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**Smallholder Dairy Farming in Himachal Pradesh, India:  
Characteristics, Constraints, and Development Opportunities**

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## Chapter 3

# Smallholder Dairy Farming in Himachal Pradesh, India: Characteristics, Constraints, and Development Opportunities

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### CONTEXT

Poor crop productivity, low availability of per capita arable land, substantial availability of common property grazing lands, and lack of other income-generating activities have made the rearing of dairy animals an economic compulsion in the western Himalayan region, especially in Himachal Pradesh, India. Besides the small investment needed, many factors have prompted all categories of farmers and even agricultural labourers to supplement their incomes through livestock rearing as a subsidiary occupation. Animal husbandry contributes between 10 and 32% of total household income in the different agroclimatic zones in the region. The contribution of animal husbandry to total agricultural output has increased steadily from about 25% in 1980/81 to 33% in 1989/90. According to the 1992 livestock census, the total livestock population in the state is 5.26 million.

In hill areas, the livestock sector still suffers from inefficiencies and underdevelopment; it requires a development strategy to parallel the changing requirements at grass-root level and to raise the production base to a higher and sustainable level. This necessitates the identification of the problems confronting the dairy sector, and their proper analysis and appropriate policy action. The present study is an effort in this direction.

### STUDY SITES AND METHODOLOGY

The study was performed at four sites in a milkshed area that extends across three districts in Himachal Pradesh: Shimla and Sirmour in the mid hill zone and Solan in the low hill zone. A total of 100 smallholder dairy farmers were selected to provide a representative sample from villages with access to different marketing systems: 20 from the Tara Devi area in Shimla (good access to an urban consumption centre); 30 from the Tonda village dairy cooperative (VDC) area (poor accessibility but cooperative marketing available) and 20 from the Gaurah VDC area (poor accessibility and non-

functioning cooperative) both in Sirmour; and 30 from the Chakki Mor area in Solan (poor accessibility with marketing through traders). A draft questionnaire was prepared, revised following consultations at a stakeholder's meeting held in the area, and then used as a basis for collecting data and information using Rapid Rural Appraisal (RRA) techniques in each location. The survey data was supplemented with data from secondary sources from official records, producer's and marketers' records, and others.

Urban consumption patterns were studied in Shimla city. A total of 150 urban households were selected for the consumers' survey from three different areas in the city, representing different types of locality, income groups, and occupations. Data and information were collected in personal interviews using a carefully designed and pretested questionnaire.

## **DAIRY PRODUCTION SYSTEMS**

Cows and buffalo are by far the most common milk producing animals in the state, contributing 96% of the total milk production. The production systems vary in part according to the main marketing form used by the farmer. Where village dairy cooperatives (VDCs) had been created but were no longer functional, crossbred cows predominated. Where VDCs were functional, local cows predominated. For local cows, 80-90% of feed was obtained through grazing whereas grazing provided only 30-40% of feed for crossbred cows. The crossbred cows are either purchased from neighbouring states or bred by artificial insemination (AI). Farmers who mainly sold milk through private traders had a slight preponderance of their animals in milk. There were two different systems of procuring buffalo. In 80% of cases they were leased for the duration of their lactation period from traders, generally from the Punjab. The remainder were purchased outright. Farmers who sold their milk direct to consumers mostly had crossbred cows, with a very few buffalo.

### **Production of milk on small dairy farms**

The analysis indicated that the most favourable scenario for farmers was the direct sale of milk to consumers. Both the total milk production and consumption and the quantities sold were highest for these farmers, ensuring a high nutritional intake for family members as well as income. This situation cannot be replicated in all areas, however, for several reasons including location vis-à-vis consumption centres and low production levels. In these areas cooperative marketing or marketing through traders are alternatives, but in general the total production and sale of milk are then lower. The least favourable situation was found where VDCs had been set up but had become non-functional.

### **Production traits of dairy animals**

The production traits of dairy animals are closely linked with the success of dairy enterprise, thus they were studied in the selected milkshed areas.

On average, a crossbred heifer had its first calf at the age of 39 months in the low hills and 45 months in the high hills, and local cows at 54 and 59 months respectively. The age at first calving amongst the Murrah improved and nondescript buffalo were almost the same, however, from 54 to 60 months.

