Smallholder Dairy
in Mixed Farming Systems of the HKH

Pradeep Man Tulachan
Mohammad A. Jabbar
M.A. Mohamed Saleem

ICIMOD
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about the organisations

The International Centre for Integrated Mountain Development (ICIMOD)

The International Centre for Integrated Mountain Development (ICIMOD) is an international organisation devoted to development of the Hindu Kush-Himalayan region covering all or parts of eight sovereign states:  Afghanistan,  Bangladesh,  Bhutan,  China,  India,  Myanmar,  Nepal, and  Pakistan. The Centre is located in Kathmandu, Nepal. The primary objective of the Centre is to promote the development of an economically and environmentally sound mountain ecosystem and to improve the living standards of mountain populations. The Mountain Farming Systems' Division at ICIMOD was established to promote improvement of farm productivity on small mountain farms without degrading the resource base.

The International Livestock Research Institute (ILRI)

The International Livestock Research Institute conducts research in animal agriculture to reduce poverty, hunger and environmental degradation in developing countries. ILRI works in the developing world: sub-Saharan Africa; South, Central and South-East Asia; and Latin America and the Caribbean.

ILRI's strategy is to use science to overcome problems in animal agriculture in developing countries and to address new opportunities and challenges presented by an increasing demand for livestock products globally. Its work encompasses strategic and adaptive research and spans the discovery to delivery continuum. ILRI conducts research in systems analysis and impact assessment; people, livestock and the environment; livestock policy analysis; livestock health; livestock feeds and nutrition; livestock genetics and genomics; strengthening partnership for livestock research; smallholder dairy; smallholder livestock systems in West-Africa; crop-livestock systems in mountainous regions; and rainfed crop-livestock systems in South-East Asia.

Smallholder Dairy

in Mixed Farming Systems of the Hindu Kush-Himalayas: Issues and Prospects for Development

Pradeep Man Tulachan
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International Centre for Integrated Mountain Development (ICIMOD)
Kathmandu, Nepal
September 2002

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Published by
International Centre for Integrated Mountain Development
G.P.O. Box 3226
Kathmandu, Nepal

ISBN 92 9115 636 1

Editorial Team
A.Beatrice Murray (Editor)
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Printed and bound in Nepal by
Hill Side Press (P) Ltd.
Kathmandu

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Foreword

Mountain resources directly contribute to the livelihoods of several hundred million people living in mountain areas and indirectly support the livelihoods of several billion people living downstream. The state and use of mountain resources constitute an issue that affects us all, and the International Centre for Integrated Mountain Development (ICIMOD) is at the forefront of efforts to help promote the development of an economically and environmentally sound mountain ecosystem and to improve the living standards of mountain populations.

The great majority of people in the Hindu Kush-Himalayan (HKH) region depend upon agriculture as their main source of livelihood; most are mountain and hill farmers with marginal or small farms covering less than two hectares of cultivated land. Thus the well-being of mountain people is to a great extent determined by the state of mountain agriculture – and the potential for economic improvement by the ability to produce products for market.

Livestock are an integral, but often under appreciated, component of farming in the mountains and highlands. They provide food, wool, and hides for people and draught power and fertiliser for the cultivation of crops. In the past, and still in remote areas, livestock have been the key to ensuring that farmers can practise a self-sustaining and self-sufficient form of agriculture in reasonable harmony with the natural resources of the mountains. In recent years, however, livestock have begun to play a somewhat different role, as important agents in the transformation from traditional subsistence-based farming to a more market-oriented approach.

Market-oriented dairy farming by smallholders practising a mixed crop-livestock form of farming, can be a key to economic development in many areas of the HKH, particularly in peri-urban areas with good access to markets. ICIMOD, supported by FAO, initiated studies of livestock in mixed farming systems some years ago, and supported by ILRI has now followed on with this detailed study of smallholder dairy farming in high pressure areas of the region.

ICIMOD is delighted to be able to present the results of this study. The publication is intended to raise awareness of the issues involved in and requirements for the development of the dairy sector in the HKH region. It outlines a number of research needs and provides a guide for future efforts. I hope that it will help raise awareness and understanding of issues and help effective promotion of the development of dairy farming in the region. The studies involved the input of a large number of smallholders, suppliers, and consumers, and once again we are grateful for the time and efforts of all involved, and hope that the study will lead to long-term benefits for the hill and mountain smallholders in the region.

Binayak Bhadra
Director of Programmes
ICIMOD

Author's Note

This publication provides a synthesis and summary of the results of four case studies carried out jointly by the International Livestock Research Institute (ILRI), and the International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, in collaboration with national partner institutions in Bhutan, India, and Nepal, under a project funded by ILRI.

The first chapter contains an overall synthesis, the remaining four chapters are summaries of the results of the detailed reports. The titles and authors of the original reports and the names of the implementing organisations are given below. Copies of the original reports are available on request from ILRI and ICIMOD.

Bhutan

Sustainable Development of Smallholder Dairy Farming in Bhutan
Phanchung, Phub Dorji, Thubten Sonam, and Kinley Pelden
Natural Resources Training Institute, Lobesa, Wangdue Phodrang, Bhutan

India

Smallholder Dairy in Highland Areas of the Hindu Kush-Himalayas: a Rapid Appraisal in Himachal Pradesh, India
Ranveer Singh and C. Shekhar Vaidya
Agro-Economic Research Centre, Himachal Pradesh University, Summer Hill, Shimla, India

Smallholder Dairy in Mixed Crop-Livestock Farming Systems in the Uttar Pradesh Himalayas, India [Uttaranchal]
Vir Singh
G.B. Pant University of Agriculture and Technology, Pantnagar, India

Nepal

Smallholder Dairy Farming in Mixed Crop-Livestock Farming Systems of Nepal
Bikash Sharma and Kamal Banskota
Centre for Resources and Environmental Studies (CREST), Kathmandu, Nepal

This report combines the results of three case studies carried out for CREST in different regions of Nepal: in the Western Hills [Western Region] by Bhoj Raj Joshi of the Lumle Agricultural Research Centre; in the Ilam Milkshed Area [Eastern Region] by Kamal R. Gautam of the Department of Agriculture; and in the Kathmandu Milkshed Area [Central Region] by Hari Ram Shrestha of the National Agricultural Research Council

Executive summary

Over the past 10 to 15 years, considerable changes have taken place in the structure and management systems of smallholder dairy farming within the mixed crop-livestock farming systems of the Hindu Kush-Himalayan (HKH) region. In particular, there have been notable changes in the species and breeds of the dairy population, infrastructure, and market developments. Increasing urban markets and improved marketing systems have led to a slow but steady move towards dairy farming as a means of supplementary income generation and even as a commercial venture rather than as part of a subsistence system.

A rapid appraisal study was carried out by the International Centre for Integrated Mountain Development and the International Livestock Research Institute in collaboration with national partner institutions in four hill/mountain regions (Bhutan, the Nepal Hills, the Central Indian Himalayas (Uttaranchal), and the Western Indian Himalayas (Himachal Pradesh)) to gather information about the way in which these changes have affected smallholder dairy production systems in the HKH region, the constraints on and opportunities for smallholder dairy development, and priority areas for further research. The results of the survey are presented in this publication, with an overall summary followed by more detailed summaries of the findings in the four different areas.

The smallholder dairy sector plays a critical role in generating cash income in the hills of India and Nepal. Smallholder dairy farming is not as advanced in Bhutan as it is in Nepal and India, but there is considerable scope for its promotion. In India and Nepal, although government programmes have promoted crossbred cows for use as dairy animals, the use of buffalo is becoming popular among small farmers because of their adaptability to local feed resources, high milk fat content, and salvage value in the hills. In Nepal and Uttaranchal, crossbred cows form a very small portion of the total number of dairy animals. In Himachal Pradesh, however, there is an increasing trend towards using crossbred cows. In Bhutan, because of a government programme, there has been a significant increase in crossbred cows in certain pocket areas where smallholder dairy farming is popular.

Smallholder dairy farming is promoted through the marketing arrangements of parastatal government organisations such as the Dairy Development Corporation (Nepal) and the Milk Federations (Himachal Pradesh, Uttaranchal, and Bhutan). These organisations have milk chilling and processing facilities and have organised farmers' groups or cooperatives to collect milk and deliver it to the chilling and processing centres. Overall, however, these systems are collecting barely a quarter of marketed milk. The greater part is channelled through the informal sector (direct sale to consumers by the farmer or through traders) and private dairies. Particularly in Nepal, private dairies with their own chilling and processing plants are rapidly becoming established. The operating costs of the parastatal organisations are high and this can lead to a variety of problems: in Himachal Pradesh, for example, many cooperatives are defunct and others are not functioning as efficiently as they could. There are some fundamental problems with these organisations, for example the existence of 'milk

holidays', with refusal of milk deliveries once or twice a week, for almost four to five months during the peak milk production season in the hills of Nepal. Such problems are very serious for smallholders because they depend on the cash income from milk sales. In view of the present state of dairy farming, it is essential that governments formulate favourable policies to promote the private sector in the dairy industry. The role of the state should be limited to facilitating the growth and monitoring the quality of the private dairy industry.

Animal feed and breeds, and policies for dairy marketing and processing are critical issues across the HKH region for the promotion of smallholder dairy farming in mixed mountain farming systems. Shortage of feed during the dry period and the winter is a serious problem affecting the milk productivity of dairy animals. Local breeds are still the most common animals and their milk productivity is low compared to that of crossbred animals. Lack of product diversification seems to be another important reason for low income from milk production.

This publication makes recommendations for the role of governments in addressing the above key issues. Community participation in natural resource management needs to be encouraged to increase animal feed resources from common property resources. Efficient use of private land to grow fodder trees and forage crops without competing with other cereal cash crops needs to be investigated. Suitable dairy animal breeds need to be identified for the different agroecological zones. All of these will assist farmers in making good investments.

The studies show that the demand for dairy products is likely to increase considerably in the future in response to increases in urban populations and incomes. With the existing technology and marketing systems, the hill and mountain regions are likely to face serious deficits in dairy products. Bhutan, for example, imports milk and milk products from neighbouring states. The fundamental issue to address is how to bring about the participation of more smallholder dairy producers in the market. Achieving this will promote mountain economies in terms of farm employment and income.

It should be possible to upscale the successes of livestock sector initiatives in certain pocket areas in other degraded uplands in the mountains of the HKH. Smallholder dairy farming integrated with agroforestry-grassland systems can ensure equitable distribution of income through greater participation of poor and vulnerable farmers; can provide upland mountain communities with alternative opportunities for income generation; and can impact positively on the environment through judicious land management for growing fodder trees and grasses, thus reducing soil erosion and landslides. Initial facilitation is required for the delivery of appropriate technological options such as agroforestry-grassland systems and for linking up with market opportunities. Such an approach can be promoted through government and donor programmes, using local non-government organisations.

Acronyms and Abbreviations

AI	artificial insemination
APROSC	Agricultural Project Service Centre
BDL	Bhutan Dairy Limited
BEH	bovine enzootic haematuria
BQ	black quarter
CBS	Central Bureau of Statistics
CDB	community development block
CDR	Central Development Region
CGR	compound growth rate
CPR	common property resource
CS	cooperative society
CU	cow unit
DAD	Department of Agricultural Development
DAP	draught animal power
DDC	Dairy Development Corporation
DLS	Department of Livestock Services
DMU	Dairy Milk Union
EDR	Eastern Development Region
FAO	Food and Agriculture Organization
FMD	foot and mouth disease
FWDR	Far Western Development Region
FWM	fresh whole milk
GDP	gross domestic product
GIS	geographic information system
HIG	high-income group
HGM/N	His Majesty's Government of Nepal
HKH	Hindu Kush-Himalayas
HS	haemorrhagic septicaemia
ICIMOD	International Centre for Integrated Mountain Development
ICMR	Indian Council of Medical Research
ILRI	International Livestock Research Institute
IRs	Indian rupees
LIG	low-income group
LSC	livestock service centre
LSU	livestock unit

MCC	milk chilling centre
MilkFed	Milk Federation
MoA	Ministry of Agriculture
MPA	Milk Producers' Association
MPC	milk producers' cooperative
MPU	milk processing unit
MSS	milk supply scheme
MWDR	Mid Western Development Region
NABARD	National Bank for Agriculture and Rural Development
NLSS	Nepal Living Standard Survey
PPR	peste des petits ruminants
RGOB	Royal Government of Bhutan
RNR-RC	Renewable Natural Resources Research Centre
NRs	Nepalese rupees
SLU	standard livestock unit
SMP	solid milk powder
SNF	solid-not-fat
VDC	village dairy cooperative
WDR	Western Development Region

NOTE:

Currencies are given in local denominations. The conversion rates at the time the surveys were carried out were:

