ANALYTICAL STUDY OF RESOURCE-USE EFFICIENCY ON DAIRY FARMS IN DIFFERENT LOCATIONS OF LUDHIANA DISTRICT OF THE PUNJAB STATE

Thesis

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IN
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by
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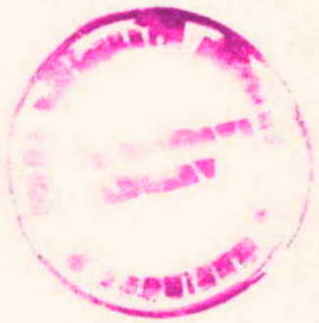

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This is to certify that the thesis entitled **"Analytical study of resource-use efficiency on dairy farms in different locations of Ludhiana district of the Punjab state"** submitted for the degree of Master of Science in the subject of Agricultural Economics (Minor subject : Statistics) of the Punjab Agricultural University, is a bonafide research work carried out by Mr. Amit Kochhar (L-95-BS-111-M) under my supervision and that no part of this thesis has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.

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CERTIFICATE - II

This is to certify that the thesis entitled **"Analytical study of resource-use efficiency on dairy farms in different locations of Ludhiana district of the Punjab state"** submitted by Mr. Amit Kochhar (L-95-BS-111-M) to the Punjab Agricultural University, in partial fulfilment of the requirements for the degree of Master of Science in the subject of Agricultural Economics (Minor subject: Statistics), has been approved by the Student's Advisory Committee after an oral examination on the same, in collaboration with an external examiner.

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ABSTRACT

The present investigation was undertaken to examine the resource-use efficiency on dairy farms in Ludhiana district. The data from 90 dairy farms (30 each from rural, semi-urban and urban dairy farm locations) were collected. It was observed that average herd-size was 11.69, 23.70 and 37.67 on rural, semi-urban and urban dairy farms respectively while buffaloes constituted the largest proportion of the herd size in all the locations followed by crossbred cows and young stock. Total capital investment per farm came to be Rs. 174980.98, Rs. 358233.51 and Rs. 613057.87 on rural, semi-urban and urban dairy farms respectively, evincing inverse relationship with the distance of dairy farms from urbanization. The fixed cost per litre of milk was found to be Rs. 1.71, Rs. 1.39 and Rs. 1.37 in rural, semi-urban and urban dairy farms respectively. This showed inverse relationship with the herd-size which implied the existence of economies of size across the herd-size range in dairy farms at different locations. Total variable cost per litre of milk worked at Rs. 5.56, on rural, Rs. 5.67 on semi-urban and Rs. 6.29 on urban dairy farms which yielded positive relationship with the herd-size and negative relationship with the distance of dairy farms from the city. This could be attributed to the higher prices of inputs near the city centres and partly to the direct relationship between milk yield per animal and herd-size.

Gross returns per litre of milk witnessed positive relationship with the herd-size and inverse relationship with the distance of dairy farms from the urbanization. It came to be Rs. 9.48, Rs. 11.05 and Rs. 12.17 on rural, semi-urban and urban dairy farms respectively. The returns to fixed farm resources were Rs. 4.89 on rural, Rs. 6.07 on semi-urban and Rs. 6.37 on urban dairy farms. This showed that herd-size and distance from the city were positively and inversely related respectively to the profitability over the use of variable resources. The net returns per litre of milk has been found to be Rs. 2.21, Rs. 3.99 and Rs. 4.51 on rural, semi-urban and urban dairy farms respectively. It may be inferred that dairy farms with greater herd-size and at lesser distance from the city have been more efficient in making use of fixed dairy structures along with variable resources.

The regression analysis suggested that increases in the herd-size and use of green fodder, concentrates, human labour, electricity/water and veterinary services would lead to the augmentation of milk production on all the dairy farm locations. The increasing returns to scale on all the dairy farms situations required the augmentation in the intensity of input use in proportion to their MVPs for profit maximization.

Signature of Major Advisor

Signature of Student

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CHAPTER - I

INTRODUCTION

The self-sufficiency in foodgrains has provided a boost to the national economy and the people in the wake of rising income levels have become selective in their food constitution with an emphasis on such protective foods as milk. Further, the demand for milk and its derivatives being income elastic is expected to increase with the rise in income levels and the size of population. In the face of increasing urbanization, the milk supply is proving short of its demand in most of the cities and towns. Also, the milk prices particularly in urban areas are showing a continuous upward trend and are inducing the producers to initiate as well as expand their existing dairy business to the extent of commercial ventures. Further, the dairy enterprise in combination with crop production reduces the income fluctuations by providing continuous and regular income flows. Hence, it is desirable to develop this enterprise in the state both as a specialized and a supplementary enterprise. The much needed adoption of dairy enterprise has a considerable initial cost in the purchase of milch animals and creating fixtures. It also requires large amounts of working capital in terms of feed, fodder, water, labour, fuel, energy and veterinary care, etc.

Different locations of dairy production units obtain different levels of yield and returns based on input-output relationships, demand/supply conditions and factor-product prices. Since, the city herdsmen run the dairy enterprise on costlier land, buildings and use higher priced fodders, feed, casual labour, etc.But their nearness to consumers allows them higher price of output and lower transportation cost advantage. On the contrary, the cost of above mentioned infrastructure and working expenses can be expected to be lower as one moves from urban to semi-urban and rural areas. However, the local demand and milk prices being lower in areas away from cities and selling milk in urban areas involves higher transportation cost and intermediary charges. Further, it might be true that the quality of milch animals in urban location may be better, productivity levels higher and the resource-use more efficient as compared to those in rural and semi-urban locations.

Keeping in view the large investments by the government of Punjab in milk plants to assure procurement at reasonable prices for the numerous milk producers scattered over the vast rural areas on one hand and to supply quality milk and milk derivatives at affordable prices to the urban consumers on the other. It can thus be hoped that there exists a considerable amount of potential for the dairy enterprise in

semi-urban as well as rural areas of the state. These horizons of dairy development amply need an attempt to study analytically the resource-use efficiency on the existing dairy farms in different locations. This exercise will help in highlighting the resource-use gaps in dairy enterprise under various study locations and suggest the measures for narrowing these gaps.

Hence, the present investigation aimed at analysing the input-output structure and resource-use efficiency of dairy farms in different locations around and away from the vicinity of urbanization was formulated. Observing the size of Ludhiana city, its industrial growth, population size and the associated demand for milk and responding development of dairy farms in urban, semi-urban and rural areas, Ludhiana district has been purposively taken up for this inquiry.

The specific objectives of the study are:

1. To critically examine the existing pattern of resource-use in milk production at different locations.
2. To estimate the resource-use efficiency of different resources used in dairying.
3. To make suggestions for the better use of these resources for higher profitability.

CHAPTER - II

REVIEW OF LITERATURE

To get an indepth insight of the problem and identification of gaps in the knowledge, it becomes imperative to review the relevant existing literature on the subject. In this chapter, therefore, the empirical studies available, having direct or indirect bearing on the objectives of the present study are briefly reviewed under the following heads:

1. Existing pattern of resource-use.
2. Resource-use efficiency of different resources.
3. Optimization of resource-use.

1 Existing pattern of resource-use.

Tewari (1971) studied the comparative economics of financial investment in dairy enterprise in rural and urban areas of Ludhiana district. Fixed and variable costs for different size-groups of dairy farms in rural and urban areas were estimated. Feed and fodder were found to be the main cost items. The returns to fixed farm resources (RFFR) on small, medium and large sized dairy units were Rs. 4356.08, 9368.20 and 16722.00 in urban areas and Rs. 1589.26, 3072.44 and 6712.01 in rural areas respectively. Under the improved plan, the RFFR showed marked increase in all the cases. The RFFR under the improved plan were Rs. 7858.30, 16713.88 and 34512.13 on small, medium and large sized dairy units of urban areas respectively and the corresponding returns in rural areas were Rs. 2479.20, 4810.00 and 11463.00.

Rai and Gangwar (1976) worked out the cost of milk production and season-wise resource-use efficiency on different herd-sizes in Hisar district. Concentrates were found to be the most significant factor influencing milk yield on small herd-size farms in each season, but on medium and large herd-size farms in winter and summer respectively. Use of human labour was in excess on each size of the farms. Thus, the labour use could be reduced without affecting milk yield and that could ultimately help in reducing the cost of milk production. Similarly, milk yield could be increased substantially by feeding more concentrates, provided these were available in adequate amounts and at affordable prices.

Singh *et al.* (1985) worked out the economics of milk production on farms of different sizes in the district of Farrukhabad of Uttar Pradesh. Fifty farms were classified by sizes of 0 to 1, 1 to 2, 2 to 3 and over 4 hectares. The number of milch animals (buffaloes and cows) maintained were on an average 1.04 to 2.99 and increased with the increase in farm size. Whereas, the labour time spent on milking, of which the major contribution was that of family labour, increased from 36.4 to 96.0 man days per year. Average annual cost of maintaining an animal was Rs. 1280.6 for a cow and Rs. 1609.00 for a buffalo; 60 to 70 per cent of this was accounted for by the feed cost. The annual milk yields from cows and buffaloes averaged to 864.35 kgs and 961.33 kgs with a value of Rs. 1512 and 2163 respectively. The maintenance cost and milk yield

tended to increase with farm size upto 3 to 4 hectare and thereafter showed a decline.

Kumar and Gupta (1988) determined the cost of milk production for buffaloes, local cows and crossbred cows maintained by landless labourers and small (2 hectares), lower medium (2.01 to 4 hectare). upper medium (4.01 to 8 hectares) and large farms (above 8 hectare) in the Muzaffar Nagar district of Uttar Pardesh. Overall mean yield (litres per day) for buffaloes, local cows and crossbred cows respectively was 6.12, 4.84 and 10.41 in winter; 3.80, 3.13 and 4.85 in summer and 5.03, 3.26 and 6.56 in the rainy season. Cost of milk production (per litre) was correspondingly Re. 1.91, 1.36 and 1.13 in winter, Rs.2.94, 2.34 and 2.86 in summer and Rs. 2.40, 2.23 and 2.18 in rainy season. Overall cost of milk production tended to be the highest for the landless labourer and the small farmer group and the lowest for the medium farmer group. Since feed and fodder constituted the major part of the maintenance cost for all the three types of animals. It was concluded that reducing these animal nutrition costs would have a significant effect in lowering the cost of milk production.

Vashist and Katiha (1988) examined the comparative economics of different breeds of dairy animals, their performance on different sized farms, and the impact of various programmes related to cattle improvement. A sample of 60 farms from Kangra district of Himachal Pradesh was selected

for the study. The profit margins (per litre of milk) for desi cows, buffaloes and cross-bred cows on small farms were Re.0.35, 0.26 and 0.70 respectively. The corresponding figures for large farms were Re. 0.57, 0.40 and 0.80. Cross-bred cows generated higher returns due to their higher milk yield and were found to be more efficient feed convertors. It was suggested that the arrangements for the regular supply of fodder and concentrates at subsidized rates by the agencies implementing cattle development programmes could provide a stimulus to the farmers to obtain higher returns.

Rajendran and Prabhaharan (1993) studied the economics of milk production in Dharampuri district of Tamil Nadu. The data were collected from (i) 32 landless labourers; (ii) 33 marginal; (iii) 28 small; and (iv) 27 large farmers producing milk. The total number of milch animals on farm categories (i) through (iv) respectively were 55, 61, 71 and 78. Among them 40, 40.98, 36.62 and 43.59 per cent were buffaloes, 32.73, 27.87, 33.80 and 34.62 per cent were crossbred cows and the remaining were the desi cows. On all the farm categories, major portion of total investment (more than 70%) was the cost of milch animals, followed by buildings (6-25%) and equipment (2-8%). Net returns from the sale of milk varied with the level of milk yield and were in the order of crossbred cows followed by buffaloes and desi cows on all the four farm categories. The cost of milk production per litre for buffaloes crossbred and desi cows on the respective

categories of farms was (i)2.93, 2.90 and 2.89; (ii) 3.17, 2.58 and 2.64; (iii) 3.25, 2.80, and 3.15; and (iv) 3.30, 2.92 and 3.30. Similarly the corresponding input-output ratios were (i) 1.38, 1.21, and 1.16; (ii) 1.33,1.40 and 1.26; (iii) 1.30,1.34 and 1.10; and (iv) 1.30, 1.23 and 1.07.