The calving interval for crossbred cows was estimated to be 350-390 days, out of which the cow remains in milk for 250-285 days. In contrast, the inter-calving period in local cows was 420-480 days, and the lactation period 180-220 days. The inter-calving periods of Murrah and nondescript buffalo were 400-450 days and 425-470 days, respectively; and the estimated dry periods 120-160 days and 130-170 days, respectively.

The proportion of crossbred cows in lactation during any given year is about 74% compared with about 55% for indigenous cows. The proportion of buffalo in lactation is about 66%.

Official estimates for 1997/98 show an average daily milk yield of crossbred cows during the whole lactation period of 3.2 l, of indigenous cows 1.6 l, and of buffalo 3.1 l.

The farmers in the survey reported an average milk yield from crossbred cows of 4-10 l/day in the low hills and 4-12 l/day in the high hills compared with a yield from local cows of only 0.5-2 l/day. The milk yield from Murrah graded buffalo was 4-9 l/day in the low hills and 4-8 l/day in the high hills and from nondescript buffalo, 3-7 l/day in the low hills and 3-6 l/day in the high hills.

### **SPECIES AND BREEDS OF DAIRY ANIMALS**

In hill areas cattle far outnumber buffalo among dairy animals because they can use the extensive grazing facilities available, but especially in low areas buffalo are generally preferred because of their higher productivity. Overall there are considerably more cows than buffalo in Himachal Pradesh. The annual population growth rates for buffalo from 1972 to 1992 were 2.0% in the low hills and 1.1% in the mid hills, whereas the growth rates for cows were 0.3% and 0.2% respectively.

In 1982, 36% of the total bovine population were milch animals, in 1992 it was 38%. Between 1982 and 1992, the proportion of crossbred cows in milch animals increased from 4% to 10%, the proportion of indigenous cows decreased from 58% to 49%, and the proportion of buffalo increased from 38% to 40%. The total population of milch animals showed an annual growth rate of 0.75% and was significantly higher in buffalo than in cows. The number of crossbred cows increased by about 17% annually while the number of indigenous cows declined.

Among various breeds tried in the state, the Jersey has been found to be most suitable for crossbreeding with hill cattle. However, when the inheritance from Jersey goes above 50% problems are encountered. Thus the Committee on Animal Breeding Policy has decided to restrict the inheritance of Jersey to 50% and infuse Red Sindhi blood in addition. The policy is designed to achieve a half Jersey half Sindhi crossbreed after 5-6 generations.

In practice, breeding management differed at different locations: for example at villages located around Tara Devi, breeding always took place using AI. The farmers were observed to increase the Jersey inheritance up to 67%. Breeding management was not so good in those areas where mainly buffalo are reared.

### **Annual milk production and utilisation pattern**

Gross milk production in the state increased from 403 million litres during 1984/85 to 714 million litres during 1997/98. Per capita milk availability in the state rose from 0.24 l/day in 1984/85 to 0.33 l/day in 1997/98. The rise in per capita milk availability was mainly due to the increase in the number of cross-bred cows.