NRs 68 = US $1
Nu 42.5 = US $1
IRs 42.5 = US $1

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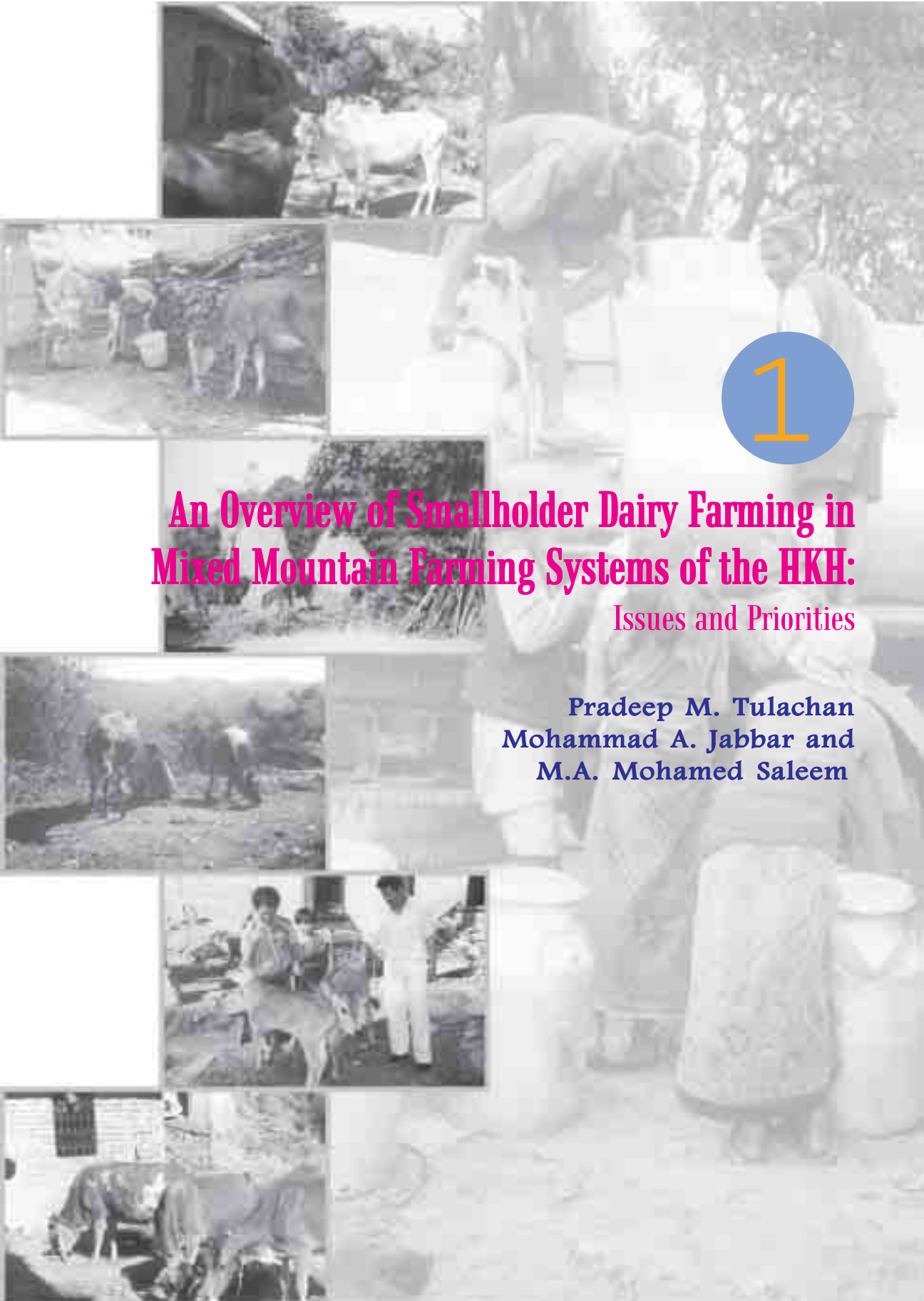

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An Overview of Smallholder Dairy Farming in Mixed Mountain Farming Systems of the HKH:

Issues and Priorities

Pradeep M. Tulachan
Mohammad A. Jabbar and
M.A. Mohamed Saleem

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 NRs[1] 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.

2

Smallholder Dairy Farming in Bhutan:

Characteristics, Constraints, and Development Opportunities

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Chapter 2

Smallholder Dairy Farming in Bhutan:
Characteristics, Constraints, and Development Opportunities

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CONTEXT

Livestock are raised in Bhutan for various reasons including milk, food, and manure production, draught power, as a source of income, and as assets. Dairy products, especially butter and cheese, form an important component of the Bhutanese dietary system and more recently have become an important source of cash for some households. About six cattle breeds are used for milk production in Bhutan.

During 1989-1999, the population of crossbred cattle (crossed with exotic breeds) increased by over 100% whereas the indigenous cattle population decreased by 9% and the overall cattle population decreased by 2.4%. There has been a steady increase in total milk production in the country mainly due to the increased number of crossbred cattle. However the growth of the dairy development sector has also encountered several constraints, particularly in terms of market development. This study was initiated to examine the issues and problems of market-oriented smallholder dairy farmers in Bhutan and to provide recommendations for the development of the dairy sector.

STUDY SITES AND METHODOLOGY

Two milkshed districts (dzongkhags) Chukha and Bumthang, both with milk cooperative society facilities, were selected to represent south-west and east central Bhutan. Within these, Darla geog, with a chilling facility for 1,000 l of milk, was selected as the study site in Chukha dzongkhag, and Chokhor geog with a milk cooperative and Tang geog without as the study sites in Bumthang dzongkhag. Thimphu district in the northwest, with no cooperative facility, was selected in view of the market potential for dairy products in Thimphu town. The study in Thimphu dzongkhag was limited to urban and periurban areas of the town, in particular Chang geog.

A rapid market appraisal and consumer survey was carried out in the capital city of Thimphu. A total of 75 consumers – hoteliers, civil servants, and businessmen – were

covered by the survey as well as 17 retailers of locally produced and imported dairy products.

The information was collected through structured questionnaires.

DAIRY PRODUCTION SYSTEMS

The majority of the population of Bhutan (overall 79% rural and 21% urban) eke a subsistence living from agriculture and most of these are smallholders. Smallholder dairy farming is an integral component of the mixed smallholder farming system in Bhutan and has been a focus of many rural development projects and plans. Considerable efforts and money have been spent on dairy development through the 5th to 8th 5-Year Plans (1982-2002) (Roder et al. 2001), and substantial improvement and development has been achieved so far. However, little has been documented about the achievements or related problems.

Cattle production in Bhutan can be categorised into two broad systems: transhumant and sedentary.

Transhumant system

The more traditional transhumant system involves cattle migration. In summer (May-June), cattle move to the cooler regions where they are herded on traditional grazing land (tsamdok) at altitudes of about 1,200-3,000m. By late autumn they move down to the subtropical regions. A subsystem, share herding, is practised in places like Paro and Haa. In this subsystem a special herding partnership is formed between cattle owners from the cooler regions and those from the subtropical regions. The herding responsibility changes hands with the migration but the ownership of the cattle remains with the original owner. The herd sizes range from about 20 to some 80-100 cattle, and the predominant breed is the local Siri and Mithun crossbreed.

Sedentary system

This system can be considered as a crop-cattle system. From two to eight cattle are kept around the homestead. The cattle are mostly grazed on common property resources (CPRs) and brought to the homestead at night, some home-mixed supplement may be given to milking cows. Some cows, particularly improved breeds, may be stall fed. In peri-urban areas that are accessible by road, the practice of keeping and stall feeding improved dairy cows is increasing.

Production of milk and milk products at household level

Most farmers keep cattle and produce some milk, mainly for home consumption. In areas near to the market and accessible by motor vehicles, the trend towards market-oriented production is increasing. Most farmers in such areas produce milk over and above the household needs and earn a substantial income from selling it. Farmers in the Deothang Milk Cooperative Society sell an average of 1.5-3 l of milk daily. Tamang and Gyeltshen (1998) reported an average monthly household production of 125 kg in winter and about 308 kg in summer.

Livestock holding and herd size

Cattle holdings in the surveyed areas consist of 83% crossbred and 17% indigenous cattle. Of the total population, 58% were breedable females and only 26% were males.

The remaining 16% were calves below 1 year of age. This is a clear indication that the improved cattle population has been increasing over the years through government intervention. The average cattle holding per household among the surveyed farmers was eight, whereas the national cattle holding per household is estimated to be around five.

In response to the interview question of whether to increase, decrease, or maintain the existing herd size, 29% of farmers wanted to increase, 39% to reduce, and around 32% to maintain their herd size. Generally it was those farmers who had direct and easy access for the sale of dairy products who wanted to increase their herd size, irrespective of the existing number and farm labour requirements. Farmers with a limited landholding, no farm labour, and a large herd size wanted to reduce the number of cattle. Those farmers who had an established market for dairy products, adequate land for pasture development, and manpower for cattle herding wanted to maintain the existing herd size.

Source of income

In the east central dzongkhag, 90% of the surveyed farmers' income was from dairy farming, in the southwest and northwest, 50-60%. Overall, field crops, especially potatoes, were the major source of income in the east central dzongkhag (Bumthang). Paddy was the main crop in the southwest and northwest dzongkhags. Off-farm activities such as contract work, agricultural machinery hire, and operation of taxis, also contribute to family income.

SPECIES AND BREEDS OF DAIRY ANIMALS

Breeds

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.

The Renewable Natural Resources (RNR) statistics for 1999 put the population at 344,595 head of cattle and 1790 buffalo. Crossbreeds of Jersey and Brown Swiss constituted about 13% of the total cattle population.

The overall cattle population shows a slightly declining trend from 1986 to 1999. But there was a steady increase in the population of exotic crossbred cattle upto 1992 and a big jump in their number thereafter. There are no data available for crossbred cattle prior to 1986, but if an extrapolation is made from the curve, it suggests that the population became more noticeable from the late 1970s to the early 1980s. This could be attributed to the impact of the distribution of Jersey and Brown Swiss bulls for crossbreeding purposes under the 2nd and 3rd 5-Year Plans (1966-1975).

Production parameters

There is wide variation in production both across and within breeds, depending on management practices and availability of quality feed. The Siri, which is known for various desirable attributes, gives a poor milk yield. Under the farmers' extensive management system, the average yield is about 1.3 l daily, and 300-380 l in a lactation period of about 270-280 days. The F1 (Mithun crossbred) female, Jatsham, is prized for its high milk fat content of 10.5 ± 2.2%. In terms of milk yield, it seems to perform better than the Siri, producing about 2-3 l of milk per day, that is, about 600-650 l during a lactation period of 270-280 days. The F2 crossbreed is reported to be better than the Siri but inferior to the Jatsham in terms of milk yield (Phanchung 1996). In the Nublang Farm at Tashiyangphu, the average first- and second-lactation milk yield of Siri was reported to be around 529 l and 599 l respectively when the lactation length was adjusted to 305 days; the normal lactation length of Siri is reported to be around 250-270 days (Tshering 1998). A nationwide survey of the breed reported an average milk yield of 478 l in a lactation period of 264 days.

For the pure Jersey cows kept by farmers using improved husbandry and feeding, the average milk yield in a lactation period adjusted to 305 days was reported to be around 2322 and 2518 l for the first and second lactation respectively, with a daily yield ranging from 4 to 15 l (Rai et al 1999). A survey in Tsirang reported an average daily yield of 5-6 kg for pure Jersey cows in the summer months (Sherpa and Wangchuk 2000). However, milk yield was reported to be higher in cows fed with good quality fodder and concentrates.

ANIMAL FEED RESOURCES

In the smallholder mixed farming system prevailing among the farmers in Bhutan, the cropping system, the agroecological conditions, and the animal type influence the use of feed resources. The most common feed resources available to farmers are CPRs, forest, cultivated fodder, and crop residues. A survey in 1996 in the temperate regions of the country has shown that forest grazing and CPRs are the most important feed resources (Table 2.1 and Roder et al. 1999).

Table 2.1: **Contribution of fodder resources to the national fodder requirement**

Fodder Source	Relative Contribution (%)
Forest grazing	23
Natural grassland	38
Improved pasture	9
Fallow land	15
Fodder trees	15
Crop residues	13

Source: Roder et al. (1999)

In winter, in areas where paddy is not grown, fallow-field grazing seems to be the dominant feed resource. Feeding of hay in the winter months contributes substantially in areas where improved pasture is well established. Rice straw, barley straw, wheat straw, and maize stovers also contribute about 13% of the feed during the hungry-gap period (November to March).

Common property resources

Common property resources in the Bhutanese context can be put broadly into two categories: (1) grazing for yaks (throughout the year) and migrating cattle (in the summer) on the alpine rangelands and sub-alpine meadows; (2) forest and community grazing grounds around settlements. The latter constitute the major source of fodder for village cattle (Table 2.1).

Cattle graze on undergrowth and browse several species of fodder shrubs in the forest, and these provide about 20% of the fodder requirements of the cattle population in the country (Roder et al. 1999). Fodder tree branches are sometimes cut and carried to the homestead to be stall fed to milking cows or as a supplement to grazing, especially during the winter months.

Bhutan has about 569,000 ha of permanent grazing land, an average of 1.36 ha of natural grazing land per head of grazing animal (Roder et al. 1999). Within Bhutan, the dzongkhags, Haa, Gasa, Wangdue, Bumthang, and Trashigang have large tracts of natural grassland, while in the remainder of the east and the south there is much less grassland but large tracts of dense forest. The productivity and nutritional value of the natural grassland is generally very low.

Cattle are grazed on the land left fallow as soon as the crop is harvested. The quality and quantity of fodder available can vary substantially depending upon the crop, the weed flora, and the harvesting system. Grazing of fallow land was cited as the most important fodder source in some areas.

Improved pasture

Establishing pasture in arable land started at the beginning of the 5th 5-Year Plan (1982-1987) and by 1998, Bhutan had about 11,000 ha of improved pasture (Roder et al. 1999; 2001). Improved pasture has been cited as the most important fodder source in the temperate areas of Bumthang, Wangdue, Trongsa, Zhemgang, Paro (Roder et al. 1999), and Haa (personal observation). These dzongkhags have the largest areas of improved pasture on a household basis, with more than 0.2 ha per milking cow. Improved fodder is mainly fed to milking cows, bulls, and growing cattle. Excess grass is cut and made into hay for winter feeding in these areas.

In the temperate areas, improved pasture consists of a mixture of white clover, tall fescue, cocksfoot, and Italian rye grass while in the subtropical areas, green leaf desmodium, molasses grass, ruzi grass, and stylo are grown.

Fodder crops

Traditionally, farmers grow small quantities of fodder crops that are fed primarily to milking cows and draught animals during the dry season. At an elevation of 2,500-4,000m, the most important fodder crops are turnips, radishes, and pumpkins. At high altitudes, individual households may cultivate up to 0.3 ha of turnips annually (Roder et al. 1999). At lower altitudes, maize is cultivated, to be fed to draught animals during rice transplantation. Wheat is cultivated in a range of production systems including the rice-based systems after the rice harvest. Oats, by virtue of higher biomass production, have partly replaced wheat as a winter fodder in the rice-growing areas of Thimphu, Paro, Wangdue, and Trongsa.

Fodder trees

Fodder trees are important feed resources in many parts of Bhutan especially during the dry winter season. In fact, fodder trees were reported to be the most important fodder source in Punakha, Wangdue, Trongsa, Chukha, Zhemgang, Lhuntsi, and Mongar where between 76 and 100% of households have fodder trees with individual households owning between 1 and 1,015 trees (Tshering et al. 1997). The most important fodder tree species were *Ficus roxburhgii* followed by *F. cunia*. These fodder trees are mainly grown around the homestead, along fences, and along borders of cropland.

The yield of a fodder tree is strongly influenced by the age of the tree and the management. The reported yield range is quite wide between and across species. The highest yield was reported for *F. roxburhgii* followed by *Artocarpus*, kanue, khamari, and kutmero. The survival of newly-planted fodder trees was estimated to be less than 20%. This could be mainly due to poor management.

