

ECONOMIC VIABILITY OF DAIRY FARMING IN COLD DESERT OF LADAKH: A COMPARATIVE STUDY OF DIFFERENT SPECIES OF MILCH ANIMALS

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ABSTRACT

*The spatial variations in agro-climatic conditions, socio-economic set-up and the cultural milieu have a direct as well as indirect influence over the domestication of animals. The domestication of plants and animals are greatly influenced by physical factors like terrain, geomorphic processes and agro-climatic conditions. Among all geographical factors climate plays a dominant role in the development of dairy farming as climate is instrumental in the formation of botanical environment which ultimately determines the vegetation and animal association. In Ladakh, vegetation is very sparse, rains are very scanty and most of the land comprises cold desert and barren mountains devoid of any vegetative cover. The region has short agricultural season and production of maximum edible biomass is possible only through the development of pastures, fodder and crop roughages. As a result, dairy farming becomes an integral part of agriculture in this region. Among the various basic human needs that the animals fulfil, milk is the most important one. Dairy animals are the best means to convert local vegetative biomass into useful products and work. The milk conversion process is however, controlled by genetic and non-genetic factors of the milch animals. In this region, the native breed of dairy animals are mostly of indigenous zebu type (*Bos indicus*). They are late maturing animals with low yield of milk and have short lactation period. In this paper, an attempt has been made to compare the productive and reproductive performance as well as the relative profitability of crossbred cows, local cows, dzomos and yaks in the cold arid region of Ladakh. All the biological parameters of dairy animals such as age at first calving, lactation yield, and milk yield are higher among the crossbred cows followed by dzomo, as compared to their indigenous counterparts. The average daily milk yield per local cow was found to be 1.80 kgs, crossbreds 5.74 kgs, dzomo 2.63 kgs and yak 2.03 kgs. The study reveals that crossbred cows are more economical, provide higher yield and profitability than the local animal stock. Popularisation of crossbred cows in Ladakh region could prove to be quite beneficial and at the same time provide round the year employment to beneficiaries resulting in significant increase in their levels of income.*

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Introduction

Mountainous areas are environmentally the most fragile ecosystems. Development concerns in these regions revolve around how resources of the region could be managed for conserving / improving the environmental value of the region together with socio-economic development of people. The strength of ecological and socio-economic concerns depends upon the specificities of the target areas and background of people involved in thinking. A strategy for resource development in these delicate agro-climatic settings should be region-specific and environment-friendly. The high altitude regions of Ladakh pose a challenge to agricultural and livestock development agency as the region is characterised by marginality, extreme diversity, environmental fragility and smallholder farming systems (Bora, 2004). Over the centuries, together the people inhabiting these regions have learnt through collective wisdom, how to interact with their habitat to survive even in the harsh climatic conditions (Robinson, 1993). The mechanisation of agriculture suited to the large plains is not advisable in mountainous areas having higher degree of slope, thin soil cover, poor moisture retaining capacity and low humus content of the soil (Andrea, 2004). In such circumstances, crop farming has to be augmented through other area-specific allied economic activities to provide the people some additional sources of employment and income.

Animal husbandry plays a vital role in the economy of Ladakh. About 88 per cent of Ladakh population lives in rural areas and only 12 per cent in urban areas. About 7.03 per cent of livestock of the State of Jammu and Kashmir is found in Ladakh (Bisht, 2008). Livestock rearing is an integral part of mountain agriculture. Dairy animals are the

best means to convert local vegetative biomass into useful products and work (Singh, 2004). The need for enhancing the production of various animal products, particularly meat, milk and eggs at faster rate needs no emphasis (Tomar, Sairam and Ganguly, 1982). Besides providing nutritious human diet and proteins through milk, meat and eggs, livestock sector provides wool, skin, hides, drought power, manure for fields and bones (Randawa, 1962). The Nutritional Advisory Committee of Indian Medical Research recommended a minimum quantity 250 grams of milk/person /day or 91 kg/year (Rajorhia, 1995). Dairy products are an important component of the diet in Ladakh and serve as important source of protein and calories. Most families keep local cows and yak for milk, though its quality and quantity are often disparaged. In late 1980s the government introduced crossbreeding programmes to increase milk production in the region (Andrea, 2004). In Ladakh region, the per capita availability of milk is only 180 grams/day (J&K, Govt. 2013). With increasing access to the outside world, Ladakh is experiencing a rapid shift from subsistence agriculture to a market oriented economy (Singh and Singh, 1998). More land is being used for production of high value cash crops such as fodder crops, vegetables and local grain production is being undermined by availability of cheap subsidised grains from Punjab and high wages charged for agricultural work. The value of livestock in the local subsistence and market economy assumes much importance. This is reflected by the fact that the majority of Ladakh's landscape is more suitable for livestock husbandry rather than crop cultivation. Most of the cattle in cold arid region of Ladakh are non-descriptive type and are termed as indigenous cattle. They are mostly black and darkish brown in colour. They are smaller in size and their milk production capacity is much lower than the exotic breeds. The

