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Smallholder Dairy Farming in Uttaranchal, India:
Characteristics, Constraints, and Development Opportunities

Vir Singh

Chapter 4

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CONTEXT

Dairy farming is an integral part of mountain agriculture in the central Himalayas, including in Uttaranchal State. Smallholders, comprising the majority of mountain farmers, are accustomed to rearing some animals as an essential component of the farming systems they have evolved. Among the various basic needs the animals fulfil, milk is the most important for a family. In the traditional mountain setting, dairy farming as a source of cash income may not be very visible, but dairy products have been and continue to be indispensable food supplements for virtually all families in the region.

Smallholders in the mountains tend to depend on the diversification of agriculture in order to reduce risks and derive more economic benefits from the limited resource base they possess. Dairy farming is one of the most important dimensions of diversified agriculture and will often be the most attractive economic activity for smallholders in the mountains to concentrate on.

STUDY SITES AND METHODOLOGY

The two milk-producing districts (milksheds) with the highest daily milk procurement in the Uttaranchal hill area were selected for the survey: Almora, which lies entirely in the hills, and Nainital, which includes some plains areas. Two community development blocks (CDBs) were selected in each district and three villages within each CDB, using the criteria of location (altitude), dairy organisation (whether or not there was a village dairy cooperative [VDC]), and representation of valley (lowland) areas (largely transformed in terms of cropping) and upland (sloping agriculture) areas with traditional practices.

The consumer survey was carried out in the two major milk-consuming cities of Nainital and Almora. A sample of 30 consumers from each of three income groups (low,

medium, and high) was selected, giving a total of sample size of 90. The data were collected by personal interview using a structured questionnaire designed specifically to enable estimation of demand.

Secondary data were collected from relevant published and unpublished sources.

DAIRY PRODUCTION SYSTEMS

There are two major mixed crop-livestock systems in smallholder farming — sedentary and migratory. In the sedentary system, livestock are kept in a village throughout the year. Almost all the smallholder dairy farms in the sample villages operated sedentary management.

Dairy animals, along with all other livestock, play a crucial role in supplying manure to the smallholders' farms, which is one of the most important inputs in mountain farming and critical for sustainability of the farming system. Draught animal power (DAP) is another input that is critical to productivity and sustainability of mountain agriculture (Singh 1998a), and dairy production systems involving cows also supply DAP. Farmers rearing dairy cattle use the bullocks at their own farms and supplement family income through hiring out ploughs and selling bullocks. The system may be referred to as a dairy-manure-draught cattle production system.

One noteworthy fact about dairy farming in Uttaranchal is that, unlike in many mountain areas in the Hindu Kush-Himalayan region, it is not associated with meat production, a characteristic shared by many other mountain areas in India. It is also true of cattle-based (but not buffalo-based) dairy farming in Nepal. In India and Nepal, cows are generally considered sacred animals. In order to develop dairy enterprise in areas such as these, the unique cultural setting must be taken into consideration.

SPECIES AND BREEDS OF DAIRY ANIMALS

Cattle and buffalo are basically the only dairy species throughout the Uttaranchal hills. The use of goats, sheep, and yaks as dairy animals is extremely rare.

Overall the bovine population comprised 72% of the total livestock in the sample villages, 63% in the Almora villages and 82% in the Nainital villages, the remainder being goats. Fifty per cent of all livestock in both areas were cattle, with similar proportions of bullocks (20%), cows (18%), and infants (12%). The buffalo proportion in the Almora villages (14%) was, however, just less than half of that in the Nainital villages (33%). Nainital district lies adjacent to the Terai area of the central Himalayas and some of it extends into the plains. Rearing of buffalo in this milkshed is more conducive than in Almora, which is located exclusively in the mountain areas lying towards the inner Himalayas.

On average each household had 5.9 head of livestock (of which 3 were cattle). The milkshed herd size in Almora (7.90) was twice that in Nainital, as a result of the substantially higher population of goats in the former.

Breeds

All buffalo in the region are indigenous; the dairy species are largely a mixture of improved Murrah and Bhadawari, with a possible mixture of other indigenous (Indian) breeds imported from the plains, but now well adapted to mountain conditions. The

presence of pure Murrah, considered to be the highest-yielding breed, or other pure or improved breeds, is rare. Moreover, there have been no systematic institutional efforts to improve or upgrade buffalo breeds in the area. Only cattle have been targeted for improvement.

Indigenous breeds constitute about 93% of the cattle population and crossbreeds for about 7%. According to the latest official Livestock Census (1993), there were 115,345 crossbred cattle, or less than 6% of the total cattle population (1,978,331), in Uttaranchal. Amongst the crossbred cattle population, females comprised 62% (Animal Husbandry Department 1998).

