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**An Overview of Smallholder Dairy Farming in
Mixed Mountain Farming Systems of the HKH:**
Issues and Priorities

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Chapter 1

An Overview of Smallholder Dairy Farming in Mixed Mountain Farming Systems of the HKH: Issues and Priorities

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BACKGROUND TO THE STUDY

A geographic information systems (GIS)-based analysis of livestock population dynamics in the Hindu Kush-Himalayan (HKH) region conducted by the International Centre for Integrated Mountain Development (ICIMOD) and the International Livestock Research Institute (ILRI) indicated that over the last 10-15 years considerable changes have been taking place in the structure and management systems of smallholder dairy farming in areas with a high concentration of dairy within mixed mountain farming systems. Recently there have been notable changes in the dairy population in terms of species and breeds, infrastructure, and market developments. It appeared that dairy farming was the most dynamic aspect of livestock farming in the region, particularly where accessible mixed farming systems dominated. In such areas, smallholder dairy farming is becoming a driving force behind the transformation of the rural economy. Such a transformation has been made possible through the establishment of markets for fresh milk and the development of milk cooperatives and milk collection centres from where milk is supplied by parastatal government organisations and private dairies to consumers in towns and cities. The transformation is more pronounced in areas near to roads. There are many inaccessible areas where subsistence oriented smallholder dairy farming is an integral part of farming systems, but where there is adequate market access for inputs and outputs there is potential for rural transformation.

Until now, there has been little attempt to gather knowledge about the specific nature of these changes and transformations or how they have affected the sustainability of the smallholder dairy production systems and the lives of people. Furthermore, the constraints on and opportunities for smallholder dairy development in the different

areas of the HKH are not well known. It was with the aim of filling some of these knowledge gaps and identifying priority areas for further research that ICIMOD and ILRI planned a study on 'Market-oriented Smallholder Dairy in the Mixed Mountain Farming Systems' in four areas in three HKH countries – Bhutan, India (Uttaranchal in the Central Himalayas and Himachal Pradesh in the Western Himalayas), and Nepal. These four areas were taken as together being representative of the greater part of the HKH region where mixed farming systems are common, although clearly there are some differences between areas.

Objectives

- To explore the trends and patterns of dairy development
- To study the characteristics of smallholder dairy production and post-production systems
- To identify the key socioeconomic, gender, and natural resource management issues related to smallholder dairy farming
- To identify policy and institutional issues for dairy development

Methodology

After initial identification of the topic, a three-day planning workshop was organised in August 1999 involving ICIMOD, ILRI, and identified national partners from the chosen regions to share a general understanding of smallholder dairy farming in the HKH and to discuss thoroughly the data and information gaps in smallholder dairy production and marketing. The major data and information gaps were identified and a common methodology to undertake the field studies was developed through a participatory process. Following the workshop, each of the study teams, from Bhutan, Nepal, Himachal Pradesh, and Uttaranchal, submitted proposals as per guidelines agreed to during the workshop. The International Livestock Research Institute and ICIMOD reviewed the proposals jointly and provided inputs for further improvement. Then each team carried out stakeholders' meetings, inviting researchers, extension workers, planners, policy makers, private dairy processors, and small dairy farmers to discuss the critical issues of smallholder dairy systems in each of the regions. The teams then carried out detailed surveys, one on household production and marketing and another on dairy product consumption. The International Centre for Integrated Mountain Development provided technical backup during this process by providing assistance in study site selection and survey questionnaire development. Thereafter, each team carried out field work, data analysis, and write up. The study districts are shown in Figure 1. ILRI and ICIMOD staff jointly reviewed the first draft reports and suggested revisions.

A three-day meeting was then organised from 17 to 19 April 2001, to review and share the final results of the regional case studies and to identify constraints, priority issues for research and development, and policy recommendations. This publication presents the final results and conclusions of the case studies. The first chapter provides a synthesis of the results across the region and a summary of the policy and research recommendations. The detailed findings of the individual case studies are summarised in the subsequent chapters. The detailed case study reports are available on CD upon request from both ILRI and ICIMOD.