average milk yield of local cows, yak and dzomo (crossbred of local cow and yak) varies from 360- 590 kgs per lactation while it varies from 1200-2100 kgs per lactation among crossbred dairy animals. Nowadays, the demand for crossbred cow is very high because of their higher production of milk. The comparative assessments of economic efficiency among the crossbred and local cows including yaks dzomos are very few in number. As a result, such studies are quite relevant and significant.

Study Area: Ladakh region, the northern most part of the Jammu and Kashmir State, forming western most part of the Outer Himalayas is situated at an altitude of 2500 to 8000 meters above sea level, lying between 32° 15' to 36° North latitude and 75° 15' to 80° 15' East longitude. Leh district has an area of 45110 sq. kms and has 112 inhabited and one inhabited village (Shah, 2006). Ladakh's climate is referred to as a "cold desert" due to its combined features of arctic and desert climates. These include wide diurnal and seasonal fluctuations in temperature, from -40°C in winter to +35°C in summer, and extremely low precipitation, with an annual 10 cm to 30 cm primarily from snow (Bisht, 2009). In this region of cold arid region of Ladakh, villages are situated at elevations of 2800 m to 4100 m above sea level.

Objectives: The present study has been conducted with the following broad objectives:

1. To study the impact of spatial variations in agro-climatic conditions on the areal distribution and typology of livestock in Ladakh region.
2. To make a comparative assessment of productive and reproductive efficiency of crossbred cows with the indigenous cows, dzomo and yak in

terms of milk production and productivity in different agro-climatic regions of Ladakh.

3. To study the economic efficiency of different species of dairy animals in different agro-climatic regions of Ladakh.

Methodology

Keeping in view the above objectives, data were collected both from primary and secondary sources. Primary data regarding biological efficiency and economic viability of dairy animals were collected by multi-stage stratified random sampling technique. For collecting primary data, a detailed questionnaire was prepared to meet the desired objectives. A total of 159 sample dairy households were selected from three agro-climatic regions i.e. Leh, Nubra and Changthang and a sample of 209 dairy animals were selected out of which 64 were local cows, 66 crossbred cows, 41 dzomos and 38 yaks. The animals which had at least two or three lactation periods were chosen for the present study. The data pertaining to indicators of biological efficiency such as age at first calving, lactation period, calving interval, dry period and daily milking average were collected from these sample households. Data were also collected from the records maintained by the Government Dairy farms, Defense Institute of High Altitude Research (DIHAR), Field Research Laboratory (FRL), Artificial Insemination Centres (AIC), and veterinary hospitals. Data were also collected from Milk Cooperative Societies, milk selling shops and milk vendors.

In this study, cost items consist of feed, labour, housing, veterinary and cost of capital, that is, interest on value of cows and other related costs. The total cost per cow per day was calculated for all the species of dairy

animals such as, local cows, crossbred cows, dzomo and yak in all the agro-climatic regions taking average age of the dairy animals as 12 years. The purchased feeds were valued according to the average prices actually paid by the dairy animal owners. Home supplied or own feeds were also charged according to the average prices prevailing in the market. Veterinary cost was calculated by taking into account the actual cost incurred by the farmers. Doctor's fee and medicine were two major components of the total veterinary cost. The cost of housing was calculated by taking into account the depreciation cost, repairing cost and interest on average value of animal shed. Capital cost was measured in the present study as the interest on the average value of dairy cows. The returns from dairy farm consisted of value of milk sold, values of cow dung and return from calf. The returns from milk were calculated on the basis of the average quantities of milk yield per cow and average price received per kg of milk. Returns from cow dung were found out by taking average price at which cow dung was sold in the study areas.

Gross returns were obtained by multiplying milk yield of an individual animal with respective prevailing price of milk in the study area, i.e.

Gross Returns = Quantity of milk x Market price of milk

In order to estimate the cost per kg of milk, the average net maintenance cost per animal per day was divided by average milk production per animal per day i.e.