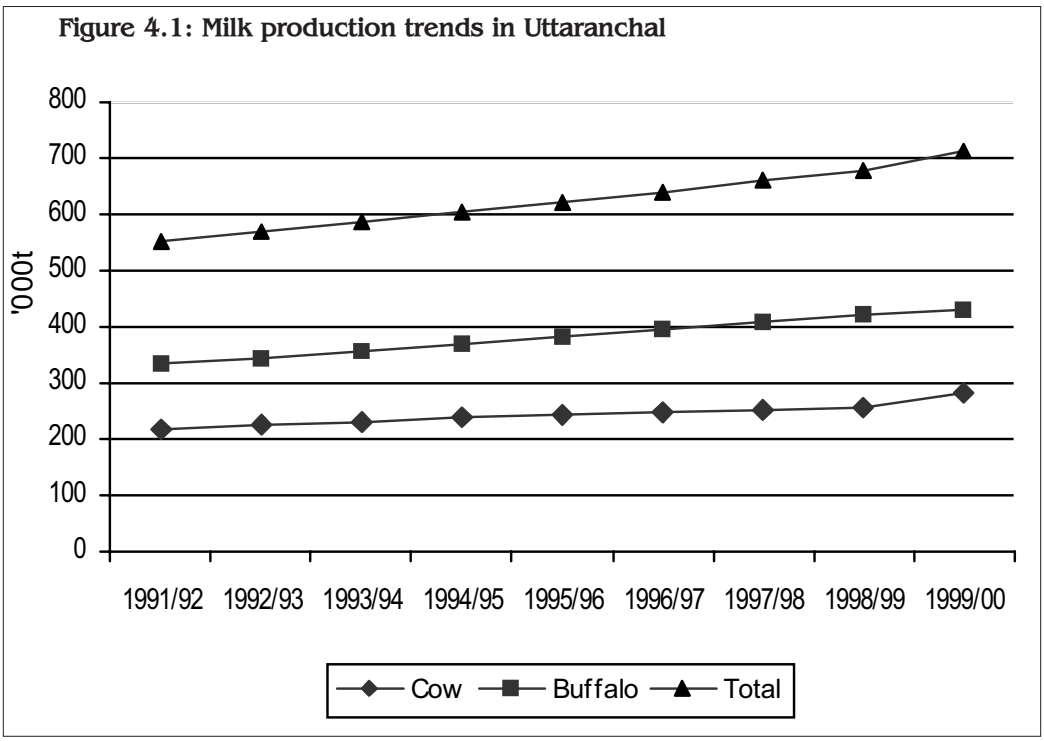
Animal population, composition, and yields

There was an overall increase of about 15% in the total ruminant population in the Uttaranchal Hills between 1961 and 1999. The most noticeable change was the increase in the populations of buffalo (55%) and goats (50%). This was accompanied by a decline in the populations of cattle (5%) and sheep (14%).

With a gradual increase in emphasis on the dairy sector, milk production in Uttaranchal has increased from 419,000t in 1979/80 to about 715,000t in 1999/2000, an impressive rise of 71%. Whereas total milk production from cows increased by only 19%, buffalo milk production leapt by 111%. The milk production increase in Uttaranchal is thus largely due to the contribution of buffalo. At present, buffalo contribute more than 60% of the total milk production in the region (Figure 4.1).

The milk productivity per animal has increased over the last two decades. In cows it increased from an average of 1.33 kg/day in 1979/80 to 2.30 kg/day in 1999/2000, in

Figure 4.1: Milk production trends in Uttaranchal



buffalo from 2.55 kg/day to 3.71 kg/day. The lactation yield increase per cow (73%) has been far higher than for buffalo (45%), however. This is attributable to the institutional policies and programmes focusing on cows and not buffalo.

Characteristics of dairy farms

Dairy farm size can be defined as follows:

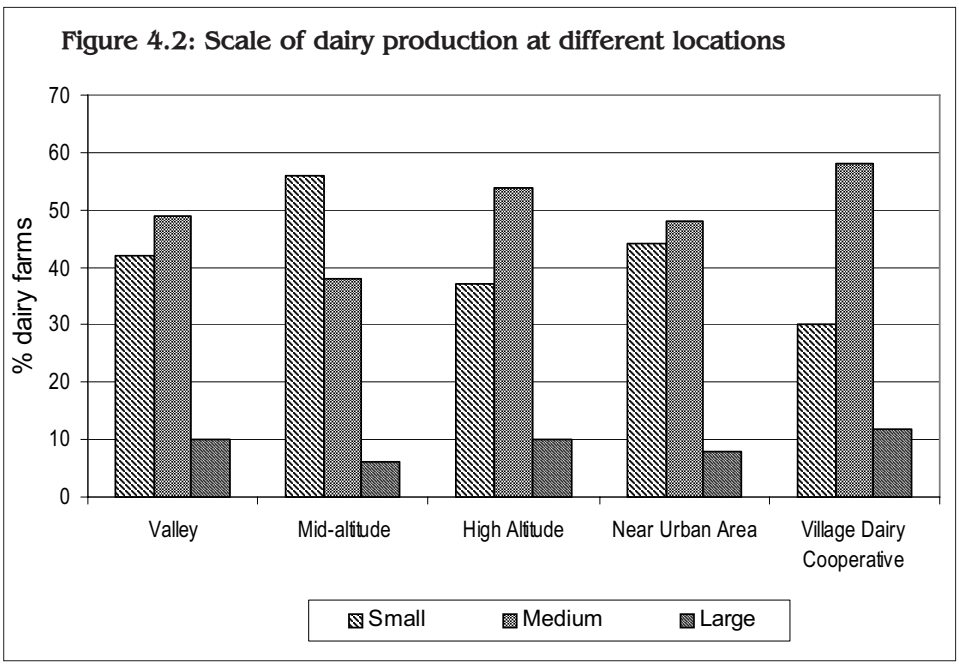
small: a dairy farm with a maximum dairy animal equivalent of two cow units (CUs);

medium: a dairy farm with three to four CUs;

large: a dairy farm with five or more CUs.

The overwhelming majority of dairy farmers operated on small and medium scales of production (45% and 47%, respectively). Only 8% of farms in the sample villages had were than five CUs (Figure 4.2).

Figure 4.2: Scale of dairy production at different locations



Many of the characteristics relating to a dairy farm depend upon its location. Composition and size of livestock (including the dairy livestock), feeding, disease management, breeding, on-farm processing, marketing of dairy products, and many other aspects relating to the success or failure of a dairy farm also depend on its location.