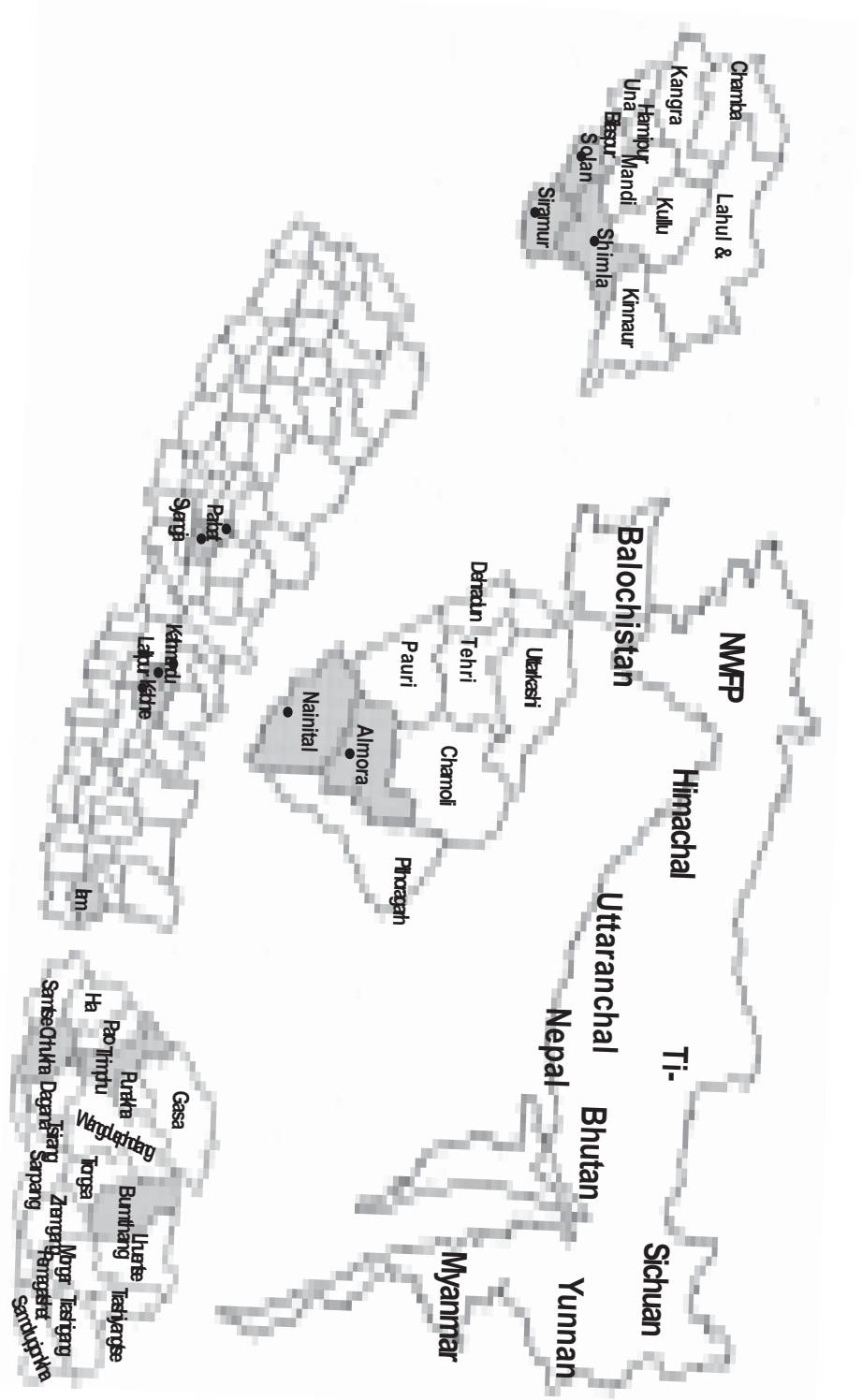


Figure 1.1: Field study sites in the Hindu Kush-Himalayas

GENERAL CHARACTERISTICS OF DAIRY PRODUCTION SYSTEMS IN THE HINDU KUSH-HIMALAYAS

Market-oriented smallholder dairy farming systems dominate in those mixed crop-livestock farming system areas in the HKH that are considered to be high-pressure areas. These areas have a high density of both human and livestock populations. One or two dairy animals are an integral part of the farming systems of individual farmers. These dairy animals are a source of cash income and soil nutrients in the form of manure. The dairy buffalo has multiple uses, producing milk, meat, and manure. The dairy cow produces milk, bullocks for draught power, and manure.

In mixed crop-livestock farming systems, farmers generally keep one or two dairy animals under a 'sedentary' system; they are mostly stall fed when they are at a productive (milk-producing) stage. Other cattle, particularly 'unproductive' animals, are mostly grazed on common land and brought to the homestead at night; some home-made supplement is provided to milking cows. Especially in peri-urban areas that are accessible by road, there is an increasing trend towards stall feeding of buffalo and feeding purchased feeds (concentrated feeds) to improve dairy cows.

There are two main types of dairy production system in the HKH region, mainly based on accessibility to road heads. The first type is more common in areas close to road heads (up to 3-5h walk) and focuses on production of milk for sale. This system has been facilitated by the development of milk collection centres from which milk is transported to main chilling centres established by parastatal government organisations and private dairies in or near urban areas. The second type is prevalent in inaccessible areas (two or more days' walking distance from a road head). Farmers keep between one and three buffalo or local cows and about 50-70% of the milk produced is converted into ghee or butter, which is taken to a distant town or market for sale.