Cost per kg (₹) of milk

$$= \frac{\text{Net maintenance cost per animal per day}}{\text{Total milk produced per animal per day}}$$

Spatial Distribution of Dairy Animals in Ladakh Cold Desert

Many factors influence the distribution of dairy cattle in cold arid region of Ladakh such as, the climate, proximity to market and availability of feed and fodder resources.

Yak (*Bos grunniens*) is multipurpose bovine. Domesticated in Ladakh region, it is hardy and can easily survive in cold temperatures (<-55°C), requires minimal care and can survive on scanty feed resources (Tomar, Sairam and Ganguly, 1982). Yak in Ladakh are found at an altitude of 3500-5500 meters above sea level. They are raised for a variety of purposes such as production of milk and milk products (cheese, butter, ghee), wool, hides, manure, drought power and as a pack animal for sustaining the livelihood of the Himalayan people. They are very hardy and can survive without food for 3 to 7 days under snow cover (Singh and Shrestha, 1990). Apart from milk, the hair and tails of these animals are used for making expensive warm clothes and their meat is consumed by local people. The high concentration of Yak is found in Changthang (64 per cent), followed by Leh (25 per cent) and Nubra (11 per cent) agro-ecological zone (Government, 2013).

Cattle local/crossbred Jersey: The Ladakh people are still rearing the traditional type of domestic cattle as only 22.10 per cent cattle are upgraded with Jersey exotic inheritance. Local cattle that produce low quantities of milk, and are kept to breed with yak to produce higher yielding hybrids, crossbred Jersey cattle are mainly kept for high milk yield. The high concentration of crossbred Jersey cows is found in Leh agro-climatic zone mainly because of proximity to market. The Leh district is producing 8500 MT of milk annually against the requirement of 11750 MT (Sastry, 1990).

Yak-cattle cross (dzo and dzomo), the dzo kept for draught power and dzomo for milk production. Indigenous cross-breeding of yak with cattle is an active good practice which has benefited from higher performance due to hybrid vigour and better adaption of crosses to intermediate altitude (Robinson, 1998). The

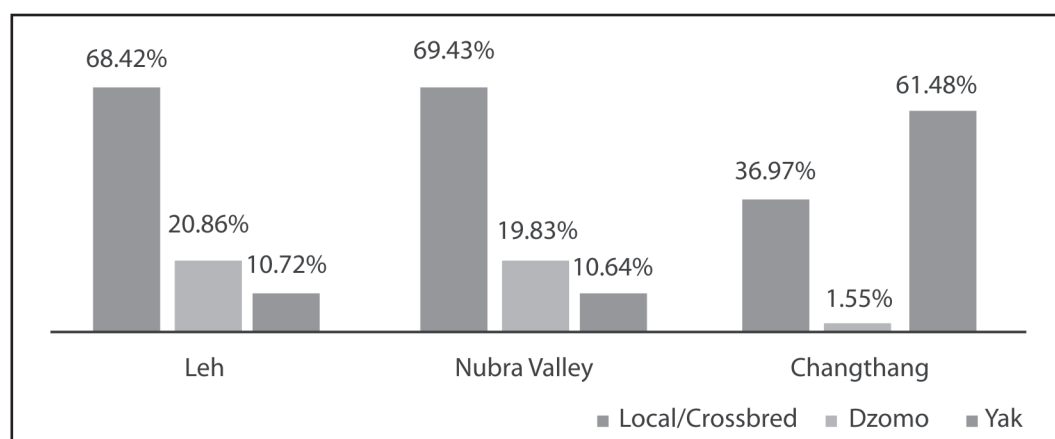
highest concentration of dzomo/dzo are found in Leh (68 per cent), followed by Nubra (30 per cent) and Changthang (2 per cent). These animals have better productive and reproductive performance, that is why these are preferred and are adaptive to the local environment conditions.

Table 1: Distribution of Livestock in Leh District - 2012-13

Agro-climatic Regions	Local/Crossbred Cattle	Species of Dairy Animals		Total Dairy Animals
		Dzomo	Yak	
Leh	21102 (68.42)	6437 (20.86)	3308 (10.72)	30847
Nubra Valley	9963 (69.43)	2841 (19.83)	1524 (10.64)	14328
Changthang	5166 (36.97)	217 (1.55)	8588 (61.48)	13971
Total	36231 (61.25)	9495 (16.07)	13420 (22.68)	59146

Source: Animal Husbandry Department, Leh (2013). Figures in brackets are per cent to total dairy animals.

Figure 1 : Distribution of Dairy Animals in Leh District (Per cent to total dairy animals)



Source: Animal Husbandry Department, Leh (2012).