Around two-thirds of the dairy farms at all locations followed a mixed cattle-buffalo-based dairy production system. Preference for such a system is remarkably high in the VDCs. In addition to manure production, which is vital for maintaining soil fertility, the cows produce bullocks for draught power, which is essential for mountain agriculture, and supply some milk mainly for family consumption. The buffalo yield more milk for cash income. A relatively high proportion of the farms (15-25%) followed a pure buffalo-

based production system, indicating a preference for market-oriented dairy management. If a dairy farm is located near a prominent town or city, its management is likely to be market-oriented. There is a higher chance of these dairy farms being semi-intensive, depending on the cost and availability of inputs, such as concentrate feed and medicines.

The overall performance of a dairy farm in the mountains, depends on a complex mix of factors. If a dairy farmer belongs to a milk society, the farm is linked with the market. Institutional programmes based on cooperative dairy development, facilitating the dairy farmers to market their produce, appear to be the most important factor for the success of a dairy farm, often irrespective of its location.

ANIMAL FEED RESOURCES AND NATURAL RESOURCE MANAGEMENT

Due to the availability of common property resources (CPRs) in mountain areas, local inhabitants do not customarily depend on cultivated fodder. Even large landholders find cereals and other cash crops to be far more remunerative than cultivated fodder crops. According to the Animal Husbandry Department (1998), a CU's requirements for green and dry fodder are 24 and 6 kg/day, respectively. In the area of the survey, the requirement in each village was far more than the availability of fodder. The average shortage of green fodder was 26% and of dry fodder 77%. From this fodder balance, it is clear that the whole livestock population in Uttaranchal is underfed. This situation obviously has a major influence on the performance of livestock in the region. The overall paucity of green and dry fodder, according to the Animal Husbandry Department (1998), is about 68% each. The green fodder being provided to the livestock is not 'available' fodder. In fact, the bulk of it is the fodder that is extracted from the CPRs. Its availability, to a great extent, depends on the quantity of the fodder cut from the forest or grazed from grazing land. The bulk of the dry fodder, however, is that grown on cropland, and its availability is equivalent to its production. Livestock farmers have their own ways of responding to the scarcity of fodder. They may feed a large part of the available nutritive fodder to a dairy animal in milk, not provide any fodder to ovine species tied to the stall at night, and may give some cereal and purchased concentrate to dairy animals. In many mountain areas, alternative management systems are evolving, including stall feeding, the planting of fodder trees close to the homestead, and cultivating grasses on private land unsuitable for growing food crops (Tulachan and Neupane 1999). Fodder supplies to livestock in the region could be improved substantially by increasing the productivity of cropland, especially through agroforestry systems, and by efficient management of CPRs. Alterations to feeding management inside the animal shed would save fodder from wastage.

Most of the concentrate feed used for dairy animals is home produced. However, the Milk Unions also supply concentrate animal feed to members of VDCs. The cost of the feed is deducted from the members' share of the remuneration from the sale of the milk. Barnyard millet, barley, black soybeans, wheat bran, and wheat flour constitute the home-grown feed. A dairy farm in the sampled villages provided, on average, only 100 kg concentrate feed to the dairy animals in a year, the bulk of which (77 kg) was produced at home. A dairy farm in a VDC fed much more concentrate, both home produced and purchased, to the dairy animals than other farms. Overall, concentrate feeding per head per day was higher in a VDC village than in other villages, though still far below the standards for dairy animal feeding. The proportion of purchased feed used was much larger in a VDC village – some 32%. Concentrate feed is generally fed to

animals in milk, and often monopolised by buffalo in lactation stage. The overall trend is that market-oriented dairy farms are more aware of concentrate feeding because the cost incurred on feeding is likely to return as household income through increased milk productivity.

Performance indicators

Dairy animals' age at first calving, lactation length, lactation yield, calving interval, and service period are important traits associated with the economic sustainability of a dairy farm. Reductions in the age at first calving and the dry period lead to increases in lactation yield and productive life of the dairy animals and thus to improved economic performance.

The survey information showed that while cow performance was poor, buffalo performance was reasonably good. The poor performance of cows is a reflection of under-nutrition, particularly during the lean period. Buffalo are better fed, because they are reared especially to give milk for sale. The long dry periods for cows (eight months) are also a reflection of short lactation periods. Another important cause of long dry periods in cows is a shortage of bulls. Most of the villages in Uttaranchal do not have a bull. Sometimes two or even more villages share a single bull. Many heat periods are undoubtedly wasted because the cows cannot be got to a bull in time. There are only a few artificial insemination (AI) centres and most of the dairy farmers have no access to them. On the whole, the experience of the dairy farmers with AI centres, are bad. The respondents who had easy access to the AI centres complained of the poor conception rate of AI. The breeding of buffalo bulls is much less problematic. Most of the villages have at least one breeding buffalo bull. One reason for this is that services by a buffalo bull offer good returns to the family owning the bull. The charge per service (on confirmation of conception) are IRs 150. The services of a 'cow' bull were free of charge until recently. However owners have also now begun to charge (IRs 100, occasionally more, per service after confirmation).

The mortality rate of male buffalo calves is very high (92%). Male buffalo calves have no value (for example, as draught or meat animals) in the farming system in Uttaranchal. They are therefore starved to death a few days after their birth. Buffalo, unlike cows, are maintained purely for milk production.

LIVESTOCK HEALTH SERVICES

Health management is one of the most important aspects of dairy development. Healthy animals are capable of producing milk to the extent of their inherent productive capacity. The role of dairy farmers in health management is crucial, for animal health largely depends on housing management, feeding practices, and understanding and dealing with various diseases affecting the livestock.