Singh *et al.* (1994) worked out the economics of buffalo milk production for 40 milk producing households in each of the two randomly selected villages of Narnaul Tehsil of Mohindergarh district of Haryana. The daily mean total cost per buffalo in milk was Rs. 20.43 and the gross cost of milk production per litre was Rs. 3.67 (Rs. 4.09, 3.63, 3.41 in summer, rainy and winter seasons respectively). Costs decreased with the increase in herd-size and net returns per litre of milk increased from Re. 0.26 for 1-2 buffaloes' herd to Re. 0.85 for 7-11 buffaloes herd (overall mean Re. 0.50). Feeds and fodders accounted for about 60 per cent and labour for about 17 per cent of the total costs of production.

Raj *et al.*(1994) investigated the seasonal cost and net returns of milk production from local cows and non-descript buffaloes maintained by (i) 14 landless labourers; (ii) 22 marginal (less than 8 acres); (iii) 29 small (8-16 acres); and (iv) 39 large (more than 16 acres) in Churu district of Rajasthan. The overall cost of milk production per litre in rupees for buffaloes and cows respectively was (i) 5.38 and 6.76, (ii) 5.37 and 6.42, (iii) 5.46 and 6.15 and (iv) 5.36 and 6.38. Milk production cost showed considerable

seasonal variation on all the milk producing groups. The net returns from milk production were negative, except for buffalo milk in winter for producer categories (i), (ii), (iii) and the overall. When the cost of family labour was excluded, the overall net returns from milk production were positive for buffalo milk in winter and all the seasons pooled (Re. 1.01 and Re.0.19/litre) and for cow milk in the rainy season only (Re. 0.03/litre). It was concluded that rearing local cows was more uneconomic than buffaloes in this region.

Kalra *et al.* (1995) worked out the maintenance cost of milch animals in case of 128 milk producing households in Haryana. The maintenance cost of buffaloes, crossbred cows and local cows was respectively, Rs. 19.11, 20.25 and 14.22 per day per animal. The milk production from a local cow resulted in a net loss of Rs. 3.82 per day. The cost of producing milk was Rs. 4.95, 3.53 and 6.91 per litre for buffaloes, crossbred cows ad local cows, respectively.

Sangu (1995) worked out the comparative economics of milk production for buffaloes, desi cows and crossbred cows in village and town conditions in Merrut district of Uttar Pradesh. The average investment on fixed assets per milking animal in villages and towns were Rs. 5713 and 5971 for buffaloes, Rs. 5435 and 5959 for crossbred cows and Rs. 2291 and 2629 for desi cows, respectively. The total maintenance cost per lactation of buffaloes, crossbred and desi cows was Rs. 6349, 7714 and 4669, respectively on villages and Rs.

7383, 8842 and 5057 in towns. Fixed costs for buffaloes, crossbred cows and desi cows contributed to 30, 31 and 25 per cent of the total maintainence costs in villages and 34, 32 and 26 per cent in towns respectively. The majority of variable costs were on concentrates, green fodder and dry fodder. The mean maintenance cost in villages (Rs. 6244) was significantly lower than that in towns (Rs. 7100). The production cost per litre of milk for buffaloes, crossbred cows and desi cows was Rs. 4.12, 3.88 and 4.10 in towns. The rate of return per rupee invested over total cost invested was the highest for crossbred cows in villages (Re. 1.43) and towns (Re. 1.45), followed by buffaloes (Re. 1.37 and 1.31 in villages and towns, respectively). The actual milk production of crossbred cows was significantly higher than that of their break even production levels (2114 litre vs. 920 litre in villages and 2280 litres vs. 940 litres in towns).

Singh *et al.* (1995) studied the economic efficiency of milk production under the rural conditions in Kurukshetra and Karnal districts of Haryana over the three seasons. The data on expenditure and income for 400 dairy farms were analysed. The producers were divided into five categories of landless, marginal (upto 2.5 acres), small (2.5 to 5 acres), medium (5.1-10 acres) and large (above 10 acres). Expenditure on feed and labour respectively was 49.7 per cent and 19.96 per cent of the total milk production expenses. These expenses increased with the increase in farm size. The variable and

fixed costs were approximately 70.03 per cent and 29.96 per cent of the total expenditure respectively. Feeds and labour charges were 70.92 per cent and 28.50 per cent of the total variable cost.

Kumar *et al.* (1996) studied the resource-use efficiency and returns to scale in milk production in Karnal district of Haryana. The roughages and concentrates intakes accounted for 71 to 88 per cent of the total variations in milk yield of indigenous cows and between 79 to 95 per cent of total variations in milk yield of crossbred cows. The regression coefficient of roughages was negative in all the months for the indigenous and crossbred cows, whereas the regression coefficient of concentrates was positive and highly significant for indigenous and crossbred cows. The marginal value products of inputs and the returns indicated an excessive use of roughages for indigenous and crossbred cows and emphasized the contribution of concentrates in increasing milk yields.

II Resource-use efficiency of different resources

Gangwar and Chhikara (1975) studied the relative efficiency of different types of milch animals in hinterland area of Jind Milk Plant, from where four villages were randomly selected. The MVPs of green fodder, dry fodder, concentrates and human labour were estimated to be Re. 0.80, 0.23, 0.46 and 0.40 in case of local cows, the MVP of green fodder was negative for Murrah buffalo. The MVPs of dry fodder

and concentrates in case of Murrah buffalo were Re. 0.41 and 0.46 whereas the MVP of human labour was very low. In case of crossbred cows the MVPs of green fodder, dry fodder, concentrates and human labour were Re. 0.46, 0.57, 0.89 and 0.27 respectively. The total cost of milk production per lactation was Rs. 1795, 3340 and 2687 for local cows, Murrah buffalo and crossbred cows respectively. The cost of milk per litre for local cows, buffaloes and crossbred cows was Re. 1.21, 1.52 and 0.96 respectively. The net return over the variable costs were the highest for the crossbred cows, followed by Murrah buffaloes and local cows.

Pandey *et al.* (1980) conducted a study in Banda district of Bundhel Khand region of Uttar Pradesh to identify the factors contributing to the efficiency in milk production and to explore the optimal reallocation of resources. The MVPs of fodder, concentrates and labour were found as Re. 0.75, 0.27, 0.01 in case of cow milk and Re. 1.45, 1.23 and 0.07 in case of buffalo milk respectively. There existed a positive and significant response of milk yield to fodder and concentrates both in cows and buffaloes. The ratio of MVP to factor cost indicated that the farmers of the region could not fully exploit the economic opportunity of fodder as the level of its use was relatively low. Farmers excessively fed concentrates to cows and buffaloes, and only in a few cases the farmers were rational in feeding concentrates. The dairy farmers were excessively using labour input both for cows and

buffaloes.

Rao (1985) found that the production of milk depended on feeding, breeding and management of the animals. In analysing the resource-use efficiency in dairying, MVPs of green fodder, dry fodder and concentrates were computed at geometric mean levels and were compared with the respective factor costs. It was brought out that the MVPs of green fodder and concentrates were higher than their factor cost implying that all the farms were under-utilizing the inputs. Hence there was a possibility of increasing milk yield through higher use of green fodder and concentrates. Only the marginal farmers were utilizing the labour input in an efficient manner while the remaining farm groups were inefficient in its use.

Gupta and Kumar (1988) worked out the input-output relationship, and efficiency in the use of resources for milk production from buffaloes and cows in Muzaffar Nagar district of Uttar Pradesh. Concentrates were the most significant input affecting the milk yield of buffaloes and cows while other inputs, such as green fodder, dry fodder and labour influenced the milk yield differently in different seasons for various categories of milk producers. In most cases, the existing use of resources was not rational. The MVP of concentrates was significantly higher than their price, which indicated that the use of this resource should be increased. For the same reason, in some cases, the MVP of green and dry fodder was higher than their prices and their use also needed to be

increased.

Sharma and Rajpali (1989) studied the economics of dairy units in rural and urban areas of Gwalior district of Madhya Pradash. The study focussed on the output elasticity of different factor inputs influencing milk production and the resource-use efficiency on different categories of dairy units. Cost of milk production was found to be the lowest (Rs.2.10/litre) in semi-urban areas and the highest in rural areas (Rs 2.67/litre) . The milk yield per day for the cow was the highest (6.99 litres) in semi-urban areas and the lowest in rural areas (4.30 litres). Even at the existing management level, the reallocation of existing resources could possibly be made to increase milk yield and hence the returns.

Lalwani (1990) studied the benefits from cross breeding indigenous cows with exotic cattle and also examined the allocative efficiency of resources. Marginal physical products and the MVPs were derived from milk production functions for buffaloes, crossbred and indigenous cows for four farm size-groups, viz. landless/small (less than 2 hac), medium (2.01 to 8 hac) and large (greater than 8 hac). A total of 104 households were randomly selected. Dairy households with land made excessive use and those having no land made lower use of green fodder. Concentrates were generally used deficiently, dry fodder use was excessive for indigenous cows. The labour use for crossbred cows was excessive on landless and medium farm sizes but deficient for buffaloes and

indigenous cows.

Kumar and Aggarwal (1992) conducted a study in Mathura district of Uttar Pradesh to find out the resource use efficiency on dairy farms. The inputs-outputs data were obtained for cows and buffaloes from 120 milk producing households in six villages. The production function and regression analysis showed that green fodder and concentrates contributed positively and significantly to milk yield both in case of cows and buffaloes. The MVPs of concentrates were positive and significantly greater than unity for cows (2.8089) and buffaloes (2.8775) on all the sample dairy units. Whereas, the MVPs of green fodder and dry fodder were 0.9432, 0.4420, and 0.3525,0.1110 for cows and buffaloes respectively. These MVPs although positive were much less than unity and thus indicated excessive use of these inputs. Furthur, the stage of lactation had a negative and significant impact on the milk yield. The elasticities of production for feeds and fodder were positive on all the study milk production units.

Shiyani *et al*. (1992) studied the interrelationship between milk yield and the various influencing factors. A sample of 240 milk producer households was selected from Kheda district of Gujarat State using two-stage stratified random sampling technique. Equal proportions of landless, small (< 2 ha), medium (2-3.5 ha) and large (> 3.5 ha) farmers were taken up for the study. The number of buffaloes on above farm groups respectively were 87, 108, 79 and 96. Correlations of green

fodder, concentrates and fixed costs with milk yield were positive and significant for all the farm groups. The labour costs were not significantly correlated with milk yield for any farm group. The MVP of fixed costs for the milk production was the highest among the MVPs of study inputs, and showed a decline with the reduction in farm size.

Sagar *et al.* (1995) conducted a study on 245 randomly selected livestock owners from 12 sample villages and grouped them as landless (36); marginal (92); small (63); and medium to large (54) milk producers. Productivity was measured as the milk yield index for desi (an indigenous/non descript breed) and crossbred cows. Some relevant management attributes of the milk producers were conceived and their relationship with dairy cattle productivity was computed. Correlation coefficients indicated that the average income from milk and milk derivatives, total annual income and feeding of the animals were positively and significantly correlated with the productivity of desi and crossbred cows of all the four groups of milk producers.

III Optimization of resource-use

Singh and Jha (1975) conducted a study in Etah district of Uttar Pradesh with the objective of investigating the resource allocation and output performance in livestock production for detecting the irrationalities and devise appropriate ameliorative measures. Feed and labour were found to be the principal inputs in milk production. Feed costs

alone contributed nearly two-thirds of the total cost of the milk production and concentrates, in turn, represented substantial portion of this cost. The multiple regression analysis showed a high association between the inputs considered and the milk output. The importance of better care and management of the animals was thrown in sharp focus by the very high MVP of labour input. It was observed that the increase in milk yield through the rational use of feeds and fodder inputs in case of Murrah buffaloes was 18.79, 2.48, 0.94 and 17.64 per cent in the rainy, winter part-I, winter Part-II and summer seasons respectively.

Saini and Jain (1979) examined the impact of dairy enterprise on farm incomes in Punjab. They observed that the optimization of the existing resources for crop activities included with their use in dairy enterprise would increase the returns to the fixed farm resources by 61.44, 55.76 and 68.22 per cent on small, medium and large farms respectively.