At elevations above 2,000m the choice of fodder tree is limited. The most important fodder trees are willow, *Quercus semicarpifolia*, *Populus robusta*, and Chinese pear, fodder yields from these trees were estimated at 4t, 2t, 4t, and 12t per ha per year, respectively.

Crop and agroindustrial residues

Crop and agroindustrial residues account for a major portion of the feed requirement of cattle. Maize, wheat, and buckwheat straw are important winter feeds in the areas where they are grown, while rice straw is used by almost all farmers in rice-growing areas. Other important crop residues include inferior and broken grain, and husks and chaff (by-products of milling). Residues from chang (local brew) production also provide an important feed for dairy cattle.

Commercial concentrate mixtures

Commercial concentrate mixtures are supplied by a feed manufacturing plant in Phuntsholing; feeding of concentrate mixture is mainly confined to the government and peri-urban dairy farms. Concentrate feed is unaffordable for most farmers and not readily available even if they could afford it. Between 33 and 97% of the sample households in the survey districts fed concentrate mixture while 89% also fed a home-made mixture consisting of mustard oil cake, maize flour, chang residue, salt , kitchen waste, and boiled water.

LIVESTOCK HEALTH SERVICES

Health management

Animal health is known to play an important role in animal production. In turn animal health is influenced by factors such as disease resistance, nutrition, and the animals' environment. The most common infectious diseases of cattle in Bhutan are foot-and-mouth disease (FMP), haemorrhagic septicaemia (HS), black quarter (BQ), and respiratory diseases. Bhutan has been fortunate enough to be able to eradicate rinderpest through rigorous vaccination and has been provisionally declared as a rinderpest free country. Control of diseases such as FMD, BQ, and HS is carried out through regular mass vaccination.

Parasite infestation is a major economic disease as it affects milk production to a considerable extent. Intestinal worm infestations and external parasite, mainly tick, infestation were the major problems in cattle in all the survey areas. Farmers receive adequate veterinary treatment for intestinal worm and liver fluke in their cattle from the livestock extension centres. However 30% of the surveyed farmers claimed that there were no drugs available against tick infestation in the veterinary centres despite a high rate of seasonal infestation of ticks in cattle.

Infestation by liver fluke is very common in rice-growing areas while roundworm infestations are more widespread. Periodic de-worming is advocated to control these parasites. Tick infestation and tick-borne diseases (babesiosis, anaplasmosis, and

theileria) are other major problems in cattle especially in the subtropical areas. A study in the east (Sharma et al. 1999) showed the incidence of tick-borne diseases to be about 19%. Other emerging diseases are bovine enzootic haematuria (BEH) and oak poisoning. The oak-poisoning morbidity rate in most cases is 100% with about 20% mortality. The poisoning results from consumption of oak leaves during the hungry-gap period. The incidence of BEH has been found to be around 62% in the east (Sharma 2000).

The most important diseases with regard to milk production are various reproductive disorders, nutritional deficiency diseases, and mastitis. The incidence of nutritional deficiency diseases has not been recorded. Dorji (1999) reported the incidence of infertility to be as high as 63% of all cows in Bumthang, the incidence of sub-clinical mastitis in eastern Bhutan was found to be about 24% (Sharma et al. 1998).

Animal health care services are provided by one veterinary hospital in each district and 109 livestock extension centres manned by 347 animal health staff. These field services are supported by a national referral laboratory, four regional veterinary laboratories, two satellite laboratories, a vaccine production centre, and two quarantine stations. All the laboratories are reasonably established and well equipped.

Cattle health management is recognised as an important aspect of dairy husbandry. Farmers ensure their cattle herds are vaccinated in good time against all major and notifiable diseases at their respective livestock extension centres. Although the animal health service in Bhutan is quite impressive, with a network of veterinary centres throughout the country, the recorded mortality of cattle over the last 3-5 years was around 130 heads in 82 households.

GENDER AND LIVESTOCK

The activities related to dairy farming are generally shared by family members. However, the contribution of women to activities like milking, milk processing, feeding, feed preparation, and fodder collection is higher than that of men. This could be attributable to the gender imbalance in the workforce available in individual households as men are more likely to be engaged in off-farm work (Roder et al. 1999). The contribution made by children to some activities, such as herding, is considerable.

Figure 2.1: Proportion of household activities related to dairying by gender

In the surveyed areas, only three of the total average family of nine were actually available for farm labour (Figure 2.1). The majority of the household were not able to contribute to farm labour as they had other occupations, for example, attending school, working in

were not able to contribute to farm labour as they had other occupations, for example, attending school, working in government jobs, or as monks and nuns.

MARKETING OF DAIRY PRODUCTS

The dairy component of the traditional Bhutanese farming system is basically subsistent, and in most areas the marketing of dairy products remains very basic and traditional and is limited to the management of local surpluses and shortages. There is no organised marketing system; occasional unplanned surpluses are bartered, or sold for cash at a high price. It is, in fact, questionable, whether these products should really be considered as surplus, considering family needs for other products and cash. Organised marketing of livestock products is very limited and exists only in certain parts of the country. However, changes in dairy production are taking place especially in the areas with access to marketing opportunities for dairy products. The ever-expanding urban population provides better marketing opportunities. For example, in the case study areas, most of the surveyed farmers produced milk for market. The fresh whole milk is sold directly to the processing units and collection centres, providing an important source of cash income.

Economics of dairy production in peri-urban areas

A case study dairy farmer in Thimphu earned a total gross income of Nu[4] 758,000 in 2000 from eight milking cows. The farm's overall net income was estimated to be Nu 383,000/year and net return excluding labour costs was Nu 347,000. The farm had a high net return mainly because there were no financial obligations such as the repayment of loans, and the feed costs were low because the farm used mostly local feed resources and cattle were grazed in the nearby forest. The feed cost accounted for only 21% of the total variable costs. The farm's breakeven production point was 15,000 l/year at an output price of Nu 25/l; the breakeven price of milk production was Nu 12.5, 50% of the output price of Nu 25/l.

Dairy marketing system

Almost all local dairy products are marketed through an informal, unorganised system. Imported dairy products are marketed through a comparatively well-organised, but nonetheless inadequate, system. However, there are now three milk processing units (MPUs) of different capacities in Bhutan (Trashiling MPU in Trongsa [500 l/day], the MPU in Bumthang [1,000 l/day], and Bhutan Dairy Limited (BDL) in Phuntsholing [4,500 l/day]) and some milk collection associations in the east for marketing fresh milk. Fresh milk marketing is mostly confined to places with access to processing facilities and peri-urban areas where producers take advantage of the urban population who buy milk for fresh consumption. In general, the major proportion of locally produced milk is processed, and consumed and/or marketed as butter and datse cheese (a cheese processed from the buttermilk after extracting the butter).

The current dairy marketing system in the sampled study areas can be classified into three main subsystems or channels as described below, involving farmers, middlemen, traders, retailers, and processing plants. The middleman is the agent between the trader and the farmer, who can also be a producer. The trader is the person who collects from the middlemen and transports to the market centres, usually performing the job of a wholesaler and supplying to the retailers in the local market or urban market centres.

[4] 42.5 Nu = US$1 (in 2000) the Nu is on par with the Indian rupee

The survey of local dairy product traders revealed that each trader supplies regularly to a number of contract retailers who sell directly to the consumers. Some traders also act as retailers, after supplying the required quantity to their contract retailers. Thus, the people involved in the system can have more than one function: farmers can be just producers selling their products, but they may also function as middleman; similarly middlemen, traders, and retailers can perform more than one role.

Marketing channels for dairy products

Although supply and demand basically determines the flow of dairy products, the accessibility and availability of transportation and markets also exerts an influence. Different market outlets (trade within the village, middleman and traders, and processing and collection units) are all part of the dairy marketing system. However, for the producers, not all market outlets or places are equally accessible, for various reasons. In the following, the market outlets are divided into two categories: the domestic market, that is urban markets within Bhutan but outside the farmer's dzongkhag, and the local market, that is the local towns and shop settlements that are visited frequently by the farmers. There are three basic marketing channels.

Producer/farm — local consumer/market

Most dairy products in Bhutan are marketed through this channel. Many producers sell their products directly from their own farms. In the study areas, many farmers sell their dairy products within the village to neighbours and also to people from other villages. Considering the small quantities the farmers have for sale and the time constraints, trade within the village is advantageous for most farmers. Beside the trade within the village, the farmers also use the local market for selling their dairy products. The main buyers include shopkeepers, local town residents, civil servants working in the area, and passers-by. Producers also sell fresh whole milk direct to consumers in close-by urban areas, for example, producers in villages nearby Thimphu sell whole milk direct to consumers in the town. Similarly, producers in Babisa village of Thimphu sell their milk direct to the Dantak (Indian road construction company) workers. These producers have virtually no marketing costs as the consumers come to the farm and collect the milk in their own containers.

Even in areas with marketing opportunities for milk, farmers retain a certain amount for processing into butter and cheese for home consumption and for sale. In the winter around 42% of the surveyed farmers retained a proportion of milk for processing into butter and cheese and in summer around 21%. These processed products are traded within the village or taken to local markets when they are visited for work or to purchase necessities such as salt and cooking oil.

More producers retain milk during winter as then they have time for processing as there is less farm work, and the butter and cheese do not spoil so easily. Furthermore, the overall quantity of milk produced also decreases in winter; the small quantity produced is retained entirely for home consumption by some households. About 20% of the producers in winter and 27% in summer retained fresh milk mainly to use in the preparation of sweet tea.

Producer — middlemen/traders — consumer outlet

Marketing through middlemen or traders is often used for the sale of dairy products like butter and cheese by dairy producers without easy access to market outlets, but

sale of fresh whole milk through this channel is uncommon. Producers with large herds process the milk and sell the products to middlemen or traders who take it to the domestic market centres. Thimphu is the main domestic market for butter and cheese coming from Samchi, Haa, and Phuntsholing through traders or middlemen. The middlemen and traders supply to contract retailers and vendors on a wholesale basis. Some informal and unwritten contractual agreements are made, particularly regarding the price and quantity to be supplied or purchased every week.

The local Saturday and Sunday markets in Thimphu are the main markets for the sale of butter and cheese. Therefore, the traders of dairy products, particularly butter and cheese, try to deliver their produce to Thimphu by Friday evening to distribute to the contract vendors and retailers the same evening for sale the next morning.

Producer — milk processing units/collection centres — retailers — consumer outlet

Currently, the sale of milk and milk products through this type of structured or organised system is limited to a few areas only, and is more common for the sale of fresh liquid milk. The producers sell their milk to the processing units or collection centres at a fixed price.

Milk marketing in Darla

The Bhutan Dairy Limited (BDL) in Phuntsholing, a government-owned plant leased out to the private sector, is the only organised processing facility for farmers from Darla to market fresh whole milk. Darla itself has a chilling centre with a capacity of 1,000 l established for the collection and storage of milk supplied by farmers. At present the actual supply is only about 500-600 l every 2 days, after which the milk is delivered to Phuntsholing. The main reasons for the low and irregular supply of milk by farmers are the low price offered by BDL, the high local demand for butter and cheese, and for some farmers the inaccessibility of the chilling plant or collection points. If BDL does not initiate a promotional programme and seriously review their pricing policies and other related issues, the supply of milk is likely to deteriorate further as the Darla Hydro Project presents a big market for almost all local products.

The Phuntsholing plant has a processing capacity of 700 l/h or 4,500 l/day based on a 6 h shift. The plant receives some 600 l daily from India, but the total supply still does not meet the plant's requirement and it is said to be operating far below the breakeven point. However, the plant sells liquid milk made from a combination of fresh (30%) and reconstituted (70%) milk, so it can increase its output and sell more milk than it receives.

Milk marketing in Bumthang

Similarly, in Bumthang, the MPU serves as the main market for the farmers within Chamkhar Valley to sell their liquid milk. The MPU has a capacity of 1,000 l/day. It gets milk from the Government Brown Swiss Farm and from farmers in nearby villages. At present the MPU has on average 25 farmers supplying milk to the unit. The quantities of milk supplied by the government farm and the farmers in the past three years, and the price offered by the MPU are shown in Table 2.2, the total supply at present is about half the capacity.

The quantity of milk supplied to the MPU by the farmers is expected to increase in the future, the small increase at the end of 2000 (Table 2.2) was mainly due to the increase in the milk price. Most farmers supplying milk to the MPU reported that the present

milk price (Nu 11 per l) was still low enough to restrict their supply. A slight increase in the price of milk per litre is likely to encourage more farmers to supply milk to the MPU and/or present suppliers to increase their quantities. Milk is supplied by producers located up to 5 km from the MPU.

Table 2.2: **Milk supply to the milk processing unit and prices offered per litre (1998-2000)**

	1998 (l/ day)		1999 (l/ day)		2000 (l/ day)	
Source	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**
Brown Swiss Farm	500	250	350	200	250	120
Member farmers	200	250	250	150	250	250
Total supply	700	500	600	450	500	370
Price offered (Nu/ l at 4% fat content)	10	10	10	10	11	11

Source: Survey 2000

Daily, the MPU produces 50 kg of hard cheese, 23 kg of soft cheese, and 40 kg of gouda. About 10 kg of local butter and 20 kg of datse cheese are produced every Sunday. These quantities are not able to meet the demand, particularly during the tourist season when it is reported to be very high.

Milk marketing in Thimphu

The sale of fresh whole milk is not organised formally in Thimphu except for the pasteurised packed milk supplied by BDL, which is sold through retailers and agents. On average about 600-700 l are sold through different retail outlets at Nu 25/l. Local fresh milk is sold by producers to consumers through informal arrangements, the price per litre (Nu 20-25) is much higher than the price received by the farmers in Bumthang and Darla who supply to the processing units.

Marketing costs and margin

The costs in marketing dairy products include all expenses incurred on the product by the producer until the product enters the consumer's bag, that is costs of product preparation, packaging, handling, transportation, storage, product losses, and so on. The sale of dairy products on the farm usually involves minimal or no marketing costs, except the processing costs when butter and cheese are sold. When the products are taken to the local markets (towns, processing units, Sunday markets, and roadside shops), marketing costs include transportation and labour charges.