The main diseases of economic importance affecting dairy stock in the region are foot-and-mouth disease, haemorrhagic scepticaemia (HS), black quarter (BQ), tuberculosis, brucellosis, mastitis, haematuria, bloat, and parasitic diseases.

Foot-and-mouth disease, HS, and BQ generally occur in dairy animals in areas at lower altitudes, perhaps due to a favourable environment for the pathogens. Black quarter occurs in summer due to bacterial infection. Foot-and-mouth, which is a viral disease, affects livestock particularly in the rainy season. Haemorrhagic scepticaemia, which is a bacterial disease, generally occurs in winter. Tuberculosis can occur at any seasonal and

animals can be affected without being noticed. Mastitis is common in high-yielding animals. Brucellosis, also a bacterial disease, generally affects the dairy animals at seven months' pregnancy. Haematuria is caused by 3-hydroxy-L-kynurenin in bracken fern found predominantly at high altitudes. Bloat occurs in the rainy season, particularly at high and mid-altitudes, wherever there is a large leguminous component in the vegetation of grazing lands.

GENDER AND LIVESTOCK

In mountainous areas of India, women's contribution to agriculture (including cropping, forestry, animal husbandry, and all land-related activities), although often not fully appreciated, is far greater than that of men. Virtually all the household chores are women's responsibility. Women, in essence, are the backbone of mountain agriculture. They are the real subsistence farmers and their role in food-chain activities is so crucial that without their participation, sustainability of mountain agriculture cannot be envisaged.

Field data show that in Uttaranchal women carry out almost all of the tasks related to small dairy production. Women collect fodder and bedding material from the forest areas, make hay and stack it, feed and look after the animals, clean the animal shed, take cows and buffalo to bulls for service, milk the animals, and process and market the milk. In light work, such as tending to grazing animals, they are often assisted by their daughters. Men's role in dairy farming is limited. They participate in marketing, in looking after grazing and sick animals, and in providing service to dairy animals. On average, women devoted 1780h/year (nearly 5h/day) to different dairy operations and men only 315h (less than 1h/day). On average women provide 85% of the time used in dairy production. The collection of bedding material and fodder and the feeding and grazing of animals take the largest part of the time.

In the conventional development programmes and projects in the field of dairy production in the Uttar Pradesh Hills, the project officials and beneficiaries of the projects are mostly men. Women are almost always marginalised, though in the traditional setting, animal husbandry and dairy production are the women's domain.

The head of a family (a man), however, takes any important decisions related to dairy farming. Men always participate in the activities in which money is involved. For instance, a man will collect the money when the milk is sold. Men also make decisions to sell or purchase dairy animals. Loans through various government agencies are sanctioned mostly to the men. Only men participate in dairy farming training, which is occasionally organised by concerned government institutions under a 'development project'.

In many households, particularly in areas where men commonly out-migrate to the plains in search of jobs, the women are the de-facto heads of their families. Here, the women are not psychologically prepared to take important decisions regarding the improvement of dairy production systems. For instance, they would not become members of a VDC, or take advantage of loan schemes or dairy training. There is, therefore, a need to identify and analyse the various constraining factors (natural, institutional, as well as sociocultural) that relate to women's role in the dairy production sector. This will help us understand the ways and means of improving the smallholder dairy farming sector through upgrading knowledge and skills and ensuring effective participation of the real smallholder dairy farmers in the hills — the women.

Marketable surplus

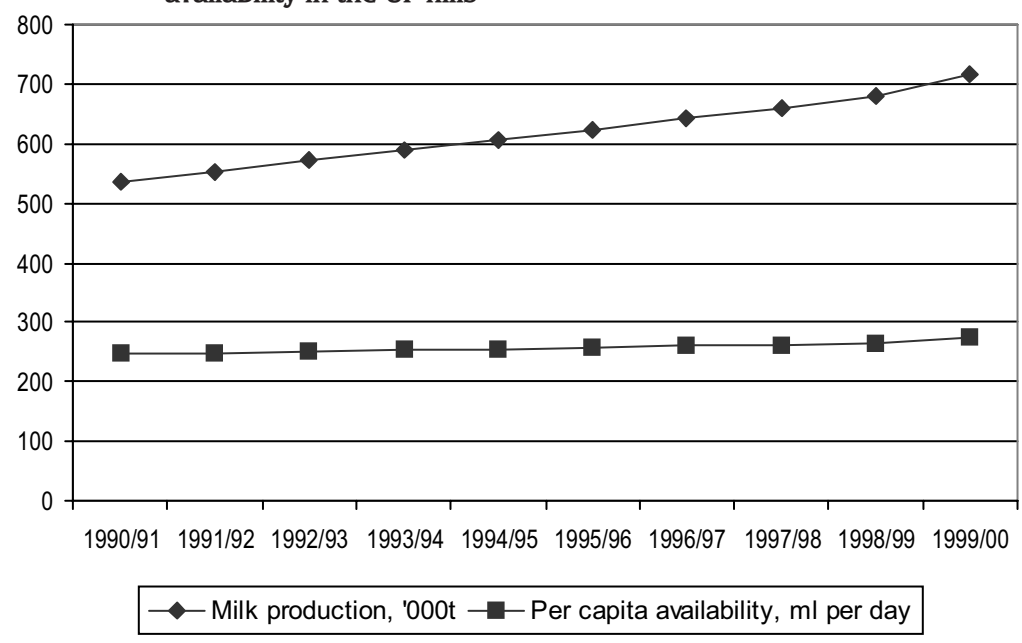
The surveyed smallholder farms in the two milksheds showed a surplus milk production above the nutritional requirement (approximately 250 ml per capita per day) in all villages in Nainital, and most in Almora (where two showed a slight deficit). Each village, on average produced 94,540 l of milk (range 28,200 l - 192,300 l) annually, slightly higher in Nainital than in Almora. Overall the average annual milk production per dairy farm was 1,032 l and the average daily per capita milk availability 372 ml (420 ml in Nainital and 330 ml in Almora). The per capita daily milk availability varied significantly from village to village (from 202 ml to 928 ml).