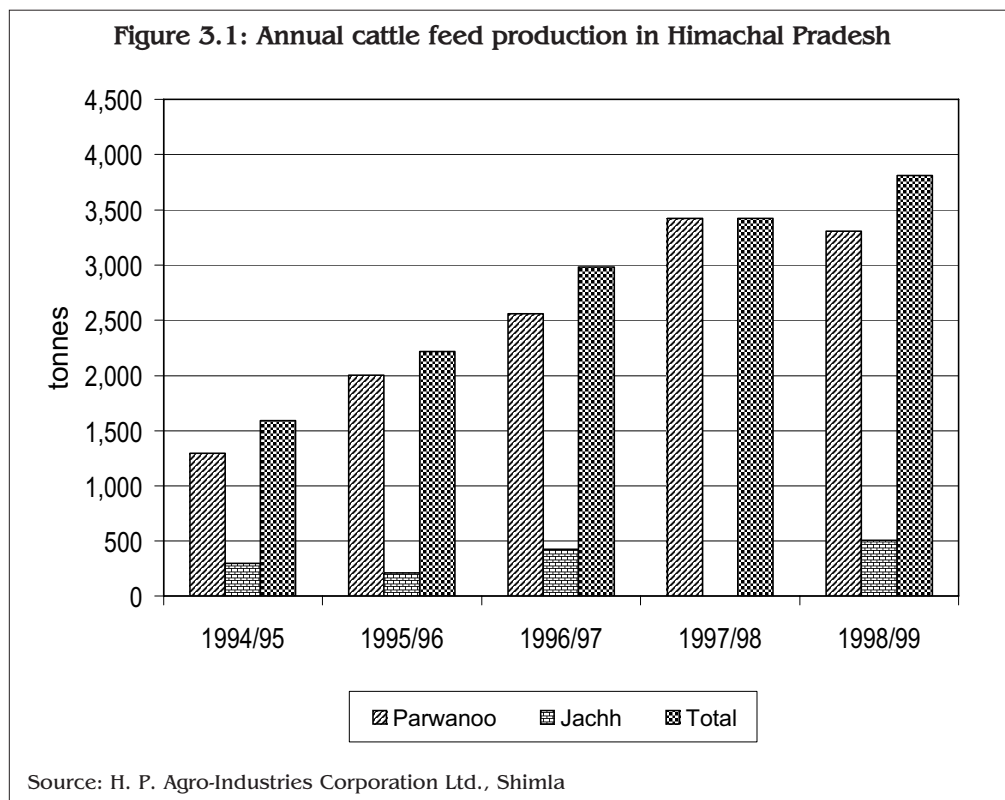
A study of the utilisation pattern of milk reveals that overall only about 13% of cows' milk and 22% of buffalo milk is marketed. About 36% of cows' milk and 28% of buffalo milk is consumed within the producer households. The remainder is processed, which might suggest that there are inadequate marketing facilities for fresh milk.

### ANIMAL FEED RESOURCES AND NATURAL RESOURCE MANAGEMENT

Own land and areas held by the Forest Department were the main sources of fodder for the farmers in the survey, each fulfilling 49% of the average fodder demand. Other sources were common land and the market.

The extent of stall feeding depends on the breed, age, and lactation stage of the animals. Those most commonly sent out to graze were adult females that had never calved or were dry (85%). About 75% of dairy cattle were both grazed and stall fed while only 25% were stall fed only. Buffalo were rarely sent out to graze. Green fodder included local grass, fodder crops, weeds, and green tree leaves. Cultivated fodder is becoming more popular in this milkshed.

Hay and wheat bran constituted the major proportion of the concentrates fed to dairy animals. Crossbred cows were fed more concentrate than graded and nondescript cows. Cottonseed and gram were only fed to animals in milk. Oil cake is not popular in the area except for feeding buffalo. The production of processed cattle feed in the state is very low (Figure 3.1). Overall cross-bred animals were fed better than local breeds.



## **LIVESTOCK HEALTH SERVICES**

The most common illnesses of dairy animals were foot-and-mouth disease, milk fever, indigestion, skin diseases, teat and udder problems, ovarian cysts, and retention of placenta. When the Jersey strain in crossbred cows exceeded 50%, the quantity of milk was too high and the animals become deficient in calcium – which led to fever. Ovarian cysts were also related to a greater than 50% proportion of Jersey strain in crossbred cows. Most of these diseases were treated in consultation with veterinary doctors. Some were treated by traditional methods. Most farmers reported problems with the supply of needed medicines, both at the government outlets and in the private market.

## **GENDER AND LIVESTOCK**

Of the different tasks associated with rearing of dairy animals, women spent nearly twice as much time as men tending animals and collecting fodder and men slightly more time grazing animals. When milk was marketed under a cooperative system, women's participation was equal to that of men. Otherwise women's participation in marketing was limited to only about 5%.

## **MARKETING OF DAIRY PRODUCTS**

### **Milk marketing systems**

During 1997/98 about 714 million litres of milk were produced in the state, of which some 594 million litres was used for home consumption, resulting in a marketed surplus of about 120 million litres. About 65% of the marketed milk was distributed through private milk traders and about 28% direct by the producer; the remaining 8% was procured by the Himachal Pradesh Milk Federation (MilkFed) for processing. MilkFed handled about 38% of the milk marketed through formal channels during 1997/98, out of which some 7% was supplied to the National Milk Grid. Of the milk marketed through formal channels, MilkFed met about 32% of demand, the Punjab and Haryana MilkFeds about 52%, and private dairies the remaining 17%. Our field survey showed four types of milk marketing channels in Himachal Pradesh. These are described below.