The Economic Efficiency of Dairy Cows

The economic aspects of milch animals have a profound influence on the cost and return from dairy farming. The comparative study of the biological aspects of different species of milch animals has been conducted with the objective of understanding the relationship between biological aspects and productivity of different species of animals in different agro-climatic regions of Leh district (Table 2).

Age at First Calving: Generally it has been found that indigenous animals such as local cows, dzomo and yak mature at a very late age and the farmers have to bear unproductive investment in rearing these animals for a longer period of time (Subulakashmi, 1998). Age at first calving is the main criterion to determine the cost of rearing a young stock of dairy cow till it attains the age of first calving. Longer the age at first calving, higher would be the cost of

rearing a dairy cow. Therefore, lower the age at the first calving, higher is the productive period, greater is the profitability. It has been found that on average, crossbreds have their first calf at the age of 1154 days in Leh district. The age at first calving of indigenous cows is delayed by 226 days due to biological aspects. There are also inter-regional variations in the age at first calving in the two species of animals. The perusal of Table 2 clearly indicates that the age at first calving among the crossbred cows varies from 1081 days in Leh region to 1205 days in Changthang region of Leh district. While making a comparative study with other dairy animals it has been found that the age at first calving of yak is 1477 days and that of dzomo is 1432 days. During the field study, it has been found that in Leh agro-climatic region, favourable agro-climatic environment and better socio-economic conditions of the people have made it possible to meet the essential input requirements of feeding and

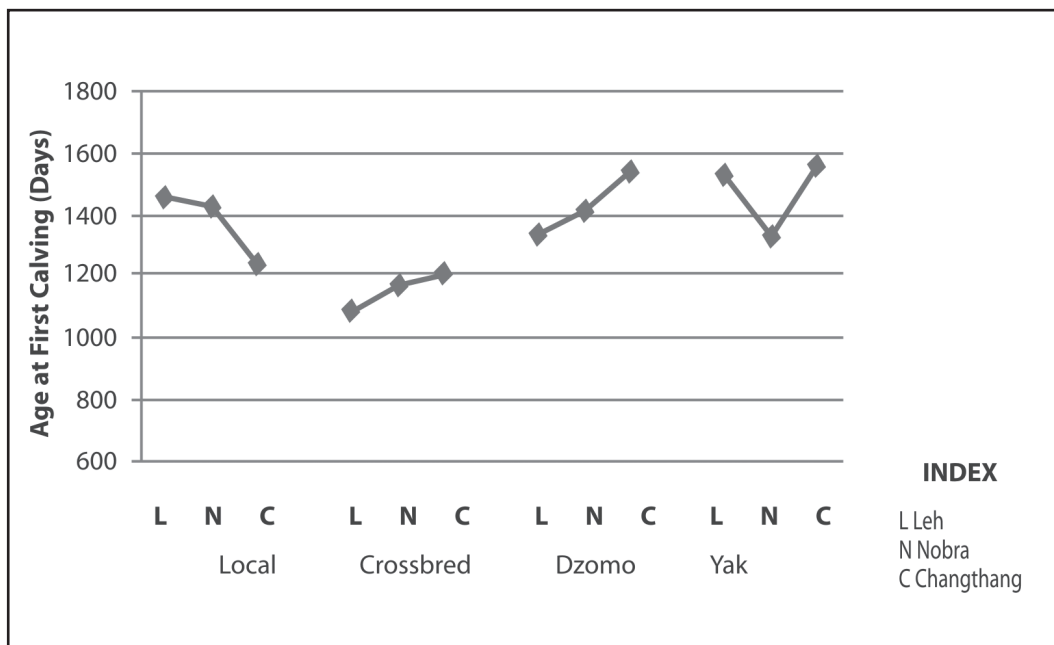
Table 2: Biological Efficiency of Different Species of Dairy Animals in Ladakh Region

Agro-climatic Regions	Species of dairy animal	Age at first calving	Lactation length (days)	Dry period (days)	Calving interval (days)	Daily milking (kgs)	Lactation yield (kgs)
Leh	Local cows	1455	270	310	580	1.70	459
	Crossbred	1084	295	120	415	7.16	2112
	Cows						
	Dzomo	1342	235	240	475	2.90	682
Nubra valley	Yak	1533	190	305	495	1.95	370
	Local cow	1443	282	343	625	1.80	507
	Crossbred	1173	215	142	457	6.80	1462
	Dzomo	1413	265	199	464	2.30	609
	Yak	1333	199	311	510	2.16	429

(Contd...)

Table 2: (Contd...)