The Indian Council of Medical Research (ICMR) recommends a minimum consumption of 250 ml [g] of milk per capita per day (Singh 1999). The average daily per capita 'surplus' of milk was thus 122 ml.

Dairy farms located near urban areas had the highest surplus of saleable milk, followed by the dairy farms in a VDC. This is due to the fact that these two types of dairy management often tend to be market oriented. These dairy farms take advantage of the facilities available near market areas and those extended by the cooperative system. Milk is a ready source of income for daily needs for a farming family.

Trends in milk production and availability per capita per day in the central Himalayas show a steady increase over the last decade. In 1990/91, the per capita daily milk availability in the area was 247 ml, which rose to 273 ml in 1999/2000, not withstanding the increase in population and reflecting a marked increase in production (Figure 4.3). Currently the availability of milk is marginally more than the minimum required, the

Figure 4.3: Trends of milk production and per capita daily milk availability in the UP hills



positive trend in dairy production is largely attributable to the contribution of smallholder dairy farmers and the strengthening of the dairy cooperative structure in the region.

Marketing systems and home consumption

Milk consumption in the mountains and hills has increased considerably over the years. Cities and towns have grown due to increasing populations. Some prominent tourist areas have witnessed unusually high numbers of tourists in the peak tourist season. Tea shops have proliferated in recent years along every road, even in rural mountain areas, so much so that these are sometimes referred to as 'the one and only industry in the hills'. They have also contributed significantly to milk consumption in the area.

On average, 52% of the milk produced on each farm was marketed through different marketing channels (50% in Almora and 54% in Nainital). The major milk marketing channels are the producer-consumer channel, the producer-trader-consumer channel, and the producer-DMU-consumer channel. The informal dairy market is still dominant, some two-thirds of marketed milk flows through this channel. The major portion is marketed directly through the producer-consumer channel (29% of total farm production and 57% of total marketed milk). The direct relationship between producers and consumers is a significant feature of smallholder subsistence dairy farming in the hills. Small traders and vendors play an important role only in milk supplies to prominent cities and towns and they collect milk only from nearby villages located on the roadside, not more than 15-20 km away from the main consumption area. The producer-trader-consumer channel accounts for only 7% of marketed milk.

The formal dairy marketing system in the hills has been developed around the Anand Pattern, which is supposedly the ideal model for dairy development in India. This system relies on chilling centres, cold chains for milk collection, milk processing plants, and packaging and marketing of the final products. In the past, this has been the driving force behind the much-discussed Operation Flood, or White Revolution, in India. This model ensures the active democratic participation of milk producers and a high standard of dairy product quality and hygiene. The main players in this organised or formal market are the District Milk Unions (DMUs). On average 37% of marketed milk went through this channel.

At the end of 1999, there were 12 DMUs in Uttaranchal supervising 1510 milk societies or VDCs. The VDCs collected milk from 75,250 members and transported it to the DMU headquarters where it is pasteurised, processed into various products, and packed, and then marketed. The DMUs sell most of the packed milk through retailers (more than 95%).

The share of the VDCs in milk marketing in Uttaranchal has been increasing steadily over the years and it is likely to be the dominant market system in the region in the future.

On average 48% of the total milk produced at the surveyed farms was retained by the family (Table 4.1). Most was used for family consumption, directly and through conversion into other dairy products. Five per cent of the total produced was fed to calves (female buffalo calves only – in some cases, they were also allowed to suck their mothers' milk directly, as was the case with cow calves.

Table 4.1: **Consumption and marketing channels of milk in the survey villages** (litres per annum)								
Milkshed	Milk production per dairy farm	Non-marketed milk			Marketed milk			
		Family consumption	Calf consumption*	Total	Producer	Trader	Milk cooperative	Total
Almora	1,066 (100.00)	470 (44.1)	68 (6.4)	538 (50.5)	227.5 (21.3)	52 (4.9)	249 (23.4)	528 (49.5)
Nainital	998 (100.00)	420 (42.1)	36 (3.6)	456 (45.7)	369 (36.9)	22 (2.2)	151 (15.1)	542 (54.3)
Average	1,032 (100.00)	445 (43.1)	52 (5.0)	497 (48.2)	298 (28.9)	37 (3.6)	200 (19.4)	535 (51.9)

Figures in parentheses are percentages of the total milk produced.

*This does not include direct suckling of milk; only female buffalo calves are given supplements of extra milk.

Marketing cost, margins, and price spread

Price spread — the difference between the price paid by the ultimate consumer and the price received by the producer — normally reflects the extent of the services given and their costs (labour costs, transportation costs, equipment costs, spoilage, and degree of risks involved in marketing (Singh 1999)). In local markets producers often have no marketing margin or costs. If the institutions and other intermediaries involved in the marketing of dairy products are to be sustainable, they have to make certain profits after investing in the various activities and functions necessary for milk marketing. Important factors that influence and determine marketing margins are the type of dairy product, marketing channel, agency involved, mode of transportation, distance between a dairy farm and the market place, and ongoing trends in the market.

The data on price spread and marketing margins for milk in the study area show that at 86% the producers' share in the price paid by the consumer was considerably higher for direct sale than in other channels. There was no expenditure on transportation or chilling; the costs were for handling (9%), and such things as depreciation on utensils, a total of 14%.