MAIN FINDINGS FROM THE COUNTRY STUDIES

Species and breeds of dairy animals

There is a dominance of dairy buffalo across the region in terms of their contribution to total milk production (except in Bhutan). There is an increasing trend towards raising crossbred buffaloes, mainly the Murrah breed, across the region. These animals are spreading fast, mainly due to private animal traders. The government programmes have not paid as much attention to this as desired by local farmers.

In Uttaranchal, dairy buffalo are largely a mixture of improved type Murrah and Bhadawari, with a possible mixture of other indigenous (Indian) breeds imported from the plains, and are well adapted to mountain conditions. Murrah is one of the highest yielding buffalo breeds. Over 90% of dairy cows are local and approximately 7% are crossbred.

In contrast, in Himachal Pradesh, there is an increasing trend towards using crossbred cows, mainly Jersey cross. The proportion of crossbred cows increased by nearly 17% annually between 1982 and 1992. This has contributed to an increased share of cows' milk in total milk production. The share of buffalo milk in total milk production declined from 56% in 1984/85 to 50% in 1997/98 and the share of cow's milk increased from 41 to 44% over the same period. In 1997/98, crossbred cows yielded an average of 3.2 l of milk per day over the whole lactation period, compared with 1.6 l for indigenous cows, and 3.1 l for buffalo.

In Bhutan, the great majority of dairy animals are cows. In 1999 there were a total of 344,595 cattle and only 1790 buffalo. The overall cattle population went down by 2.4% between 1989 and 1999 and the number of indigenous cattle by 9%, whereas the number of cattle crossbred with exotic breeds went up by more than 100%. About 13% of the total cattle population in Bhutan are crossbreeds of Jersey and Brown Swiss. In the study areas, 83% of cattle were crossbreeds and only 17% were indigenous. The increase in the improved cattle population is partly a result of government intervention. The surveyed farmers had an average of eight animals per household compared with the national cattle average of around five.

The predominant local cattle breed in Bhutan is the Siri, which is found all over the country. Although a poor milk producer, this breed has survived over centuries as a result of its adaptability to different agroecological systems, its disease resistance, and its usefulness as a draught animal. Siri are used as the base stock for developing composite breeds with breeds like Jersey, Brown Swiss, and Mithun. The Mithun crossbreeds are more common in the lower temperate and subtropical regions (150-2,600m); the Mithun males are popular as draught animals and the females because they have a higher fat content in their milk. Brown Swiss crossbreeds are found in the higher altitudes of the temperate region, whereas Jerseys are more prevalent in the lower temperate and subtropical regions of the country. A small number of Swamp crossbreeds and improved buffalo (mainly Murrah) are also found in the southern belts.

In Nepal, the overall proportion of cows among milking animals remained stable at around 47-48% from 1984 to 1998. The proportion of cows among milking animals was highest in the mountains (58%), followed by the Terai (lowland) (50%), and the hills (45%). Crossbred animals comprise only 2% of the total dairy cow population overall. In the western hills, buffalo (local and Murrah cross) are the most common dairy animal, followed by crossbred cows (mostly Jersey cross but also Holstein and Jersey/Holstein); local cattle are not reared as dairy animals. In the lower hill area, 80% of dairy animals are buffalo, of which about 50% are Murrah crossbreeds. Households kept an average of 2.5 dairy animals. In the central hills, the majority of dairy farmers in the study areas kept Murrah cross buffalo and a few Jersey cross and local cattle; overall 75% of dairy animals were buffalo. Murrah cross and native buffalo gave average daily milk yields of about 5.2 and 3.5 l respectively. In the eastern hills, the sampled households had an average of 3.4 dairy animals per household.

Animal feed resources and natural resource management

In the Indian Central and Western Himalayas, common property resources (CPRs) play a critical role in supplying animal feed in terms of fodder and native grass. This is also true in Bhutan. However, in the hills of Nepal, because of community forestry rules, dairy animals depend more on crop residues and fodder and grass from private land grown around field borders. There is an increasing trend in management practice towards keeping stall-fed dairy animals, mostly crossbreeds. Also, there is an increasing trend towards feeding purchased concentrate feed to these animals.

In the villages studied in Uttaranchal, an average of 83% of dry fodder was grown on cultivated land (crop residues), and only 17% was grass or hay from CPRs. Common property resources contributed most to dry fodder supplies in a village at high altitude (33%), more than twice the average in the valley, and at mid-altitudes. Green grass contributed 84% of the total green fodder (35% hand-cut, 49% grazed) and tree leaves about 16%. On average, 58% of total fodder biomass was extracted from CPRs and 42%

was cultivated on private cropland. Farms provided an average of 100 kg of concentrate feed to each dairy animal in a year, the bulk of which (77 kg) was produced at home. One village dairy cooperative (VDC) reported the use of 32% purchased feed, much more than any other village. There was a phenomenal 300% increase in the sale of concentrate feed to VDCs by the Milk Unions between 1989/90 and 1998/99.