Agro-climatic Regions	Species of dairy animal	Age at first calving	Lactation length (days)	Dry period (days)	Calving interval (days)	Daily milking (kgs)	Lactation yield (kgs)
Changthang	Local cow	1235	170	301	471	1.90	323
	Crossbred	1205	201	185	386	3.27	657
	Dzomo	1543	281	205	486	2.70	759
	Yak	1565	192	386	578	2.00	384
Average	Local cow	1377	241	318	559	1.80	430
	Crossbred	1154	237	149	386	5.74	1604
	Dzomo	1432	260	215	475	2.63	683
	Yak	1477	194	334	528	2.03	394

Figure 2: Age at First Calving of Defferent Species of Dairy Animals in Ladakh

health care which in turn helped in decreasing the age at first calving of all these dairy animals in this cold arid region of Ladakh. In the Changthang and Nubra regions, due to unfavourable agro-climatic conditions, especially the harsh climatic conditions, the exotic and crossbred animals, the products of western technology cannot survive on the community grazing lands as they are highly susceptible to diseases. Naturally, only those economically privileged farmers who can afford stall-feeding, fodder cultivation, can take intensive care to adopt such improved cattle breeds (Achaya and Hurria, 1986).

During the winter season, poor infrastructural base for dairy development and the poor socio-economic conditions of the farmers resulted in an increase in the age at first calving of all the dairy animals in these regions.

Lactation Length: It is the period successive and should ideally be more than one year. Lactation length affects the total milk production as well as the income from the lactating dairy animals. Table 2 depicts that the average lactation period varies between 260 days in dzomo to 194 days in yak. Thus, the lactation period of dzomo exceeds than the other dairy animals. Intra-regional variations in lactation period reveal that in Leh agro-climatic region, crossbred cows have the highest lactation lengths of 295 days, while in Changthang region it is 201 days among crossbred cows. It has been also found that the performance of dzomo in terms of lactation length is better in Changthang region as compared to crossbred and yak in Leh and Nubra regions. A close look at Table 2 reveals that lactation period of crossbred Jersey cows exceeds in Leh and Nubra agro-climatic regions, while in Changthang region, dzomo have the highest lactation length. In Changthang

region, the lactation period of the crossbred Jersey cows is retarded, mainly due to harsh climatic conditions.

Dry Period: Dry period is an important reproductive period of the dairy cows when the dairy operators have to feed and care for the dairy animals without deriving any income from these animals (Singh and Singh, 1994). In this study, dry period was defined as the time period starting from the end of lactation up to next calving. Therefore, shorter dry period in milch animals is desirable from an economic point of view. In Leh agro-climatic region, the dry period among crossbred cows was found to be 120 days, Nubra 142 days and Changthang 185 days. It was found that the average dry period of yak is 334 days followed by local cattle by 318 days. The highest dry period of 386 days was found in yak in Changthang region followed by 343 days among local cows. During the field study it was found that farmers adopt crossbred dairy animals mainly because of their short dry period.

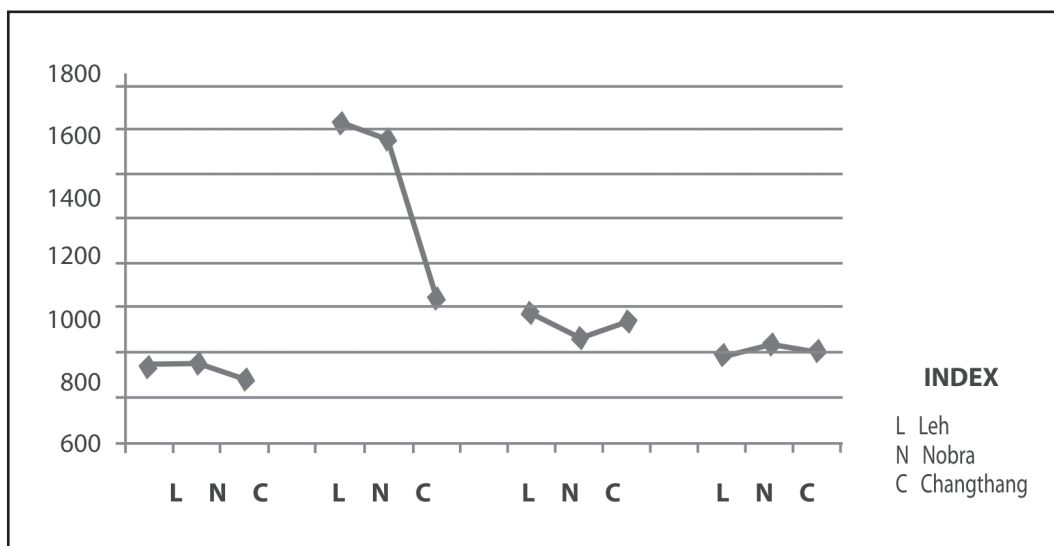
Calving Interval: Calving interval was reported to indicate the periods between two successive calving (Peters and Ball, 1995). Calving interval is one of the main indicators of the reproductive efficiency of the dairy animals. In this study, the calving interval has been defined as the period of the time from one calving to another calving. This is the period which lies between two calvings. In other words, it is the sum of the dry period and lactation period. A shorter calving interval of the milch cow is considered as an important economic aspect for maximising profit from dairy animals. It has been found that shorter the calving interval, more calves will be produced in the life cycle of animals, more will be the profitability from these animals. The average calving length of crossbred cows, local cows, dzomo and yak was recorded as 449 days, 556 days, 472 days