Rao *et al.* (1991) studied the economics of buffalo milk production using data from Murrah buffaloes on 20 each of the small (less than 10 buffaloes), medium (11-20) and large (>20) farmers around Hyderabad city. Investment in dairy equipment per farm increased with the herd-size whereas investment per animal showed the reverse trend. On small, medium and large farms respectively, the total annual cost of milk production per animal was Rs.10026, 9886 and 9612 (overall mean Rs.9754); mean milk production per animal was

2122, 2180 and 2250 litres (overall mean 2210 litres); net income per animal was Rs. 1979, 2224 and 2634. The break-even output was 1226, 1113 and 891 litres for small, medium and large farms respectively. Overall mean break-even yield was 1005 litres and it represented 57.44, 51.08 and 39.62 per cent (overall mean 45.66 percent) of total output.

Chaudhary and Chaudhary (1992) investigated the possibilities of increasing net farm income by including labour-intensive dairy and vegetables enterprises with the crops at the existing levels of technology in Pakistan. Linear programming was used to determine the optimum allocation of resources and combination of activities on farms. Results indicated that dairy animals were an essential part of farm plans. Besides providing milk, these helped to secure regular net cash returns which could not be achieved through crops alone; provided employment for some of the family's surplus labour; and served as a useful outlet for crop byproducts otherwise going waste. Basically the prices of milk determined the profitability of buffaloes. It was included that increased net cash returns could be achieved through mixed farming (even with subsistence food restrictions) through efficient resource allocation and improved marketing practices.

Kumar *et al.* (1994) conducted a study on various farming systems. The results revealed that mixed farming with three crossbred cows and one hectare of canal-irrigated land gave a higher economic return, Rs. 21323 than Rs. 9438

obtained from mixed farming of three Murrah buffaloes. Expenditure on feeds accounted for more than 40 per cent and that on labour was more than 30 per cent on both the units. Approximately, 71.8 and 59.3 per cent of income was obtained from the sale of cow milk and buffalo milk respectively. The cost of milk production per litre was Rs. 5.29 and 2.74 in case of buffaloes and crossbred cows respectively. The results revealed that for a small holding of one hectare under canal-irrigated conditions, mixed farming with crossbred cows was more efficient for the utilization of land, capital inputs and the labour resources of the farmers.

Shah *et al.* (1994) calculated the cost of milk production, profit per litre of milk and factors influencing the profitability of milk from Murrah buffaloes, local buffaloes, crossbred cows and local cows in the Bulandshehar district of Uttar Pradesh. The cost of milk production was the lowest for crossbred cows (Rs. 3.29/litre) and the highest for local buffaloes (Rs. 3.92/litre). The net returns per litre were the highest for Murrah buffaloes (Re. 1.15) and the lowest for local cows (Re. 0.55). The fixed and variable costs of milk production had significant negative effect on the profit and the price of the milk had a significant positive effect on the profit in case of all the buffaloes and cows. One percent increase in the price of milk resulted in the 5.5 to 13.7 per cent increase in profit; one per cent decrease in variable cost resulted in 2.4 to 3.4 per cent increase in

profits.

Sharma and Singh (1994) calculated the costs and returns from different breeds of dairy animals on different categories of farmers in Himachal Pradesh. The average cost of maintenance per animal per annum of crossbred cows, graded-Murrah buffaloes and local buffaloes were Rs. 3624.55, 1981.95, 4161.00 and 2584.20 respectively, yielding a gross income of Rs. 5099.48, 2013.32, 6069.62 and 3385.65. The net income from crossbred cows, graded-Murrah buffaloes, local cows and local buffaloes were Rs. 1613.64, 2072.87, 127.62 and 925.55 respectively. The findings indicated that it is more profitable to follow vigorously a crossbreeding programme for improving the potential of local cows, whereas in the case of buffaloes, the selection of high yielding breeds will greatly augment the milk production in Himachal Pradesh. Extension education efforts are also necessary to educate the farmers regarding proper feeding and management of dairy animals and learn to optimize returns and resources.

Kairon *et al.* (1995) conducted a study in the operational area of the Ambala - Kurukshetra Regional Rural Bank in Haryana State. The regression analysis established the concentrates to be the most important input affecting milk production. The optimization of resources with existing amount of capital indicated that it could be possible to increase milk output by diverting part of funds from green fodder and

labour to concentrates.

Shah and Shah (1995) analysed the factors which influenced the profitability of milk production in rural areas of Uttar Pradesh. The milk production of different breeds of milch animals was assessed. It was shown that a reduction in fixed costs and expenditure on feeds and fodder and better price of milk would result in a higher profit margin for the farmers. The profit from crossbred cow milk was more price sensitive than that for other breeds.

The review of the literature cited above showed that the research workers highlighted the importance of such inputs as feeds and human labour and their contribution in production costs. In some cases, the marginal value productivities were estimated for these inputs only. The comparisons mainly for the costs were made between the urban and rural dairy farms. But in the proposed exercise, an attempt will be made to bring out the use of all the important inputs employed along with their MVPs as well as an analysis on costs and returns in the various existing locations of dairy farms in the study area.

CHAPTER-III

METHODOLOGY

The framework followed in the selection of the study sample, collection of data, concepts used for analysis and specification of analytical framework is detailed and presented in this chapter.

The discussion is focussed on the following main aspects:

i) Sampling frame

ii) Collection of the data

iii) Concepts used

iv) Tools of analysis

Sampling frame:

The sampling frame included the selection of the study area and the respondent dairy farmers for intensive inquiry.

Locale of the study:

Since this investigation aimed at estimating input-output structure, cost and returns and the resource-use efficiency on dairy farms in such locations as the urban, semi-urban and away from the vicinity of urbanization. Hence, considering the size of Ludhiana city, its industrial growth, population size and the resultant demand for milk and responding development of dairy farms in urban, semi-urban and rural areas, Ludhiana district was purposively taken for this inquiry. To meet the objectives of the study, Ludhiana

district was divided into urban, semi-urban and rural locations on the basis of distance from Ludhiana city purposively selected as the urban location. The villages being ten km away from the periphery of Ludhiana city were the semi-urban location. Further, the villages ten km ahead of this semi-urban location and not closer than five km to a town were the rural location.

Selection of villages

Following the above mentioned procedure, Haibowal and Tajpur dairy complexes in the urban location of Ludhiana city were taken up for this study. The total number of villages in the semi-urban location was 124. Out of which five villages were selected on the basis of area proportionate to the total geographical area of the semi-urban location. Similarly, in the rural location the total number of villages was 189. Among these five villages were selected on the basis of the area proportionate to the total geographical area in this location.

Selection of dairy farms

For the selection of dairy farms in the urban, semi-urban and rural locations, the list of dairy farmers who sold milk throughout the year, was prepared with the help of key informants in the selected locations. There were 952 commercial dairy farms in the sample urban location, 186 in semi-urban location and 243 in rural sample villages.

Population of commercial dairy farms in different sample locations of Ludhiana district, 1996-97

Location	Name of the Village/ dairy complex	No. of commercial dairy farms
Urban	Haibowal	679
	Tajpur	273
Semi-urban	Dad	31
	Phulanwal	48
	Lalton Kalan	44
	Akalgarh	32
	Thrickey	61
Rural	Jodhan	57
	Mohi	72
	Ghuman	27
	Sahauli	36
	Khandur	51

Keeping in view the time and resources at the disposal, 30 dairy farms were selected from each location. The dairy farms were randomly selected from the sample villages and the dairy complexes in proportion to their respective population in each complex and village. This gave a total sample of 90 dairy farms for this study.

3.2 Collection of data:

The data relating to the structure of dairy herd, number of animals, their present value, capital investment and cost structure, input use, productivity, input-output use were collected from the sample farmers through personal interviews with the help of specially constructed and pretested questionnaire for the year 1996-97.

Concepts used:

The concepts used in computing the capital investments, fixed costs, variable costs and total costs incurred on dairy farms and the output in terms of the main and by products are discussed below:

Standard animal units (SAU):

In order to make the herd-size comparable, their number was homogenized expressing the number of animals in terms of standard animal units (SAU) as explained below

i)	Cow and buffalo above 3 years	1 SAU
ii)	Young stick between 2 and 3 years	½ SAU
iii)	Young stock below 2 years	¼ SAU

Fixed costs:

These costs included depreciation on the value of capital investment on milch animals, bulls, buildings and equipment and interest on fixed capital investment.

a) Depreciation:

Depreciation on these animals is charged because their productivity and productive period gets reduced lactation after lactation. Depreciation in an accounting year, therefore, becomes a cost and is included in the fixed costs.

For the purpose of this study, the productive period for determining the rates of depreciation for various forms of capital assets was taken as under:

Particulars	Productive period	Rate of depreciation
A. Animals		
i) Buffaloes	10 years	10 per cent
ii) Crossbred cows	12.5 years	08 per cent
ii) Indigenous cows	10 years	10 per cent
B. Sheds and Structures		
i) Shed (Cement concrete)	50 years	02 per cent
ii) Shed (Katcha)	10 years	10 per cent
C. Equipments and Machinery		
a) Major machinery items		
i) Diesel pump	10 years	10 per cent
ii) Electric motor	15 years	07 per cent
iii) Fodder cutter	10 years	10 per cent
b) Minor tools and small dairy equipments viz. cans, chains and buckets.	02 years	50 per cent
c) Other farm hand tools baskets, sickles, khurpas, pans, etc.	01 year	100 per cent

b) Interest on fixed capital investment:

The interest on the value of fixed capital investment at the going bank rate of 12.5 per cent per annum was accounted for while estimating the fixed costs.

Variable costs:

Variable costs included such costs as vary directly with the levels of output. For dairy enterprise the variable cost were the cost of fodder, feeds, manual labour. medicines, veterinary care, water, electricity, repairs and maintenance of fixed assets and the interest on working capital. These costs were estimated as under:

a) Cost of green and dry fodder:

The cost structure for market purchased fodder was based on the market price of green and dry fodder. The price was obtained from the record of the market committees of the Ludhiana district. The cost was taken from their daily records so that the market fluctuations could be taken care of. Thus, the average price for each month was derived for the whole year which was used to estimate the cost of feeding in urban and semi-urban locations.

Contrary to this, in rural areas,the cost of production of green fodder and the post harvest prices for dry fodder were used to calculate the cost of feeding.

b) Cost of concentrate mixture:

Prevailing market price were considered for computing the cost of concentrates whether home produced or purchased.

c) Wages of human labour:

The permanent labour was engaged on fixed annual basis and the casual labour was hired on daily wages. To render the data comparable, the labour put in by the permanent hired and family labour was recorded in terms of adult man hours. The wages of family labour were assumed to be the same as that prevailing for the permanent hired labour in the study area.

d) Veterinary and Health care charges:

The actual amount spent on medicines and the consultation fee of the doctor comprised the veterinary charges for the sample dairy farms. The average annual amount paid for hiring the service of the bull/artificial insemination was taken into consideration as an item of variable costs.

e) Transportation cost:

The amount spent on transporting the milk and inputs was considered among variable costs.

f) Electricity charges:

The actual payment to the State Electricity Board against their bills was apportioned to this source of energy use for the dairy enterprise during the year.

g) Water charges

The dairy farmers paid monthly bills to the municipal corporation for the supply of tap water. This expenditure was considered in proportion to the water used for dairy farming. Whereas in case of farmers having their own tubewells, the energy charges and maintenance cost were apportioned to the use of tubewell service for the dairy enterprise.

h) Repair and maintenance charges:

The expenses on repairs and maintenance of fixed assets such as building, machinery, equipment, etc. were estimated per annum.

Interest on working capital:

It was charged at the rate of 14.0 per cent per annum on the amount of working capital.

Gross returns:

The gross returns on a dairy farm comprised income from milk production, appreciation in the value of young stock and the value of dung produced.

a) Milk production:

The milk produced on a dairy farm consisted of the actual quantity of milk produced on the farm. Its value was calculated by multiplying the total quantity of milk produced by the farm gate price per litre of milk.

b) Appreciation in the value of young stock and income from young stock:

The amount of appreciation in case of young stock was treated as an item of income to the enterprise. Also the actual amount received per year through the sale of young stock was considered as an item of income.

c) Value of dung:

The dung produced by dairy herd on the farm was evaluated at the prevailing market rate in terms of farm yard manure and was treated as a part of gross income.

d) Price of milk:

The per litre price of milk was estimated in terms of farm gate price. It was the actual money received by the dairy farmer from the sale of milk whether sold directly to

consumers or to middle men net of the marketing cost. Milk consumed at the farm and at home was valued at the average sale price.

Returns to fixed farm resources:

The returns to fixed farm resources (RFFR) were arrived at by deducting the total variable costs from the gross returns.