#### *Producer — consumer channel*

This is the favoured channel for dairy farmers living near urban centres. Since there is no middleman involved, farmers receive the full price paid by the consumer. Milk is distributed door-to-door in the morning to a set number of households and payments are collected once at the end of the month. On average, each dairy farmer supplies 10-15 l of milk daily. During 1999 the retail price of milk per litre ranged from IRs\* 11 to 13 for cows' milk and IRs 13 to 15 for buffalo milk. The purchase price of milk in villages was about IRs 8 for cows' milk and IRs 10 for buffalo milk.

#### *Producer — other producer — consumer channel*

This channel is similar to that described above, except that the milk vendor buys milk from some other producers to sell in addition to the milk he produces.

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\* IRs 42.5 = US\$ 1 (in 2000)

### *Producer — trader — consumer channel*

In the villages that do not have easy access to towns, the role of milk traders has gained in importance. Farmers sell milk to traders who in turn sell it directly to consumers. This is the most prevalent milk-marketing channel in Himachal Pradesh. Small milk producers bring their surplus milk to the nearby road head where a trader waits for them. The rates offered vary between IRs 6/l and IRs 10/l. After mixing this milk, traders sell it to the final consumer at a price ranging from IRs 12 to IRs 14/l. Payments to the farmers are normally made at the end of each month. However, the traders may also give a loan advance which is adjusted in subsequent payments. Normally, each trader collects 300 to 500 l of milk from 20-30 small dairy farmers and sells it to teashop owners and about 50-60 households.

### *Producer — MilkFed (through village dairy cooperatives) — retailer — consumer channel*

In areas where there is no marketing outlet, the Government of Himachal Pradesh has encouraged the formation of VDCs to supply milk to MilkFed. The VDCs are concerned with helping members increase milk production and arranging for the profitable sale of milk through MilkFed.

MilkFed has established 3 dairy processing plants and 22 milk chilling plants in various parts of the state. During the year 1997/98, MilkFed received 9.14 million litres of milk from 250 VDCs with 18,904 member farmers. The total capacity of milk chilling plants was 61,000 l/day (22 million l/year). The milk from dairy plants is further processed into ghee and pasteurised fluid milk. The total capacity of the three dairy processing plants in the state is 40,000 l milk per day, or 14.6 million litres per year.

### **Milk marketing costs**

The producers' average net share of the consumer price was about 85% from direct sales, (with 15% for costs of marketing such as transportation and labour); about 66% for sales through VDCs (MilkFed); and 58% for sales through traders. The costs incurred by MilkFed on transportation, chilling, and handling of milk accounted for about 22% of the consumer price, and the traders' milk marketing costs about 6%. The profit margins of MilkFed and the traders were 14% and 36% respectively.

The retail prices of MilkFed standardised milk (4.5% fat) and toned milk (partially skimmed, contains 3.1% fat) were IRs 16/l and IRs 12.5/l, respectively. MilkFed's total costs for toned milk were IRs 13.85, including the procurement price of IRs 6.50/l and a retailer margin of IRs 0.50/l, hence there was a theoretical loss to MilkFed of IRs 1.35/l. The overhead costs (establishment cost) alone were IRs 2.9/l and the single most costly item in the processing of toned milk.

### **Economics of milk production**

The cost of milk production was estimated to be IRs 6.13/l for crossbred cows, the average price of milk was IRs 7.00/l. The gain per day was IRs 4.35 with an average yield of 5 l/day. The cost of milk production for local cows was marginally higher, at IRs 6.28/l. Consequently the net gain per day was only IRs 0.83. The cost of production of buffalo milk was higher at IRs 8.28, but the average price of buffalo milk was IRs 9/l as the fat content is higher and the average gain per day was IRs 3.24. This calculation included putting a value on such things as fodder, interest and capital depreciation of

investment, and similar factors. If the cost is calculated in terms of actual payments to be made, like veterinary bills and commercial concentrate, then the production cost are IRs 0.75/l for crossbred cows, IRs 0.30/l for local cows, and IRs 0.18/l for buffalo, resulting in a net gain per day of IRs 31.25 for cross-bred cows, IRs 8.39 for local cows, and IRs 39.69 for buffalo.