The producer's share in the consumer price was 71% when milk was marketed through traders and 79% when it was marketed through the producer-DMU-consumer channel. Costs incurred on transportation, handling, and other functions in the producer- trader-consumer channel accounted for 4% of the consumer's price; the trader's margin was 25%. Costs incurred on the same functions and chilling in milk marketed through DMUs amount to 10%, and the DMU margin was 10%.

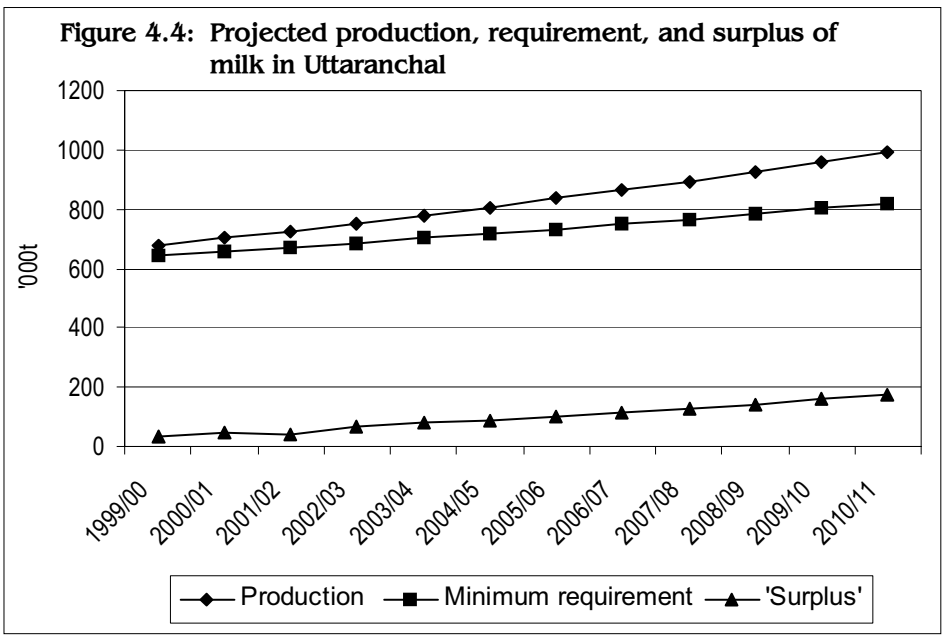
Overall the marketing costs were highest for direct sale because of the small quantities involved, and next highest for DMUs because of the transportation costs involved in collecting from scattered villages over large distances. The traders' marketing costs were much lower, but the profit margin higher. Overall the net price received by the farmer from the DMU was the same as for direct sale, reflecting a higher price to the consumer of DMU milk, and lower from tradrs because of the trader profit margin.

MILK SUPPLY AND DEMAND

The year-wise requirement for milk up to 2011 was projected from the trend in total milk production from 1980 to 2000. Trends in human population growth over the last decade (1981-1991) were used to project the population. The population was assumed to increase at a rate of 2.25% per year, and milk production at a rate of 3.53% per year.

The annual (minimum) requirement for milk in Uttaranchal in 1999/2000 was estimated to be 641,000t, based on the per capita minimum daily requirement of 250g (91 kg/year) recommended by the Indian Council of Medical Research (ICMR) (Singh 1999). This compares with actual total production in the same year of 678,000t, a 'surplus' of 37,000t. By 2010/11, the requirement for milk is likely to increase to 819,000t against an estimated supply of 993,000t (if growth rates can be maintained), giving a surplus of 174,000t, an increase of nearly 380%. This projected increase over 12 years indicates a likely higher per capita availability of milk in the years to come (Figure 4.4).

Figure 4.4: Projected production, requirement, and surplus of milk in Uttaranchal



Given public consciousness about health, rising standards of living, and the growth of market centres, the actual demand for milk is likely to show an ever-increasing trend in the future. The actual demand, like for other consumable items, is a function of several variables, like population size, income levels, gross domestic production, elasticity of demand for milk, and retail price. Future milk consumption will depend on these factors. The expected intervention by the private sector may also further influence milk consumption in the region.

Consumption of dairy products

The pattern of consumption of dairy products in urban areas was observed in the two cities of Almora and Nainital. Because family income is the most important criterion determining consumption behaviour, three categories of income were selected for the

study – low (monthly income up to IRs 5,000), medium (monthly income from IRs 5,000 to IRs 15,000), and high (monthly income more than IRs 15,000). The total of families surveyed in each city comprised 40 low-income families, 30 middle-income families, and 20 high-income families.

The consumption pattern in rural areas was observed in the selected families in the 12 sample villages in the two milksheds. Because the villages were in milk production centres, and the income level of families in rural areas does not vary significantly, there was no categorisation based on income.

Overall families in the urban areas purchased an average of 45 l milk per month, equivalent to 321 ml per capita per day. The consumption of milk per capita per day increased with family income (Table 4.2). The per capita daily consumption in the high income families was more than three times that in the low-income families; and in middle-income families more than twice that in low-income families. Milk consumption in Nainital was higher than in Almora for middle- and high-income families, but lower for low-income families.

Table 4.2: **Daily milk consumption per capita (ml) in two urban centres**

Family Category	Almora	Nainital	Average
Low-income	150	125	138
Middle-income	350	400	375
High-income	400	500	450
Average	300	342	321

The average milk consumption in urban areas was 71 ml more than the recommended minimum consumption level of 250 ml per capita per day. But whereas high-income and middle-income families benefited from excess milk, low-income families did not receive the minimum daily requirement, 112 ml per capita per day deficit on average.