The average marketing margins for butter and cheese for wholesale and retail were estimated from the survey results. The marketing margins for the producer are 68% for butter and 50% for cheese. It may not be appropriate to assess the efficiency based on these margins without careful analysis of different costs incurred through various marketing activities required at different stages. However, the results, indicate that the producer is likely to be better off with the higher margin on butter. The most common costs incurred at producer level include the processing and packaging costs (mainly time as the packaging materials used are from the jungle — banana leaves and bamboo for baskets). On the other hand, the most important costs for the middlemen and traders include transportation and losses during transportation and storage. The product losses are reported to be as high as 5-10% in the summer, especially for datse cheese, due to lack of storage facilities but winter losses are said to be minimal, at 1-2%. Most retailers reported that in summer they quite often sell their products at zero profit margin so as to ensure that at least the cost is covered.

Consumption pattern, preference, and use of dairy products

Fresh milk consumption is uncommon among the Bhutanese, except in the south and some parts of western Bhutan, where a certain proportion of fresh milk is used for preparing sweet tea or occasionally for fresh consumption especially for children. The major proportion of milk produced in the country is processed into butter and cheese, which form a substantial part of the Bhutanese diet. The butter is mostly used for preparing the salted butter tea (suja) that is commonly consumed by the majority of the Bhutanese population and the cheese is used as an important ingredient in almost all Bhutanese curries. Some processed cheese (mostly imported) is consumed direct.

A rapid market appraisal was conducted in Thimphu, to study consumer preference and consumption pattern of dairy products. The appraisal covered a total of 75 consumers representing different income and occupational groups. The sampled group was categorised into three different groups: civil servants (47, average family size 6.8), business and private entrepreneurs (22, average family size 9.2), and hoteliers (6) (as catering organisations, the hotels were expected to be important consumers of dairy products).

Purchase of dairy products by urban consumers

Overall, the businessmen and civil servants' purchased an average of 14.6 l and 10.8 l of fresh liquid milk per month, respectively. However, only half of the businessmen and one third of the civil servants actually purchased fresh milk. The liquid milk included both fresh whole milk and pasteurised packed milk supplied by BDL in Phuntsholing.

On average about 83% of the total respondents purchased milk powder for sweet tea; 76% purchased local butter for use in butter tea; and 87% datse cheese for use in curry. These figures reflect the importance of cheese and butter as ingredients in Bhutanese cooking.

All the sampled hotels depended on imported products; they did not purchase fresh milk or local cheese, except for one hotel that purchased datse cheese. On average the hotels purchased about 40.7 kg of imported milk powder, 26.3 packets of processed butter, and 33.8 tins of preserved cheese per year.

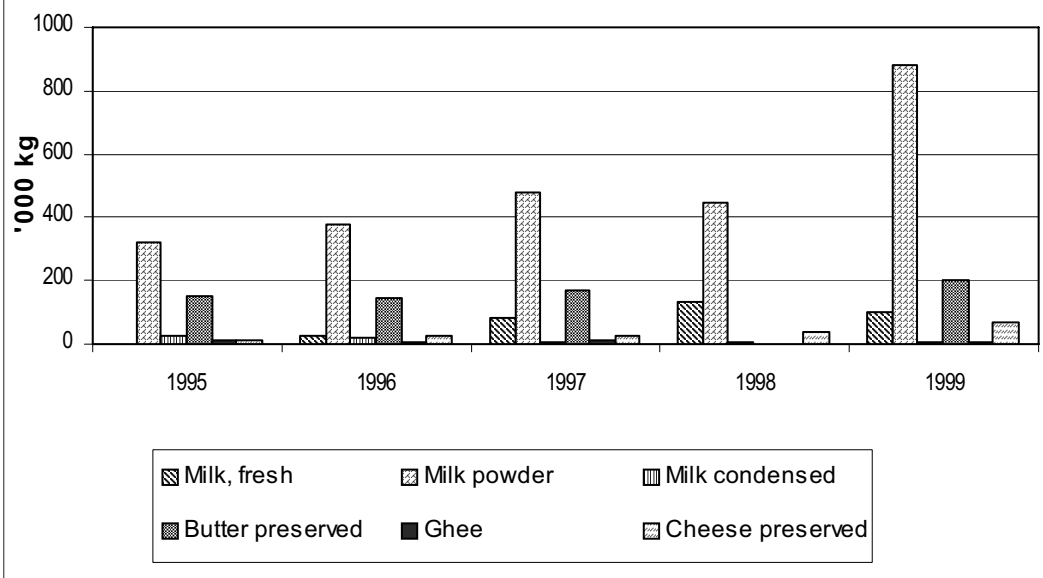
About 59% of the sampled households purchased imported milk powder because it was easily available; and about 41% for reasons of convenience, preference, and hygiene. Some 57% of the respondents said that local dairy products were not readily available, which is an important consideration for all consumers. The hotels in particular reported that ready availability and regular supply are important in the running of their day-to-day catering business. About 43% did not buy local products due to poor quality, poor hygiene, irregular supply, and adulteration.

SUPPLY AND DEMAND OF DAIRY PRODUCTS

In general, the supply of dairy products (milk, butter, and cheese) in Bhutan is a function of production, with other factors having very little or no effect. In Thimphu, however, the supply is influenced by a variety of factors including production, season, price, and transportation. At the same time the demand for dairy products is also determined by many factors including income, price, taste, preference, quality, and availability.

The domestic supply of livestock products in general is unable to meet the local demand, especially in the main urban areas throughout the country where the majority of the population depend on dairy products imported from India (Figure 2.2). It may not be appropriate to consider the annual dairy imports as equalling the excess demand over domestic production, however, the huge annual imports from India clearly reflect a shortfall in domestic production.

Figure 2.2: Import of selected dairy products from India from 1995 to 1999



Source: RGOB 1995, 1996, 1997, 1998, 1999

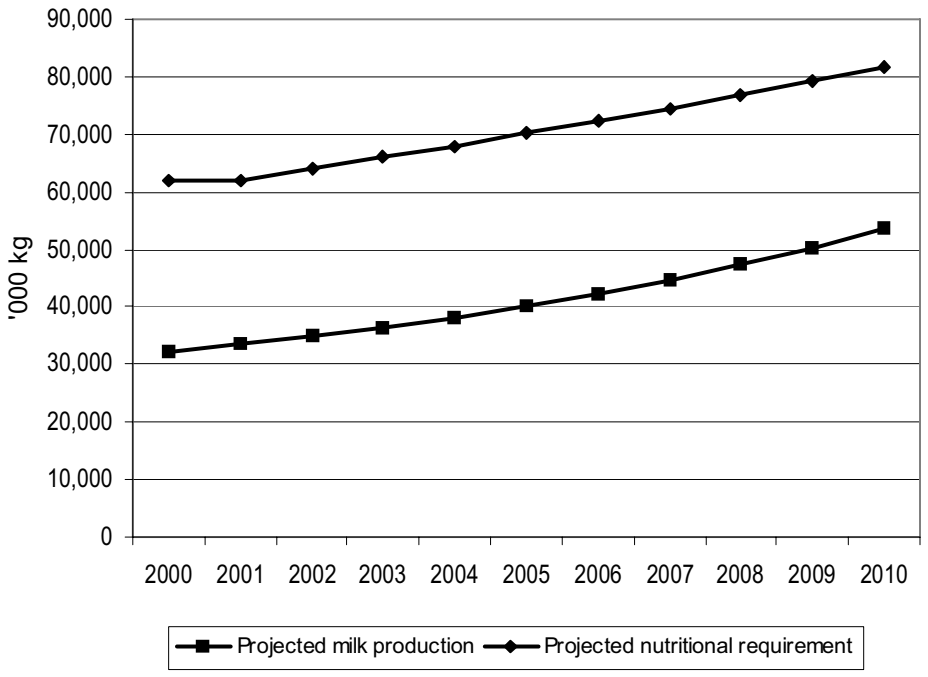
Imports of dairy products

It is difficult to be precise about the statistics on imports of dairy products, as most of the available information seems to underestimate the actual quantity being imported into the country. However, the information compiled by Revenue and Customs (RGOB 1995, 1996, 1997, 1998, 1999) provides an important baseline reflecting the inability of domestic production to meet the growing demand. The increasing trend in importation of dairy products from India clearly reveals the significant production deficit, with huge amounts of milk powder, processed butter, and cheese being imported in the last five years.

Projected demand and supply

A 10-year projection of demand and supply was made (2000-2010) based on the available data on the increase in annual production over the past 10 years and the expected increase in human population. The 'nutritional demand' is based on the recommended minimum requirement of 250g per capita per day. With the present population growth rate of 3.1% per annum, the population of Bhutan is expected to increase from 678,000 in 2000 to 895,000_ by 2010. The annual milk production during the same period is expected to increase from 32,357,000 kg to 53,683,000 kg (Figure 2.3).

Figure 2.3: Projected supply and demand of milk up to 2010



The projections reveal that if the growth in milk production continues at the same rate over the next 10 years the production will not be able to meet the basic nutritional requirement of the projected population. It seems likely that Bhutan will remain a milk deficit country for some time to come and that imports of dairy products from India will continue at an increasing rate. The official statistics indicate that there was a three-fold increase in the total value of livestock product imports between 1995 and 1999. The low quantity and quality of domestic production, and the easy availability of imported processed dairy products which are well packed and more hygienic, are likely to encourage increased importation of dairy products from India in the future. When pursuing and implementing dairy development activities in Bhutan, it will be necessary to address these problems.

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

Fodder development

Despite about 20 years of activities aimed at production of improved fodder, fodder shortage is still rated the most important constraint on increased milk production and sustainability. The small gain towards meeting the feed requirement has been offset by the increase in livestock population.

Land shortages are widely considered to be the single most important limitation to fodder resource development. One view is that land shortages occur because farmers allocate lower priority to fodder development than to cash crops such as apples and potatoes. This in turn can be attributed to dairy farming generating a lower income

than cash crops due mainly to the lack of marketing opportunities, which is reflected by the fact that farmers in areas with marketing opportunities are ready to use arable land for pasture development. Whatever the cause, it is evident that farmers do not generally spare land for fodder resource development.

The most effective approach to improving fodder availability is thus likely to be the development of feed resources that require less land and exploration of possibilities for integrating growing of fodder within the existing farming systems, rather than emphasising pasture development. For serious dairy farmers willing to allocate land for growing fodder, the development of a feed garden incorporating grass, legumes, and fodder trees presents great potential for increasing fodder production.

Research and development issues

In Bhutan, livestock production in general remains far below the domestic requirement, and it is supplemented by huge annual imports from India. Annual imports of dairy products from India have increased steadily over the last five years. In 1999, Bhutan imported dairy products worth Nu 35,000,000 (fresh, powdered, and condensed milk, buttermilk, yoghurt, fresh and preserved cheese, preserved butter, and curd). The trend in importation clearly suggests that opportunities exist for the growth of smallholder dairying in Bhutan.

Although overall production in the country seems to be low, with a better market infrastructure, larger quantities of milk and milk products could enter the market. Marketing is as important as production, better structured and organised marketing systems need to be introduced and the existing systems should be improved. For example, at present there are very few organised marketing structures for the sale of fresh milk, and the performance of the existing organised marketing units is questionable if looked at in terms of membership. In most cases, withdrawals of members, an irregular supply of milk, and lack of interest from new members in joining are the most commonly raised issues. One reason for the organisations' unpopularity is very clear, the prices offered for milk are not very attractive, around half the direct market price.

In general, consumers prefer local produce because of its freshness and nutritional value. The reasons consumers gave for not buying local dairy products thus indicate areas where improvements coulld be made. About 57% of consumers reported lack of availability as the main problem, 16% were not happy with the erratic supply, and 12% with the poor quality. The respondents bought the easily available imported products because domestic products were not readily available.

Many consumers felt there was a need to maintain the quality of local products, particularly to check for adulteration. The consumers' suggestions for maintaining quality include the introduction of strict quality control measures, such as setting standards and frequently checking the quality of the products, and taking legal action against defaulters. The establishment in urban areas of sales counters especially designed for dairy products has been suggested by the consumers in order to improve access to dairy products. At present they depend on the weekly markets for the purchase of products like butter and cheese.

The consumers also felt there was a need for the concerned authorities to educate traders and producers, particularly with regard to product handling, packaging, processing, and hygienic issues, in order to improve quality.

In general, marketing opportunities are the main driving forces for producers to produce more of any type of product. Identification of market opportunities and the development of proper marketing strategies for milk and milk products for selected groups of villages would be a useful approach to support dairy development.

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3

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:
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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.

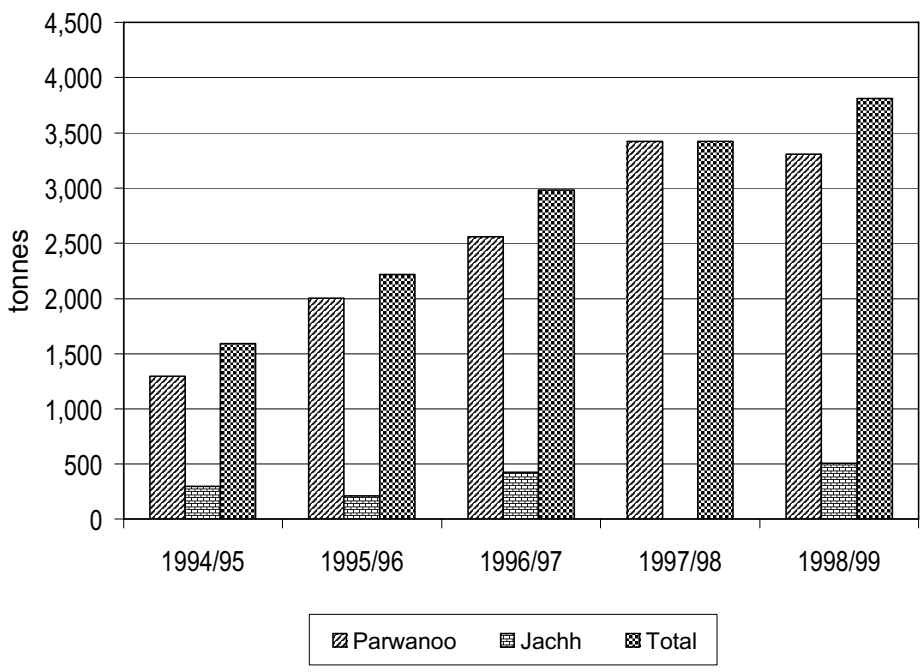
ANIMAL FEED RESOURCES AND NATURAL RESOURCE MANAGEMENT

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.

Figure 3.1: Annual cattle feed production in Himachal Pradesh



Source: H. P. Agro-Industries Corporation Ltd., Shimla

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.