In Himachal Pradesh, 75% of dairy cattle were both grazed and stall fed and only 25% were stall fed completely. Buffalo rarely grazed because of the problems encountered with these heavy animals on the steep hill strips. Green grass was only available during the rainy season; tree leaves were fed during the winter and dry summer seasons. Cultivated fodder was becoming popular in the milkshed area. Except in the rainy season, hay (dried local grass) and wheat bran were the main constituents of concentrates fed to milch animals. Crossbred cows were fed more concentrate than graded or nondescript cows.

The most common feed resources available to farmers in Bhutan were from CPRs, forest, cultivated fodder, and crop residues. A 1996 survey showed that forest grazing and CPRs were the most important feed resources in the temperate areas. In winter, grazing in fallow fields is the most important feed resource in areas where paddy is not grown. Hay is also a major contributor in areas where improved pasture is well established. Rice, barley, wheat straw, and maize stovers provide about 13% of feed when fresh fodder is scarce. Between 75 and 100% of households had fodder trees, mainly grown around the homestead, along fences, and along the borders of cropland.

The feeding strategies in Nepal differed from region to region. In the eastern hills, a cow was fed an average of 25 kg of green grass, 5 kg of dry grass, and 2.24 kg of concentrates per day. In the study area, 20% of farmers had leased land for grass. There is an acute shortage of green forage at all times except in the wet season (July to October). The net deficit periods for good quality forage were November to December and April to June. In the central hills, on average every household in the study area collected about 30 kg of grass and 25-30 kg of fodder leaves per day per adult animal. In the western hills, the majority of forage was home grown and forest resources contributed only 3-14% according to the season. Rice straw was the main crop by-product fed during the winter and maize stovers during the rainy season. Lactating dairy animals were given about 1.5 kg of home-made concentrate feed daily during the lactation period. Commercial feed was only purchased by those farmers who were rearing crossbred cows.

Livestock health services

In all the study areas across the HKH the government is the principal provider of veterinary health services. However, there is an increasing trend towards the private sector providing health services, particularly in terms of supplying veterinary medicines and in some cases veterinary surgeons. These private veterinary services are concentrated in areas where smallholder dairy producers have access to raw milk markets.

The common diseases across the region are foot-and-mouth disease (FMD), haemorrhagic septicaemia (HS), and parasites. However, the intensity of each of these diseases differs from one region to another.

In Uttaranchal, the diseases of most economic importance affecting dairy stock are FMD, HS, black quarter (BQ), tuberculosis, brucellosis, mastitis, haematuria, bloat, and parasitic diseases. In the Garhwal area, 27% of the dairy livestock population was

affected by internal parasites; of these 25% had *Ascaris*, 57% liver fluke, and 18% other parasites.

The most common dairy animal illnesses found in Himachal Pradesh were FMD, 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 became deficient in calcium – which led to fever. Ovarian cysts were also related to a greater than 50% proportion of Jersey strain in crossbred cows.

In the east of Bhutan the incidence of tick-borne diseases was about 19%. Bovine enzootic haematuria, with an incidence of around 62%, and oak poisoning are also emerging as important diseases. The morbidity rate for oak poisoning is close to 100% with about 20% mortality. The problem arises when oak leaves are eaten during the 'hungry gap period'. The incidence of sub-clinical mastitis ranges from 24 to 34% in different areas of Bhutan. Infertility is another problem, with reported rates as high as 63% in one area. Animal health care services are provided by a veterinary hospital in each district and 109 livestock extension centres manned by 347 animal health staff. Even so, 30% of farmers said they relied on ethno-veterinary practices in addition to the services received from livestock extension centres.

The most common communicable diseases of animals in Nepal are 'pestee des petits ruminants', rinderpest, FMD, rabies, brucellosis, HS, black leg disease, anthrax, mastitis, and fasciolosis (liver fluke). Internal parasites like liver fluke and roundworm are widespread. Mastitis is increasing in crossbred cows. Animal health services are mainly provided by veterinary hospitals, livestock service centres, and livestock service sub-centres. About 50% of the farmers in the study were satisfied with the level of services at these centres. Major complaints included a lack of technicians, high service charges for treatment, and unfair distribution of medicines. Village animal health workers and private practitioners also provide animal health services.

Gender and livestock

Women play a critical role in dairy animal production and management in the HKH. Nevertheless, their role has not been well recognised in past development planning. As a result, dairy animal development strategies are now being increasingly tuned to reflect the role of women.

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. Men's role in dairy farming is limited. They participate in marketing, in looking after grazing and sick animals, and in providing service to the dairy animals. On average, women devote 1780h/year (nearly 5h/day) to different dairy operations and men only 315h (less than 1h/day). As much as 85% of a woman's farmwork time is devoted to dairy production. This is one reason why a Women's Dairy Development Project was started in Uttaranchal in 1994/95 with the support of UNICEF, the Government of India, and the Government of Uttar Pradesh.

