loss will improve the milk productivity and generate social surpluses.

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