and 685 days, respectively. Intra-regional variations reveal that lowest dry period is found in Jersey crossbred cows in all the regions of Ladakh. Calving interval of 415 days, 457 days, and 475 days was found in crossbred cows in Leh, Nubra and Changthang regions among crossbred dairy animals. The highest calving interval was found among the yak in all the agro-climatic regions of Ladakh.

Daily Milking Average and Daily Overall Average: Daily milking average has been

considered an important indicator because it is ultimately milk average that gives a fair return to the farmer. Both these indicators are found to be high for crossbred cows as compared to other milch cattle in this region. Daily milking average from crossbred cows is 5.74 kgs/day, 2.63 kg/day from dzomo 2.03 kgs/day from yak and 1.8 kgs/day from local cows. The regional variations show that the highest daily milk yield from crossbred cows is obtained in Leh region i.e. 7.16 kgs/day followed by 6.80 kgs/day in Nubra and 3.27 kgs/day in Changthang regions.

Figure 3: Daily Milk Yield Kgs / Day



Lactation Yield: Lactation yield is worked out by multiplying the average milk yield recorded per day with the length of the lactation period. In cold arid region of Ladakh, the average lactation yield of milk from local dairy cows was 423 kg, 1604 from crossbred Jersey cows, 591 kg for dzomos, and 368 kg from yak. On the basis of economic parameters studied above, it can

be inferred that crossbred cows are more economical followed by dzomo, yak and local cows.

Cost and Return of Rearing Dairy Animals

The potential for milk production is not only attributed to the genetic make-up of the dairy animals, but also an interaction with environment or variations of

management could considerably limit the expected milk production. Due to unique topography, scenic beauty, environmental conditions, political importance of the region generates high demand for milk and milk products. Therefore, the need of the hour is dairy farming which could be emerged as the backbone of economy for local people. Several research workers have shown dairy farming as profitability system over arable farming (Singh and Singh, 1998). Economic analysis of an activity in a given situation is

very essential for the proper assessment of its economic feasibility and viability. This may help the producers, extension workers, scientists and planners alike in making rational decisions on various matters. Therefore, an attempt has been made to analyse the economic aspects of dairy enterprise. Table 3 presents cost and returns of the different species of dairy animals in different agro-climatic environments of cold arid region of Ladakh.

Table 3: Cost and Returns from Different Species of Dairy Animals in Ladakh Region

Agro-climatic Regions	Species of dairy animal	Expenditure on feed and fodder (₹)/day	Expenditure on labour (₹)/day	Expenditure on miscellaneous (₹)/day	Total expenditure (₹)/day	Total income (₹)/day	Net profit / milch animal/day (₹)
Leh	Local cows	25 (63)	12(30)	3.00(7.00)	40	61	21
	Crossbred	96 (70)	36(26)	6.00(4.00)	138	229	91
	Dzomo	30 (68)	11(25)	3.00(7.00)	44	92	46
	Yak	27 (67)	11 (28)	2.00(5.00)	40	58	18
Nubra	Local	23(65)	10(28)	3.00(7.00)	36	59	23
	Crossbred	78(68)	30(26)	7.00(6.00)	115	200	85
	Dzomo	27(66)	11(27)	3.00(7.00)	41	72	31
	Yak	25(69)	09(25)	2.00(6.00)	36	65	29
Changthang	Local	24(69)	09(26)	2.00(5.00)	35	58	23
	Crossbred	69(74)	18(19)	7.00(7.00)	94	107	13
	Dzomo	22(61)	11(31)	3.00(8.00)	36	77	41
	Yak	19(65)	09(31)	1(3.00)	29	62	33
Average of Ladakh	Local	24(65)	10(27)	3.00(8.00)	37	56	24
	Crossbred	81(69)	28(25)	7.00(6.00)	114	153	66
	Dzomo	26(65)	11(28)	3.00(7.00)	40	65	35
	Yak	24(67)	10(28)	2.00(5.00)	36	58	33

Figures in brackets are per cent expenditure to total expenditure.