### **The performance of village dairy cooperatives**

Tonda VDC, a co-operative for the Milk Chilling Centre (MCC) in Rajgarh, Sirmour district was selected for a case study of VDCs. This cooperative is 54 km away from the MCC and has 85 members, who supply 300 litres of milk daily to the VDC. The benefits of the VDC as perceived by its members were the timely and regular payment for milk (the most important benefit) and the fact that any quantity of milk, however small, is procured by the cooperative. The provision of cattle feed and fodder seeds was also considered an important benefit by the members.

According to some members the VDC could be improved further if milk prices were increased and the facility of cash advances were made available to them. Farmers also wanted a rebate in the solid-not-fat (SNF) level of their milk for fixing the milk price. Other suggestions included the supply of adequate quantities of cattle feed, the provision of dairy awareness camps within the village, the arrangement of evening milk collections, and better veterinary facilities for their dairy animals.

A non-functional dairy cooperative at Gaur village was selected for a second case study to examine the reasons for the failure of many cooperatives. Gaur is 5 km from Maryog MCC and was established in 1985. The society had 40 members who were supplying 300 l of milk per day. This cooperative became non-functional in 1997. The analysis of its failure revealed that the most important reasons were delayed and irregular payments for the milk collected, corrupt officials managing the cooperative, and the low price offered for milk. The members were also annoyed by irregular and improper measurements of fat and SNF.

Dairy cooperatives are popular in areas where there are no other milk marketing channels. In areas where the quantity of milk is substantial or where the producing areas are close to urban centres, alternative private marketing channels have emerged that provide higher returns to the milk producers. In such areas the members have either opted out of cooperatives or cooperatives have never been formed.