Of the total milk purchased, on average about 45% was consumed directly (63% of this by children), and about 44% in tea and coffee. Only 11% was consumed after being converted into other products, 80% as curd, 13% as butter or ghee, and 7% as paneer. The pattern of conversion of milk into other dairy products changes from season to season. For instance, curd is consumed more in summer than in winter.

Overall about half of the milk purchased was fresh whole milk (FWM) and half packed, but there were big differences between the cites: two-thirds of the milk supplied in Nainital was packed, and two-thirds of that in Almora was FWM. In both towns, use of packed milk increased with family income.

Most of the low-income families preferred FWM particularly because of the low purchase price and monthly payment arrangement. More of the consumers from the medium income families and most of those from high income families, however, preferred pasteurised packed milk. They like to depend on the formal market to avoid any health risks associated with the supply of FWM through private traders. Cases of the supply of synthetic or spurious milk by some traders in the plains have been in the newspaper headlines and have raised people's interest in packed milk. The supply of very dilute milk (mixed with large quantities of water) by producers and traders is an issue widely discussed in the urban hill areas. Nevertheless, all categories of consumers would prefer unpacked milk, if they were assured it was pure and unadulterated (without water) and fresh, particularly because of its natural flavour and original chemical composition. Home delivery and convenient monthly payment are the other advantages.

Virtually all the families in the rural areas surveyed owned their own dairy animals. When dairy animals belonging to a family are not in milk, neighbours may give milk, or occasionally buttermilk, to the family free of charge. This kind of sharing of milk and milk products among villagers is traditional. Purchasing or selling milk within the same village is rare.

The rural families retained 37 l milk per month on average for home consumption (39 l in Almora villages and 35 l in Nainital villages). The average milk consumption per capita per day was 337 ml, 87 ml higher than the recommended amount, but with considerable variation among villages (221-435 ml per capita per day). [The average family size only includes those living permanently at the farm, overall 3.6 persons per household. ed]

Thus contrary to popular belief, milk consumption is no higher in milk producers' households, than in urban households. Whereas a dairy farming family consumes more milk than a low-income family in urban areas, its daily milk consumption status is lower than that of middle- and high-income urban families.

Of the total milk consumed per month, about 32% is consumed directly by family members and 45% in tea. The remaining 24% is converted into other dairy products. The average consumption of milk was similar in the two milksheds, but the average consumption as other dairy products was significantly higher in the Almora villages than in the Nainital villages.

Economics of milk production

Production costs were compared for both the dairy animals (cows and buffalo) and the three main production systems (traditional, semi-urban, and VDC) averaged over all locations (Table 4.3).

Table 4.3: **Economic returns in smallholder dairy production systems (IRs/ animal/ year)**

	Traditional		Semi-urban		Village Dairy Cooperative	
	Cow	**Buffalo**	**Cow**	**Buffalo**	**Cow**	**Buffalo**
Variable Costs						
Fodder	1,000	3,560	1,040	3,560	860	2,540
Concentrate	20	150	20	140	50	200
Labour	2,020	1,450	2,760	1,450	1,650	1,450
Miscellaneous	100	200	180	250	200	250
Sub-total	*3,140*	*5,360*	*4,000*	*5,400*	*2,760*	*4,440*
Fixed Costs						
Interest	350	1,500	400	1,500	400	1,500
Depreciation	250	1,000	640	1,000	650	1,000
Sub-total	*600*	*2,500*	*1,040*	*2,500*	*1,050*	*2,500*
Total Maintenance Cost	**3,740**	**7,860**	**5,040**	**7,900**	**3,810**	**6,940**
Economic Gains						
Milk	4,590	13,360	5,900	16,030	5,280	14,030
Farmyard manure	1,500	3,000	1,500	3,000	1,500	3,000
Total gains	6,090	16,360	7,400	19,030	6,780	17,030
Net margin per animal	2,350	8,500	2,360	11,130	2,970	10,090
Net margin per litre	4.87	7.64	3.80	8.33	4.78	7.55
Return to family	**3,020**	**5,010**	**3,800**	**5,010**	**2,510**	**3,990**

The greatest cost in the maintenance of a dairy animal, particularly in the plains, is usually the cost of feed. But in mountain areas, like those of the Uttar Pradesh Himalayas, the bulk of the fodder comes from CPRs free of charge. Therefore fresh feed costs were not included in the overall maintenance costs apart from the costs incurred on labour for collecting the fodder from the CPRs. Dry fodder comes mostly from private cropland, and its costs have been included.

The greatest part of the total maintenance cost were household labour costs for cows and fodder costs for buffalo. The labour costs for cows varied from 43% on the VDC farms to about 54% on traditional and semi-urban farms. Fodder costs for buffalo ranged from 37% on the VDC farms to 45% on traditional and semi-urban farms (Table 4.3). These costs are primarily dependent on overall livestock management and the source of the fodder. A reduction in these costs through alternative livestock management would significantly improve the economy of milk production.

The economic returns for buffalo were higher than for cows, in all situations. Because in rural areas the actual cost of labour used for raising dairy animals is close to zero, the estimated costs of fodder collection and other labour can be considered as an additional economic return to the family, approximately doubling the actual benefit. This suggests that smallholder dairy farmers are in fact receiving considerable economic benefits from dairy farming (Table 4.3).