Expenditure on Milch Animals: The expenditure on milch animals broadly can be classified into three types as expenditure on feed and fodder, expenditure on labour and miscellaneous expenditure.

Expenditure on Feed and Fodder: When the cost structure is examined by items of expenditure, it is found that cost of feed has emerged as the major component accounting for 69 per cent of the total cost in all the cases. Again when feed cost has been divided into cost on green fodder, dry fodder and concentrates, cost on concentrates has come out to be the most important one both in winter and summer seasons. It has also been found that the expenditure on concentrates was much higher in crossbred Jersey cows in all the agro-climatic regions.

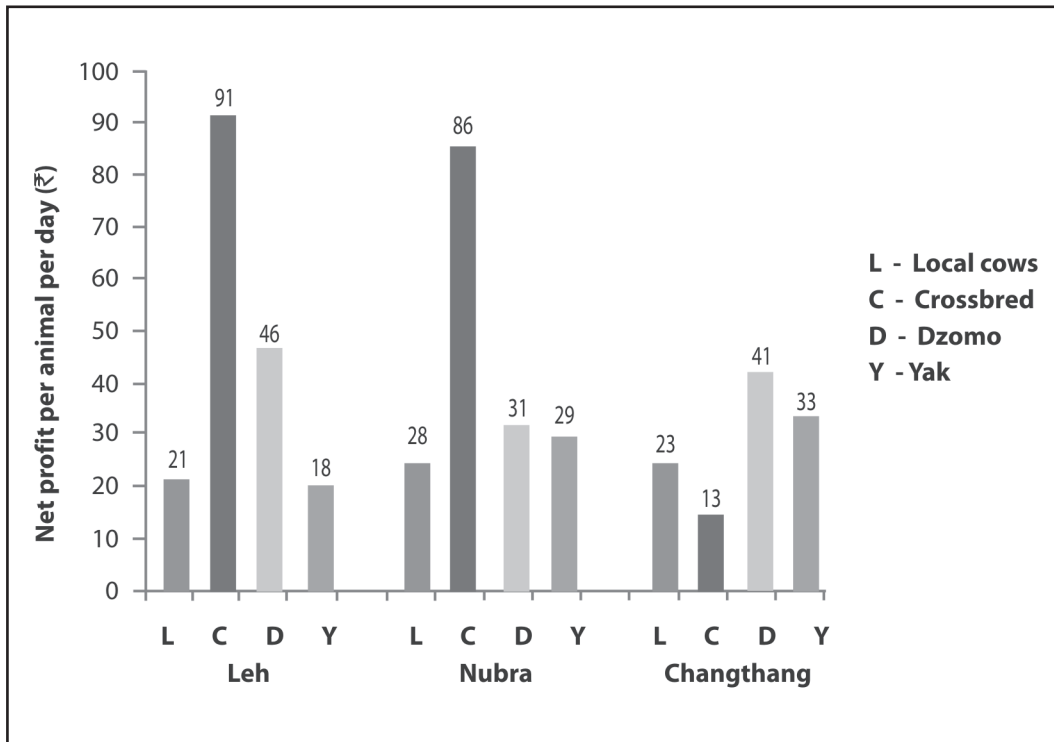
Labour Cost: In order of importance, the labour cost came next to feed and fodder cost. The dairy farmers require labour mainly for attending the herds, cleaning the sheds, milking the dairy animals, collection of fodder, grazing of animals and the distribution of milk. In this study, contribution of the family members in dairy activity is calculated on the basis of current wage rates. No distinction is made between male and female labours wage. One labour day was assumed to be equivalent to eight hours work and accordingly the labour input is calculated. Labour cost was found 25 per cent of the total cost. It was also found that 96 per cent of the work in dairy sector in this region is performed by females. Women in this region perform all the work related to dairy such as milking of milch animals, cleaning of shed, production of fodder crops,

selling of milk, grazing of animals, collecting of fodder and marketing of milk etc., highest expenditure on labour was found among crossbred dairy animals as compared to other dairy animals.

Miscellaneous Expenditure: Miscellaneous expenditure consists of the expenditure on medicine, expenditure on housing, expenditure on germicides and artificial insemination. Daily expenditure on miscellaneous items was found to be 4 per cent of the total expenditure. These expenses were found higher among crossbred animals, among crossbred dairy animals, as compared to other dairy animals.