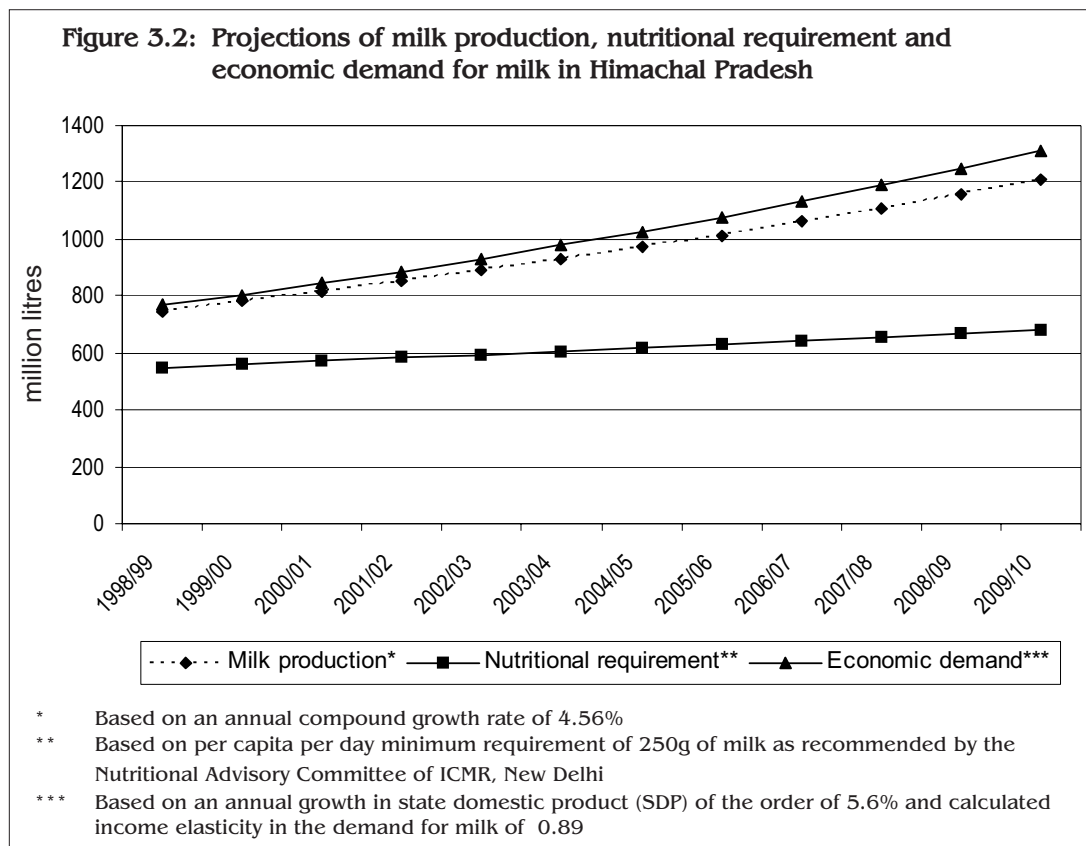
### **MILK SUPPLY AND DEMAND**

Projections were made year-wise from 1998/99 to 2009/10 on the basis of the annual compound growth rate (CGR) for milk over the last 15 years. The human population was assumed to increase from about 6 million in 1998/99 to about 7.5 million in 2009/10. Milk production was projected to increase from 746 million litres to 1,211 million litres based on an annual CGR of 4.56%. Thus, a population increase of 24%, would be complemented by a 62% increase in milk production.

Two types of demand were considered: nutritional requirement, based on a per capita need of 250g per day, and economic demand. The nutritional demand for milk in 1998/99 was 550 million litres, providing a surplus in terms of actual consumption of about 196 million litres. This surplus could increase to 530 million litres in 2009/10 according to the projection.



The economic demand is higher than the nutritional demand and could increase to 1,300 million litres by 2009/10 based on the current increase in state domestic product and an income elasticity of 0.89% as derived from the survey. This indicates that the gap between actual demand and supply will increase continuously from 21 million litres in 1998/99 to 99 million litres in 2009/10, despite the greatly increased production (Figure 3.2).



## Milk processing

Commercial milk processing in the selected milkshed area is very limited. Over 90% of the milk produced is either sold direct or retained for domestic consumption. A small part of the milk retained for domestic consumption is converted into ghee (clarified butter). Only MilkFed carries out milk processing for commercial purposes.

The milk received at the MilkFed processing plants is processed to achieve the required fat content, pasteurised, and packed in polythene pouches. The plants produce 'standardised' milk (4.5% fat and 8.5% SNF), 'toned' (partially skimmed) milk (3.1% fat and 8.6% SNF), double-toned (semi-skimmed) milk (1.6% fat and 9.1% SNF), and skimmed milk (0.1% fat and 9.1% SNF).

## Consumer behaviour towards milk and milk products

The consumption pattern of milk and milk products in Himachal Pradesh was analysed using National Sample Survey Organisation data of the 38<sup>th</sup> round (1983) and the 54<sup>th</sup>

round (1998). The proportion of per capita monthly expenditure spent on milk and milk products in the rural sector was 14% in 1983, rising to 16% in 1998; in contrast it dropped from 14% to 11% in urban households.

## **Results of the urban consumer behaviour survey**

The urban consumer survey was carried out in Shimla. The average family size of the respondents was 4.08 persons and inversely related to income; about 66% of family members were vegetarian and the average family income was IRs 12,652/month.

### *Purchase and consumption*

The average household purchased 52 l of milk per month, ranging from 39 l in the low-income group (LIG) households to 72 l in the high-income group (HIG) households. On average, households also purchased 1.3 kg ghee, 0.45 kg each of butter and cheese, and 1.6 kg curd per month. The average household spent about 9% of total income on dairy products, with the relative share higher among LIG households (14%) than HIG households (6%).

Out of the total milk purchased, 72% was loose whole milk and the remainder pasteurised packed milk. Fifty-eight per cent of loose whole milk was consumed direct, 31% used in tea and coffee, 17% converted to curd, and 2% and 1% used to make butter and cheese. In contrast, 31% of packed milk was consumed direct, 36% used in tea and coffee, and 33% converted into curd.

The average prices of loose whole and packed milk were IRs 13.6/l and IRs 16/l respectively. The prices of ghee, butter, cheese, and curd were IRs 168/kg, IRs 116/kg, IRs 80/kg, and IRs 21/kg respectively.

### *Preferences*

The reasons cited by consumers for purchasing fresh whole milk were natural flavour (63%), home delivery (76%), and monthly payment (82%). The importance of home delivery reflects the value of the service being provided by the milkmen, against which the packed milk market may find it difficult to compete.

High and consistent quality convinced about 82% of consumers (and 92% of those buying it) to buy packed milk. Nearly 80% of consumers preferred packed milk because it is good for making curd.