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

Livestock and natural resource base: potentials

The evidence from this study suggests an increasing trend in milk production, marketing, and consumption rates. The natural resource base, including vast areas of CPRs, the huge population of dairy animals, including unique and highly adapted breeds, and the diverse animal production systems together hold the key to dairy development in the region. Because farming systems in the region are self-contained, almost all inputs regarded as indispensable for the development of dairy farming grow within the system itself. Smallholder dairy farmers have particularly good prospects for economic development because of the natural resource base they have access to.

The main problem the dairy sector in this region faces is low productivity. The large dairy animal populations, and the natural resources that serve as rich repositories of quality fodder, remain underexploited by the dairy sector. Institutional interventions focus on three aspects of dairy production: crossbreeding, health care, and fodder production. This approach, as discussed in detail in the text, is not perspective based. Smallholders do not participate in the process and therefore, the strategies have had almost no visible impact on the transformation of dairy production systems. They have, however, impacted greatly on the marketing system.

Dairy development with a focus on the natural and livestock resource base will be the most appropriate perspective-based strategy for the smallholder-based community of the region. Inadequate supply of feed to dairy animals, as we have noted earlier, is one of the major constraints to dairy production in the region. Milk yields of both cows and buffalo could be increased by feeding them adequate amounts of green fodder obtainable from CPRs, particularly the forests. Smallholders get CPR-based feed free of charge, which results in a reduced cost of dairy maintenance and a consequent increase in the gross returns to the farm.

Natural resource management

Uttaranchal has large areas of uncultivated land covered with forests, grasslands, scrub (poor forest cover), or perpetual snow. Common property resources comprise large areas of forests and grasslands. This natural resource base which is endowed with a diversity of fodder-yielding plants holds the most potential for the development of dairy farming in the region. Natural resource management, in fact, is the most important issue relating to dairy development in the UP Hills.

Dairy farming is linked with other farming systems through the nutrient cycle. These links are vital for the sustainability of the mountain farming system, and detailed study of them will be very useful for evolving strategies for the efficient management of the natural resource base as well as for realising improvements in the production performance of the mountain farming system.

Technological options

The seasonality of fodder supplies, the acute shortage of fodder, and low rates of concentrate feeding impose severe constraints on smallholder dairy production systems and highlight the need to formulate balanced rations incorporating local feed resources and to assess them on farm. Feeding chemically treated dry fodder; supplementing the diet with urea, molasses, and mineral mixtures; designing new feeding systems ensuring little or no wastage, and increased usage of available feed; and the application of fodder-preservation methods could all help increase dairy production in the region. There is a need for long-term testing on farms of the impact and feasibility of these technologies.

Tree leaves are used as a bedding material in animal sheds in the hills. Bedding mixed with dung is composted and applied to the soil. Composting techniques in the mountains, however, appear to lose tremendous amounts of energy and nutrients. Improved composting techniques would help enhance soil fertility and fodder output from cropland.

Applying breeding techniques aimed at reducing first calving age, increasing lactation length and productivity, and decreasing the dry period, and taking advantage of modern veterinary advances to control some prevailing problems, such as parasite infestation and infertility, are yet other relevant areas for research. Eliminating internal and external parasites in dairy animals through the administration of effective medicines on a regular basis could lead to considerable increases in milk production. This needs to be tested on a large population of dairy animals in the hills.

Institutional intervention

The huge investment by the public sector has not led to a proportional growth in the dairy sector in the mountains. The main problem is that institutional policies and programmes are not aimed at the conservation and management of indigenous livestock and the natural resource base. Market-oriented production is necessary to ensure income opportunities for smallholder dairy farmers. However, market-oriented dairy farming without the conservation of the resource base will not help in the evolution of sustainable dairy production systems.

The protection of community ownership of CPRs and the participation of local people in their management (conservation and usage) is essential for the sustainability of dairy production systems. An assessment needs to be made of the current status of the CPRs, community ownership, agencies involved in their management, usage pattern, and their direct contribution to dairy development.

Characterisation of specific local breeds, particularly cattle, might be helpful in developing an appropriate participatory, mountain perspective based, breeding policy ensuring conservation of local breeds with unique traits. Implementation of such a breeding policy could be instrumental in helping dairy systems in the region.

Integrated animal health management involving both traditional and modern systems of treatment aimed at providing adequate health care to all animals, and addressing the inherent problem of the inaccessibility of mountain areas, would provide a cost effective and accessible system for smallholder dairy farmers.

A study of the cooperative system regulations will be important to help build an environment conducive for smallholder dairy development in mountain areas.

Quality control of dairy products in the informal market and the imposition of regulations on milk suppliers are issues of great public interest. A framework based on intensive information and suggestions from a large number of consumers could be formulated to help address these issues.

The continuous exposure of small dairy farmers to dairy-related education and training, the provision of subsidies and credit, and ensuring good prices for produce, together with an increased awareness about health and hygiene among consumers could all contribute towards creating a dairy revolution in this mountain region.

STUDY IMPLICATIONS

Institutional intervention must encourage various agencies, including the gram panchayats, non-government organisations, schools, and colleges to be involved in the regeneration and efficient management of CPRs. Management through intensive afforestation and reforestation, protection, preservation, and judicious use will help to create a stable feed resource base for dairy farming.

Dry fodder is found in surplus in the neighbouring plains areas and could be supplied to the mountain areas. Subsidies should be given to smallholder dairy farmers for commercial feed, improved dairy species or breeds, mineral mixtures, and medicines.

Adequate animal health care should be developed and extended to the remote villages. Well-proven traditional methods of disease management should also be recognised and integrated. A cooperative system of milk collection, marketing, processing, and distribution is the most effective system for the dairy sector. This, therefore, must be strengthened. An extension system of dairy technology dissemination, on-farm demonstrations, experimentation, training, and quality control, with increased participation of women also needs to be developed.

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