In Himachal Pradesh, women spent more time than men tending animals and collecting fodder (64 and 66% of the time spent on these tasks was by women) and men slightly more time grazing animals (55%), but the difference was far less than in Uttaranchal.

In Bhutan, activities related to dairy farming are generally carried out jointly by all family members. Overall, women contributed more to activities like milking, milk processing, feeding, feed preparation, and fodder collection, possibly because many men work away from the farms and were thus not available. A lot of cattle herding is done by children. In the surveyed areas, the average family comprised nine people but on average only three of these were available for farm work; the others were in school, government jobs, monasteries, or other places.

In the mountain areas of Nepal, sex and age both play a critical role in determining labour allocation in dairy farming. Generally, women carry out most activities including collecting green fodder (including fodder tree forage), feeding animals, grazing animals, cleaning animal sheds, and composting animal waste. Older women milk the animals and prepare butter and ghee. Children of both sexes (although mostly girls) graze the animals. Older men make decisions regarding the breeding of animals and the marketing of dairy products.

Marketing of dairy products

In all the study areas, there were three to four milk-marketing channels. Informal marketing channels dominate the markets. However, there are also formal channels established via milk cooperatives or milk producers' groups delivering milk to milk collection centres, and chilling and processing plants that are supported by parastatal government organisations such as the Milk Federations (MilkFeds) in Bhutan, Himachal Pradesh, and Uttaranchal, and the Dairy Development Corporation (DDC) in Nepal. The major share of farmers' milk is distributed through informal channels such as producers-traders-consumers and producers-consumers.

There are three major milk-marketing channels in Uttaranchal. The first is the direct producer-consumer channel; this involves no middlemen so there is less chance of exploitation. Producers distribute the milk to households on a door-to-door basis. The second is the producer-trader-consumer channel with around 30-40 small traders supplying milk daily to the city. This channel is particularly important for those dairy farmers in rural areas who do not have easy access to the market. The quantities handled by each small trader mostly range from 10 to 50 l/day. Traders travel some 4-25 km each day by public transport, truck, or motor cycle. The third is the formal producer-Dairy Milk Union (DMU)-consumer channel; this is a cooperative system in which VDCs help member farmers to sell their milk at set rates.

In the formal distribution system, there are 12 major 'milksheds' or catchment areas for milk production. In total, 12 DMUs in Uttaranchal supervise 1,510 milk societies or VDCs, which in turn collect milk from some 75,000 members. Milk is pasteurised, processed into various products, packed, and marketed in city and town areas through chilling centres and agents.

The two milkshed study areas were Almora and Nainital. The Almora milkshed at present covers 1,650 sq. km (from a theoretical 3,000 sq. km) and has 230 functioning milk societies or VDCs. The Nainital milkshed covers about 2,100 sq. km (from a theoretical 3,000 sq. km) and has 220 functioning milk societies. Almora receives around 12,000 l of milk per day, 3,000 l (25%) from the Almora DMU and the remainder from farmers (25%) and traders (50%). Nainital receives around 14,000 l/day, most (63%) from the DMU and only 27 and 9% from farmers and traders respectively.

The average daily per capita milk availability in Uttaranchal is about 372 ml but it varies significantly from village to village and area to area. In the Almora and Nainital milksheds about half the milk is marketed, and nearly half is retained by the family, mostly for direct consumption or for conversion into other dairy products. About 5% is used for calves. During the tourist season, milk has to be imported from the plains in some centres. The average quantity of milk imported to the region in 1989/90 was just under 10,000 l/day, but this increased to over 20,000 l/day by 1998/99. Milk is imported in the form of solid milk powder (SMP) or the 'Parag' brand. One kg of SMP is equivalent to about 10 l of liquid milk.

In Himachal Pradesh there are three channels through which milk is marketed: the producer-consumer, the producer-trader-consumer, and the formal channels. The dairy farmers living near to towns accounted for about 28% of total sales and favoured direct marketing. Farmers supplied an average of 10-15 l of milk daily to their customers. Marketing through the private milk trader channel was the most common route (65% of sales); less than 8% of milk was marketed through formal channels. Private traders were favoured because of the inaccessibility of producing areas and the low price offered by the Himachal Pradesh MilkFed. During 1997/98, the MilkFed met 32% of the total demand being fulfilled through formal channels, the remainder came from the MilkFeds of the Unions of Punjab (33%) and Haryana (19%) and from private dairies.

In Bhutan, there is a chilling centre in Darla for collection and storage of milk with a capacity of 1,000 l. Farmers bring only 500-600 l every two days, after which the milk is delivered to Phuntsholing. The main reasons for the low and irregular supply of milk by the farmers are the low price offered by Bhutan Dairy Limited (BDL), the high local demand for butter and cheese, and for some farmers the difficulty in reaching the chilling plant or collection points. The processing plant at Phuntsholing has a capacity of 700 l/h or 4,500 l/day, far more than the supply. Bhutan Dairy Limited receives 600 l daily from India, but this is still not enough to fill the capacity.