Net returns:

Net returns referred to the excess of gross returns over the total costs (fixed and variable).

Marginal value productivity:

The marginal value productivity (MVP) of a resource represented the unit change in the dependent variable with a unit change in the independent variable, keeping all other variables constant. The marginal value products were computed at arithmatic mean level.

Tools of analysis:

Different statistical tools were used to analyse the results from the data. Besides, simple mathematical tools like averages and percentages, advance statistical tools such as multiple regression analysis, and Tintnet's F-test were employed.

Regression analysis:

In order to identify the factors affecting milk production, the functional analysis was done by using both the linear as well as Cobb-Douglas production functions. A number

of equations were tried for both the functions. Finally, the Cobb-Douglas regression equation of the following order was chosen, in view of the highest R^2 value and the economic and logical significance of the regression coefficients.

$$\text{Log } Y = \text{Log } a + \sum_{i=1}^{n} X_i^{b1} + \text{Log } u$$

where Y = Value of daily milk production (Rupees)

a = constant

X_1 = Herd-size (No.)

X_2 = Green fodder (Rs/day)

X_3 = Dry fodder (Rs/day)

X_4 = Concentrates (Rs/day)

X_5 = Human labour (Rs/day)

X_6 = Fuel cost (Rs/day)

X_7 = Electricity/water (Rs/day)

X_8 = Veterinary charges (Rs/day)

b_1 to b_8 = Regression coefficients of the X_1 to X_8

u = a random error term

Returns to scale:

The sum of elasticities gives the returns to scale. The significance of departures of these sums from the unity were statistically tested by applying the Tintner's F-test. Moreover, in order to become doubly sure regarding the nature of returns to scale, regression coeffcients of area in otherwise per hectare production function or in other words the Cobb-Douglas yield function was tested whether it was

significantly different from zero or not.

$$F = \frac{\Sigma e_2^2 - \Sigma e_1^2}{\Sigma e_1^2} \times (n-k)$$

Where Σe_1^2= Sum of squared residuals from the unrestricted function (All variables measured at per farm level)

Σe_2^2= Sum of squared residuals from the restricted function* (Per hectare production function)

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* G. Tintner. Econometrics. New York, Wiley, pp 90-91, 1952.

CHAPTER IV

RESULTS AND DISCUSSION

The data related to the objectives of the study were collected from the sample dairy farmers. These data were tabulated and analysed employing the appropriate analytical tools. The results then arrived at are discussed in this chapter. For precision in explanation of the results of the investigation, this chapter has been divided into three sections. Section-I deals with the composition of the dairy-herd and the pattern of capital investment on sample dairy farms in different locations. While section-II deals with the existing resource-use pattern. Section-III is devoted to the study of the resource-use efficiency which involved the comparisons of marginal value productivities of resources with their prices.

SECTION -I

Structure and size of dairy-herd

The composition and size of herd on dairy farms in different locations are shown in Table 4.1.1. There were two types of milch animals on sample dairy farms, viz cows and buffaloes which had been accompanied by their calves and heifers. The average size of dairy-herd in standard animal

Table 4.1.1: Composition of herd-size on dairy farms in different locations of Ludhiana district of Punjab, 1996-97.

Farm location	Buffaloes	Local cows	Cross-bred cows	Total milch animals	Animals in milk	Heifers	Calves	Total herd size (SAU)
Rural	7.20 (61.60)	0.98 (8.38)	1.83 (15.65)	10.01 (85.62)	7.26 (72.52)	2.18 (9.32)	2.37 (5.05)	11.69 (100)
Semi-urban	17.13 (72.28)	-	4.23 (17.85)	21.36 (90.13)	16.38 (76.69)	3.40 (7.17)	2.57 (2.70)	23.70 (100)
Urban	27.30 (72.47)	-	8.37 (22.22)	35.67 (94.69)	30.23 (84.74)	2.42 (3.22)	3.17 (2.09)	37.67 (100)

Figures in paranthsese are the percentage of total herd-size

unit (SAU) was 11.69, 23.70 and 37.67 on rural, semi-urban and urban dairy farms, respectively. This showed that herd-size had an inverse relationship with the distance from urbanization. The constitution of dairy-herd showed that on rural dairy farms, 85.62 per cent of the total animals stock were the milch animals, out of which 61.60 per cent were buffaloes, 8.38 per cent and 15.65 per cent were local cows and crossbred cows respectively. The remaining 14.37 per cent of the herd were the young stock.

On semi-urban dairy farms, out of the total animal stock, 90.13 per cent were the milch animals, among these 72.28 per cent were buffaloes and 17.85 per cent were crossbred cows. The percentage of young stock in the total herd was 9.87 per cent.

On urban dairy farms, 94.69 per cent of the total animals stock were the milch animals, out of these 72.47 per cent were buffaloes, 22.22 per cent crossbred cows and the remaining 5.31 per cent were the young stock. The percentage of animals in milk was the highest i.e. 84.74 on urban dairy farms, and it was the lowest i.e. 72.52 on rural dairy farms which indicated that urban dairy farms had better animal stock as compared to rural areas.

The data revealed that buffaloes constituted the highest proportion of the herd-size in all the locations followed by crossbred cows and the young stock. The Table further revealed that the proportion of buffaloes had the direct relationship with the distance from the city while that of crossbred cows was inversely related with this distance. Calves and heifers were in proportion to the cows and buffaloes, respectively. Local cows were not reported on the sample dairy farms, except the rural dairy farms. The reason being their much lower milk yield than crossbred cows. The greater proportion of crossbred cows was observed on dairy farms nearer to the city due to the easy availability of better health care services that were more required for crossbred cows than the buffaloes.

Capital Investment:

Dairy enterprise requires a considerable quantum of initial investments funds. The investments made on different items on dairy farms in different locations are presented in Table 4.1.2. Total capital investments per farm came to be Rs. 174980.98, 358233.51 and Rs. 613057.87 on rural, semi-urban and urban dairy farms, respectively. Investment per dairy farm evinced inverse relationship with the distance of dairy farms from the city. Total capital investments per milch animal were

Table 4.1.2: Capital investment on dairy farms in different locations of Ludhiana district 1996-97

(Rupees)

S. No	Item	Farm Location		
		Rural	Semi-urban	Urban
1.	Milch Animals	106963.50 (61.13)	244110.00 (68.14)	455807.00 (74.34)
2.	Dairy buildings	52610.76 (30.07)	86792.85 (24.22)	121394.38 (19.80)
3.	Equipments and utensils	3239.57 (1.86)	4937.50 (1.37)	6261.49 (1.02)
4.	Water supply/ drainage structure	5249.31 (2.99)	10106.67 (2.82)	12045.14 (1.96)
5.	Electricity structure	3567.52 (2.04)	5621.65 (1.56)	7611.33 (1.24)
6.	Fodder chaffing structure	2227.13 (1.27)	1627.51 (0.45)	1175.00 (0.19)
7.	Transportation	1123.19 (0.64)	5037.33 (1.44)	8763.52 (1.45)
	Total (per farm)	174980.98 (100)	358233.51 (100)	613057.87 (100)
	Total (per milch animal)	17480.61	16771.23	17186.93
	Total (per SAU)	14968.43	15115.33	16274.43

Figures in parentheses are the percentages of total capital investment per farm

Rs. 17480.61, Rs. 16771.23 and Rs. 17186.93 on rural, semi-urban and urban dairy farms, respectively. Whereas, total capital investments per SAU were Rs. 14968.43, Rs. 15115.33 and Rs. 16274.43 on rural, semi-urban and urban dairy farms, respectively. Thus there was an inverse relationship between capital investment per SAU and distance of the dairy farm from city, whereas in case of capital investment per milch animal the relation was positive. The discussion on the component-wise investment of total capital on dairy farms as follows:

1. Milch animals:

Dairy animals formed the major component in dairy enterprise. Also the data revealed that the highest proportion of the total capital investment was allocated to this resource in different dairy farms locations. The highest proportion of capital investment on milch animals was observed on urban areas which was 74.34 followed by 68.14 in semi-urban and 61.13 in rural areas.

2. Dairy buildings:

Dairy buildings included cattle sheds, feed stores, managers' accommodation, milk parlours, etc. and formed the second major resource in terms of proportion of capital invested. The highest proportion of 30.07 per cent of capital investment on dairy buildings was observed in rural areas (Rs.

52610.76) followed by 24.22 per cent (Rs. 86792.85) in semi-urban areas and 19.80 per cent (Rs. 121394.38) in urban areas. Also the capital investment on dairy buildings per SAU was computed which was to the tune of Rs. 4500.49 in rural areas, Rs. 3662.14 in semi-urban and Rs. 3222.57 in urban areas. Although the prices of land and cost of construction was higher in urban areas as compared to semi-urban and rural, but the rural and semi-urban dairy farms had the herd-size disadvantage in term of economy of scale/size.

3. Water Supply/Drainage Structure:

This includes the capital invested on installation of water supply structure and construction of drainage outlets. The highest proportion of capital investment on water supply/drainage structure was observed in rural areas which was 2.99 (Rs. 5249.31) followed by 2.82 (Rs. 10106.67) in semi-urban and 1.96 per cent in (Rs. 12045.14) in urban areas. Also the capital investment per SAU was Rs. 449.04, 426.44 and Rs. 319.75 in rural, semi-urban and urban areas respectively.

4. Electric Structures:

These included investment on electric and other motor, electric fixtures. The highest proportion of the capital invested on electric structures was in rural areas which was Rs. 3567.52 (2.04%) followed by Rs. 5621.65 (1.56%)

and Rs. 7611.34 (1.24%) in semi-urban and urban areas respectively. The highest proportion of capital invested on electric structures on rural dairy farms can be attributed to the fact that dairy farms were away from the main of electricity supply lines. Moreover, they had to instal their own higher sizes electric motors for water supply. The investment on this herd per SAU came to be Rs. 305.17, 220.01 and 202.05 on rural, semi-urban and urban dairy farms respectively.

5.Equipment and utensils

The highest proportion of capital invested on equipment and utensils including minor tools and implements was made on rural dairy farms which was Rs. 3239.57 (1.86%), followed by 4937.50 (1.37%) in semi-urban and Rs. 6261.49 (1.02%) on urban dairy farms per SAU investment on this factor was found to be Rs. 277.13, 208.33 and 166.22 on rural, semi-urban and urban dairy farms respectively, showing inverse relationship with distance from city.

6. Fodder Chaffing structure:

It included investment on '*tokka*', electric motor, belts, etc. The highest proportion of capital investment on this resource was observed in rural areas which has 2227.13 (1.27%) followed by Rs. 1627.51 (0.45%) in semi-urban areas

and Rs. 1175.00(0.19%) on urban dairy farms. The urban dairy farms made such a low investment on fodder-chaffing structure because they used to purchased chaffed fodder from the market. Per SAU investment was Rs. 190.52 on rural, Rs. 68.67 on semi-urban and Rs. 31.19 on urban dairy farms. There was a positive relationship between per SAU investment and distance of dairy farm from city.

7. Transportation:

It included investment on vehicles used for marketing of milk and transportation of fodder. The highest proportion of investment of the order of Rs. 8763.52 (1.45%) was made on urban dairy farms which was followed by Rs. 5037.33 (1.44%) in semi-urban and 1123.19 (0.64%) in rural areas. The investment per SAU on transportation came to be Rs. 96.08, Rs. 212.54 and Rs. 232.64 on rural, semi-urban and urban dairy farms respectively indicating an inverse relationship with the distance of dairy farms from the city.

It could be summed up that the proportion of capital investment was the highest on dairy animals followed by dairy buildings, water supply/drainage structures, electric structures, equipments and utensils and fodder chaffing structure on dairy farms in different locations. Although, the capital investment per farm was higher on urban dairy farms

followed by semi-urban ones. But this investment per SAU and per milch animal was found to be higher on rural dairy farms facing scale diseconomies.

SECTION - II

Existing resource-use pattern

The resources are generally categorized into two groups in the literature of economics, i.e. fixed and variable resources. Fixed resources provided services for a longer period of time and their annual costs are represented by the depreciation and interest thereupon. Variable resources included inputs like feeds, fodders, labour, veterinary care, medicines, water, power, fuel, repairs and maintenance, etc. In order to examine the existing resource-use pattern on dairy farms in different locations, the cost structure on different locations was studied. The discussion proceeds according to the above mentioned above mentioned concepts of costs..