### *Problems and concerns*

The major problem reported by the consumers (89%) of fresh whole milk was dilution by the milkmen. The high price was the next biggest problem (67%). The vast majority (88%) suggested that there should be quality control on the milk supplied by milkmen. The prices of milk are increasing year after year despite poor quality, and 39% of consumers suggested that there should be a price control mechanism. Consumers also suggested that the government or MilkFed should supply fresh whole milk through booths in the city (36%).

The major problem reported by consumers of packed milk (91%) was the bad smell. The high price of this milk compared to fresh whole milk was seen as a problem by 65% of consumers. Most shop owners do not sell packed milk on credit and 38% of consumers saw this as a problem. To increase the consumption of packed milk, 63% of consumers suggested price control and 54% suggested the provision of home delivery.

The government has entrusted the Department of Health with ensuring the quality of milk marketed through informal channels. Health inspectors are authorised to check the quality of the milk by taking random samples; about 60-65% meet the required standards.

## **LIVESTOCK SUPPORT SERVICES**

### **Research**

Research input for the dairy sector comes mainly from the State Agricultural University, which has a separate college for veterinary sciences. The other agency involved is the Department of Animal Husbandry; although it does not conduct research of its own it is always on the look-out for the latest research that can be applied in the state.

### **Inputs**

There are many agencies involved in the supply of inputs. The Department of Animal Husbandry is the only agency that provides the facility of AI and it also supplies staff to advise in the purchase of animals. Private agencies are involved in the supply of improved breeds of cow and buffalo. Cooperatives, private traders, and the Agro-Industries Corporation facilitate the procurement of cattle feed and seeds for fodder. The Agricultural University provides a package of practice and consultancy for dairy farmers and also improved seeds for fodder.

### **Extension and veterinary services**

Extension and veterinary services come under the domain of the State Agricultural University and the Department of Animal Husbandry. Bilateral donor agencies also provide services in their particular areas of expertise.

### **Credit and incentives**

A provision for credit has been created with commercial banks. Loans are also available under the Integrated Rural Development Programme. The National Bank for Agriculture and Rural Development (NABARD) has a special scheme for dairy development.

### **Training**

Training for dairy farmers is provided by cooperatives, the Agricultural University, the Department of Animal Husbandry, and the Marketing Board. Opportunities for training were found to be insufficient and there are very few dairy farmers who have received any training.

## **CONSTRAINTS, OPPORTUNITIES, AND RESEARCH AND DEVELOPMENT ISSUES IN DAIRY PRODUCTION AND MARKETING**

The analysis indicates that in order to obtain higher returns, proper breeding, feeding, and weaning of livestock are required urgently. At present, these are lacking due to the hilly terrain and inaccessibility of dairy farms. The quality of the cattle feed available is poor and prices are high leading to a low use of cattle feed; this results in poor milk yield and animal health. To overcome this problem some of the farmers were purchasing cattle feed directly from manufacturing plants in the neighbouring state.

There is a need to manufacture feed within the state that ensures affordable prices and reasonably good quality. The problem is further compounded by the fact that lack of availability of seed for improved fodder has meant that there is negligible cultivation of fodder crops. The resultant effect is poor nutrition for the dairy animals. In this regard, it is essential to develop agroforestry on degraded common property resource (CPR) lands to enhance the green leaf fodder supply. The major policy issues are reducing inequalities in farm income, improving the production efficiency of milch animals, and meeting the feeding requirements of dairy animals from CPRs without environmental and natural resource degradation.

The higher growth rates in the buffalo and crossbred cow populations reflect that farmers are shifting towards animals that give a higher milk yield and that consumer preference is shifting towards buffalo milk. The concentration of buffalo is higher in the low hills whereas cows predominate in the mid and high hills. Any development strategy should address these trends.

Current training programmes are designed for men, ignoring women's participation. Addressing this anomaly could lead to a considerable improvement in the management of smallholder dairies in the state. This should be combined with improvement in veterinary facilities, particularly in remote areas.

Reliance on the non-formal sector for credit also needs to be reduced, which requires that the procedures for obtaining credit from commercial banks be simplified.

The supply-and-demand projections suggest that there are excellent opportunities for significant growth in smallholder dairy farming, with a potential rise in milk demand of about 100% over the next 12 years.