Returns from Dairy Enterprises

The purpose of this section was to determine gross returns from dairy cows over total costs. The returns from dairy animals consist of sale proceeds of milk, the value of cow dung and value of calf. The average sale proceeds of milk were calculated on the basis of the average quantity of milk produced per day per cow and the average price received per kg / day. The value of calves was estimated on the basis of the respondent's expectation. Price of cow dung was computed by taking the average price at which cow dung was sold at the locality. The average price of cow dung was taken as ₹ 2 from crossbred cow per day and ₹ 1 for other dairy animals. An analysis of Table 3 reveals that the average net profit from per milch animal per day in Ladakh region was higher among crossbred Jersey cows (₹ 66), while as it was ₹ 24, ₹ 36, and ₹ 33 from local cows, dzomo and yak, respectively.

Figure 4: Profitability Per Unit of Dairy Animals Per Day in Ladakh Region

The intra-regional variations reveal that the net profit from Jersey cows was ₹ 91 in Leh agro-climatic region, ₹ 85 in Nubra valley and only ₹ 13 in Changthang region, although the milk production of crossbred cows was found higher as compared to local cows, dzomo and yak. While making cost and return analysis it was found that rearing cost of crossbred Jersey cows was higher in Changthang region. Thus, the net profit from these dairy animals was least in Changthang region as compared to dzomo and yak. That is the main reason that adaptation of Jersey cows has not been widespread in Changthang. Their poor acceptance is popularly attributed to restricted fodder supplies, and the limited resources available to these farmers. The need for increased fodder supplies is supported by the evidence

that crossbred cows required substantially higher feed input than local cows, yak and dzomo.

Conclusion and Suggestions

Many factors influence the spatial distribution of dairy animals in cold arid region of Ladakh, such as, the agro-climatic conditions, proximity to market and availability of infrastructural facilities and feed resources. In Ladakh, the native local breeds of dairy animals are mostly of indigenous type (zebu type). They mature very late and yield of milk of these dairy animals is low and have short lactation length, long dry periods and long calving interval periods. From the results of the comparative study of biological parameters

of local cows, crossbred cows, yak and dzomo, it may be concluded that crossbred Jersey cows are most suited for high milk production than indigenous cows, dzomo and yak. It was also found that crossbred cows are more efficient animals in converting feed into milk. All the economical biological parameters lend credence to the fact that crossbreeding programmes can be successful only if the exotics and their productive progeny are introduced into optimal nutritional and healthy environments, which will permit their normal rates of development and production. The high-grade exotic breed cows, especially Jersey and Holstein - Friesian dairy animals perform better in the surroundings of urban areas of Leh. This is mainly due to the overall management differences. During the field study, it was found that in Ladakh, especially in Leh region, better socio-economic conditions of the people have made it possible to meet the essential requirements of feeding and health care which in turn helped in decreasing the unproductive periods in dairy animals. It was also found that Leh and Nubra agro- climatic regions have slightly higher temperature as compared to Changthang region and thus have more fodder available both from pastures and cultivated fodder.

However, the potential for milk production is not only attributed to the genetic make-up of the dairy animals, but also have an interaction with environment or variation of management could considerably limit the expected milk production. That is the main reason that crossbred Jersey cows are not performing better in Changthang region of Ladakh. Rearing cost of crossbred

cows is high in Changthang region as they need more feed, more care which increase cost of rearing. Crossbred dairy cows are not well adopted with cold arid climatic conditions and at the same time their disease resistance capacity is very low and the farmers have to spend more for their management. Although milk production of dzomo, yak and local cows is slightly lower than crossbred cows, the other performance is better especially in Changthang region. Due to their small size than the crossbred, Jersey cows need less feed and less care. Their disease resistance capacity is very high and needs less management facilities for rearing. By selective breeding of better type of native breeds, it will be possible to decrease their unproductive periods. Therefore, training and awareness programmes should be given particularly to the farmers to increase the reproductive and productive performances of the dairy cattle and livelihood of the dairy farmers through improved management practices. There is imperative need for stepping up the fodder development and manufacturing of quality compound feed in the region. To augment the limited fodder resources in Changthang region, the supply of nutritious feed in the form of concentrates is very essential for dairy sector in this region. Steps should be taken up progressively to eliminate the surplus livestock and to reduce the unproductive periods of the life of these cattle. Cooperative dairying in the region is playing an important role in production and marketing of milk. Organisation of tribal farmers of Ladakh into cooperative enterprise will help the farmers from the bounds of poverty.

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