* 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 IRs16/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.

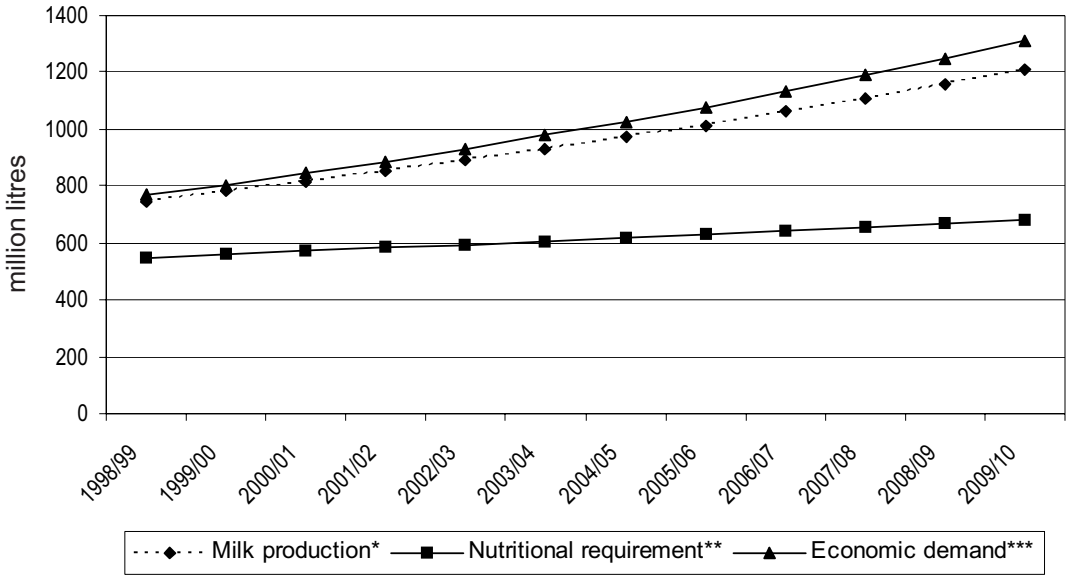
MILK SUPPLY AND DEMAND

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).

Figure 3.2: Projections of milk production, nutritional requirement and economic demand for milk in Himachal Pradesh



* Based on an annual compound growth rate of 4.56%

** Based on per capita per day minimum requirement of 250g of milk as recommended by the Nutritional Advisory Committee of ICMR, New Delhi

*** Based on an annual growth in state domestic product (SDP) of the order of 5.6% and calculated income elasticity in the demand for milk of 0.89

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 38th round (1983) and the 54th

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.

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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).

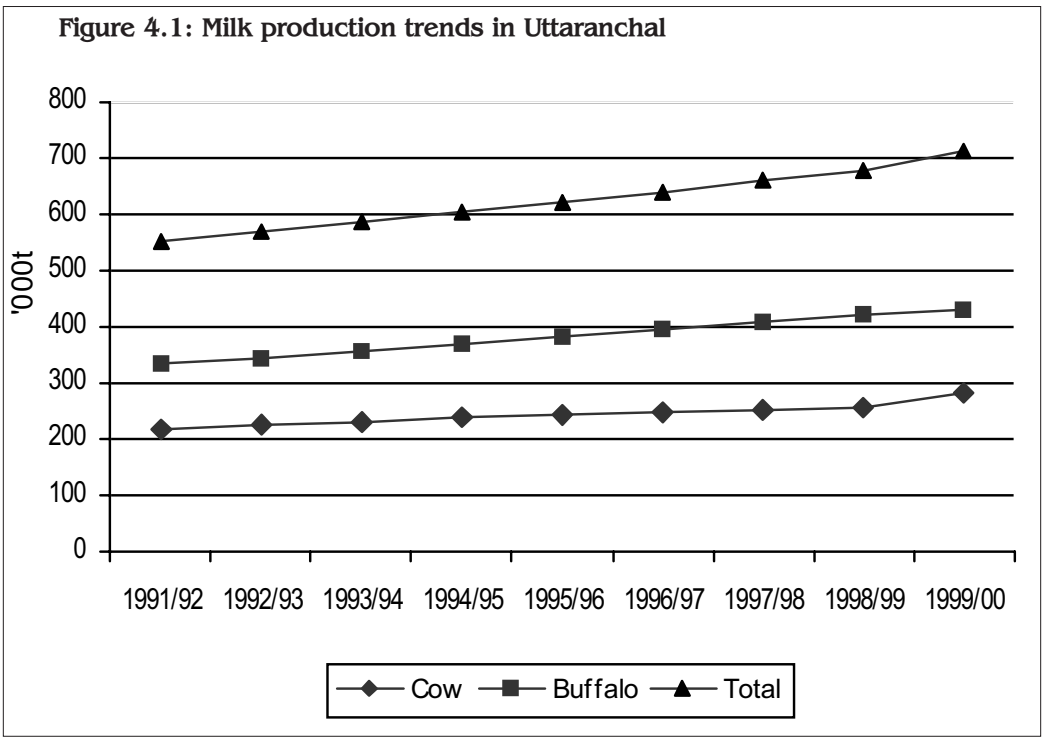
Animal population, composition, and yields

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:

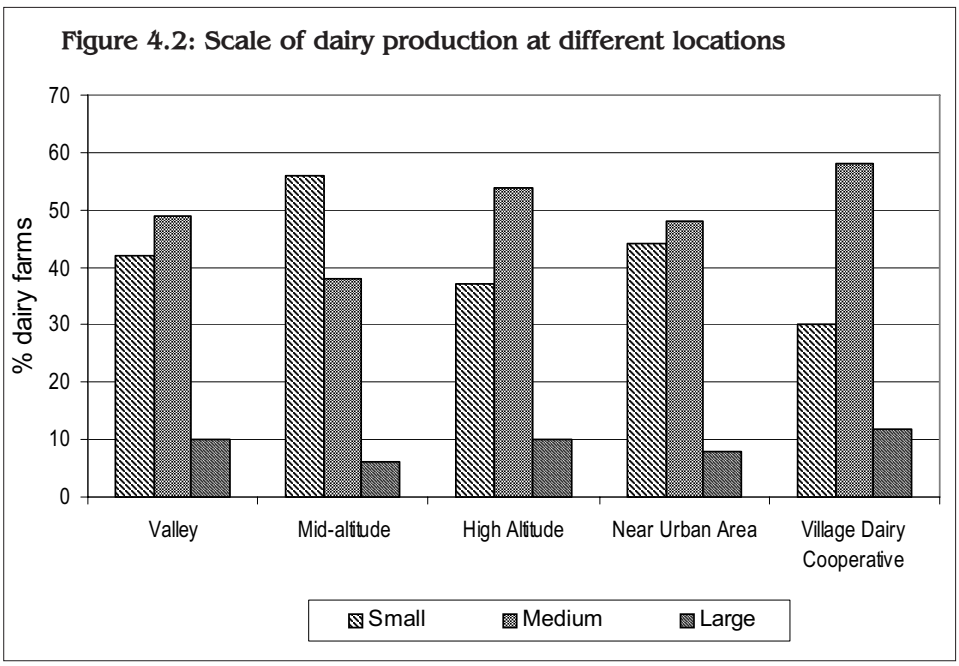
small: a dairy farm with a maximum dairy animal equivalent of two cow units (CUs);

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

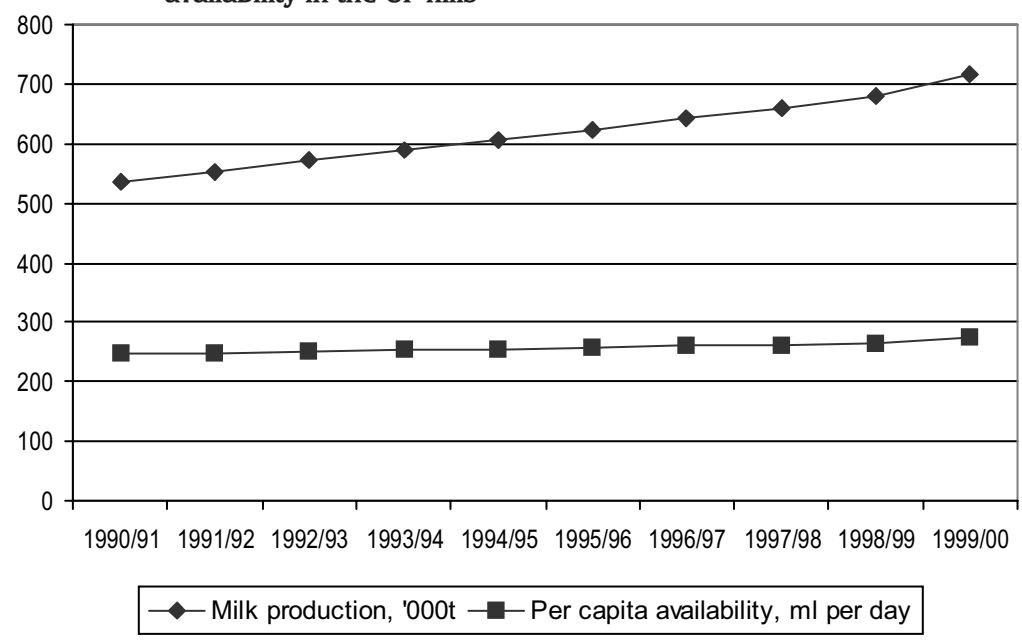
The surveyed smallholder farms in the two milksheds showed a surplus milk production above the nutritional requirement (approximately 250 ml per capita per day) in all villages in Nainital, and most in Almora (where two showed a slight deficit). Each village, on average produced 94,540 l of milk (range 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%.

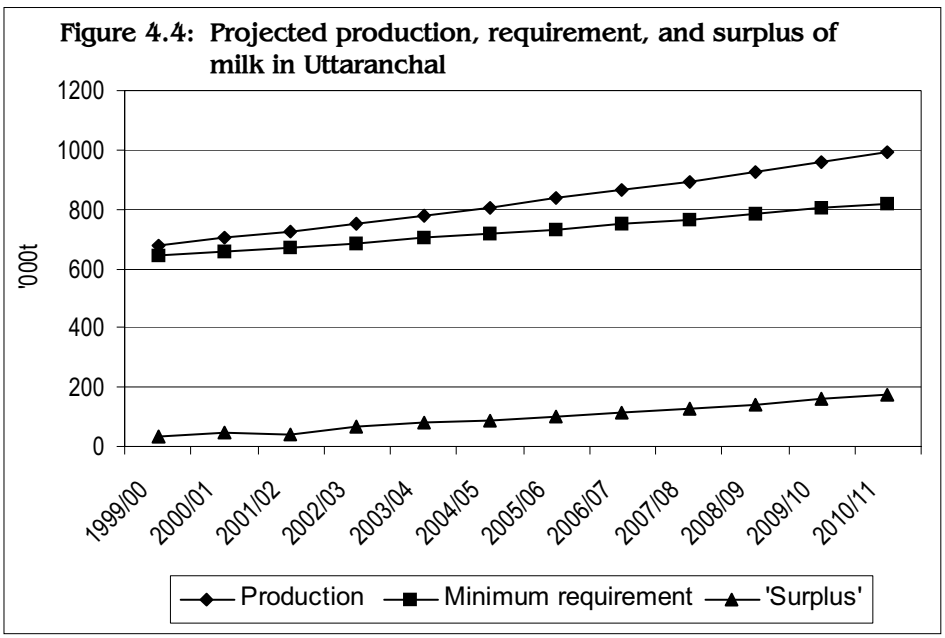
Overall the marketing costs were highest for direct sale because of the small quantities involved, and next highest for DMUs because of the transportation costs involved in collecting from scattered villages over large distances. The traders' marketing costs were much lower, but the profit margin higher. 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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5

Smallholder Dairy Farming in Nepal:
Characteristics, Constraints, and Development Opportunities

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Chapter 5

Smallholder Dairy Farming in Nepal:
Characteristics, Constraints, and Development Opportunities

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CONTEXT

Livestock is an integral component of farming systems in Nepal; it contributes about 12.8% to the total national gross domestic product (GDP) and 31.5% to the agricultural GDP. It is estimated that the livestock share of agricultural GDP will reach 45% by the end of 20 years of the Agricultural Perspective Plan (APP) programme, that is by fiscal year 2014/15. The major components of livestock GDP are milk and milk products from buffalo and cattle (32.7% and 24.7% respectively). At present, the total annual milk production of Nepal is just over one million tonnes (70% from buffalo and 30% from cattle). Based on this figure, the per capita milk consumption over the country is about 48 l/year or approximately 130 ml per day. The average growth rate of milk production from 1985 to 1995 was 2.4%, and the population growth rate 2.9%. This gap is likely to increase in the future unless serious efforts are made to improve dairy production and marketing. In this chapter, we discuss the current characteristics of the dairy sector, its constraints, and opportunities for development.

STUDY SITES AND METHODOLOGY

A milkshed approach was taken to select three case study areas all with milk supply schemes (MSSs), namely Biratnagar, Kathmandu, and Pokhara, located in the eastern, central, and western regions, respectively. Two or three chilling centres were selected in each case study area, and in each of the selected chilling centre areas, six to eight groups of smallholder dairy farmers (between four and seven farmers in each group; three to four groups from valley/river basin farming areas and three to four from upland sloping agricultural land areas) and some key informants were interviewed using rapid appraisal techniques with a semi-structured interview and a prestructured questionnare cum checklist to obtain information and data on issues related to production, consumption, and marketing.

The Nepal Living Standard Survey (NLSS) at household level, conducted by the Central Bureau of Statistics (CBS) with support from the World Bank, was used for consumer and demand studies. This survey provides detailed information (quantities and costs) on household consumption of purchased and home-produced milk and milk products (milk, condensed milk, baby milk, curd, ghee, and other milk products).

DAIRY PRODUCTION SYSTEMS

Table 5.1 summarises the characteristics of the smallholder dairy production systems in the different study areas. Cows are the dominant dairy animals in the eastern hills and buffalo in the central and western hills. Animal herd size differs from region to region and ranges from 1 to 4 dairy animals per household. Stall feeding of dairy animals is common across the region.