A market survey on imported dairy products was carried out among 10 retailers. The most common brands of imported dairy products in Bhutan were Amul butter and cheese, Amuliya cheese and milk powder, and Everyday milk powder. Packed liquid milk (Amul Taja) is fairly new in Bhutan and only available in very few shops. An estimated 12,828 kg of processed milk powder is sold annually, and accounted for 1.46% of total national imports in 1999. Estimated annual sales of imported processed butter (8,976 kg) and preserved cheese (2,900 kg) accounted for 4.5 and 4.1% of national imports in 1999, respectively.

In Nepal, the DDC is responsible for marketing in the public sector (the formal government channel). Currently there are five milk supply schemes (MSS): in Kathmandu, Biratnagar, Hetauda, Pokhara, and Lumbini. The milk producers' associations (MPAs) and cooperative societies (CS) manage a number of milk collection centres and have expanded operations in recent years. About 35% of the total milk market share is estimated to be controlled by private dairies. The processing facilities and working conditions of these dairies vary widely, from simple (dekchi) cream separator dairies to well-established dairies with a collection network and processing facilities. There are currently 12 cheese production centres in Nepal (6 in high mountain areas). They collect milk from a network of 25 milk producer-cooperative associations.

In the eastern hills of Nepal most milk (about 79% of total production) is sold directly to the MPAs who send it to DDC chilling centres. Even local consumers have to purchase milk from the MPAs as do private-sector cheese factories (with the exception of Neelam Cheese Factory which collects a small amount of milk directly from farmers). In the central hills most dairy farmers are happy to sell milk to the DDC (through cooperatives) at a fixed price, even though they receive 10 paisa (or NRs¹ 0.10) less per litre than from a private dairy. The price paid is based on fat and solid-not-fat (SNF) content. However, the DDC's purchasing policy is not regular and the introduction of 'milk holidays' (days when milk is not purchased) is posing problems for smallholder dairy farmers. In the western hills farmers prefer to sell their milk on the open market or to teashops because the open market price of fresh milk is about 20-25% higher than the price given by milk collection centres or cooperatives and there is no measurement of milk quality. In the areas accessible to markets and teashops, only a third of sales are through dairies and milk collection centres.

Milk supply and demand

The milk supply-and-demand situation differs from region to region. While Bhutan faces a considerable shortage of domestically produced milk and milk products, and thus meets demand mainly through imports, in Nepal the situation is different. During the flush or peak season (rainy season), Nepal has milk holidays, which is attributed to limited processing capacity, lack of product diversification, and the use of imported cheap powder milk. In major cities like Shimla in Himachal Pradesh, 25-30% of pasteurised milk for daily consumption is supplied from the plains areas of Punjab and Haryana. Similarly, during the peak tourist season Uttaranchal depends on imports of milk and milk products.

The present scenarios suggest there is considerable scope for improving farm income and employment in rural areas of Bhutan, Himachal Pradesh, and Uttaranchal by promoting smallholder dairies. In order to examine the potential for promoting the participation of poor and small farmers in dairy farming, future projections for demand and supply were made for ten years ahead. While the demand estimates for Nepal and Himachal Pradesh were based on economics, in Bhutan and Uttaranchal they were based on nutritional requirement.

Based on the projected milk demand, by 2010 Bhutan will face a serious annual deficit of some 28,000t in the quantity required to meet the minimum basic nutritional needs of the growing population. Unless the government or private sector invest considerably to promote the participation of small farmers in small dairy farming, the importation of dairy products from India and other countries will continue, at a significantly increasing rate. This will have a negative impact on Bhutan's rural economy in terms of income and employment generation.

In Uttaranchal, the annual demand for milk in 1999/2000 was estimated to be 641,000t, based on a per capita minimum daily requirement of 250g (91 kg/year) as recommended by the Indian Council of Medical Research (ICMR). This compares with actual total production in the same year of 678,000t, which indicates a surplus of 37,000t. By 2010/11, the demand for milk is likely to increase to 819,000t against an estimated supply of 993,000t, giving a 'surplus' of 174,000t, which is an increase of nearly 380%. Actual consumption of milk per capita per day increases with income. At present, the

¹ NRs 68 = \$US 1 (in 2000)

actual average per capita, per day consumption in urban areas is 320 ml. The per capita daily consumption in a high-income family is more than three times higher than that in a low-income family.

In Himachal Pradesh, there was an economic demand for 730 million litres of milk in 1997/98, which rose to 767 million litres in 1998/99, giving a projected increase to 1,309 million litres in 2009/10. Domestic supply is unlikely to be able to keep pace with requirements and the gap between demand and supply is expected to increase continuously from 21 million litres in 1998/99 to 99 million litres by 2009/10. This deficit is likely to be met by the importation of milk from neighbouring states; currently 16.5 million litres/year are imported. The State Directorate of Animal Husbandry in Himachal Pradesh estimates that less than 8% of total milk produced is collected through dairy cooperatives, which indicates that there is a lot of scope for expanding dairy cooperatives or private dairies. There are 250 dairy cooperatives in Himachal Pradesh of which 25% are non-functional.