1. Fixed Cost:

Fixed costs were worked out on per farm, per milch animal, per standard animal unit (SAU) and per litre of milk produced were worked out.

Fixed costs per farm:

Though the variability in the herd-size across different locations invalidated the comparison of per farm fixed costs of dairy farms, yet the comparison of the proportion of different constituents of fixed costs may be meaningful. Table 4.2.1 contains the information pertaining to fixed costs per farms. It can be seen from the Table that there were three parts of fixed cost, depreciation, interest on fixed capital and insurance premium. It was seen that the interest cost was more than the depreciation cost on all the locations of dairy farms. It was 59.69, 59.12 and 58.88 per cent on rural, semi-urban and urban dairy farms, respectively. This indicated an inverse relationship with the herd-size and positively related with the distance from the city location. Among the depreciation cost components, milch animals secured the highest proportion followed by equipment and utensils on all the dairy farms. The lowest proportion of depreciation cost ranged from 0.09 per cent in case of fodder chaffing structures on urban dairy farms to 0.31 per cent on transportation facilities on rural location. The Table further revealed that proportion of dairy buildings, equipment and utensils, water supply structure, electric installation and fodder chaffing structure were inversely related with the herd-

Table 4.2.1: Fixed cost on dairy farms at different locations of Ludhiana district, 1996-97

(Rs./per farm)

S.No.	Item	Farm location		
		Rural	Semi-urban	Urban
1.	Depriciation			
a	Milch Animals	10567.99 (28.83)	23922.78 (31.58)	43392.82 (33.33)
b	Dairy buildings	1052.21 (2.87)	1735.86 (2.29)	2427.89 (1.86)
c	Equipments and utensils	1619.78 (4.41)	2468.75 (3.26)	3130.74 (2.40)
d	Water supply/ drainage structure	524.93 (1.43)	1010.66 (1.33)	1204.51 (0.93)
e	Electricity structure	249.72 (0.68)	368.31 (0.49)	532.79 (0.41)
f	Fodder chaffing structure	222.71 (0.61)	162.75 (0.22)	117.50 (0.09)
g	Transportation	112.31 (0.31)	503.73 (0.66)	876.35 (0.67)
2.	Interest on fixed capital	21872.62 (59.69)	44779.18 (59.12)	76632.23 (58.88)
3.	Insurance Premium	432.23 (1.17)	786.86 (1.05)	1866.66 (1.43)
	Total	36656.60 (100.00)	75738.88 (100.00)	130181.49 (100.00)

Figures in parentheses are the percentage of total fixed cost per farm

size and positively correlated with the distance of dairy locations from the city. Whereas, it depicted the reverse trend in case of transportation facilities. The total fixed costs per farm came out to be Rs. 36656.60, Rs.75738.88 and Rs. 130481.49 on rural, semi-urban and urban dairy farms, respectively.

Fixed costs per milch animal

The fixed costs per milch animal were computed by dividing the per farm fixed costs with the average number of milch animals and the same are presented in table 4.2.2. Total fixed costs per milch animal were found to be Rs. 3661.79, Rs. 3545.79 and Rs. 3648.71 on rural, semi-urban and urban dairy farms, respectively.

Among the various components of fixed costs, interest charges on fixed investments representing the opportunity cost of farmers' owned funds used in dairying. The table revealed that returns to capital came out to be the highest i.e. Rs. 2185.07 on rural , Rs. 2096.40 on semi-urban and Rs. 2148.36 on urban dairy farms. Among the other components of fixed costs, depreciation charges on dairy animals were highest, i.e. Rs. 1055.74, Rs. 1119.98 and Rs. 1216.50 on rural, semi-urban and urban dairy farms respectively.

Table 4.2.2: Fixed costs on Dairy farms at different locations of Ludhiana district, 1996-97

(Rs./Per milch animal)

S.No.	Item	Farm location		
		Rural	Semi-urban	Urban
1.	Depriciation			
a	Milch Animals	1055.74	1119.98	1216.50
b	Dairy buildings	105.11	81.26	68.06
c	Equipments and utensils	161.82	115.57	87.76
d	Water supply/ drainage structure	52.44	47.31	33.76
e	Electricity structure	24.97	17.24	14.93
f	Fodder chaffing structure	22.24	7.61	3.29
g	Transportation facility	11.21	23.58	23.72
2.	Interest on fixed capital	2185.07	2096.40	2148.36
3.	Insurance Premium	43.19	36.84	52.33
	Total (per milch animal)	3661.79	3545.79	3648.71

The rural dairy farms had to create a proper fodder chaffing structure, depreciated to Rs. 22.24 which decrease to Rs. 7.61 per milch animal on semi-urban dairy farms and further to Rs. 3.29 on urban dairy farms. This practice has negative relationship with the distance from the city. The positive relationship of cost of water supply with the distance may be due to the fact that the urban and semi-urban dairy farms use the municipality water supply at much cheeper rates which is not available in rural areas. The insurance premium was paid at the rate of Rs. 43.19, Rs. 36.84 and Rs. 52.33 per milch animal on rural, semi-urban and urban dairy locations, respectively.

Fixed Cost Per Standard Animals Unit:

The fixed cost per standard animal unit is shown in table 4.2.3. It did not depict any different trend than that in case of fixed cost per milch animal. This was so because the calves and heifers were almost equally proportionate to the milch animals on all types of dairy farms. Total fixed cost per standard animal unit came to be Rs. 3135.53, Rs. 3195.70 and Rs. 3455.80 on rural, semi-urban and urban dairy farms, respectively. Out of this Rs. 1871.05, Rs. 1889.41 and Rs. 2034.30 were secured by the interest charges while Rs. 1227.50, Rs. 1273.09 and Rs, 1371.95 were the depreciation

Table 4.2.3: Fixed costs on dairy farms in different locations of Ludhiana district, 1996-97

(Rs./SAU)

S. No	Item	Farm Locations		
		Rural	Semi-urban	Urban
1.	Depriciation			
a	Milch Animals	904.01	1009.40	1151.91
b	Dairy buildings	90.00	73.24	64.45
c	Equipments and utensils	138.56	104.16	83.11
d	Water supply/ drainage structure	44.90	42.64	31.97
e	Electricity structure	21.36	15.54	14.14
f	Fodder chaffing structure	19.06	6.86	3.11
g	Transportation	9.61	21.25	23.26
2.	Interest on fixed capital	1871.05	1889.41	2034.30
3.	Insurance Premium	36.98	33.20	49.55
	Total (per SAU)	3135.53	3195.70	3455.80

charges on rural, semi-urban and urban dairy farms respectively. Total fixed costs, depreciation charges and interest charges were directly correlated with the distance of dairy farms from the city. This was also true, by and large, for individual items. Insurance premium charges did not show any definite trend.

Fixed cost per litre of milk

Per litre cost of milk production being more precisely comparable across different categories of dairy farms. Thus it was considered appropriate for drawing inferences of much practical utility on the basis of existing resource use pattern in different dairy farms.

The perusal of table 4.2.4 indicated that behaviour of total fixed costs per litre, conformed to the logical expectations in the sense that these costs witnessed inverse relationship with the herd-size. The logicality of this relationship lies in the fact that an increase in the herd-size can lead to higher level of output. The unit total fixed cost, came to be Rs. 1.71, Rs. 1.39 and Rs. 1.37 on rural, semi-urban and urban dairy farms respectively. Thus, the fixed costs per litre of milk evinced inverse relationship with the herd-size which implied the existence of economies of scale across the herd-size range in dairy farms at different

Table 4.2.4: Fixed cost on dairy farms in different locations of Ludhiana district, 1996-97

(Rs/litre of milk)

S. No	Item	Farm Locations		
		Rural	Semi-urban	Urban
1.	Depriciation			
a	Milch Animals	0.50	0.44	0.46
b	Dairy buildings	0.05	0.003	0.003
c	Equipments and utensils	0.008	0.005	0.003
d	Water supply/ drainage structure	0.02	0.02	0.01
e	Electricity structure	0.01	0.007	0.006
f	Fodder chaffing structure	0.01	0.003	0.001
g	Transportation	0.005	0.009	0.009
2.	Interest on fixed cost	1.02	0.82	0.80
3.	Insurance Premium	0.02	0.01	0.02
	Total	1.71	1.39	1.37

locations. The highest and the largest figures of total unit and fixed cost were Rs. 1.71 and Rs. 1.37 on rural and urban dairy farms respectively. The differences in these cost figures indicate the extent of saving of fixed cost which would be attained by increase in the herd size and by decreasing the distance of dairy farms from the city.

It may be seen from the table that highest cost item was interest on fixed capital, i.e., Re. 1.02, 0.82 and 0.80 on rural, semi-rural and urban dairy farms respectively, followed by depreciation charges on animals. These costs were in positive relationship with the distance from urbanization. Urban dairy farms saved fixed cost in case all the fixed inputs in comparison to the rural dairy farms whereas rural dairy farms were in better position than the urban ones in case of transportation cost. This relationship can be explained in its consistency with the economic logic of economies of scale.

From the results, it was evident that rural and semi-urban dairy farms could have reduced further the costs if they had increased the herd-size. In other words, it may be said that no selected farm location could witness diseconomies of size.

II Variable costs

The variable costs were also computed on per farm, per milch animal, per standard animal unit and per litre of milk. The application and prices of green fodder, dry fodder and concentrates on different dairy farm locations came to as under.

Green Fodder: Green fodder was used at the rate of 27.73, 23.16 and 18.11 kg per day per dairy animal on rural, semi-urban and urban dairy farms respectively. The price of green fodder came to be Rs. 28.33/qtl on rural, Rs. 36.06/qtl on semi-urban and Rs. 47.32/qtl on urban dairy farms. High price of green fodder on urban locations was due to the fact that they purchased chaffed fodder from the market and it may also be the reason of less consumption of green fodder.

Dry Fodder: Dry fodder was used at the rate of 2.23, 2.76 and 3.07 kg per animal on rural, semi-urban and urban dairy farms respectively depicting an inverse relationship with the distance from city. This may be due to the dry fodder being supplementary of green fodder. The price of dry fodder also showed a similar trend. It was Rs. 80/qtl on rural, Rs. 103/qtl on semi-urban and Rs. 131/qtl on urban dairy farms. The higher price of dry fodder in urban areas could be attributed to the monopoly of rural fodder producers on fodder

production and supply.

Concentrates: The concentrates fed to dairy animals were 1.67 kg, 2.03 kg and 2.40 kg per day per dairy animal on rural, semi-urban and urban dairy farms, respectively. This indicated an inverse relationship with the distance of dairy farms from the city. Moreover, concentrates were used on urban dairy farms to supplement the green fodder during the off-seasons. The price of concentrates was found to be Rs. 4.18/kg on rural, Rs. 4.84/kg on semi-urban and Rs. 5.27/kg on urban dairy farms.

Thus the prices of feeds and fodders were higher in urban areas than that in rural areas.

Variable costs per farm:

The variable cost per dairy unit is presented in Table 4.2.5. The Table revealed that total variable cost per farm varied with the distance of farms from the city. This was due to increasing herd-size with the decrease in the distance from the city. The highest proportion of the order of 27.16 and 28.93 per cent of the total variable cost on semi-urban and urban dairy farms, respectively was secured by concentrates while the lowest proportion to the tune of 0.92 and 0.68 per cent on the same order of farm categories was in favour of the miscellaneous items. The trend was somewhat

Table 4.2.5: Variable costs on dairy farms in different locations of Ludhiana district, 1996-97

(Rs./per farm)

S.No.	Item	Farm location		
		Rural	Semi-urban	Urban
1.	Green fodder	33519.98 (28.15)	72244.61 (23.09)	117828.85 (19.60)
2.	Dry fodder	7612.06 (6.39)	24591.64 (7.86)	69706.09 (11.59)
3.	Concentrates	29785.17 (25.02)	84992.89 (27.16)	173904.30 (28.93)
4.	Human labour	20491.97 (17.21)	58112.19 (18.57)	98295.26 (16.35)
5.	Veterinary care	5107.68 (4.29)	17071.78 (5.46)	39773.40 (6.62)
6.	Electricity/ water	2035.75 (1.71)	4354.60 (1.39)	8137.50 (1.35)
7.	Fuel cost	5138.46 (4.31)	10249.49 (3.27)	15648.93 (2.60)
8.	Miscellencous	1769.23 (0.64)	2896.86 (0.92)	4099.79 (0.68)
9.	Interest on Variable costs	14624.44 (12.28)	38431.97 (12.28)	73835.17 (12.28)
	Total	119084.74 (100.00)	312946.03 (100.00)	601229.29 (100.00)

Figures in parentheses are the percentage of total variable cost per farm

different on rural dairy farms where green fodder accounted for the highest i.e. 28.15 per cent cost followed by 25.02 per cent on concentrates. The relationship of the proportionate share of green fodder, concentrates, human labour, fuel and oil and electricity/water charges with the distance of dairy farms from the city was positive while that with the herd-size it came to be negative. On other hand, proportionate shares of dry fodder, veterinary services and miscellaneous items were positively related with the herd-size and inversely related with the distance from the city. The per farm total variable cost on urban dairy farms was 5.05 times the total variable cost on rural dairy farms but the herd-size of dairy farms came to be 3.22 times the herd-size on the rural dairy farms.