Table 5.1: **Characteristics of the main dairy production systems prevailing in the three case study areas**

	Eastern Hills	Central Hills	Western Hills
Important species	Cows	Buffalo, cows (ratio 3:1)	Buffalo, cows (ratio 4:1)
Important breeds	Jersey/ Holstein crosses	Murrah cross buffalo, Jersey cross cows	Murrah cross buffalo (50% of buffalo)
Average herd size	3.4 (< 2 dairy cows)	3	4-5 (2.5 dairy animals)
Normal feed (daily, per head of dairy animal)	25 kg green grass (rainy season), 5 kg crop residues, 2.24 kg concentrate	30 kg grass in the rainy season; 12-15 kg of fodder leaves in winter; total 15-30% nutrients from concentrates	Green grass in rainy season, rice straw/ maize stovers, tree fodder leaves 1.5 kg home-made concentrate during lactation; 200- 700 kg commercial feed purchased per year
Feeding system	Stall feeding	Stall feeding	Stall feeding
Reproductive performance			
Age at first calving	28 months	3-4 years for improved buffalo, 5 years for native buffalo	4 years for local buffalo, 2.5 years for cross-bred cows, 4 years for local cows
Milk productivity	8.37 l/ day, 2660 l/ lactation	5.2 l/ day for Murrah buffalo, 3.5 l/ day for native buffalo (1590-1920 l/ lactation)	3.5 l / day for local buffalo, 4.7 l/ day for Murrah buffalo, 6.3 l/ day for crossbred cattle
Calving interval	13 months	14-15 months	NA
Lactation period	315 days	305 days	NA

SPECIES AND BREEDS OF DAIRY ANIMALS

Major milking animal breeds

There are about 7 million cattle and 3.5 million buffalo in the country. The hill region has the highest number of both cattle and buffalo. The Eastern Development Region

(EDR) has the highest cattle population (1,703,000) and the Far Western Development Region (FWDR) the lowest (940,000). The buffalo population is highest in the Western Development Region (WDR) followed by the Central Development Region (CDR). Although the cattle population is dominant in most of Nepal, there are more buffalo in the middle mountains of the CDR and WDR. The total population of cattle in the country increased from about 6.5 million in 1991/92 to about 7 million in 1998/99 with an average annual growth rate of just over 1%; and the buffalo population from about 3.3 million in 1991/92 to about 3.5 million in 1998/99, with an average annual growth rate of about 0.6%

The type of cattle found in Nepal varies according to the agroecological zone and also between east and west. The dominant breeds are the indigenous Zebu breeds (*Bos indicus*). There are also some improved cattle breeds – the result of the cattle improvement programmes being implemented by the Department of Agricultural Development (DAD) both by natural service using upgraded bulls and by artificial insemination. The main breeds being used are Brown Swiss in the upper Mid Hills, Jersey and Holstein in the Mid Hills, and Haryana and Sahiwal in the Terai. A buffalo improvement programme is also being implemented by DAD using the Murrah breed through both natural service and artificial insemination.

Trends in the dairy animal population

Despite large cattle and buffalo populations, the proportion of dairy animals has remained low, indicating a large number of 'unproductive' animals. Only 12% and 26% of cattle and buffalo, respectively, produce milk. The disposal of unproductive cattle is difficult, mainly because of religious beliefs.

The total population of milking animals (comprising cows and buffalo) in the country increased from about 1.4 million in 1984/1985 to about 1.7 million in 1998/99 with an average annual growth rate of 1.8%. Milking animals are mostly concentrated in the hills (58% of the country's total milking population). The Terai region has experienced the highest growth rate in milking animal population and the mountains the lowest. Among the regions, the average annual growth rate was highest in the FWDR and lowest in the Mid Western Development Region (MWDR).

The proportion of cows in the total milking animal population of the country remained at just under half over the period 1984-1998. The proportion is highest in the mountains (57%), followed by the Terai (52%), and then the hills (45%). Across the development regions, the proportion is highest in the MWDR (59%) and lowest in the WDR (34%). The proportion remained virtually unchanged between 1984/85 and 1998/99 across all ecological and development regions of the country (Table 5.2). The proportion of crossbred dairy cows in the country is reported to be around 2% of the total dairy cow population.

Table 5.2 **Proportion of cows in the total milking animal population**

	Mountain	Hill	Terai	EDR	CDR	WDR	MWDR	FWDR	Overall
1984/85	61.6	46.2	52.5	59.1	50.2	33.4	58.5	53.7	49.8
1998/99	56.7	44.6	51.6	55.5	45.8	34.4	59.1	51.6	48.0
Average annual growth rate (%)	-0.59	-0.25	-0.12	-0.45	-0.65	0.20	0.08	-0.29	0.25

Source: Agricultural Statistics Division, Ministry of Agriculture, His Majesty's Government of Nepal (HMGN)

In the eastern hills, the average number of livestock per sampled household was 3.4. The number of dairy cows owned by the farmers did not exceed two. The smallholders manage their herds in order to maintain a steady supply of milk. Dairy animals are predominantly improved crossbred cows, which give on average 8.4 l of milk per day (2,659 l/ lactation period), calve at an early age, and have shorter calving intervals (Table 5.1).

In the central hills, the majority of the dairy farmers in the selected milkshed area raised Murrah cross buffalo, a few kept Jersey cross and local cows. Once a cow is dry, it is exchanged immediately for a milking buffalo. Buffalo traders have reached each and every corner of the study area to sell Murrah cross buffalo brought from India. These traders sell milking Murrah cross buffalo at NRs* 20,000-30,000 each. The average milk yield per day is about 5.2 l for Murrah cross and 3.5 l for native buffalo. The milk yield per lactation of 305 days varied from 1,590 l to 1,920 l at different locations. The average milk yield of local cows was much lower.

In the western hills, the dominant dairy species is buffalo (local and Murrah cross) followed by crossbred cows (mostly Jersey cross but also Holstein, and in some cases, both breeds mixed). Local cattle were not reared as dairy animals.

The average numbers of livestock per household were 4.7 and 5.4 livestock units in lowland and upland areas respectively, with an average holding of about 2.5 dairy animals per household. The ratio of buffalo to cows ranged from 4:1 in the lower areas to 1:1 in the cooperatives located in the higher areas. Fifty per cent of the buffalo were Murrah crossbred.

The productivity of the crossbred animals (cattle or buffalo) was not significantly higher than that of the local buffalo. This indicates clearly that despite the potential, the productivity of the crossbred buffalo could not be raised in the absence of adequate nutrition and health care management. The difference in yield between the Murrah cross buffalo and the local buffalo was also marginal. The higher yield in the Murrah cross buffalo was at the cost of higher feed intake.

ANIMAL FEED RESOURCES AND NATURAL RESOURCE MANAGEMENT

Animal feed

Several animal feed improvement projects have been implemented in the past. In 1985, the Integrated Livestock Development Programme was implemented by the Department of Livestock Services (DLS) in 35 districts and in 1989, this programme was extended to 11 more districts. In 1992, the Hill Leasehold Forestry and Forage Development Project was implemented in 12 districts. The implementation of these projects over the past decades has resulted in available rangeland of 17 million ha, which is 12% of the total land area delineated in the Land Reform and Mapping Project of 1986. Estimates indicate that available rangeland supplies only 36% of the total food requirement of the livestock in the country (Mathema and Joshi 2000). Experience further reveals that while past initiatives in fodder development in Nepal have had some success in areas that were accessible by vehicles, programmes have not been successful in most of the poorly accessible hill and mountain areas. The present area of rangeland is thus inadequate not only to meet the current deficit but also to meet the demand of the increasing livestock population in the future.

* NRs 68.00 = US$1 (in 2000)

Eastern hills

Unlike other districts, the link between common property resources (CPRs) and livestock in the study area was weak due to the lack of availability of grass and fodder. All animals were stall fed and the planting of grasses, shrubs, and fodder trees on private land was quite common.

Grass, which is mostly used in the rainy season, makes a significant contribution to livestock feed; it is collected from private land specially leased for grass. Interestingly, 20% of the farmers in the study area have leased land for grass.

Concentrates and high-quality feeds are given in the morning and evening during milking. Grain by-products such as rice and wheat bran, oil cake, maize flour, and salt are fed to dairy animals throughout the year. 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.

The main calving season for cows in the area is November to February. There is an acute shortage of green forage throughout the year, except during the wet season from July to October. The net deficit periods of good quality forage are November to December and April to June.

Central hills

Crop by-products like rice straw and maize stovers were the main feed for dairy animals in the lowland parts of the central hills study area. In the upland areas animals are fed tree fodder and grass collected from government forests and the diet is supplemented with rice bran and maize stovers. All animals were stall fed.

Dairy farmers have become more conscious about feed. Improved grass crops have been observed in farmers' fields, and native grasses like amriso, nigalo, siru (*Imperata cylendrica),* khar (*Andropogan* spp.), and banso (*Setaria pallidesesca*) are also used in large quantities. On average every household in the study area collected about 30 kg of grass per day per adult animal in the rainy and autumn seasons (for six months).

In lowland areas, the cutting of tree fodder in government forests is prohibited. In the upland areas, many farmers collected 25-30 kg of fodder leaves on alternate days during spring and winter, and some dairy farmers went far from their villages (6 hrs walk) to bring tree fodder (a load of 50-60 kg). The most common fodder species in order of farmers' preference were *Leucaena leucocephala*, *Artocarpus lakoocha*, *Ficus hispida*, *Ficus roxburghii*, *Premna integrifolia*, *Morus alba*, *Litsea polyantha*, *Eriobotrya elliptica*, *Ficus nemoralis*, and *Ficus lacoor*.

The farmers mix about 2 kg of rice bran with beverage by-products and feed this to the lactating animals. Concentrate feeding practices varied from location to location.

Normally, one standard livestock unit (SLU) should be provided with 5.09 kg total digestible nutrient (TDN) per day; about 66% of this TDN requirement should be met from roughage and 34% from concentrate feed. The feed resources in terms of TDN were sufficient in two of the three chilling centre areas and slightly deficit in the third. Between 13% and 33% of TDN was estimated to come from concentrate feed.

Western hills

Dairy animals were stall fed throughout the year. The composition of the forage varies according to season, depending on what is available. Only a few farmers raising

crossbred cattle cultivate forage (oats) during the winter months as a green supplement. The type and proportion of feed resources available were similar in the higher and lower areas.

The majority of the forage was home grown; the contribution from the forest was only 3-14% (according to the season). This figure is lower than the national average, perhaps reflecting the close proximity of the dairy animals to market areas where forest resources are less. The homestead grass production was minimal during the winter months and animals were fed almost exclusively on crop by-products and tree fodder.

Rice straw was the main crop by-product during the winter and maize stovers in the rainy season. Various species of fodder tree are cultivated by farmers, but the most popular are badhar, bans, khanyu, koiralo, kutmiro, and ginderi.

Concentrate feed was mostly home made and based on cereal grains (maize, rice, and rice bran in different combinations). Lactating dairy animals were given about 1.5 kg of home-made concentrate feed per day during the lactation period. Commercial feed was only purchased by farmers rearing crossbred cows. Some of the farmers rearing crossbred cattle also bought wheat bran in addition to concentrate feed and mixed it with equal amounts of maize or rice grain before feeding it to the animals. The amount of commercial feed purchased per year ranged from 200 kg in the inaccessible areas to 700 kg in the accessible areas. The costs of concentrate feed varied with supplier and area within the range of 12-15 NRs/kg.

LIVESTOCK HEALTH SERVICES

Animal health and diseases

The most common communicable diseases of animals in Nepal are peste des petits ruminants (PPR), rinderpest, foot-and-mouth disease (FMD), rabies, brucellosis, haemorrhagic septicaemia, black leg disease, anthrax, mastitis, and fasciolosis (liver fluke) (Mathema and Joshi 2000). Some animals, especially in the eastern and central hills, are also affected by contagious diseases such as black quarter and red water. Mastitis is an increasing problem in crossbred cows. Internal parasites like liver fluke and roundworm are quite widespread in all the districts. These parasites affect young and adult animals equally. In the western hills mortality from the diseases was not reported to be very high: 0.23% and 4.85% from liver fluke and FMD respectively, in affected cattle and buffalo.

Poor feed has also reduced reproductive performance in dairy animals. In the past, breeding improvement programmes have been undertaken to introduce Jersey, Holstein, Brown Swiss, and Murrah into native cattle and buffalo. However, because of poor diet, the upgraded dairy animals have not performed well.

Treatment

Efforts have been made to improve animal health services with the establishment of several veterinary hospitals which include various specialised divisions and sections. The government veterinary section was established in 1961, the biological product division in 1967, and the infectious disease and parasite control division in 1981. In addition, to support the different sectors of the veterinary service, a disease investigation and parasite control project was started in 1968, a rabies control project in 1981, and a national foot-and-mouth disease control project in 1983. Veterinary services

in Nepal are largely provided by the government sector with little or no encouragement given to the involvement of the private sector. Veterinary services are only sought when the animals are clinically ill. Animal health services are mainly provided by veterinary hospitals, livestock service centres (LSCs), and livestock service sub-centres in nearby villages. About 50% of the farmers in the study were satisfied with the level of services they obtained from these centres. The unavailability of technicians at the centres, high service charges for treatment, and unfair distribution of medicines were the major complaints. Village animal health workers and private practitioners also provide some animal health services.

Although the farmers in most areas reported drenching twice a year against liver fluke, they had little knowledge about correct drenching timing. Preventive vaccinations were not carried out in any of the areas, but vaccinations were carried out during disease outbreaks. The farmers in the western hills were willing to pay for the veterinary care provided to their animals; the average cost of animal treatment was NRs 350 per household per year.

MARKETING OF DAIRY PRODUCTS

Milk marketing and market structure

The market structure for dairy products may be separated into three segments: the rural or informal component, the urban or formal component, and the export market component. The rural component of dairy marketing comprises the over 90% of farm households with dairy animals where most of the milk produced is consumed within the households either in the form of fresh milk (usually boiled) or in the form of traditional dairy products. Some products are traded directly with consumers (raw milk) or through traditional collecting agents for consumption in urban areas or export to India. In the urban component of dairy marketing, most of the dairy products consumed in households and at restaurants and hotels are purchased from rural producers through several market networks. Milk-marketing agents include both private dairies and Dairy Development Cooperation (DDC) supported outlets. In some smaller cities, some households may also produce, consume, and sell dairy products. Fresh and pasteurised milk, yoghurt, cream, butter, ghee, cheese, and ice-cream are the main products of both the private and the public dairy industries.