The most important variable affecting the success or failure of VDCs is accountability. However many other factors also contribute to the failure of VDCs and these are: (i) the majority of the farmers lack educational advantages and have small landholdings, which means that the cooperatives tend to be dominated by rich farmers, who use them for political power; (ii) there is no genuine cooperative leadership; (iii) people have no tradition of working in cooperatives with each other; (iv) cooperatives can become government enterprises, leaving little scope and incentive for them to survive and prosper on their own.

For the enhancement of milk production, it is essential that farmers are trained in integrated dairy development. To improve the efficiency of milk marketing systems, there is a need for training and the promotion of cooperative principles. A marketing strategy needs to be developed for groups of villages, rather than single producers. The organisation can be done easily once the objectives and benefits are clearly defined. For a cooperative to be successful it should be controlled democratically by its members and managed professionally by honest workers with the intention of passing on benefits to members. In remote areas of the state there is a considerable quantity of milk available for sale that cannot be disposed of because there are no marketing facilities. In some areas where traders operate, the prices offered are low. The dairy farmers located in such areas have little knowledge about cooperative milk marketing.

**BIBLIOGRAPHY** (not necessarily cited in the text)

- Acharya, R.M. (1992) 'Problems and Prospects of Dairying in India'. In Kaul, J.L. (ed.) *Growth of Indian Agriculture: Issues and Policies*. Ludhiana (India): Punjab Agricultural University
- Bal, H.S.; Singh, B.; Singh, I.P. (1989) 'Economics of Milk Production and its Marketing in Rural Punjab'. In Indian Society of Agricultural Economics (eds) *Livestock Economy of India*. New Delhi: Oxford & IBH Publishing
- Bhati, J.P.; Singh, R.; Rathore, M.S.; Sharma, L.R. (1992) 'Diversity of Mountain Farming Systems in Himachal Pradesh, India'. In Jodha, N.S.; Banskota, M.; Partap, T. (eds) *Sustainable Mountain Agriculture*, pp 498-515. New Delhi: Oxford & IBH Publishing
- Chand, K.P.; Swarup, R. (1991) *Appraisal of a Successful Marketing Co-operative in Himachal Pradesh*. Shimla (India): Himachal Pradesh University, Agro-Economic Research Centre
- Chand, R. (1995) 'Livestock in Himachal Pradesh: Factors Affecting Growth, Composition and Intensity'. In *Indian Journal of Agricultural Economics*, 1. Vol 1(3)
- George, P.S.; Nair, K.N. (1990) *Livestock Economy of Kerala*. Trivandrum (India): Centre for Development Studies
- Indian Society of Agricultural Economics (1989) *Livestock Economy of India*. New Delhi: Oxford & IBH Publishing
- Mamoria, C.B. (1983) *Agricultural Co-operative Structure in India*. Delhi: Kitab Mahal
- Mishra, S.N. (1978) *Livestock Planning in India*. New Delhi: Vikas Publishing
- NABARD (1997) *Dairy Development in Mandi District, Himachal Pradesh. Ex-post Evaluation Study*. Shimla: National Bank for Agriculture and Rural Development
- Pandey, U.K. (1995) 'The Livestock Economy of India: A Profile'. In *Indian Journal of Agricultural Economics*, Vol 50.
- Rao, C.H.H. (1969) 'India's Surplus Cattle: Some Empirical Results'. In *Economic and Political Weekly*, Vol 4(62)
- Shah, T. (1996) *Catalysing Co-operation: Design of Self-Governing Organisations*. New Delhi: Sage
- Sharma, V.P; Singh, R. (1993) 'Resource Productivity and Allocation Efficiency in Milk Production in Himachal Pradesh'. In *Indian Journal of Agricultural Economics*, Vol 48
- Singh, R. (1992) *Production and Marketing of Wool and Mutton in India*. New Delhi: Mittal
- Singh, R. (1997) *Economics of Livestock Production System in Himachal Pradesh*. Shimla: Himachal Pradesh University, Agro-Economic Research Centre
- Tulachan, P.M. (1998a) *Livestock Development in Mixed Crop Farming Systems: Lessons and Research Priorities*, Issues in Mountain Development 98/5. Kathmandu: ICIMOD
- Tulachan, P.M. (1998b) *Trends and Prospects of Sustainable Mountain Agriculture in the Hindu Kush- Himalayan Region: A Comparative Analysis*, Issues in Mountain Development 99/2. Kathmandu: ICIMOD