Variable costs per milch animal:

The variable costs per milch animal are given in Table 4.2.6. Total variable cost per milch animal came to be Rs. 11896.55 on rural, Rs. 14650.98 on semi-urban and Rs.16855.28 on urban dairy farms, indicating positive relationship with the herd-size and negative relationship with the distance of the dairy farms from the city. The difference in the variable cost was mainly due to the much higher cost on dry fodder, concentrates and veterinary care on urban dairy farms as compared to that on rural dairy farms. On rural dairy

Table 4.2.6: Variable costs on dairy farms in different locations of Ludhiana district, 1996-97.

(Rs./milch animal)

S.No.	Item	Farm Locations		
		Rural	Semi-urban	Urban
1.	Green fodder	3348.65	3382.23	3303.30
2.	Dry fodder	760.44	1151.29	1954.19
3.	Concentrates	2957.54	3979.06	4875.06
4.	Human labour	2047.14	2720.60	2755.68
5.	Veterinary care	510.25	799.24	1115.03
6.	Electricity/ water	203.37	203.86	228.13
7.	Fuel and oil	513.33	479.84	438.71
8.	Miscellencous	76.85	135.62	114.93
9.	Interest on Variable costs	1460.98	1799.24	2069.95
	Total	11896.55	14650.98	16855.28

farms, highest cost per milch animal was found to be Rs. 3348.65 on green fodder followed by Rs. 2975.54 on concentrates while on semi-urban and urban dairy farms, concentrates were followed by green fodder.

The per milch animal variable cost on dry fodder, concentrates, human labour, veterinary care, electricity/water supply, miscellaneous items and interest on variable cost depicted a positive relationship with the herd-size and inversely related with the distance from the city. Whereas the cost of green fodder and fuel and oil was inversely related with the herd-size and positively related with the distance from city.

Variable cost per standard animal unit:

The variable cost per standard animal unit on different items on dairy farms at different locations is presented in table 4.2.7. Total variable cost per standard unit worked at Rs. 10186.87, Rs. 13204.43 and Rs. 15960.39 on rural, semi-urban and urban dairy farms respectively, revealing a positive relationship with the herd-size and negative relationship with the distance from city. This pointed towards the higher prices of inputs in urban dairy centres than in rural areas. Rural dairy farms incurred more cost on green fodder while the urban dairy farms made higher

Table 4.2.7: Variable costs on dairy farms in different locations of Ludhiana district, 1996-97

(Rs./SAU)

S.No.	Item	Farm Locations		
		Rural	Semi-urban	Urban
1.	Green fodder	2867.40	3048.29	3127.92
2.	Dry fodder	651.16	1037.62	1850.44
3.	Concentrates	2547.91	3586.19	4616.51
4.	Human labour	1752.95	2451.99	2609.37
5.	Veterinary care	436.93	720.32	1055.83
6.	Electricity/ water	174.14	183.73	216.02
7.	Fuel cost	439.56	432.46	415.42
8.	Miscellencous	65.80	122.23	108.83
9.	Interest on Variable costs	1251.02	1621.60	1960.05
	Total (Per SAU)	10186.87	13204.43	15960. 39

expenditure on concentrates than their counterparts at different locations. Human labour was also found to be more on urban dairy farms. This may be due to the dearer hired labour in urban areas than the rural ones. The variable cost per standard animal unit on green fodder was inversely related with the distance from city and directly related with the herd size whereas all other items were inversely related with the herd-size and directly related to the distance of dairy farms from the city. This showed that from cost point of view rural dairy farms were more efficient than the urban ones.

Variable costs per litre of milk:

A perusal of table 4.2.8 revealed that total variable cost per litre of milk yielded positive relationship with the herd-size and negative relationship with the distance from city which implied that herd-size had witnessed negative effect and the distance showed it positive effect on the efficiency in the use of variable resources. Per litre variable cost for rural, semi-urban and urban dairy farms were Rs. 5.56, Rs. 5.67 and Rs. 6.29, respectively. The positive relationship between the unit variable cost and herd-size could be attributed to the higher prices of inputs in city centres and partly to the direct relationship between milk yield per animal and herd-size.

Table 4.2.8: Variable costs on dairy farms in different locations of Ludhiana district, 1996-97

(Rs./litre of milk)

S.No	Item	Farm Locations		
		Rural	Semi-urban	urban
1.	Green fodder	0.57	0.31	1.24
2.	Dry fodder	0.35	0.44	0.73
3.	Concentrates	1.40	1.54	1.82
4.	Human labour	0.96	1.05	1.03
5.	Veterinary care	0.24	0.31	0.42
6.	Electricity/ water	0.09	0.08	0.08
7.	Fuel and oil	0.24	0.19	0.16
8.	Miscellencous	0.03	0.05	0.04
9.	Interest on Variable costs	0.68	0.70	0.77
	Total (Per litre of milk)	5.56	5.67	6.29

Among the various components of unit variable cost, concentrates accounted for the largest cost, semi-urban and urban dairy farms, i.e. Rs. 1.54 and Rs. 1.82 respectively which was followed by green fodder i.e. Rs. 1.31 and Rs. 1.24 on semi-urban and urban dairy farms, respectively. Rural dairy farms depicted a different trend. Green fodder secured the highest (Rs. 1.57) cost which was followed by concentrates (Rs. 1.40).

Further examination of this table portrayed direct relationship of herd - size with the per litre cost of dry fodder, concentrates, human labour, veterinary care and miscellaneous inputs while these variables were inversely related to the distance from the city. Certainly, herd-size was found in inverse relationship with the per litre cost of green fodder and positively related with the distance from the city. It may be inferred from there results that unit variable cost could be reduced further by intensifying the use of dry fodder, concentrates, human labour, veterinary care and miscellaneous items with the decrease in herd-size on one hand and increase in distance on the other hand. Reduction in the intensity of green fodder use with the decrease in herd-size and increase in the distance from the city would also lead to reduction in the variable cost. This is so because as the herd-

size decreased and the distance from the city increased, the inadequacy in the use of dry fodder, concentrate feeds, veterinary care and human labour increased which in turn widened gap between optimum level and existing level of these inputs. The opposite of this explanation applies with regard to the use of green fodder because the over doze and the prices of this input increased with the decrease in the distance of dairy farm from the city.

Returns from dairy farming:

The level of turn over and profitability of dairy farm business across different locations have been studied by means of gross returns, RFFR and net returns. The income concepts on per farm, per milch animal, per standard animal unit and per litre of milk have been discussed separately as follows:

Gross returns:

The term gross returns and gross income have been treated as synonymous and are therefore, used interchangeably in this study. The results are presented in Table 4.2.9.

Gross returns per farm:

It may be seen from the Table that gross returns per farm were Rs. 222361.84, Rs. 646787.44 and Rs. 1205984.29 in rural, semi-urban and urban dairy farms respectively. The

Table 4.2.9: Gross return from dairy farming in different locations of Ludhiana District 1996-97

(Ruppes)

Particulars	Farm Locations		
	Rural	Semi-urban	Urban
Per farm			
Milk production	201584.98 (90.65)	607939.83 (94.00)	1159838.72 (96.17)
Dung	6399.98 (2.88)	16336.35 (2.53)	25748.46 (2.14)
Appreciation on young stock	14376.88 (6.47)	22511.26 (3.47)	20397.11 (1.69)
Total	222360.84 (100.00)	646787.44 (100.00)	1205984.29 (100.00)
Per milch animal			
Milk production	20138.35	28461.60	32515.80
Dung	639.35	764.81	721.85
Apreciation on young stock	1436.25	1053.89	571.82
Total	22213.95	30280.30	33809.47
Per standard animal unit			
Milk production	17244.22	25651.46	30789.45
Dung	547.47	689.29	683.52
Appreciation on young stock	1229.84	949.84	541.46
Total	19021.51	27290.61	32014.43
Per litre of milk	9.48	11.05	12.17

Figures in parentheses are the percentage of total gross returns per farm.

highest proportionate share of milk was inversely related to the distance of dairy farms from the city and positively related to the herd-size.

The income from dung were found to be 2.88 per cent, 2.53 per cent and 2.14 per cent of the gross income from milk production on rural, semi-urban and urban dairies respectively which was positively related to the distance and negatively related to the herd-size. Similarly, the income from appreciation of young stock was found to be 6.47 per cent, 3.47 per cent and 1.69 per cent of the gross income from milk production in rural, semi-urban and urban dairy units respectively, which again was in positive relationship with the distance from city and inversely related with the herd-size.

Gross returns per milch animal:

Gross income from all the resources per milch animal came to be Rs. 22213.95 on rural, Rs.30280.30 on semi-urban and Rs. 33809.47 on urban dairy farms witnessing inverse relationship with the distance from the city and positively related with the herd-size. Similar was the relationship of gross income from milk production and dung with the distance and herd-size while appreciation of young stock could depict an otherway relationship. This showed that more gross income

could be generated by increasing the herd-size and reducing the distance of dairy farms from the city.

Gross returns per standard animal unit:

Table 4.2.9 further revealed that the gross returns per standard animal unit worked at Rs. 19021.53, Rs. 27290.59 and Rs. 32014.43 on rural, semi-urban and urban dairy farms, respectively, depicting an inverse relationship with the distance of dairy farms from the city and positive relationship with the herd-size. The income from dung and appreciation of young stock witnessed almost the similar relationships with distance and herd-size as was found in case of gross returns on per milch animal basis. Thus, it can firmly be inferred that gross returns could further be intensified by increasing the herd-size and installing the dairy units nearer to the city centres.

Gross returns per litre of milk

The amount of gross returns per litre of milk can help us for deciding what should be the level of total costs per litre of milk for obtaining particular amount of profit from a given level of milk production or this information on gross returns can help us in determining the level of milk production necessary for obtaining particular amount of profit given the amount of total cost per litre of milk.

A glance on the table revealed that gross returns per litre of milk from the dairy farm business witnessed positive relationship with the herd-size and negative relationship with the distance of dairy farms from the city. It came to be Rs. 9.48, Rs. 11.05 and Rs. 12.17 on rural, semi-urban and urban dairy farms respectively. The variation in gross returns across locations have largely been explained in price of milk.

The higher price of milk in case of urban dairy farms as compared to the rural dairy farms might be attributed to the excess demand over and above the supply of milk in the urban centres as compared to demand and supply relationship in the rural areas.

It is pertinent to be mentioned here that higher milk price in urban areas was also made possible by larger effect of higher input cost and demand for milk overtime than that in the rural areas.

Returns to fixed farm resources (RFFR)

Returns to fixed farm resources are also called returns over the variable expenses. This measure of dairy farm income indicates the level of profitability resulting from the existing use of variable resources in the business of dairy farming. These returns being responsive to the change of the

unit of output, thus RFFR ceased to be comparable across different locations on the basis of herd-size. But to have an idea of the quantum of returns it can be worked out on per farm basis. The comparisons were made by working out the RFFR on per milch animal, per standard animal unit and per litre of milk basis. Same comparisons were carried out in case of net returns. The results are presented in table 4.2.10.