The production figures for dairy products of the DDC (the figures for the private sector are not available) indicate that the market is growing. Some high-value products like dried milk, cheese, and ice cream are also imported for sale in addition to the locally produced dairy products.

The public sector

The DDC was established in July 1969 under the Corporation Act of 1964 to consolidate formal dairy development activities. A network of milk collection and chilling centres was established that feed into 'milk supply schemes' (MSS) to form the so-called national milk grid. Currently there are five MSSs, in Kathmandu, Biratnagar, Hetauda, Pokhara, and Lumbini, and a cheese production scheme under the Dairy Product Production and Marketing Scheme.

Milk producer associations (MPAs) manage the milk collection centres and have expanded their operations in recent years. The DDC supports the MPAs with management and accounting assistance. A fixed commission is also provided to MPAs

on the basis of the solid content of the milk they supply to the chilling centres. The commission covers not only the marketing cost involved in the collection and transport of milk, but also the overheads for the operations of their cooperative institutions.

Pasteurised milk is sold in half-litre plastic packs. Milk is distributed by trucks to milk booths and shops, and most sales take place in the morning. The booths are privately operated and receive a commission from the DDC, while the shops are owned and operated by the DDC itself. As of 1998, there were 400 booths, 11 shops, and 2 dealers operating under the DDC.

There are currently 12 cheese production centres (of which 6 are located in the high mountains) operating in different parts of the country. These cheese production centres collect milk from the network of 25 milk producer cooperative associations.

The growth in the number of chilling centres and cooperatives over a six-year period (1992/93 to 1997/98) is summarised in Table 5.3. The catchment areas of the milk collection centres located in different parts of the country cover a total of 39 hill and Terai districts. The supply of milk in the Kathmandu MSS originates from nine highland districts, in Biratnagar from seven districts (three highland), in Hetauda from five districts (one highland), in Pokhara from seven hill districts, and in Lumbini from eight districts (one hill). Some 60 million litres was collected by the DDC in 1998, about 5% of the total milk production in the country. Out of all the DDC milk factories, the one in Kathmandu collects and processes the most milk. Between 1992/93 and 1997/98, the total milk collection from all the centres increased by 74%, an average annual growth rate of 12%.

Table 5.3: **Total number of chilling centres and cooperatives**

	Chilling Centres	Cooperatives
1992/93	37	696
1997/98	45	939
Growth rates (% per annum)	4.0	6.2

There is, however, a seasonal fluctuation in the milk supply from the rural areas. During the peak season supply is greater than demand, whereas in other seasons the supply of milk is inadequate. To overcome this situation, the DDC has established a milk powder factory with technical assistance from the government of Denmark. This factory has helped substitute more than 50% of the powder milk imported by the DDC from abroad for producing liquid milk during the lean season.

Private dairies

Many large and small dairies have been established in the private sector. The Nepal Dairy was the first dairy established in Kathmandu, followed by the Himalayan Dairy of Lalitpur. Currently, the Sita Ram Gokul Dairy in Kathmandu has the biggest milk processing facility (100,000 l/day) among the private dairies. Most of the private dairies are situated in the CDR and clustered in and around Kathmandu. Notable private dairies outside Kathmandu are the Namo in Dharan, the Ram Janaki in Janakpur, the Jai Ganesh in Chitwan, the Pan/Panthi in Pokhara, the Pandav-Pabitra in Butwal, the Gurudev in Nepalgunj, and the Western Himalaya Dairy near Mahendrangar. The processing facilities and working conditions in these private dairies vary widely from simple cream separator dairies to well-established dairies with a collection network and processing facilities. Cheese industries have also been established in the private sector.

The private dairies have distribution and sales systems similar to those of the DDC, with booths located in urban areas as well as direct sales from their plants. Some dairies compete with the DDC on milk routes and secure quality milk by paying a premium price. The small private dairies pay contractors to collect their milk and some have their own dairy farms. It is believed that about 35% of the market share is controlled by private dairies.

Eastern hills

The main marketing channels in the eastern region are

(1) producers – MPAs – DDC
(2) producers – vendors – semi-urban/urban consumers
(3) producers – semi-urban consumers
(4) producers – urban consumers.

In the study area itself, the milk was sold directly to the MPAs who supplied it to the DDC chilling centres. About 80% of the total milk produced in the area was sold in the market. Even local consumers who want to purchase milk for home consumption have to purchase milk from the MPAs. All the private sector cheese factories in the study area also collected milk from the MPAs with the exception of Neelam Cheese Factory, which collected a very small amount of milk directly from the farmers. The private sector was unable to collect milk.

The highway passing through the milkshed helped greatly in the transportation of milk to various market centres.

Central hills

The milk produced by the farmers in the central hills milkshed area was either sold to the chilling centre of the DDC direct or through milk producers' cooperatives (MPCs) and contractors, or sold to teashops, restaurants, and house-to-house. Some was sold in the form of milk products (for example, ghee, butter, and cream)

The price paid to cooperative members was based on fat and solid–not–fat content. The majority of farmers in the study were willing to sell milk to the DDC for a standard and reliable price, although the price paid was NRs 0.10 per litre less than by private dairies. Only 4 of the 29 dairy farmers sold milk to restaurants for a high price.

However, the DDC's purchasing policy was not regular, and the introduction of 'milk holidays' (when no milk is accepted) is posing problems for the smallholder dairy farmers. 'Milk holidays' were introduced because production during the wet season was considerably higher than the DDC's handling capacity. There are limited alternative outlets, particularly for farmers far away from towns, so on some days farmers faced difficulties in disposing of their milk. Milk holidays twice a month are common from the month of August, and later in the year they are practised weekly until the end of January.

Western hills

Farmers in the case study area in the western hills preferred to sell their milk direct to the market or teashops because the open market price of fresh milk was about 20-25% higher than the price given by the milk collection centre and cooperatives, and there is little consideration given in the open market to the quality of the milk. Thus in the areas with access to markets and teashops, only a third of the milk was sold to the dairy

and milk collection centres, and two-thirds through informal markets (teashops, private dairies, and direct to consumers).

Overall farmers who have enough labour sell their milk directly on the open market, and those without labour sell to the dairy collection centres. Milk is mostly transported from the collection to the chilling centres through contracted hired porters. Wage rates varied among the areas from NRs 50 to NRs 60 per day.

MILK SUPPLY AND DEMAND

Although the population density of dairy cattle in Nepal is high, milk productivity is low due to poor feeding, breeding, and management practices. On average, the annual production of milk from cattle and buffalo is only about 386 and 827 l per animal respectively. Nepal's total milk production in 1998/99 was 1,073,000t of which about 70% (774,000t) was from buffalo and the rest (329,000t) from cattle. The Western Development Region produced the highest quantity of milk (281,000t), and the MWDR the lowest (121,000t) (Table 5.4).

Milk production increased from 1984 to 1998/99 at an average annual rate of 2.6%; the annual growth rate from 1991 to 1998 was around 3%. Milk production in the mountains showed a declining trend (negative growth rate of 3.7%) from 1984 to 1998, whereas both hill and Terai regions showed a positive growth rate (Table 5.4).

Table 5.4: **Trends in total milk production (t)**

	Hill	Mountain	Terai	CDR	EDR	FWDR	MWDR	WDR	Overall
1984/85	391	148	206	220	153	89	140	144	745
1998/99	605	88	380	294	242	127	125	285	1073
Average annual growth rate (%)	3.16	-3.67	4.49	2.10	3.33	2.61	-0.80	5.00	2.64

Source: Agriculture Statistics Division, Ministry of Agriculture, HMGN

This milk consumption in the country was estimated from the NLSS data (1996). All units have been standardised into litres. The different sources of supply (purchased, home produced, quantity received in kind) were aggregated to obtain the total quantity consumed by households. It is worth noting that unlike the information on quantity of purchased and home-produced milk and milk products, milk and milk products received in kind are all reported as monetary values in this source. The quantity of milk consumed was derived by dividing the total value of milk received in kind by prices reported for purchased milk.

The distribution of the households purchasing milk and milk products is reported by region, and consumption estimates made for milk and milk products among rural and urban households and for different sectors. Regression equations were estimated from the NLSS data to derive demand elasticity (price and income) for milk and ghee for urban and rural consumers. The estimated income elasticity parameters were used to forecast the milk demand.

Purchase of milk and milk products

Nearly 66% of urban households purchased milk compared to about 23% of rural households, reflecting that many rural households have dairy animals. In the country

as a whole, only 26% of households purchased milk from the market. In both urban and rural areas, the proportions of milk buyers vary greatly among development regions, with the CDR having the largest proportion, followed by the WDR. The number of milk buyers decreased from south to north.

The proportion of households buying milk increased consistently with increasing household income. This relationship is more marked in urban Nepal than in rural Nepal. For example, about 79% of urban households in the highest income group purchase milk, but only 2% in the lowest income group.

In urban Nepal, about 4% and 5% of households purchased baby milk powder and condensed milk, respectively. The corresponding figures in rural Nepal are less than 1%. The percentage of households purchasing ghee was 38% in urban Nepal and 24% in rural Nepal with an average of 25% over the country as a whole. Curd was purchased by roughly 28% of the households in urban areas compared to just 11% in rural Nepal.

Annual consumption pattern

Milk

The average annual per capita consumption of milk (purchased + home produced + received in kind) estimated from the NLSS survey statistics was about 27 l across Nepal (about 5 ml per day) with the consumption rate higher in urban areas (38 l) than in rural areas (26 l). The per capita milk + milk product consumption was only slightly higher at 29 l per year. Across the development regions, the per capita milk consumption was highest in the WDR (34 l) followed by the CDR (29 l).

The comparable figures reported in New ERA (1990) range from 49 to 68 l per person per year in urban areas; the value calculated on the assumption that all milk in Nepal is consumed in country is also about 48 l. In a more recent study by Nepal Rastra Bank (1999) for urban Nepal, the average annual per capita consumption of fresh and dairy milk was reported to be about 26 l and 11.4 l respectively, a total of 37 l. Annual per capita consumption of milk in developing countries is about 40 kg (approximately 40 l) (Staal and Jabbar 2000) [in western countries 60-160 kg, CDIC 2002, ed].

Three-quarters of the milk consumed in urban areas is purchased, whereas the rural milk demand is met primarily through home production.

Ghee

The estimated average annual per capita consumption of ghee (purchased + home produced + received in kind) is about 0.94 l, 1.0 l in urban areas and 0.93 l in rural areas. This is fairly close to the per capita consumption of 0.7 l reported by the Nepal Rastra Bank for urban Nepal. The per capita ghee consumption was highest in the FWDR (1.36 l) and lowest in the CDR. The bulk of the ghee consumed in rural areas is home produced while in urban areas the bulk is purchased. Per capita consumption of other milk products such as condensed milk, baby milk powder, and curd is low, even in urban Nepal.

Milk and milk product expenditure

The per capita annual value of purchased and home-produced milk (including that received in kind) was estimated to be NRs 604 in urban areas and NRs 362 in rural areas, with an average of NRs 380 in the country overall. The annual per capita value of

ghee was estimated to be NRs 119 in the country overall, and higher in urban areas (NRs 139) than in rural areas (NRs 117).

The total annual per capita value of all consumed milk and milk products was estimated to be NRs 514 overall, NRs 812 in urban Nepal and NRs 491 in rural Nepal.

Milk and milk product expenditure (value) represented 5% and 7% of total household expenditure in urban areas and rural areas respectively, with an average of 6% in the country overall, about 11% and 10% of the total annual food budget. The level of household milk consumption and the proportion of total household expenditure increased with increasing income.

The per capita milk expenditure increased with increasing income, with a wide gap in consumption levels between households belonging to the top and bottom expenditure classes. The mean per capita expenditure of the top 10% of households in urban areas (NRs 1,153) was almost 2.5 times that of the bottom 10% (NRs 477); in rural areas the difference between the top and bottom 10% of households was much smaller. Similarly the top 10% of households in urban areas accounted for about 60% of total expenditure on milk and milk products and the bottom 70% account for less than 5%. The disparity was less in rural areas: the bottom 40% of households and the top 10% each accounted for about 16% of the total expenditure on milk and milk products.

Estimated milk demand functions

Milk demand functions were estimated using the NLSS data. The price elasticity of milk is expected to be negative and numerically less than one because milk is a necessity and, according to the law of demand, the demand for necessities falls as their price increases. Likewise, income elasticity is expected to be positive, as is the case with all necessities (as income rises so does the amount purchased). Usually, income elasticity estimates from cross-sectional data are higher than estimates from time-series data, because cross-sectional data reflect that families have had time to make necessary adjustments over time with respect to changes in their incomes.

Milk demand is assumed to be a function of milk price, household income, and family size. Different functional forms can be used to estimate demand functions. Two types of functional forms (linear and double-log linear) were estimated. The annual purchase of milk (in litres) was regressed with the average milk price, household income, and household size. A set of dummy variables was included to capture the variation in milk consumption across regions (Terai, hills, mountains) and the source of supply (purchased compared with home-produced).

The results of the double log model were better than those of the linear regression model in all cases (rural, urban, Nepal total). As expected, the regression coefficients were negative for price elasticity and positive for income elasticity and were significant in all equations estimated (six in total, Table 5.5). The results indicate that over 40% of the variation in milk consumption can be explained by the variables included in the double-log model. The results also indicated that milk demand in the Terai is significantly lower than in the hill and mountain regions.

The sign and magnitude of the price elasticity confirmed that milk is a necessity. The estimated overall price elasticity of milk demand of -0.35 is comparable with the price elasticity parameters estimated by New ERA (1990) for Kathmandu (-0.33) and by the Agricultural Project Service Centre (APROSC) (-0.51) using time-series data.

The positive income elasticity also confirmed that milk is a necessity. The income elasticity was higher in urban areas (0.87) than in rural areas (0.78). The estimated values for income elasticity of milk demand for urban Nepal seem fairly close to the earlier estimates of the APROSC and New ERA studies. The widely used income elasticity parameter for milk demand at national level for the Agricultural Perspective Plan is 1.0.

Table 5.5: **Coefficient of ordinary milk demand function**

Item	New Era (1990)	APROSC (1986)	Present Study (2000)		
			Urban	Rural	Whole country
Price elasticity	-0.35*	-0.51	-0.21	-0.38	-0.35
Income elasticity	0.31**	0.56	0.87	0.78	0.79

Source: New Era (1990) and APROSC (1995)

* a 10% increase in price would lead to a 3.5% decrease in demand
** a 10% increase in household income would lead to a 3.1% increase in demand

Projected supply and demand of milk in Nepal

Estimates of projected milk supply and demand were made based on assumptions about growth rates of the population, incomes, and income elasticity of milk demand until 2015. Most of the demand for milk is in urban areas where approximately 15% of the population currently lives and where average income and population growth rate are higher than in rural areas.