Nepal's total milk production in 1998/99 was 1,073,000t, about 70% from buffalo and the remainder from cows. The average annual production of milk from cattle and buffalo was only about 386 and 827 l per animal respectively. Total milk production increased at an average annual rate of 2.6% between 1984 and 1998/99. In urban areas in particular, the percentage of households buying milk increases with an increase in household income. About 79% of urban households in the top 10% purchased milk but only 21% of households in the bottom 10%. The average annual per capita consumption of milk (purchased + home produced + received in kind) was estimated to be about 27 l (38 l in urban areas and 26 l in rural areas). Total annual per capita expenditure on milk, ghee, and other milk products was estimated to be NRs 514 (NRs 812 in urban areas and NRs 491 in rural areas). Milk accounts for an average of 6% of total household expenditure (about 5% in urban areas and 7% in rural areas) and milk products about 10% (11% in urban areas and 10% in rural areas).

Under the real per capita income growth scenario, the projected demand for milk in urban areas is expected to rise from 115 million litres in 1999 to 1,221 million litres in 2015. In rural areas, the projected demand for milk would rise from 638 million litres in 1999 to about 1,076 million litres in 2015. Under the current state of technology and productivity, the milk supply-demand balance is expected to decrease from a surplus of 347 million litres in 1999 to 96 million litres in 2010 and a net deficit of 422 million litres by 2015. If 3% additional growth in supplies is assumed, a net surplus of 380 million litres of milk in 1999 would increase to 429 million litres in 2015. If higher real gross domestic product (GDP) growth is assumed, the deficit under the lower production scenario would be 615 million litres. If per capita consumption increases but milk production stagnates, the country could experience a net deficit of nearly 1,800 million litres of milk by 2015.

CONSTRAINTS, PRIORITIES, AND OPPORTUNITIES IN SMALLHOLDER DAIRY PRODUCTION

The studies have pointed out various constraints encountered by dairy farmers. Shortage of feed and fodder is the most significant. The primary reasons for the shortage of fodder are small farm size, limited access to CPRs, limited use of common property land for growing fodder grasses, and lack of group action on common property land. The rising price of concentrate feed and the poor quality of purchased feed are

further large drawbacks for farmers. The low productivity of milch animals, due to poor feeding practices and the keeping of inappropriate breeds, is also one of the major constraints.

Across the study areas, the acute shortage of green forage during winter and early summer compared to the summer (rainy season) can be noted. This calls for appropriate technologies to produce green forage during the dry period. It would also be advantageous if leguminous forage species could be identified for winter-feed supplementation as at present rice straw constitutes the bulk of feed during this period. The cultivation of leguminous crops would also improve the fertility of the soil.

Similarly, a vast opportunity exists for the planting of suitable fodder trees on private land and community wasteland, which eventually could mitigate the shortage of animal feed during the winter and dry period of the year. Forage crops can be introduced as relay crops between agronomic crops. If five crops are grown over two years, at least two crops should be forage crops.

Another important constraint is the shortage of veterinary services. This is primarily due to the limited number of private enterprises dealing with veterinary medicine and vaccines and to poor upland-lowland linkages. The lack of veterinary services directly affects the choice made by farmers regarding the breed of livestock they rear. In Himachal Pradesh and Bhutan, the availability of better veterinary services has helped farmers to rear more productive crossbred cows.

A lack of quality animals is another major constraint. This is common in inaccessible mountain areas. The high price of crossbred animals, the lack of quality feeds, the risks involved, and government restrictions on animal trade are some of the key reasons for limited adoption of improved dairy animals. According to farmers, the low price of milk is a disincentive to raising quality dairy animals. Milk pricing is not based on the price of dairy inputs and the pricing policy does not reflect the farmers' investment in dairy production.

A shortage of farm labour as a result of increased out-migration and high wages has also been pointed out by some studies as being a major constraint. This is particularly relevant in the Bhutan study. Furthermore, farmers need proper credit services to be able to buy high-yielding milch animals. The present inadequate number of field-based credit institutions to cater for the needs of smallholder dairy farmers seems a critical constraint.

Despite playing a key role in dairy farming, women have not been recognised for their contribution. The insensitivity of planners and local institutions to gender needs and concerns is another major constraint. Hence, women's role in dairy-animal management should be well recognised and village-level training programmes on dairy management should be organised for women farmers, covering all aspects of dairy production including feeding, preventive health care, breeding, calf rearing, and milk marketing. Continuous exposure of small-dairy women farmers to dairy-related education and training, provision of subsidies and credit, remunerative prices for produce, and awareness of health and hygiene among consumers, could create a dairy revolution in this mountain region.