Table 4.2.10 showed that RFFR were Rs. 103277.10, Rs. 333841.41 and Rs. 604755.00 per farm on rural, semi-urban and urban dairy farms respectively. The RFFR per milch animal came to be Rs. 10317.40 on rural, Rs. 15629.32 on semi-urban and Rs. 16954.19 on urban dairy farms. This revealed that greater the herd-size and lesser the distance from the city witnessed the positive effect on profitability in the use of variable resources. Same was the case with RFFR per standard animal unit. The RFFR per litre of milk came to be Rs. 4.89, Rs. 6.07 and Rs. 6.37 on rural, semi-urban and urban dairy farms respectively. This highlighted that herd-size and distance from the city were positively and inversely related respectively to the profitability over the use of variable resources. This can also be inferred that urban dairy farms are more efficient in utilizing the variable resources than the rural ones. Thus profitability can further be increased by

Table 4.2.10 : RFFR and net returns on dairy farms in different locations in Ludhiana district, 1996-97

(Rupees)

Particular	Farm Locations		
	Rural	Semi-urban	Urban
RFFR			
Per farm	103277.10	333841.41	604755.00
Per milch animal	10317.40	15629.32	16954.19
Per SAU	8834.66	14086.16	16054.04
Per litre of milk	4.89	6.07	6.37

* Milk production + Dung + Appreciation on young stock

Net returns

Per farm	82428.14	219254.92	428427.94
Per milch animal	4580.01	10264.83	12011.81
Per SAU	3921.82	9251.33	11373.26
Per litre of milk	2.21	3.99	4.51

** Only milk production

increasing the herd-size and by installing the dairy farms nearer to the city centre where demand of milk play an important role towards returns.

Net returns from milk production:

The concept of net returns has been used to indicate the amount by which the value of milk production exceeds the total cost (fixed and variable costs). This concept reveals the level of efficiency in the existing use of fixed and variable resources. The greater the value of net returns higher would be the level of resource-use efficiency and vice versa.

Table 4.2.10 showed that net returns per farm were Rs. 82428.14, Rs. 219254.92 and Rs. 428427.94 on rural, semi-urban and urban dairy farms respectively. This needs no explanation as the variations in per farm net returns is attributed only to the herd-size. A comparison of the figures of net returns from milk production per milch animals evinced that the greater herd-size and lesser distance from the city had positive effect on the profitability in the use of fixed as well as variable resources. This came to be Rs. 4580.01 on rural, Rs. 10264.83 on semi-urban and Rs. 12011.81 on urban dairy farms. Similar was the trend in case of net returns per standard animal unit. This showed calves and heifers were

generally proportionate to the milch animals on all the dairy farm locations. The net returns per litre of milk has been found to be Rs. 2.21, Rs. 3.99 and Rs. 4.51 on rural, semi-urban and urban dairy farms respectively. Thus, these have been found to provide good incentive for accelerating the growth of dairy farm business. It may also be inferred that dairy farms with greater herd-size and at lesser distance from the city have been more efficient in making use of fixed dairy structures alongwith variable resources as compared to the dairy farms with the smaller herd-size and farther distance from the city centres.

It seems appropriate to attribute higher profitability of urban dairy farms than that of rural ones to the relatively larger number of milch animals with higher yields which have been responsible for the economies of scale in the former situation as compared to the latter. Besides, more intensive use of variable inputs, better management and favourable milk prices might also be the other reasons for the trend.

In the absence of milk yield / milch animal, this discussion is not obvious.

Section-III

Factors affecting milk production

The various production resources are used differently on dairy farms at different locations. But the concern is whether the resource-use was efficient, indifferent or inefficient. In order to provide answer for this question, the regression analysis was carried out by using two functional forms i.e. linear and Cobb-Douglas. Cobb-Douglas regression analysis brought out more significant and logical results than the linear production function. Thus, Cobb-Douglas production function was chosen to explain the existing resource-use efficiency and while the same production function was used to work out the returns to scale.

Cobb-Douglas production function analysis:

The results of Cobb-Douglas regression analysis are presented in Table 4.3.1. The value of multiple determination (R^2) came to be 0.9811, 0.9673 and 0.9573 on rural, semi-urban and urban dairy farms respectively. This indicated that 95 to 98 per cent of the variation in the value of daily milk production on dairy farms on different locations was explained by the independent variables included in the equation.

Table 4.3.1: Factors affecting value of daily milk production in different locations of Ludhiana district, 1996-97 (Cobb-Douglas production function)

Factors	Farm Locations		
	Rural	Semi-urban	Urban
Constant	0.42 (0.895)	0.56 (1.057)	0.14 (1.246)
Herd-size	0.96*** (4.421)	0.93*** (3.924)	0.88*** (5.042)
Green fodder (Rs/day)	0.12*** (3.118)	0.32*** (3.284)	0.28*** (3.567)
Dry fodder (Rs/day)	0.05 (0.948)	0.06 (1.057)	0.12 (1.289)
Concentrates (Rs/day)	0.30*** (3.942)	0.26*** (2.867)	0.26** (2.404)
Human labour (Rs/day)	0.09 (1.113)	0.10** (2.241)	0.11*** (3.618)
Fuel cost (Rs/day)	0.01 (1.087	0.01 (0.810)	0.01* (1.985)
Electricity/ water (Rs/day)	0.01* (1.998)	0.01** (2.489)	0.009 (0.811)
Veterinary charges (Rs/day)	0.05*** (3.272)	0.04*** (3.109)	0.04** (2.591)
R^2	0.9322***	0.9186**	0.9411***
Returens to scale	1.59***	1.72***	1.71***
F-ratio	5.23	6.11	4.96

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

Resource-wise position showed that the regression coefficient of herd-size came to be 0.96, 0.93 and 0.88 on rural, semi-urban and urban dairy farms respectively, all significant at 1 per cent level. This indicated that there would be an increase of 0.96, 0.93 and 0.88 per cent in the value of daily milk production with an increase of one per cent in the herd-size on dairy farms at each location. An increase of one per cent in the daily cost of green fodder contributed 0.12, 0.31 and 0.28 per cent towards the value of daily milk production on rural, semi-urban and urban dairy farms respectively. This showed that the increments in herd-size and green fodder in proportion to the magnitudes of the elasticities can go a long way to increase profits from dairy business.

The coefficient of concentrates came to be 0.30 on rural dairy farms, significant at 1 per cent, 0.26 on semi-urban dairy farms, significant at 1 per cent level and 0.26 on urban dairy farms, significant at 5 per cent level. This highlighted that an increase of one per cent daily in the expenditure on concentrates would lead to an increase of 0.30, 0.26 and 0.26 per cent in the value of daily milk production on rural, semi-urban and urban dairy farms respectively. This revealed that the increases in the expenditure on concentrates

can lead to higher returns in dairy farming.

The regression coefficient of human labour was significant at 5 and 1 per cent level on semi-urban and urban dairy farms respectively while the same was found to be non-significant on rural dairy farms. This suggested that this input could more be increased on semi-urban and urban dairy farms while the same could not make significant contribution on rural dairy farms.

The regression coefficient of electricity and water showed that there would be an increase of 0.01 per cent in the value of milk production if an increase of one per cent was made in the expenditure on electricity and water each on rural and semi-urban dairy farms respectively. But there would be no significant increase on urban dairy farms.

The regression coefficient of veterinary charges came to be 0.05 on rural, 0.04 on semi-urban and 0.04 on urban dairy farms, all significant at one per cent level. This conveyed that an increase of one per cent in this input would lead to an increase of 0.05, 0.04 and Rs. 0.04 per cent in the value of daily milk production on rural, semi-urban and urban dairy farms respectively.

The non-significant regression coefficient of dry fodder revealed that it failed to make significant

contribution in the production of milk. The regression coefficient of fuel was non-significant on rural and semi-urban dairy farms while it was positively significant at 10 per cent level on urban dairy farms. This indicated that fuel could not make significant contribution in the production of milk which implied no constraining influence of fuel on the value of milk production on rural and urban dairy farms while its increased use could fetch more returns on urban dairy farms.

Overall, it can be stated that all the inputs had more potential to contribute towards milk production on all the locations of dairy farms.

Returns to scale:

In order to use the regression coefficients of Cobb-Douglas production function for suggesting optimal adjustments in the existing resource use patterns, it is imperative to know the nature of returns to scale. This is so because the profit maximizing measures change with the nature of returns to scale. For instance, increasing returns to scale require augmentation in the intensity of use in case of all the resources irrespective of input-output prices and no curtailment in the use of any resource is warranted in such a situation. The constant returns to scale indicate optimal use

of resources, because in this situation only the equality of MVPs and factor prices of different resources can hold true.

This situation reveals the equilibrium condition under the given scenario of input-output prices. An adherence to the existing resource use pattern is required to maximize the profits unless the changes in the input-output prices do not warrant the change otherwise.

In case of decreasing returns to scale, optimal adjustments in resource use require the augmentation in the use of resources having MVPs greater than factor prices and vice versa.

The nature of returns to scale is indicated by the sum of regression coefficients of Cobb-Douglas production function. In the present study the sum of regression coefficients came to be 1.59, 1.72 and 1.71 in rural, semi-urban and urban dairy farms respectively which being substantially greater than unity, gave string signal of increasing returns to scale. This necessitated us to statistically verify the nature of returns to scale. From the statistical testing, the hypothesis of increasing returns to scale was not rejected. The prevalence of increasing returns to scale revealed inadequate use of resources in the dairy business in all the locations. The profit maximization in this situation requires augmentation in the intensity of input use

in case of all the resources. However, in case of limited availability of funds the additional funds should be used on different resources in accordance with the magnitudes of their MVPs.

Marginal value productivities (MVP)

Table 4.3.2 contains the marginal value productivities of the factor inputs of milk production.

The MVP of herd-size was found to be in positive relationship with the herd-size and inversely related to the distance of dairy farms from the city. This showed that urban dairy farms were in better position in respect of yield of milk per animal than their counterparts in rural and semi-urban locations.

The MVP of daily cost of green fodder also showed a similar trend. It was 0.75 on rural, 2.59 on semi-urban and 2.78 on urban dairy farms. This showed a further addition of expenditure on green fodder would fetch higher increase in returns on urban dairy farms than the rural ones. The trend was inverse in case of concentrates. The MVP of concentrates was inversely related to the distance from city and positively related to the herd-size. This showed that concentrates had more potential on rural dairy farms than their counterparts on semi-urban and urban locations.

Table 4.3.2: MVPs of different factor inputs of Milk production

Factors	Farm Locations		
	Rural	Semi-urban	Urban
Herd-size	45.35	65.35	74.23
Green fodder (Rs/day)	0.75	2.59	2.78
Concentrates (Rs/day)	2.04	1.86	1.73
Human labour (Rs/day)	0.897	1.04	1.30
Electricity/ water (Rs/day)	1.17	1.40	1.23
Veterinary charges (Rs/day)	2.13	1.49	1.20

The MVP of human labour on urban dairy farms came to be greater than that on semi-urban dairy farms. This showed that an equal addition in the expenditure on human labour would lead to contribute more towards returns on urban dairy farms than semi-urban dairy farms. The MVP of electricity/water cost was highest on semi-urban dairy farms (1.40) followed by urban (1.23) and rural (1.17) dairy farms. This indicated that an increase of rupee one in the expenditure on this input would result in an increase of Rs. 1.17, 1.40 and Rs. 1.23 in the value of daily milk production on rural, semi-urban and urban dairy farms respectively.

The MVP of cost on veterinary services came to be in direct relationship with the distance of dairy farms from the urbanization and inversely related to the herd-size. This revealed that an increase of Rs. 2.13, Rs. 1.49 and Rs. 1.20 would occur with an increase of rupee one in the cost of veterinary services on rural, semi-urban and urban dairy locations, respectively.

Notwithstanding less than unity MVPs of green fodder and human labour on rural dairy farms, the MVPs of all the resources in all other situations were greater than unity which portrayed inadequate use of resources. Thus, profit maximization requires more intensive use of these resources.

Thus, it can be stated that the resources on dairy farms could be utilized in more rational manner in order to get higher returns. The potential of herd-size and green fodder was more on urban than rural dairy farms while the trend was inverse in case of concentrates and veterinary services.

Suggestions for improving resource-use:

The suggestions to make better use of the resources taken up for the study have flown in from the regression analysis attempted for this purpose. The use of Cobb-Douglas production function showed that there were increasing returns to scale. The MVPs of different factor inputs were the guide lines for the suggestions to improve the use of existing resources with an aim for increasing the profitability from dairying. The resource wise diagnosis is as follows:

Herd-size: Herd-size was found to be the strong contributor towards the production of milk on all the dairy locations. Thus, the increase in the herd-size could lead to more and higher level of milk production. Its potential had an inverse relationship with the distance of dairy farms from the city. Therefore, the situation of dairy farms nearer to the city was seen to be advantageous.