Two different scenarios for growth rate of per capita milk demand were used, with annual per capita real GDP growth rates of 0.5% (Scenario 1) and 1% (Scenario 2) and the income elasticity coefficients shown in Table 5.5. The population growth rates in rural and urban areas were taken as 1.53% and 7.1% from official estimates.

The projected levels of milk demand in relation to supply were calculated over a 15-year period from 2000-2015. The results are shown in Tables 5.6 and 5.7 for the present level of consumption (Table 5.6) and a postulated higher annual per capita level of consumption of 40 l in rural areas and 50 l in urban areas (Table 5.7).

The current per capita consumption of milk in urban areas (38 l) is 1.46 times higher than in rural areas (26 l). The average income and population growth in urban areas is much higher than in rural areas. Under the real per capita income growth scenario 1, the projected demand for milk in urban areas is expected to rise to 1,221 million litres by 2015 from 115 million litres in 1999. In rural areas, the projected demand for milk would rise to about 1,076 million litres by 2015 from 638 million litres in 1999. Put another way, projected demand of milk in urban areas is expected to rise at an annual rate of about 16% compared to an annual rate of about 3% in rural areas (Table 5.6).

The results indicate that at present consumption levels projected milk production will be able to meet the milk demand for the next 12 years, and that from 2012 onwards the country will experience a net deficit in milk supply unless there is an additional 3% growth rate in production. If per capita consumption is assumed to be higher (Table 5.7) the country will experience an increasing net deficit over the whole period under both scenarios for milk production growth rates. Overall the estimates range from a surplus of 429 million l in 2015 in the best case scenario, to a deficit of 1,766 million litres in the worst case.

Table 5.6: **Projected supply and demand of milk based on present per capita consumption rates#**						
	1998/ 99	1999	2000	2005	2010	2015
Scenario 1: 0.5 % Real annual per capita GDP growth rate						
Total demand (million litres)						
Rural Nepal	614	638	663	797	943	1076
Urban Nepal	101	115	131	258	539	1221
Whole of Nepal	715	753	794	1055	1483	2297
Total milk supply (million litres)						
Milk production scenario A*	1073	1100	1140	1337	1579	1875
Milk production scenario B**	1073	1133	1197	1575	2072	2726
Supply-Demand Balance (million litres)						
Milk production scenario A*	357	347	347	282	96	-422
Milk production scenario B**	357	380	404	520	590	429
Scenario 2: 1% Real annual per capita GDP growth rate						
Total demand (million litres)						
Rural Nepal	614	641	669	825	1000	1169
Urban Nepal	101	116	132	267	570	1321
Whole of Nepal	715	757	801	1091	1570	2490
Total milk supply (million litres)						
Milk production scenario A*	1073	1100	1140	1337	1579	1875
Milk production scenario B**	1073	1133	1197	1575	2072	2726
Supply-demand balance (million litres)						
Milk production scenario A*	357	343	339	245	8	-615
Milk production scenario B**	357	377	396	484	502	236

\# Annual per capita consumption of 26 l in rural areas, 38 l in urban areas.
* Milking population (cows and buffalo) projected based on present population growth rate
** 3% increase over and above the present population growth rate of milking animals

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

General problems and constraints

In Nepal, milk is produced by small farmers in rural areas, whereas much is consumed in the major urban areas, in particular Kathmandu Valley. In the absence of an assured market, the producers do not have an incentive to invest in good breeding stock, feeds, or veterinary medicines and services. Without these inputs, it is difficult to raise productivity and profits. Similarly, because of the low purchasing power of the consumers, the effective demand for milk locally is also low, necessitating transportation to major urban areas for marketing. At the same time the price the DDC pays to farmers does not match growing feed prices.

Poor feed base

The lack of availability of good quality forage is a major problem among smallholder farmers. This has made the dairy industry become more concentrate-based than forage-based. Commercially produced concentrates are expensive and their use increases the cost of milk production and reduces profits. In many parts of the study areas, finding adequate amounts of tree fodder is becoming a problem.

Table 5.7: **Projected supply and demand of milk based on higher per-capita consumption rates#**						
	1998/ 99	**1999**	**2000**	**2005**	**2010**	**2015**
Scenario 1: 0.5% Real annual per capita GDP growth rate						
Total demand (million litres)						
Rural Nepal	945	982	1020	1226	1451	1655
Urban Nepal	141	160	183	360	752	1703
Whole of Nepal	1086	1142	1202	1586	2203	3358
Total milk supply (million litres)						
Milk production scenario A*	1073	1100	1140	1337	1579	1875
Milk production scenario B**	1073	1133	1197	1575	2072	2726
Supply-demand balance (million litres)						
Milk production scenario A*	-13	-42	-62	-249	-625	-1483
Milk production scenario B**	-13	-9	-5	-11	-131	-632
Scenario 2: 1% Real annual per capita GDP growth rate						
Total demand (million litres)						
Rural Nepal	945	987	1030	1269	1539	1799
Urban Nepal	141	161	184	372	795	1843
Whole of Nepal	1086	1148	1214	1640	2334	3641
Total milk supply (million litres)						
Milk production scenario A*	1073	1100	1140	1337	1579	1875
Milk production scenario B**	1073	1133	1197	1575	2072	2726
Supply-demand balance (million litres)						
Milk production scenario A*	-13	-48	-74	-304	-756	-1766
Milk production scenario B**	-13	-14	-17	-65	-262	-915

\# Annual per capita consumption of 40 l in rural areas and 50 l in urban areas.
* Milking population (cows and buffalo) projected based on present population growth rate
** 3% increase over and above the present population growth rate of milking animals

Encouraging the private sector

The price paid by the government is not determined by market mechanisms and this creates difficulties for private entrepreneurs to compete effectively with the DDC. Although the private sector is not bound to follow the DDC's pricing policy, its prices act as a reference point for buyers. Consequently, private dairies are seen to operate and expand only in those market segments not reached by the DDC.

It would be desirable to devise ways for the private sector to use the under-used chilling centres of the DDC. This could be done by leasing out the chilling centre facilities to the private sector, by custom chilling milk collected by the private sector but guaranteed under contractual arrangements, or by handing over the operation and management of the facilities to private entrepreneurs or groups. The involvement of the private sector should also be encouraged for new chilling centres.

Milk holidays

The term 'milk holiday' was coined in 1991 when the DDC could not buy all the milk offered, and refers to days in the week when public or private dairy organisations do not buy milk from their regular suppliers (dairy farmers) (Upadhaya et al. 2000). The reasons may be limited consumer demand for the processed milk and milk products or

lack of processing or storage capacity of the dairy factory. The 'milk holiday' is announced in advance and can last for a day, several days, or even weeks.

Milk holidays are largely a phenomenon of the flush season (September to March) during which the supply of milk is four times greater than in the lean season (Upadhaya et al. 2000). The large seasonal difference in milk production in the country is attributed to short supply of green fodder and to buffalo, which calve during August to September; the calving season for cattle is more uniformly spread throughout the year. Despite higher efficiency and uniformity in milk production throughout the year from cattle, farmers prefer buffalo due to their greater immunity to disease, greater capacity to absorb roughage, low risk, and low investment, including their salvage value. Existing milk pricing systems also give higher value to buffalo milk (on a milk-fat basis) than to cow milk.

The import of cheap skimmed milk powder is cited as another key reason for milk holidays. The establishment of the Biratnagar skimmed powder plant in 1994 helped reduce the severity of the milk holiday for two years after which there was surplus production. Skimmed milk powder is entering the country at a price of less than NRs 100/kg, far less than even the production cost in Nepal (NRs 169/kg) (Upadhaya et al. 2000). Therefore, the plant in Biratnagar was unable to sell its products to the private sector, who are believed to have made extensive use of the imported product. The small scale of operation of private dairies in the country has been unable to alleviate the milk holiday problem.

One possible option for the surplus milk produced during the flush season in Nepal is to export it to neighbouring countries, if Nepal can provide products at cheaper prices. Since the flush production season in Nepal overlaps with that of India, this has not materialised. The only possibility for export of milk from Nepal to India is through milk producer associations, provided the public dairy milk procurement price is not set artificially high. The private dairies can also purchase such milk but it is extremely difficult for them to set a price independently of the DDC (Upadhaya et al. 2000).

Overall, milk holidays are becoming an annual phenomenon in Nepal. The available evidence indicates that this is mainly a result of the inability of the formal dairy organisations to sell milk and milk products (Upadhaya et al. 2000). Product diversification could be instrumental in increasing the demand for milk products if quality standards are maintained. A strong marketing drive together with quality improvement could increase market uptake.

Milk quality

The inability to maintain acceptable quality standards for milk has been an ongoing problem resulting in the rejection of inferior quality milk at collection centres and spoilage during transportation and processing. A number of factors are known to have caused this problem: a high bacterial count at farms due to improper washing of hand and pots, adulteration, and time taken for transportation between farms and collection centres (a maximum of 3.5 h is recommended), and between collection and processing (a maximum of 24 h is recommended).

Pricing

The DDC has had conflicting objectives of providing attractive prices to rural milk producers and supplying milk to urban consumers at the lowest possible price. The

availability of significant quantities of donated skimmed milk powder has encouraged the government to keep the consumer price from rising, at the expense of producer prices (ADB and APROSC 1993). While the donors have a clear agreement with the government regarding not using donated commodities for consumer subsidy, this has been largely circumvented in the past for the benefit of a consumer milk price subsidy in urban areas. Currently milk prices are fixed on a regular basis and reflect differences in transportation costs.

While the 10-year Dairy Development Plan (1990-2000) proposes that the DDC set its own price for milk based on commercial considerations, this has not yet materialised. Although the DDC has been responsible for formulating and executing pricing policy, in practice it has to obtain government approval before implementing any price change.

POLICY ISSUES AND IMPLICATIONS FOR DAIRY FARMING

There has been no clear long-term policy or concerted effort on the part of the government to perceive the dairy sub-sector as potentially rich in its comparative advantage to transform the rural economy. Existing policies and programmes are weak in addressing the number of problems faced by smallholder dairy farmers in different ecological settings.

Given the inability of the formal dairy organisation to handle the surplus milk during the flush season, the milk holiday is becoming an annual phenomenon for a large majority of smallholder dairy farmers and will continue to be so in future unless timely measures are taken to formulate and implement both short- and long-term plans and policies. The problem is compounded by weaknesses in existing national dairy policy that keep the producer price of milk constant across the seasons while at the same time allowing the import of cheap skimmed milk powder. Under the existing DDC-dominated price structure, there is little scope for adjusting market price according to seasonal fluctuations in price and consumption. Policy failure arises from the fact that while farmers are facing regular milk holidays consumers have not found the milk available in the market whenever they want to buy. This paradox suggests that there is a need for a substantial shift in policy and priority towards diversification of dairy products, through a strong marketing strategy together with quality improvement.

The DDC has been operating at a loss. Restructuring the operation and functions of the DDC with a view to making it a self-sustaining institution will have far-reaching implications for sustained improvement in the dairy sector. Success will also depend strongly on how well the government can mobilise the National Dairy Development Board (NDDB) to provide strategic direction to HMGN for planning, implementation, monitoring, and evaluation in the area of dairy development, thereby increasing the participation of the private sector and smallholders.

Dairy development should be an integral part of mountain community development. The national interest has always been guided by political interest in terms of where DDC coverage is increased, with little or no attention paid to the development of a minimum complementary infrastructure such as road and other support and input services that are important for sustained dairy development.

Currently, there is no established mechanism for monitoring and evaluating the milk producer cooperatives operating in different parts of the country. Such a system would have important implications for restructuring towards their sustainability.

In the past, most of the animal breeding development programmes have been supply driven with no attention being paid to the farmer's requirements from dairy development. Because the present area of rangeland is inadequate to meet the feed demand of the increasing livestock population, sustained improvement in dairy development will require a greater use of high-quality forage and purchased concentrates along with improved grassland. More emphasis on the farming of buffalo and crossbred cattle is also required.

The supply-and-demand projections based on the current state of technology and infrastructure have shown that the country is likely to experience a net deficit in milk supply in the future. The implication of a deficit in milk supply over the projected period is clear.

On the supply side, there is a need to increase the participation of a large number of smallholder dairy farmers in the formal market. To achieve this, restrictive policies and regulations must be relaxed. Also, measures need to be taken to reduce high transaction costs due to poor infrastructure and information systems and a poorly developed market for inputs and outputs. On the demand side, diversification of dairy products with emphasis on quality and a strong marketing drive will be important, along with proper analysis of consumer demand for dairy products.

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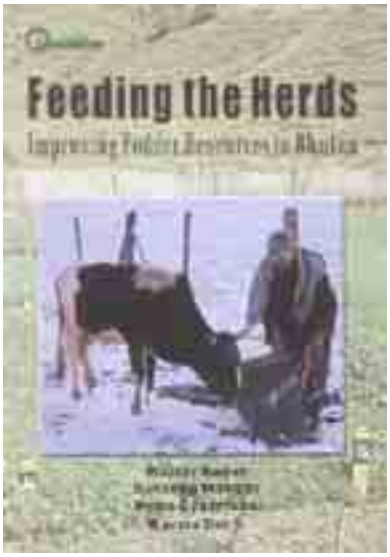

Feeding the Herds: Improving Fodder Resources in Bhutan

Roder, W.; Wangdi, K.; Gyamtsho, P.
2001. 124p. ISBN: 92-9115-409-1

The development of the livestock sector is of prime importance in Bhutan, where more than 80% of the population is involved in agriculture in some way, but only 8% of the land area is suitable for arable production. As in other parts of the Himalayan region, fodder is a significant limiting factor, and research into fodder development has long been a major component of the government research programme.

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Contribution of Livestock to Mountain Livelihoods: Research and Development Issues

Tulachan, P.M.; Mohamed Saleen, M.A.; J Maki-Hokkonen, Partap, T. (eds), ICIMOD/FAO/CIP (2000). 319p. ISBN: 92-9115-264-1

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Tulachan, P. M. and Neupane, A.
ICIMOD/FAO (1999) 116p. ISBN 92-9115-071-1

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ISBN 92 9115 636 1

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