Dairy activities appear to be concentrating near urban and peri-urban areas. As the urban areas in the mountains grow, the demand for dairy products will increase. This will further increase the scope for dairy development near urban areas. The current

environmental impact and long-term dimension of this development must be examined. The dynamics of dairy development also seem to affect nutrient-cycle links with rural areas and this aspect also needs to be studied.

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

Quality control of dairy products in informal markets and rules and regulations to be imposed on milk suppliers is an issue of great public interest. It would be useful to formulate a framework based on extensive information and suggestions from a large number of consumers. To achieve quality dairy products, both traders and producers should be trained by the authorities concerned in the improvement of product quality, especially product handling, packaging, processing, and hygiene issues.

Milk holidays remain a constraint for marketing.

IMPLICATIONS, POLICY RECOMMENDATIONS, AND PRIORITY RESEARCH AREAS

The smallholder dairy sector is playing a critical role in generating cash income in the hills of India and Nepal. It is not as advanced in Bhutan as it is in Nepal and India, though considerable scope for the promotion of smallholder dairy farming in Bhutan does exist. Although government programmes have pushed for crossbred cows as dairy animals, buffalo, although they have not received much attention, are becoming popular among small farmers as dairy animals, because of their adaptability to local feed resources and their high milk fat content and salvage value in the hills of India and Nepal. In Bhutan, because of the government programme, there is a significant increase in crossbred cows in certain pocket areas where smallholder dairy farming is popular. On the other hand, in Nepal and Uttaranchal crossbred cows form a very small portion of the total dairy animal population. In Himachal Pradesh, there is an increasing trend towards crossbred cows. Thus, the present scenario shows a diversity in terms of the keeping of crossbred cows, and their number seems to increase with increasing quality of veterinary services and access to manufactured feeds.

Initially, smallholder dairy farming was promoted through the marketing arrangements of parastatal government organisations such as DDC (Nepal) and MilkFed (Himachal Pradesh, Uttaranchal, and Bhutan). These organisations have milk chilling and processing facilities and they have organised farmers groups' or cooperatives to collect farmers' milk to be taken to chilling and then to processing centres. Nevertheless, these systems are collecting barely a quarter of the total marketable milk. A lot of milk is still being channelled through the informal sector, and in Nepal private dairies with their own chilling and processing plants are increasing significantly. The producers' share of the consumer price is lowest with the sales of milk to the parastatal organisations. The operating costs of these organisations are high and many cooperatives, for example in Himachal Pradesh, are defunct; others are functioning inefficiently. There are also some critical problems related to these organisations, for example, having milk holidays for almost four to five months during the peak milk production season in the hills of Nepal. This problem seems to be a very

serious one for smallholders because they depend on cash income from milk sales. The problem seems to be compounded by the importation of cheap powdered milk and the government's lack of monitoring for assuring the quality of pasteurised milk for consumption. Lack of product diversification seems to be one of the reasons for milk holidays. These organisations, which are heavily subsidised with government or donor aid money, have not contributed to dairy sector development to the extent that was expected. This suggests that the government needs to formulate a favourable policy to promote the private-sector dairy industry. The role of the state should be limited to facilitating the growth of private dairy industries and monitoring for the quality assurance of these industries.

Animal feed, animal breed, and marketing and processing and their related policies are critical issues across the HKH region for promoting smallholder dairy farming in mixed mountain farming system areas. Shortage of feed during the dry period and the winter is a serious problem affecting the milk productivity of dairy animals. Commonly the animals kept are local breeds in which milk productivity is low compared to crossbred animals. Product diversification appears to be a key issue in terms of low income from milk marketing and processing.

In order to address the above key issues, it is recommended that the government plays a role in addressing the issues of natural resource management, with community participation, to increase animal feed resources from CPRs. Another important issue the government needs to address is how private land can be used efficiently to grow fodder trees and forage crops without them competing with other cereal cash crops. In addition, the identification of suitable dairy animal breeds for different agroecological zones could assist farmers in making the right investment.

Finally all the studies show that the demand for dairy products is likely to increase considerably in the future due to an increase in the urban population and its income. With the existing levels of technology and participation of smallholder dairy farmers in the market, the hill and mountain regions are likely to face serious deficits. Currently, Bhutan and Himachal Pradesh both import milk and milk products (from India and neighbouring states, respectively). In Bhutan a fairly large proportion of urban demand is met through imports. The fundamental issue is how to help a greater number of smallholder dairy producers participate in the market. Enabling greater participation of smallholder producers has positive implications for mountain economies in terms of farm employment and income.

In view of the constraints and opportunities that are common across the HKH region, the participants of the stakeholders' meeting in August 2001 identified the following as priority research issues for the region.

- The promotion of sustainable use of CPRs and private land for improved dairy production.
- The characterisation and identification of dairy breeds and species for the HKH region
- The impact of national dairy policy on smallholder dairy development in the HKH region.