Green fodder: It was brought out that green fodder use was lower on all the sample of dairy farms, particularly in the urban and semi-urban locations. Therefore, more green fodder could be used to increase the milk production to the level of its price equality with the marginal value product. Its use potential was inversely related with the distance of dairy farms from the city. Thus, its use could be increased keeping in view its availability and price-MVP comparisons on all the dairy locations.

Dry fodder: The regression coefficients of dry fodder were not significant. This indicated that there would not be any significant change in milk production with the change in the use level of dry fodder. Thus, the increase in the use of this resource was not advisable.

Concentrates: This resource was found to be in smaller use on all the locations of dairy farms. The regression coefficients of Cobb-Douglas production function indicated greater than unity values of MVPS. Thus, the concentrates could be fed in more quantity with better quality than the ones in existing use. The concentrates use potential was directly related with the distance of the dairy farms from the city.

Human labour: Human labour comprised of family, permanent and casual labour. As observed from the regression analysis, this

input did not carry the significant coefficient on rural dairy farms but the same were positive and significant on urban dairy farms. However, a weak hint of over-utilization of this labour input was observed for rural dairy farms. This may be due to disguised unemployment of family labour on rural areas whereas most of the labour on urban dairy farms was the hired labour more judiciously used because of being more costly. Thus the use of human labour needed to be rationalized.

Fuel cost: The regression coefficients obtained for fuel were not significant. It implied that there would not be any significant change in the milk production through a change in the use level of this input. However, the use of this input could be increased to some extent on urban followed by semi-urban and rural dairy farms.

Electricity/water: The electricity/water resource were under utilized on all the dairy farms. These had a great potential for increasing the milk production. Therefore, adequate electricity and water structure needed to be developed to make these resources used rationally for increase the milk production on all the dairy farm locations.

Veterinary care: The veterinary services were not in adequate use and found to be hired in lower amounts. It highlighted that the health care of animals was not proper and adequate.

The rational use of this input could appreciably contribute to the production of milk. Its potential was observed to be directly related with the distance of dairy farms from the city. Therefore, the use of veterinary services needed to be rationalized by raising its existing level on all the locations of dairy farms.

On the whole, it can be said that majority of the herd was milch animals out of which buffaloes dominated the scene on all the dairy farms. The herd-size was inversely related with the distance from the city. Animals and dairy buildings had the major share in fixed investment while concentrates were the major cost item among the variable cost items followed by the green fodder and dry fodder. The costs and returns were also in inverse relationship with the distance of dairy farms from the city. Herd-size, green fodder, concentrates, human labour, electricity & water and veterinary services were found to make positive and significant contributions to milk production and increasing returns to scale prevailed in all the dairy farming situations. Therefore, the use of different resources needs to be augmented in order to increase the milk production. The intensification of resources use in proportion to their MVPs can go a long way to increase the profitability from dairying.

SUMMARY AND CONCLUSIONS

The self-sufficiency in food grains has provided a boost to the national economy and the people in the wake of rising income levels have become selective in their food constitution with an emphasis on such protective foods as milk. Further, the demand for milk and its derivatives being income elastic is expected to increase with the rise in income levels and the size of population. In the face of increasing urbanization, the milk supply is proving short of its demand in most of the cities and towns. Also, the milk prices particularly in urban areas are showing a continuous upward trend and are inducing the producers to initiate as well as expand their existing dairy business to the extent of commercial ventures.

Hence, it is desirable to develop this enterprise in the state both as a specialized and a supplementary enterprise. The much needed adoption of dairy enterprise has a considerable initial cost in the purchase of milch animals and creating fixtures. It also requires large amounts of working capital in terms of feed, fodder, water, labour, fuel, energy and veterinary care, etc.

Different locations of dairy production units obtain different levels of yield and returns based on input-output relationships, demand/supply conditions and factor-product prices. These horizons of dairy development amply need of an attempt to study analytically the resource-use efficiency on the existing dairy farms in different locations.

Hence, the present investigation aimed at analysing the input-output structure and resource-use efficiency of dairy farms in different locations around and away from the vicinity of urbanization was formulated with the following specific objectives.

1. To critically examine the existing pattern of resource-use in milk production at different locations.
2. To estimate the resource-use efficiency of different resources used in dairying.
3. To make suggestions for the better use of these resources for higher profitability.

Observing the size of Ludhiana city, its industrial growth, population size and the associated demand for milk and responding development of dairy farms in urban, semi-urban and rural areas, Ludhiana district was purposely taken for this inquiry. A sample of 30 dairy farms each from rural, semi-urban and urban area was randomly selected. Data

pertaining to the dairy herd structure, input-output pattern and prices were collected on a pretested questionnaire by personal interview method.

Main findings of the study

Buffaloes constituted the largest proportion of the herd-size in all the locations followed by crossbred cows and young stock. The table further revealed that the proportion of buffaloes was in direct relationship with the distance from the city while that of crossbred cows was inversely related with the distance. Calves and heifers were in proportion to the cows and buffaloes, respectively. Desi cows were not reported to be domesticated on the sample dairy farms, except on rural dairy farms. The reason being their much lower milk yield than crossbred cows. The greater proportion of crossbred cows were observed on dairy farms nearer to city due to the easy availability of better veterinary services which are required more for crossbred cows than buffaloes.

Total capital investments per farm came to be Rs. 174980.98, 358233.51 and Rs. 613057.87 on rural, semi-urban and urban dairy farms, respectively. Per dairy farm investment evinced inverse relationship with the distance of dairy farms from the city. Overall, it can be said that fixed investment is affected by the distance of the dairy farm from the city

limits. The proportion of capital investment was highest on dairy animals followed by dairy buildings, water supply/drainage structure, electricity structure, equipments and utensils and fodder chaffing structure on dairy farms in different locations.

Behaviour of total fixed costs per litre, conformed to the logical expectations in the sense that these costs witnessed inverse relationship with the herd-size. The logicality of this relationship lies in the fact that an increase in the herd-size can lead to higher level of output. The unit total fixed cost, came to be Rs. 1.71, Rs. 1.39 and Rs. 1.37 in rural, semi-urban and urban dairy farms respectively. Thus, the fixed costs per litre of milk evinced inverse relationship with the herd-size which implied the existence of economies of scale across the herd-size range in dairy farms at different locations. The highest and the largest figures of total unit and fixed cost were Rs. 1.71 and Rs. 1.37 on rural and urban dairy farms respectively. The differences in these cost figures indicate the extent of saving of fixed cost which would be attained by increase in the herd-size and by decreasing the distance of dairy farms from the city. It was evident that rural and semi-urban dairy farms could have reduced further the costs if they had

increased the herd-size. In other words, it may be said that no selected farm location could witness diseconomies of size.

Total variable cost per litre of milk yielded positive relationship with the herd-size and negative relationship with the distance from city which implied that herd-size had witnessed negative effect and the distance showed it positive effect on the efficiency in the use of variable resources. Per litre variable cost for rural, semi-urban and urban dairy farms were Rs. 5.56, Rs. 5.67 and Rs. 6.29, respectively. The positive relationship between the unit variable cost and herd-size could be attributed to the higher prices of inputs in city centres and partly to the direct relationship between milk yield per animal and herd-size. Gross returns per litre of milk from the dairy farm business witnessed positive relationship with the herd-size and negative relationship with the distance of dairy farms from the city. It came to be Rs. 9.48, Rs. 11.05 and Rs. 12.17 on rural, semi-urban and urban dairy farms respectively. The relationships were found to be positive in case of income from dung but the relationship was entirely inverse with the gross income from appreciation of young stock. The variation in gross returns across locations have largely been explained in price of milk. The likely decrease in the proportion of young

stock in the total herd-size with the increase in herd-size might have mitigated this variation. Otherwise, it could have widened the variation more between dairy farms at different locations.

The RFFR per litre of milk came to be Rs. 4.89, Rs. 6.07 and Rs. 6.37 on rural, semi-urban and urban dairy farms respectively. This highlighted that herd-size and distance from city were positively and inversely related respectively to the profitability over the use of variable resources. This can also be inferred that urban dairy farms in terms of profitability are more efficient in utilizing the variable resources than the rural ones. Thus profitability can further be increased by increasing the herd-size and by installing the dairy farms nearer to the city centre where demand of milk expressed through milk prices plays an important role towards returns.

The net returns per litre of milk has been found to be Rs. 2.21, Rs. 3.99 and Rs. 4.51 on rural, semi-urban and urban dairy farms respectively. Thus, these have been found to provide good incentive for accelerating the growth of dairy farm business. It may also be inferred that dairy farms with greater herd-size and at lesser distance from the city have been more efficient in making use of fixed dairy structures alongwith variable resources as compared to the dairy farms

with the smaller herd-size and farther distance from the city centres.

It seems appropriate to attribute higher profitability of urban dairy farms than that of rural ones to the relatively large number of milch animals with higher yields which have been responsible for the economies of scale in the former situation as compared to the latter. Besides, more intensive use of variable inputs, better management and favourable milk prices might also be the other reasons for the trend.

It can be concluded on the basis of results derived by Cobb-Douglas production function analysis that increases in herd-size and the intensity of use of green fodder, concentrates, human labour, electricity/water and veterinary services in the proportion to their MVPs would lead to the augmentation in the profit from dairy business in all the situations. The returns to scale were found to be increasing on all the dairy farm locations. This indicated that the resource-use was inadequate in the dairy business in all the situations. The profit maximization in this situation requires augmentation in the intensity of input use in case of all the resources.

Overall, it can be said that majority of the herd size were milch animals out of which buffaloes dominated the scene on all the dairy farms. The herd-size was inversely related with the distance from the city. Animals and dairy buildings secured the major share of fixed investment while concentrates were the major cost item among the variable cost items followed by green fodder and dry fodder. The costs and returns were also in inverse relationship with the distance of dairy farms from the city. Herd- size, green fodder, concentrates, human labour, electricity & water and veterinary services were found to make positive significant contributions in milk production and the augmentation in the intensity of use of these resources would lead to the increased returns from dairy business. Therefore, the use of different resources should be enhanced in the proportion to their MVPs in order to make significant increase in the milk production. The reallocations of resources in proportion to their MVP's can go a long way to increase the profitability from dairying.

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ABSTRACT

The present investigation was undertaken to examine the resource use efficiency on dairy farms in Ludhiana district. The data from 90 dairy farms (30 each from rural, semi-urban and urban dairy farm locations) were collected. It was observed that average herd size was 11.69, 23.70 and 37.67 on rural, semi-urban and urban dairy farms respectively while buffaloes constituted the largest proportion of the herd size in all the locations followed by crossbred cows and young stock. Total capital investment per farm came to be Rs. 174980.98, Rs. 358233.51 and Rs. 613057.87 on rural, semi-urban and urban dairy farms respectively, evincing inverse relationship with the distance of dairy farms from urbanization. The fixed cost per litre of milk was found to be Rs. 1.71, Rs. 1.39 and Rs. 1.37 in rural, semi-urban and urban dairy farms respectively. This showed inverse relationship with the herd size which implied the existence of economies of size across the herd size range in dairy farms at different locations. Total variable cost per litre of milk worked at Rs. 5.56, on rural, Rs. 5.67 on semi-urban and Rs. 6.29 on urban dairy farms which yielded positive relationship with the herd size and negative relationship with the distance of dairy farms from the city. This could be attributed to the higher prices of inputs near the city centres and partly to the direct relationship between milk yield per animal and herd size.

Gross returns per litre of milk witnessed positive relationship with the herd size and inverse relationship with the distance of dairy farms from the urbanization. It came to be Rs. 9.48, Rs. 11.05 and Rs. 12.17 on rural, semi-urban and urban dairy farms respectively. The returns to fixed farm resources were Rs. 4.89 on rural, Rs. 6.07 on semi-urban and Rs. 6.37 on urban dairy farms. This showed that herd size and distance from the city were positively and inversely related respectively to the profitability over the use of variable resources. The net returns per litre of milk has been found to be Rs. 2.21, Rs. 3.99 and Rs. 4.51 on rural, semi-urban and urban dairy farms respectively. It may be inferred that dairy farms with greater herd size and at lesser distance from the city have been more efficient in making use of fixed dairy structures along with variable resources.

The regression analysis suggested that increases in the herd size and use of green fodder, concentrates, human labour, electricity/water and veterinary services would lead to the augmentation of milk production on all the dairy farm locations. The increasing returns to scale on all the dairy farms situations required the augmentation in the intensity of input use in proportion to their MVPs for profit maximization.

Signature of Major Advisor

Signature of Student